WAPCOS LIMITED

A Government of India Undertaking - Ministry of Jal Shakti

76-C, Institutional Area, Sector-18, Gurugram, Haryana - 122015

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Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works

At Sector-19 Dwarka, Delhi

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Volume-I

Notice Inviting Tender, Instruction to Bidders, Forms, Conditions of Contract

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DISCLAIMER

Department of Law, Justice And Legislative Affairs, Govt. of National Capital Territory (NCT) of Delhi has appointed PMC (M/s WAPCOS Limited) who has prepared this document for and behalf of Department of Law, Justice And Legislative Affairs, Govt. of National Capital Territory (NCT) of Delhi to give information on the Project to the interested Bidder. The information is provided to Bidders on the terms and conditions set out in this document and any other terms and conditions subject to which such information is provided.

The purpose of this document is to provide Bidders with information to assist the formulation of their Bid. The information is not intended to be exhaustive. Bidders are required to make their own inquiries and respondents will be required to confirm in writing that they have done so and they do not rely solely on the information in the document.

The information is provided on the basis that it is non-binding on WAPCOS Limited/ Client, any of its authorities or agencies or subsidiaries or any of their respective officers, employees, agents or advisors.

The client / WAPCOS reserve the right not to proceed with the Project or to change the configuration of the Project, to alter the timetable reflected in this document or to change the process or procedure to be applied. It also reserves the right to decline to discuss the Project further with any party submitting the Bid.

While WAPCOS has taken due care in the preparation of the information contained herein and believe it to be accurate Client/ WAPCOS Ltd., any of its authorities or agencies nor any of their respective officers, employees, agents or advisors gives any warranty or make any representations, express or implied as to the completeness or accuracy of the information contained in this document or any information which may be provided in association with it.

NOTICE INVITING TENDER (NIT)

NIT No.: [WAP/C&C/DelhiLaw/2026/01] **Dated: [July 30th, 2026]**

WAPCOS Limited (A Government of India Undertaking), acting as Project Management Consultant (PMC) on behalf of Department of Law, Justice And Legislative Affairs, Govt. of National Capital Territory (NCT) of Delhi (hereinafter referred to as 'Client' or 'Principal Employer'), invites open online Tender on Percentage Rate for Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works At Sector-19 Dwarka, Delhi, (Name of Work/ Project) from Experienced, Competent and Eligible Contractors in a Single-Stage Two-Envelope System (Technical Bid and Financial Bid) for the work detailed herein. Submission of online bids is mandatory through the Central Public Procurement (CPP) Portal (www.etenders.gov.in/eprocure) using a valid Class III Digital Signature Certificate (DSC).

Sl.	Particulars	Details
1	**Name of Work / Project**	Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works At Sector-19 Dwarka, Delhi. (hereinafter 'the Work')
2	**Site / Location**	Sector-19, Dwarka, Delhi
3	**Nature of Work**	Engineering, Procurement and Construction of Residential flats including all Civil, Structural, Mechanical, Electrical, Plumbing, Fire Fighting, Horticulture, Landscaping and all associated works
4	**Estimated / NIT Cost (Excluding GST)**	Rs.136,51,43,477/- (Rupees One Hundred Thirty Six Crore, Fifty One Lakh, Forty Three Thousand Four Hundred and Seventy Seven Only). GST shall be payable extra at applicable rates.
5	**Cost of Tender Document**	Rs. 11,800/- (non-refundable). To be paid by Demand Draft payable at Gurugram, Haryana in favour of 'WAPCOS Limited'. Or through RTGS/NEFT to WAPCOS Bank A/c (Indian Overseas Bank, NHB Building, G-85, Industrial Area, Sector-18, Gurugram-122015; A/C No. 193502000000287; IFSC: IOBA0001935);
6	**Earnest Money Deposit (EMD) / Bid Security**	Rs. 1,46,52,000/- (refundable). Acceptable forms: (i) RTGS/NEFT to WAPCOS Bank A/c (Indian Overseas Bank, NHB Building, G-85, Industrial Area, Sector-18, Gurugram-122015; A/C No. 193502000000405; IFSC: IOBA0001935); (ii) Account Payee DD / Banker's Cheque / FDR; (iii) Insurance Surety Bond; (iv) Partial in Bank Guarantee - Rs. 20 Lakhs in cash - equivalent form + balance as BG from Nationalized/Scheduled Commercial Bank (RBI-approved).

		BG validity: 45 days beyond final bid validity period.
7	**Solvency Certificate** - *specific to this Bid submission only and mentioning the name of the work/project*	Rs. 54,60,57,391/- (40% of Estimated Cost) from Nationalized/Scheduled Commercial Bank (RBI-approved). Specific to this bid; mentioning name of work/project; addressed to WAPCOS Limited; issued between NIT publication date and bid submission deadline (incl. extensions). To be submitted in original. Exemption to MSMEs. Alternatively, the MSME bidders may submit Banker's Certificate from a commercial Bank for 40% of the estimated cost of work or Net Worth certificate from CA with Unique Document Identification Number (UDIN) of minimum 10% of the value of estimated cost of work (Scanned copy of original to be uploaded).
8	**Performance Security**	5% of Tendered Value in the form of Bank Guarantee from Scheduled Commercial Bank (RBI-approved), confirmed via SFMS. Additional Performance Security (APS) required if bid is below Minus (-) 10% of Estimated Cost - see Clause 1 of SCC.
9	**Project Completion Period**	21 Months from Date of Commencement (Date of LOA or date of first handing over of site, whichever is later). Completion Covers: Planning, Designing, Approvals, Execution, Testing, Commissioning, Statutory NOCs, and Successful Handing over to Client/Principal Employer
10	**Defect Liability Period (DLP)**	24 (Twenty Four) Months from date of issue of Taking Over Certificate by Principal Employer / Completion Certificate by Principal Employer - whichever is later.
11	**Bid Validity Period**	180 days from date of opening of Technical Bid.
12	**Portal for Tender Viewing / Download**	www.wapcos.co.in and www.etenders.gov.in/eprocure. Bidders must check for Corrigenda/Addenda regularly.
13	**Portal for Registration & Bid Submission**	www.etenders.gov.in/eprocure (CPP Portal - DSC Class III mandatory)
14	**Pre-Bid Meeting**	Date: 07.08.2026, Time: 15:00 hours. Venue: Office of Deputy Chief Engineer, WAPCOS Limited, Construction Vertical, Room No. D-14, 76-C, Institutional Area, Sector-18, Gurugram-122015. Email: rd@wapcos.co.in; Ph: 0124-2399830
16	**Last Date & Time for Online Bid Submission**	20.08.2026 up to 16:00 hours
17	**Offline Submission of Bid Documents (Originals - mandatory documents only)**	20.08.2026 up to 17:30 hours at Office of Deputy Chief Engineer, WAPCOS Limited, Construction Vertical, Room No. D-14, 76-C, Institutional Area, Sector-18, Gurugram-122015.
18	**Technical Bid Opening**	21.08.2026 at 16:00 hours

	(Online)	
19	**Financial Bid Opening (Online)**	Intimated to technically qualified bidders.
20	**Tender Inviting Authority**	Designation: Deputy Chief Engineer, WAPCOS Limited, Construction Vertical, Room No. D-14, 76-C, Institutional Area, Sector-18, Gurugram, Haryana-122015. Email: rd@wapcos.co.in; Ph: 0124-2399830
21	**Address for BGs, EMD, Solvency Certificate**	WAPCOS Limited, 76-C, Institutional Area, Sector-18, Gurugram, Haryana-122015

General Conditions

- The tender document has to be viewed/ downloaded from above specified websites. Bidders are advised to visit above specified websites regularly for updates /Amendments/ Corrigendum, if any and not be published elsewhere. The Updates/Corrigendum/Addendum shall be followed up to submission of tender and it will be the part of tender.
- The purpose of this NIT is to provide interested parties with information to assist the preparation of their bid. While WAPCOS Limited has taken due care in the preparation of the information contained herein, and believe it to be complete and accurate, neither it nor any of its authorities or agencies nor any of its respective officers, employees, agents or advisors give any warranty or make any representations, expressed or implied as to the completeness or accuracy of the information contained in this document or any information which may be provided in association with it. The bidders must read all the terms and conditions of bidding document carefully and only submit the bid, if eligible and in possession of all the documents required. Corrigendum while all efforts have been made to avoid errors in the drafting of the tender documents, the bidder is advised to check the same carefully. No claim on account of any errors detected in the tender documents shall be entertained.
- Further, WAPCOS Limited does not claim that the information is exhaustive. Respondents to this NIT are required to make their own inquiries/ surveys and will be required to confirm, in writing, that they have done so and they did not rely solely on the information in NIT. WAPCOS Limited is not responsible if no due diligence is performed by the bidders.
- If the office of WAPCOS Limited happens to be closed on the last date and time mentioned for any of the event, the said event will take place on the next working day at the same time and venue.
- WAPCOS Ltd. reserves the right to accept or reject any or all bids without assigning any reasons. No bidder shall have any cause of action or claim against WAPCOS Ltd. For rejection of his Bid and will not be bound to accept the lowest or any other tender.
- No reimbursement of cost of any type or on any account will be paid to persons or entities submitting their Bid.
- All information submitted in response to this NIT shall be the property of WAPCOS Limited and it shall be free to use the concept of the same at its will.
- It is hereby declared that WAPCOS is committed to follow the principle of transparency, equity and competitiveness in public procurement. The subject Notice Inviting Tender (NIT) is an invitation to offer made on the condition that the bidder will sign the integrity Agreement, which is an integral part of tender/bid documents, failing which the tenderer/bidder will stand disqualified from the tendering process and the bid of the bidder would be summarily rejected. This declaration shall form part and parcel of the Integrity Agreement and signing of the same shall be deemed as acceptance and signing of the Integrity Agreement on behalf of the WAPCOS.
- Conditional offers, offers with deviations, bids with tampered formats, or bids without EMD/Tender Fees shall be summarily rejected.

- All information submitted by bidders becomes the property of WAPCOS and shall not be returned.
- The bidders are advised/ encouraged to visit the site for actual assessment of the project site location and its consequences during execution of work.

For and on behalf of WAPCOS LIMITED

Tender Inviting Authority

SECTION I - INSTRUCTIONS TO BIDDERS (ITB)

1. General Instructions

a. Purpose

These instructions guide bidders in preparing their offers for the execution of construction works. Submission of a bid implies the bidder has read the complete Tender Document, Corrigendum(da), Addendum(da), and all related correspondence, and is fully aware of the scope of work, site conditions, and all terms and conditions. The particulars of the work given in Scope of Work are provisional. They are liable to change and must be considered only as advance information to assist the bidder.

b. Ethical Standards

WAPCOS requires all bidders, suppliers, and sub-contractors to observe the highest standards of ethics during procurement and execution. The following definitions apply and any such practice will result in disqualification and/or banning from future procurements:

- Corrupt Practice: Offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party.
- Fraudulent Practice: Submission of forged documents, misrepresentation, or omission — whether knowingly or recklessly — that misleads a party to obtain financial or other benefit.
- Coercive Practice: Impairing, harming, or threatening to impair or harm, directly or indirectly, any party or its property to influence their actions.
- Collusive Practice: An arrangement between two or more parties designed to achieve an improper purpose, including restricting competitiveness or cartelising the bidding process.

WAPCOS will: (a) reject the award of contract if the selected bidder is found to have engaged in any of the above practices; (b) sanction or declare ineligible any party found guilty of the above practices, either indefinitely or for a stated period; and (c) require bidders to permit WAPCOS to inspect their accounts, records, and documents relating to bid submission and contract performance, and have them audited by WAPCOS-appointed auditors.

The party may be required to sign an Integrity Pact, if required; and WAPCOS Limited will have the right to require the bidders, or its suppliers, contractors and consultants to permit WAPCOS Limited to inspect their accounts and records and other documents relating to the bid submission and contract performance and to have them audited by auditors appointed by WAPCOS Limited at the cost of the bidders.

c. Bidder's Responsibility

The bidder is solely responsible for the details in and preparation of their bid. The bidder must obtain, at their own cost and responsibility, all information necessary for preparing the bid and entering into a contract, including examining all drawings, inspecting the site, ascertaining local conditions, means of access, nature of work, and all pertaining matters. WAPCOS shall not be responsible or liable for any such costs, regardless of the conduct or outcome of the bidding process.

All bidders are explicitly informed that the following shall result in summary rejection of the bid:

- Conditional offers or offers with deviations from the Conditions of Contract.
- Bids not meeting the minimum eligibility criteria.
- Technical Bids not accompanied by EMD and Tender Document Fees of requisite amount in acceptable format.
- Bids submitted in altered, modified, or tampered formats.
- Bids in deviation with any other requirement stipulated in the tender documents.

WAPCOS reserves the right to waive minor deviations if they do not materially affect the bidder's capability to perform the contract.

d. Non-Tampering with Tender Documents

Bidders shall not tamper with or modify any part of the tender documents. If any part of the bid is found to have been tampered with or modified at any stage, the bid shall be rejected, the contract shall be liable to be terminated, all financial deposits shall be forfeited, and the bidder shall be liable to be banned from doing any business with WAPCOS Limited.

Incomplete Price bid shall be liable to be rejected, at the discretion of WAPCOS Limited. The total bid price shall cover the entire scope of works covered in the tender.

2. Brief Information about the Project

The project involves Engineering, Procurement and Construction of project for Construction of Judicial Officer's Flats at Sector-19, Dwarka, Delhi including Buildings & site development works and other associated Infrastructure, to be developed within Residential campus. The construction shall be done on EPC basis. The project will include all Civil works in Sub-Structure and Super-Structure, Finishing as per Schedule, MEP (Plumbing, Fire Fighting, Electrical, EPABX, PA system), Lifts, fixed wooden furniture in kitchen/ Dress/ Shoe-rack/ Cupboards (excluding any loose furniture) etc. as per Drawings, Specifications and Design Basis Reports mentioned in RFP Document complete.

- ***Project Components:***

  Type V Residential Tower (G+12) - 3BHK + Servant (52 flats)
  Type VI Residential Tower (G+12) - 4BHK + Servant (34 flats)
  Common Basement (2 Basements)
  Boundary Wall with Gate Complex
  Badminton Hall
  Multipurpose Hall
  Gym/Indoor Sports Hall
  WTP, STP, Substation, Pump Room & UGT
  Guard Room & Security Infrastructure
  Landscape Open Space
  Central Recreational Area (Swimming Pool + Play Area)
  Cricket Practice Pitch
  CC Road throughout with Pavers
  Horticulture

3. Project Site

The project site is located at Sector-19, Dwarka, New Delhi, a well-developed sub-city in South-West Delhi with proximity to Dwarka Courts, IGI Airport, and major arterial roads. The proposed site is spread over Total Plot Area: ~2.47 Acres.





4. Site Visit

- Intending Bidder(s) are advised to inspect and examine the site at his own cost and its surroundings and satisfy themselves before submitting their bids as to the nature of the ground and sub-soil (so far as is practicable), the form and nature of the site, the means of access to the site, the accommodation they may require and in general shall themselves obtain all necessary information as to risks, contingencies and other circumstances which may influence or affect their bid in order to avoid impractical and non-serious bids.
- The bidder(s) shall be deemed to have full knowledge of the site whether he inspects it or not and no extra charge consequent on any misunderstanding or otherwise shall be allowed.
- The bidder(s) shall be responsible for arranging and maintaining at his own cost all materials, tools & plants, water, electricity access, facilities for workers and all other services required for executing the work unless otherwise specifically provided for in the contract documents. Submission of a bid by a bidder(s) implies that he has read this notice and all other contract documents and has made himself aware of the scope and specifications of the work to be done and of conditions and rates at which stores, tools and plant, etc. will be issued to him by the Government and local conditions and other factors having a bearing on the execution of the work.
- The bidder and any of its personnel or agents will be granted permission by the Employer/Owner to enter upon its premises and lands for the purpose of such visit, but only upon the express condition that the bidder, its personnel, and agents will release and Indemnify the Employer/Owner and its personnel and agents from and against all liability in respect thereof, and will be responsible for death or personal injury, loss of or damage to property, and any other loss, damage, costs, and expenses incurred as a result of the inspection.

5. Pre-bid Meeting

Prospective Bidder requiring any clarification of the bidding documents may notify the Employer via email mentioned in NIT, at least one working day prior to pre-bid meeting. The queries shall be discussed

during the pre-bid meeting and the last date for submission of any further queries of Bidders shall be within two days from the date pre-bid meeting. Thereafter no further queries/clarifications shall be entertained. The Employer will reply to only those queries which received before the scheduled time as mentioned above via e-portal which are essentially required for submission of bids. The Employer will not reply to the queries which are not considered fit like replies of which can be implied /found in the NIT/Tender Documents or which are not relevant or in contravention to NIT/Tender Documents.

The intending bidders should depute their authorized person with authorization letter in original to attend the pre-bid meeting. The pre-bid meeting shall be held at the communication address mentioned in NIT. The Addendum/ Corrigendum/Replies to pre bid queries as per Pre bid meeting, shall be uploaded on e-portal & WAPCOS website.

6. Special Instructions for e-Tendering

Submission of Online Bids is mandatory for this Tender. E-Tendering is a methodology for conducting Public Procurement in a transparent and secured manner. For conducting electronic tendering, bidders shall use the portal www.etenders.gov.in/eprocure. Tender is invited in Single Stage -Two Envelope system, one Technical Bid and second as financial bid. Accordingly, bidder is directed to make all formalities and registration on www.etenders.gov.in/eprocure website and submit the Technical Bid and Financial bid.

The bidders are required to submit soft copies of their bids electronically on the CPP Portal, using valid Digital Signature Certificates. The instructions given below are meant to assist the bidders in registering on the CPP Portal, prepare their bids in accordance with the requirements and submitting their bids online on the CPP Portal.

More information useful for submitting online bids on the CPP Portal may be obtained from website: https://etenders.gov.in/eprocure/app**.**

a) Registration

- Bidders are required to enroll on the e-Procurement module of the Central Public Procurement Portal (URL: https://etenders.gov.in/eprocure/app) by clicking on the link “Online bidder Enrollment” on the CPP Portal which is free of charge.
- As part of the enrolment process, the bidders will be required to choose a unique username and assign a password for their accounts.
- Bidders are advised to register their valid email address and mobile numbers as part of the registration process. These would be used for any communication from the CPP Portal.
- Upon enrolment, the bidders will be required to register their valid Digital Signature Certificate (Class III Certificates with signing key usage) issued by any Certifying Authority recognized by CCA India (e.g. Sify / nCode / eMudhra etc.), with their profile.
- Only one valid DSC should be registered by a bidder. Please note that the bidders are responsible to ensure that they do not lend their DSC’s to others which may lead to misuse.
- Bidder then logs in to the site through the secured log-in by entering their user ID /password and the password of the DSC / e-Token.

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b) Searching for and Downloading Tender Documents

- There are various search options built in the CPP Portal, to facilitate bidders to search active tenders by several parameters. These parameters could include Tender ID, Organization Name, Location, Date, Value, etc. There is also an option of advanced search for tenders, wherein the bidders may combine a number of search parameters such as Organization Name, Form of Contract, Location, Date, Other keywords etc. to search for a tender published on the CPP Portal.

- Once the bidders have selected the tenders they are interested in, they may download the required documents / tender schedules. These tenders can be moved to the respective 'My Tenders' folder. This would enable the CPP Portal to intimate the bidders through SMS / e- mail in case there is any corrigendum issued to the tender document.
- The bidder should make a note of the unique Tender ID assigned to each tender, in case they want to obtain any clarification / help from the Helpdesk.

c) Preparation and Submission of Bids

- Download the prescribed Java version from https://eprocure.gov.in/cppp/jre-windows-i586.exe before bid submission. Do NOT use other Java versions.
- Prepare bid documents (scanned colour PDFs, signed and stamped on every page) in serial order as per the Check List (Section II). Scan quality: minimum 100 dpi, black-and-white.
- The Financial Bid shall be submitted ONLY in the standard BoQ format provided. Fill only white (unprotected) cells. Do NOT modify any protected cell or the filename. Any modification to the BoQ file results in automatic rejection.
- Log in well before the submission deadline. The server time displayed on the bidder's dashboard is the definitive reference time.
- Documents are encrypted using PKI/SSL-128-bit technology and remain unreadable until authorised bid opening.
- After 'Freeze Bid Submission', the portal generates a Bid Submission Acknowledgement with bid number, date, and time. Print and retain this as entry pass for opening meetings.
- Select payment option as 'Offline' and enter details of EMD instrument. The instrument details entered must exactly match the physical instrument submitted offline.

7. Earnest Money Deposit (EMD) / Bid Security

The Earnest Money Deposit shall be as per the details mentioned in NIT. EMD shall not carry any interest. The Bid Security/ EMD of the unsuccessful bidder shall be returned at the earliest after expiry of final bid validity period and latest by 30 days after the award of the contract. Bid Security shall be refunded to the successful bidder on receipt of Performance Security.

Online Bid documents submitted by intending bidders shall be opened only of those bidders, whose EMD will be received within stipulated time.

The successful bidder shall accept the Letter of Award (LOA) within 15 (Fifteen) days from receipt of the same, failing which the EMD shall be forfeited and the award of work may be liable to be cancelled.

If any bidder withdraws or make any changes in his offer already submitted before the expiry of the validity period or any extension thereof without the written consent of the company, the EMD amount will be forfeited for such act of the bidder.

WAPCOS Limited reserves the right of forfeiture of Earnest Money deposit (EMD) in case of the successful bidder.

i. After opening of Tender, revokes his tender within the validity period or increases his earlier quoted rates.
ii. Does not commence the work within the period as per LOA/Contract. In case the LOA/Contract is silent in this regard then within 15 days after award of contract.

The Bid Security will be forfeited in the bidder:

i) withdraws or amends its/ his tender;
ii) impairs or derogates from the tender in any respect within the period of validity of the tender;
iii) If the bidder does not accept the correction of his bid price during evaluation; and

iv) If the successful bidder fails to sign the contract or furnish the required performance security within the specified period.

8. Language of Bid

The Bid and all related correspondence and documents relating to the Project shall be in English language. Supporting documents and printed literature furnished by the Bidder may be in another language provided they are accompanied by an accurate English translation which shall be certified by a qualified translator. Any material that is submitted in a language other than English and which is not accompanied by an accurate English translation will not be considered.

9. CURRENCY OF BID

Bid prices shall be quoted in Indian Rupees.

10. Period of Completion

The completion period specified in the NIT is for the entire scope of work including: planning, designing, execution, procurement, transportation, construction/installation, testing, commissioning, statutory approvals and NOCs, and successful handing over to the Principal Employer to their full satisfaction. The period is the essence of the contract.

11. Amendment of Bid Documents

At any time prior to the deadline for submission of bids, the Employer may, for any reason (s), whether at their own initiative or in response to a clarification requested by a prospective Bidder, modify the Bidding Documents by the issuance of a corrigendum/ addendum. No modification of Bid shall be permissible after last date of submission, whatever may be the reason. The Employer may at their discretion may extend the deadline for submission of Tender/ Bid, if considered necessary.

Any corrigendum/ addendum thus issued shall be part of the bidding documents. Prospective Bidders shall download the same from the e-portal and submit along with the submission of Bid as token of acceptance.

12. Bid Validity Period

Bids shall remain valid for acceptance for a period of 180 days from the date of opening of financial Bids.

In exceptional circumstances, prior to expiry of the original bid validity period, the Employer may request the Bidder for a specified extension in the period of validity. The request and the responses thereto shall be made in writing or by e-mail. A Bidder may refuse the request. A Bidder agreeing to the request will not be required/nor permitted to modify his bid.

13. Bid Opening and Evaluation

Bids shall be opened as per the schedule. The Bidder will be at liberty to be present either in person or through an authorized representative at the time of opening of the Bid. The Bids will be opened in the presence of Bidders' representatives who wish to attend on the time, date and venue as mentioned in NIT. The physical Bid shall also be opened on the day of Tender opening.

14. Offline Submission of Documents

The following originals must be physically delivered in a sealed envelope clearly labelled 'OFFLINE DOCUMENTS FOR [WORK NAME] — NIT No. [_____]' with the bidder's name, address, phone, and email, by the date and time specified in the NIT:

- Original Tender Document Fee (Demand Draft)

- Original EMD / Bid Security (all acceptable instruments except RTGS - attach RTGS transaction proof online)
- Original Solvency Certificate (on Bank's letter head), if applicable
- Original Form-A (Financial Information certified by Statutory Auditor with UDIN)

Late offline submissions will result in rejection of the bid irrespective of online submission status.

15. OTHER IMPORTANT INFORMATION TO BIDDERES

1. The bid submitted shall become invalid and Tender processing fee shall not be refunded if any:
   i. The tenderer is found ineligible.
   ii. The tenderer does not upload scanned copies of all the documents stipulated in the tender document.
   iii. If any discrepancy is noticed between the documents as uploaded at the time of submission of tender and hard copies as submitted physically by the lowest tenderer in the office of tender opening authority.
   iv. If a tenderer does not quote the total amount of the tender or any section/sub head, the tender shall be treated as invalid and will not be considered as lowest tenderer.

2. After submission of the bid, the bidder can re-submit revised bid any number of times but before last time and date of submission of bid as notified.

3. While submitting the revised bid, the bidder can revise the rate/percentage of one or more item(s) any number of times (he need not re-enter rate of all the items) but before last time and date of submission of bid as notified.

4. WAPCOS or Client does not bind itself to accept the lowest or any other bid and reserves to itself the authority to reject any or all the bids received without the assignment of any reason. All bids in which any of the prescribed condition is not fulfilled or any condition including that of conditional rebate is put forth by the bidders shall be summarily rejected.

5. Canvassing whether directly or indirectly, in connection with bidders is strictly prohibited and the bids submitted by the contractors who resort to canvassing will be liable to rejection.

6. WAPCOS reserves the right of accepting the whole or any part of the bid and the bidders shall be bound to perform the same at the rate quoted.

7. No Engineer of Gazetted rank or other Gazetted Officer employed in Engineering or Administrative duties in an Engineering Department of the Government of India is allowed to work as a contractor for a period of one year after his retirement from Government service, without the previous permission of the Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found any time to be such a person who had not obtained the permission of the Government of India as aforesaid before submission of the bid or engagement in the contractor's service.

8. The bid for the works shall remain open for acceptance for a period of bid validity period from the date of opening of Technical bid. Further,

   i) If any bidder withdraws his bid or makes any modifications in the terms & conditions of the bid which is not acceptable to the department within 7 days after last date of submission of the bids, then WAPCOS shall without prejudice to any other right or remedy, be at liberty to forfeit 50% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

ii) In case, the bidder withdraws his bid or makes any modification in the terms &conditions of the bid which is not acceptable to the department after expiry of 7 days after last date of submission of bids, the Government shall without prejudice to any right or remedy, be at liberty to forfeit 100% of the earnest money absolutely irrespective of letter of acceptance for the work is issued or not.

iii) In case of forfeiture of earnest money as prescribed in Para (i) and (ii) above, the bidders shall not be allowed to participate in the re-bidding process of the work.

9. This notice inviting bid shall form a part of the contract document. The successful bidders/ contractor, on acceptance of his bid by the Accepting Authority shall within 30 days from the letter of acceptance, sign the agreement consisting of:

   i. The Notice Inviting Bid, all the documents including GCC, SCC, additional conditions, specifications, Design Basis Reports and drawings, if any, forming part of the bid as uploaded at the time of invitation of bid and the rates quoted online at the time of submission of bid and acceptance thereof together with any correspondence leading there to.
   ii. All annexures and Form as applicable.

10. The main contractor if required, may be allowed to associate agencies for specialized component(s) during the execution of works. The associated specialized agency shall have experience of 1 work of atleast 80% of value/ Scope of component given in Scope of works OR 2 works of at least 60% of value/ Scope of component given in Scope of works OR 3 works of atleast 40% of value/ Scope of component given in Scope of works. The main contractor shall submit detail of such agency(s) to Engineer-in-Charge of relevant component(s). Name of the agency(s) to be associated shall be approved by Engineer-in-Charge of relevant component(s). The

11. The main contractor has to enter into MoU with agency(s) associated by him. Copy of such MoU shall be submitted to WAPCOS of each relevant component within 60 (Sixty) days of award of work. In case of change of associate contractor, the main agency(s) has to enter into MoU/Agreement with the new contractor associated by him. The Main Contractor shall be responsible for ultimate performance towards the contract.

12. Integrity Pact: The contractor shall download the Integrity Pact, which is a part of tender documents, affix his signature in the presence of a witness, and upload the same while submitting online bids. **In the event of his failure to sign and upload the Integrity Pact along with other bid documents, his bid shall be rejected.**

13. In case of any reduction in scope of work NO CLAIM on account of reduction in value of work, loss of expected profit, consequential overheads etc. shall be entertained.

14. The information and instructions for bidders posted on website shall form part of bid document.

15. WAPCOS reserves the right to reject any prospective application without assigning any reason and to restrict the list of qualified contractors to any number deemed suitable by it, if too many bids are received satisfying the laid down criterion.

16. The Bidder is solely responsible for the details of their Bid and the preparation of bids. In no case shall the WAPCOS be responsible for any part of the tender documents submitted by him. Any Site information given in this tender document is for guidance only. The Bidder is advised to visit and examine the Site of works and its surroundings at their cost and obtain for themself on their own responsibility, all information that may be necessary for preparing the tender and entering into a

Contract. Irrespective of whether or not the Bidders have attended the pre-bid meeting, they shall be deemed to have inspected the Site and its surroundings beforehand and taken into account all relevant factors pertaining to the Site and clarifications/ modifications/ additions given in Pre-Bid meeting or addendum issued in the preparation and submission of the Bid.

17. The Bidder shall bear all costs associated with the preparation and submission of his Bid, and the Employer will in no case be responsible and liable for those costs. WAPCOS shall in no case be responsible or liable for these costs, regardless of the conduct or outcome of the bidding process.

18. The Employer/ PMC reserves the right to accept or reject any bid and to annul the process and reject all bids at any time, without assigning any reason or incurring any liability to the bidders.

SECTION II - SELECTION AND QUALIFYING CRITERIA

1. Qualifying Criteria - Online Technical Bid Submission

The Technical Bid shall contain coloured scanned copies of all documents listed in the Check List below. Documents shall be arranged in the exact serial order of the Check List with continuous page numbering (no breaks). A duly filled Check List with page numbers noted against each item shall be placed on top. The Authorised Signatory shall sign and stamp every page.

Documents that are NOT in the prescribed serial order, do not have continuous page numbering, or are unsigned/unstamped shall be liable to render the bid invalid.

No information relating to financial terms of services should be included in the technical bid. Bids are to be submitted to determine that the bidder has a full comprehension of the tendered work. Where a bidder technical submittal is found non–compliant with the requirement or work, it may be rejected. This process is to assure that only technical acceptable bids are considered for the tendered work.

Sl.	Document	Requirement / Description	Form / Evidence	Page Nos. (from – to)
a	**Authority to Sign the Tender**	Authority to Sign the tender: a) In case of proprietary firm, the Proprietor shall sign with full name, current address OR by the authorized person holding Notarized Power of Attorney issued by the Proprietor for signing of this bid. b) In case of a Limited Company, Partnership firm or Corporation, the Application shall be signed by an authorized person holding the Power of Attorney. A certified copy of the Power of Attorney shall accompany the Application. **Note:** Power of Attorney duly notarized and on a stamp paper of appropriate value, issued and signed by the member, authorizing the person for signing the tender documents, make corrections/ modifications, to interact with the Employer and act as the contact person, shall be submitted along with Technical Bid. The Power of Attorney shall be submitted in original and shall be specific to the Bid submission only.	Original Notarised POA / Certified Board Resolution	
b	**Earnest Money Deposit (EMD)**	As per NIT - in acceptable form. Scanned copy to be uploaded online; original to be submitted offline. Where partial BG is used: Rs. 20 Lakhs in cash-equivalent form + BG for balance from Nationalized/Scheduled Bank. **Note:** The EMD documents will be verified from the	NEFT receipt / DD / BG / FDR / Insurance Surety Bond (scanned)	

		issuing bank by WAPCOS prior to opening of Financial Bid		
c	**Tender Document Fee**	Demand Draft as per NIT payable at Gurugram, Haryana in favour of 'WAPCOS Limited'. Original submitted offline.	DD (scanned online; original offline)	
d	**Letter of Transmittal + Declaration**	On bidder's original letter head. Combined Technical & Financial transmittal with Declaration by the Bidder as per prescribed format in Section III.	Letter of Transmittal (Section III format)	
e	**Financial Information (Form-A)**	Yearly sales Turnover and Audited Balance Sheet for Last 5 (five) years ending on the financial year 2024-25. The requisite certificates (**Form-A**) must be certified by Statutory Auditor of the firm/company which must carry UDIN (Unique Document Identification Number) which will be verified from ICAI Portal.	Form-A on Statutory Auditor's original letter head with UDIN. WAPCOS to verify via ICAI Portal.	
		Profit / loss (after Tax): The bidder should not have incurred any loss (profit after tax should be positive) in more than two years during last five years ending 2024-25.		
		Turnover: Average annual financial turnover of bidder should be at least Rs. 68.26 Crore during the immediate last 3 consecutive financial years ending 2024-25.		
		Full Balance Sheet and Profit & loss Statement of Bidder, duly audited by Independent Chartered Accountant.		
		The net worth of the bidder should be positive during the last financial year i.e.2024-25. **Note:** There is no need to upload entire voluminous balance sheet. However, summarized balance sheet (Audited) and summarized Profit & Loss Account (Audited) for last 05 years shall be uploaded.		
f	**Solvency Certificate (Form-B)**	i) Solvency / Banker's Certificate The bidder should not be insolvent, in receivership, bankrupt or being wound up, not have had their business activities suspended. Bank Solvency Certificate	Form-B on Bank's original letter head. WAPCOS to verify from issuing bank.	

		issued from a Nationalized / Scheduled Commercial Bank approved by Reserve Bank of India (RBI) should be at least 40% of the estimated cost of the work. The Certificate should be issued between the publishing of NIT & last date of submission of Bids, including extensions if any and shall be addressed to WAPCOS Limited, 76-C, Institutional Area, Sector-18, Gurugram, Haryana specific to this Bid submission only and mentioning the name of the work/project. The certificate shall be submitted in original and the colour / b&w copy / scanned copy shall not be accepted. The certificate should carry name, designation of the bank official, who has the authority to issue Solvency Certificate. Note: This Certificate will be verified from the issuing authority by WAPCOS. ii) Exemption for MSMEs Alternatively, the MSME bidders may submit Banker's Certificate from a commercial Bank for 40% of the estimated cost of work or Net Worth certificate from CA with Unique Document Identification Number (UDIN) of minimum 10% of the value of estimated cost of work (Scanned copy of original to be uploaded).	Form - B1 Form of Banker's certificate Form - B2 Form of Certificate of Net Wroth	
g	**Correspondence Details (Form-C)**	Official email, landline number, and present address of issuing authorities for: (i) EMD (bank), (ii) Solvency Certificate (bank), (iii) Completion Certificates (clients), (iv) Project Performance Certificates (PSUs, if applicable). Bidder to certify the contact details are active and verified. If Bank Guarantee/ Solvency / Banker's Certificate/ completion certificate is not verified by the issuing authority, then it will not be considered for technical evaluation.	Form-C on bidder's letter head	
h	**Bid Capacity (Form-D)**	Bid Capacity as prescribed in Form-D. Should have bidding capacity equal to or	Form-D with Existing	

		more than the estimated cost of the work. The bidding capacity shall be worked out by the following formula: Available bid capacity = A x 1.5 x N – B, where A = Maximum value of engineering (Civil/ Electrical/ Mechanical as relevant to work being procured) works executed in any one year during the last five years (updated at the current price level), taking into account the completed as well as works in progress. N = Number of years prescribed for completion of the work in question. B = Value (updated at the current price level) of the existing commitments and ongoing works to be completed in the next 'N' years. NOTE: The bid capacity should be more than the estimated cost of the project. Otherwise the bid shall be rejected. The bidder shall furnish statements showing the value of existing commitments and on-going works as well as stipulated period of completion remaining for each of the works separately. The value of executed works shall be brought to the current level by enhancing the actual value of work done at a simple rate of 7% per annum, calculated from the date of completion of last day of the month previous to the one in which applications are invited.	Commitments Table. Supporting statements required.	
i	**Structure & Organisation (Form-E)**	Name, registered address, official website, legal status (proprietary/ partnership/ company), names of directors/ partners/ promoters, contact details of authorised person, and any other relevant information.	Form-E on bidder's letter head	
j	**Undertaking for Manpower Deployment (Form-F)**	Commitment to deploy qualified technical and supervisory manpower as per minimum requirements specified in Appendix B.	Form-F on bidder's letter head	
k	**No Conviction**	Certification that the	Form-G on bidder's	

	Certificate (Form-G)	organisation/promoters/directors have never been convicted by any Central/State Government Department or Court of Law. Also certifies no involvement in corrupt or fraudulent practices.	letter head	
l	**No Deviation Certificate (Form-H)**	Unconditional acceptance of all tender terms. Confirmation that site has been visited; no change or modification has been made to the tender document; and no deviation from any tender clause has been taken.	Form-H on bidder's letter head	
m	**Non-Blacklisting Undertaking (Form-I)**	Declaration that the firm has not been blacklisted/de-registered/debarred by any Government Department/PSU/Private Sector/Agency for which works were executed during the last 5 years.	Form-I on bidder's letter head	
n	**GFR Rule 144(xi) Undertaking (Form-J)**	Declaration of eligibility per Rule 144(xi) of General Financial Rules 2017 - relating to restrictions on procurement from countries sharing a land border with India. Bidder to certify eligibility to participate.	Form-J on bidder's letter head	
o	**Make in India - Local Content (Form-K)**	Undertaking to follow the Make in India Policy and achieve minimum 50% local content in execution of the work per the Public Procurement (Preference to Make in India) Order. Must be signed by Statutory Auditor with UDIN for ICAI verification.	Form-K on bidder's letter head, countersigned by Statutory Auditor with UDIN	
p	**Performance in WAPCOS or Delhi Law Department Projects (Form-L)**	If the bidder is currently engaged in or has completed any works of the same client (through any PSU), or has completed any projects of WAPCOS (for any other client) details of such works must be disclosed using Form-L. If no such works, a NIL declaration on Form-L must be submitted. Performance data will be verified from the concerned WAPCOS/PSU officer.	Form-L (on relevant PSU/WAPCOS letter head for non-NIL; on bidder's letter head for NIL)	
q	**Site Understanding (Form-M)**	Confirmation of actual site visit; description of site constraints observed (approach, terrain, soil conditions, utilities, logistics); explanation of how the bidder proposes to manage identified constraints; and confirmation that all site factors have been accounted for in the	Form-M on bidder's letter head	

		quoted price.		
r	**EPF & ESIC Registration**	Valid Employees' Provident Fund (EPF) Organisation registration certificate. Valid Employees' State Insurance Corporation (ESIC) registration certificate. Both are mandatory under EPF & MP Act 1952 and ESIC Act 1948.	Self-attested copies of both certificates	
s	**GST Registration & PAN**	Valid GST Registration Certificate for the state where the work is to be executed (or undertaking on letter head to register before submission of 1st bill). Valid PAN Card of the firm/company.	Self-attested copies	
t	**Indian Registered Company**	Certificate of Incorporation (Companies Act 2013) / Partnership Deed Registration / Proprietorship proof + address proof. Joint Ventures (JVs) are NOT accepted.	Self-attested copies	
u	**Completed Similar Work Experience**	i) One similar completed work costing not less than 80% of the estimated cost of work. Or ii) Two similar completed works of order value each not less than 50% of the estimated cost of work. Or iii) Three similar completed works of order value not less than 40% of the estimated cost of work. **Note:** **Similar work** shall mean 'the building consisting of RCC Framed Structure having minimum 8 (Eight) storeys including Finishing works, internal Water Supply, Sanitary installations & plumbing works, Internal Electrical Installation, fire fighting etc., all executed under one agreement / contract'. For this purpose, each basement / stilt constructed in the building shall be considered as a storey. Mumty and Machine Room shall not be counted as storey / height. The bidder shall submit Completion Certificate(s) for the same along-with LOI(s)/W.O(s) from respective Owner(s)/Client(s). The Completion	Completion Certificates + LOI/Work Orders from client organisations. For private sector: TDS certificates. Verification contact details in Form-C.	

		certificates shall clearly specify the similar nature works. Otherwise the Completion Certificate will not be considered as experience in similar nature of work. The copy of completion certificates shall be got verified from the issuing authority/organizations prior to award of works. The value of the work done declared is to be without GST / Taxes. For the works, where the Taxes or GST is not clearly defined, the value of works shall be considered as including GST and GST @12% shall be deducted for the works completed up to 31.12.2021 and GST @18% shall be deducted for the works completed after 01.01.2022 to establish the value of work done. The value of executed works shall be brought to the current level by enhancing the actual value of work done at a simple rate of 7% per annum, calculated from the date of completion of last day of the month previous to the one in which applications are invited. Note: The completion / experience certificates, along with the supporting documents, shall be got verified from the issuing authority / organizations prior to opening of Financial Bid The past experience in similar nature of work and also for additional experience should be supported by certificates issued by the Client's organization. In case, the works / certificates are not verified by the issuing authority, WAPCOS reserves the right to not consider for the award of works. For work experience of private sector, the completion certificates shall be supported with copies of corresponding TDS certificates. In case of mismatch in value in TDS certificate & completion certificate, then value mentioned in TDS certificate will be considered during evaluation.		

		WAPCOS reserves the right to get this work inspected through its representatives before or after accepting the Technical bid.		
v	**Additional eligibility Criteria**	1. One similar work should have at least 1 (one) basement in a single agreement/ contract. 2. At least 1 (one) similar work should be executed with minimum GRIHA 3-star/ IGBC Silver/ LEED Silver rating or equivalent. 3. At least 1 (one) similar work should be executed in EPC Mode.	Completion Certificates + LOI/Work Orders from client organisations. For private sector: TDS certificates. Verification contact details in Form-C.	
w	**Handing Over Undertaking (Form-N)**	Bidder acknowledges and undertakes to deliver the complete handing over package at project completion: As-built drawings (3 sets - civil, structural, MEP), Inventory list, Guarantee/warranty bonds for all equipment and waterproofing/anti-termite works, Equipment certificates and invoices, Keys to all rooms/areas, Occupancy Certificate from Local Body, NOCs from all statutory departments (Fire, Electrical Inspector, Forest, Pollution Control, etc.), and No Claim Certificate.	Form-N on bidder's letter head	
x	**Litigation History (Form-O)**	Information about Litigation or arbitration history resulting from contracts with WAPCOS and other agencies / clients. **Pending Arbitration Proceedings with WAPCOS** Notwithstanding any other provision of this Tender Document, where a Bidder, either individually or as a member of a Joint Venture/Consortium, is involved in any pending arbitration proceedings with WAPCOS Limited arising out of any existing or previous contract, the Employer may examine the nature and circumstances of such proceedings while determining the Bidder's eligibility. Pending arbitration proceedings shall not, by themselves, constitute an automatic ground for disqualification. However, where the arbitration proceedings arise from allegations or records indicating one or more of the following, the Employer may, after	Form–O on bidder’s letter head	

		recording detailed reasons in writing and upon an objective assessment of the facts and circumstances of the case, declare the Bidder ineligible to participate in the Tender: (a) Fundamental or material breach of contractual obligations resulting in substantial non-performance of the contract; (b) Abandonment of the work, unjustified suspension of execution, or failure to mobilize resources resulting in serious delay or disruption of the project; (c) Fraud, corruption, misrepresentation, submission of forged or fabricated documents, collusive bidding, or any other act affecting the integrity of the procurement or contract execution process; (d) Persistent or repeated contractual defaults, including failure to achieve contractual milestones, failure to rectify defects despite notice, non-compliance with contractual directions, or any other conduct demonstrating inability or unwillingness to perform contractual obligations; (e) Serious deficiencies in quality of work, safety standards, project management, or contractual compliance which have materially affected the execution of previous contracts with WAPCOS; (f) Recovery proceedings, substantial contractual claims, damages, or other disputes arising directly from the Bidder's alleged defaults, where, in the opinion of WAPCOS, such disputes may materially impair the Bidder's financial capability, reliability, or ability to successfully execute the present work; (g) Any other conduct which, based on documentary records available with WAPCOS, demonstrates that award of the present contract to the Bidder would expose WAPCOS to significant contractual, financial, operational, or reputational risk. While exercising its discretion under this clause, WAPCOS shall consider, inter alia, the seriousness of the alleged default, the stage of the arbitration		

		proceedings, the evidence available on record, the Bidder's overall performance history, any corrective measures undertaken by the Bidder, and the likelihood of successful execution of the proposed contract. The decision of WAPCOS shall be final and binding. The Bidder shall disclose all pending arbitration proceedings with WAPCOS in the prescribed format. Failure to make a true and complete disclosure, or furnishing false or misleading information, shall constitute a material misrepresentation and may result in rejection of the bid, cancellation of award, forfeiture of bid security, termination of the contract, and any other action permissible under the Tender Conditions and applicable law.		
y	**Integrity Pact (Form-P)**	Integrity Pact along with letter	Letter on bidder's letter head and integrity pact on Rs.100 letter head	
z	**Undertaking Regarding Non-Demolition of Executed Works (Form-Q)**	The Bidder shall submit a duly certified undertaking, on their original letterhead, affirming that no work executed by them - either in India or abroad - has been demolished, dismantled, or ordered to be demolished on account of structural failure, structural unsafety/instability, non-compliance with the provisions of applicable Indian Standard (IS) Codes/National Building Code, or any other similar deficiency. **In the event any such demolition has been carried out or ordered against any work executed by the Bidder, the Bidder shall not be eligible to participate in / be considered for this Bid.**	Form – Q on bidder's letter head	
aa	**Undertaking from OEMs for specialized work**	The Agency shall submit within 45 days after award of work an undertaking from the OEMs for specialised E&M works of Substation, STP, DG set, Lifts, Fire-fighting, Fire Alarm, Ventilation EPABX, CCTV and Solar PV System, UPS, Water Supply System, etc. that "OEM shall unconditionally support the lowest bidder technically throughout the execution of	Form-R on bidder's letter head	

		contract as well as for Maintenance/Comprehensive Maintenance Contract for the useful life of the system, and they shall also provide all the spares required for healthy functioning of the equipment for at least seven years from the date of supply of equipment".		

No information relating to financial terms of services should be included in the technical bid. Bids are to be submitted to determine that the bidder has a full comprehension of the tendered work. Where a bidder technical submittal is found non–compliant with the requirement or work, it may be rejected. This process is to assure that only technical acceptable bids are considered for the tendered work.

2. Contents of Financial Bid

The Financial Bid should be uploaded online before last date & time of submission of Tender Document.

Quoted amount by the Bidder shall be firm during the performance of the Contract. Quoted amount by the Bidder with any condition shall not be accepted and same is liable to be rejected.

Quoted amount by the Bidder shall include all Materials, Tools & Plant, labour, supervision, profit; other levies together with all general risks, liabilities and obligations set out or implied in the contract, applicable Labour Cess, cost of insurance to this contract, all applicable tax liabilities like Income Tax & Surcharges, etc. Any other taxes /cess as per Government directives shall be deducted from each bill paid to the Contractor, from time to time. GST shall be payable extra as per prevailing rates.

The Contractor shall submit e-invoice / Tax Invoice (as applicable for the bidder's Firms) to WAPCOS showing (i) Basic amount (ii) GST amount separately in each bill. It is mandatory to bidders to deposit GST within time limit framed by Govt. of India, if applicable. The Goods and Services Tax (GST), shall be reimbursed to the Agency only after uploading of bills by Contractor on GST Portal "to avail Input benefit of GST".

WAPCOS shall be performing all its duties of deduction of TDS and other deduction on payment made to the contractor as per applicable legislation in force on the date of submission of bid or to be newly/amended introduced during the execution of the Contract.

3. Opening of Financial Bid

The financial bids of technically qualified bidders (those who pass the Technical Evaluation) shall be opened at the notified date and time. The final selection shall be based on the Least Cost Method (L1).

In case two or more technically qualified bidders quote the same L1 amount (for Percentage Rate Tenders), they shall be invited to submit sealed revised offers - quoting percentage above/below the estimated cost. Revised quotes must not be higher than the original quote. The lowest revised tender shall be awarded. If revised quotes are again equal, selection shall be by draw of lots in the presence of WAPCOS and the concerned bidders. If any such bidder refuses to submit a revised offer, 50% of EMD shall be forfeited and they shall be ineligible for re-tendering.

4. Award of Work

The final selection shall be based on the Least Cost Method (L1). The technically qualified bidder quoting the lowest amount shall be selected, subject to satisfactory negotiation where applicable.

5. Signing of Contract

The Letter of Award (LOA) shall be issued to the successful bidder. The bidder shall sign and return the duplicate copy of the LOA within 15 days as token of unequivocal acceptance and confirmation. Subsequently, the bidder shall submit Performance Security of the required value within 21 days of LOA acceptance (but not later than the date of signing of the Agreement). Thereafter, on a mutually agreed date, the successful bidder or their authorised representative shall attend WAPCOS office for signing of the Contract Agreement. No payment for any work done shall be made unless the Contract Agreement is duly signed.

Failure to comply with the above requirements shall constitute sufficient grounds for the annulment of the award and forfeiture of the Bid Security.

SECTION III - BID FORMS

- All forms shall be submitted on the bidder's original letter head unless otherwise specified. All forms must be signed and stamped by the Authorised Signatory on every page.

- All information called for in the enclosed forms should be furnished against the relevant columns in the forms. If for any reason, information is furnished on a separate sheet, this fact should be mentioned against the relevant column. Even if no information is to be provided in a column, a “nil” or “no such case” entry should be made in that column. If any particulars / query are not applicable in case of the bidder, it should be stated as “not applicable”. The bidders are cautioned that not giving complete information called for in the application forms or not giving it in clear terms or making any change in the prescribed forms or deliberately suppressing the information may result in the bid being summarily disqualified. Bids received late will not be entertained.

- References, information and certificates from the respective clients certifying suitability, technical knowledge or capability of the bidder should be signed by an officer not below the rank of Executive Engineer or equivalent.

- The bidder may furnish any additional information which he thinks is necessary to establish his capabilities to successfully complete the envisaged work. He is, however, advised not to furnish superfluous information. No information shall be entertained after submission of eligibility criteria document unless it is called for by the Employer.

Letter of Transmittal - Technical Bid (with Financial Bid and Declaration)

(TO BE SUBMITTED ON BIDDER'S ORIGINAL LETTER HEAD)

To,
[_____*(Tender Inviting Authority)*_____],
WAPCOS Limited,
76-C, Institutional Area, Sector-18, Gurugram, Haryana-122015
Email: rd@wapcos.co.in

Subject: Submission of Technical Bid and Financial Bid for "[_____]"
Tender No. [_____]

Sir,

This is to certify that We, M/s ……., in submission of this offer confirm that:-

We have inspected the site of work and have made myself/ourselves fully acquainted with local conditions in and around the site of work. We have carefully gone through each & every section of the tender document for the work "……..".

I/We hereby declare that:

(i) I/We acknowledge that WAPCOS will rely on the information and documents submitted in this bid for selection of the Contractor. I/We certify that all information provided is true, correct, and complete; nothing has been omitted which renders such information misleading; all documents are true copies of their respective originals.

(ii) I/We have furnished all information and details necessary for establishing eligibility and have no further pertinent information to supply.

(iii) I/We submit the requisite Solvency Certificate, Completion Certificates, and Financial Information, and authorise WAPCOS Ltd. to approach the issuing authorities to confirm the correctness thereof. I/We also authorise WAPCOS Ltd. to approach individuals, employers, firms, and corporations to verify our competence and general reputation.

(iv) The Cost has been quoted by me/us for bid after taking into consideration all the terms and conditions stated in the Tender Document, our own estimates of costs and after a careful assessment of the site and all own the conditions that may affect the project cost and implementation of the project.

(v) I/We acknowledge WAPCOS's unconditional right to reject our bid without assigning any reason, and hereby waive, to the fullest extent permitted by applicable law, any right to challenge the same.

(vi) I/We have inspected the site and are fully acquainted with local conditions. All site factors and conditions of the tender documents have been accounted for in our quoted price.

(vii) I/We have not made any misleading or false representation in any form, statement, or attachment.

(viii) We do not have records of poor performance such as abandoning the work, not properly completing the Contract, inordinate delays in completion or financial failures etc.

(ix) We are financially sound and are not under any debt restructuring or insolvency proceedings.

(x) List of Similar Works satisfying Qualification Criterion as indicated hereinafter, does not include any work which has been carried out by us through a Subcontractor on a back-to-back basis.

(xi) In the event of my/ our being declared as the Selected bidder, I/we agree to enter into a Agreement in accordance with the format of Contract Agreement. We agree not to seek any changes in the aforesaid format of Contract Agreement and agree to abide by the same.

(xii) We promise to abide by all the stipulations of the Contract documents and carry out and complete the work to the satisfaction of the Employer/ Principal Employer.

(xiii) I / We shall keep this offer valid as period specified in the NIT.

(xiv) I / We hereby submit our FINANCIAL BID and Offer Cost for undertaking the aforesaid Project in accordance with the Bidding Documents and the Agreement.

(xv) We also agree to procure Plants and Machineries at our cost required for the work. We also submit that we have Organizational Structure comprising adequate Technical Personnel in the line of requirement. We also agree to accomplish the job entrusted to us in the stipulated time laid out in document except situations not under our control.

Date: _____ Place: _____

Signature and Stamp of Authorised Signatory: _____

Name: _____ Designation: _____

Form-A: Financial Information

(To be submitted on original letter head of Statutory Auditor of the firm/company - with UDIN)

Financial Year	Gross Annual Turnover (Rs. Cr.)	Profit / Loss After Tax (Rs. Cr.)	Net Worth (Rs. Cr.)
2020-2021			
2021-2022			
2022-2023			
2023-2024			
2024-2025			

Above details are furnished as per audited financial statements submitted to the Income Tax Department.
Name & Address of Firm: _____

Date: _____ Place: _____
Signature & Seal of Statutory Auditor: _____
UDIN No.: _____

(This certificate will be verified through ICAI Portal using the UDIN number above.)

Form-B: Solvency Certificate

(To be obtained from Issuing Bank and submitted on Bank's original letter head)

To,
WAPCOS Limited,
76-C, Institutional Area, Sector-18, Gurugram, Haryana

Re: Solvency Certificate for Tender No. [_____]

Work: "[_____]"

This is to certify that M/s _____ (Name and Address of Bidder)
is a customer of our Bank and is respectable, and can be treated as good for any engagement up to a limit of Rs. _____ (Rupees _____ only).

This certificate is specific to the above bid submission and is issued on the specific request of M/s _____.

Name of Bank Official: _____ Designation: _____
Bank Branch: _____ Date: _____
Signature & Seal of Bank Official: _____

NOTE:

1. Note: This certificate will be verified by WAPCOS from the issuing branch by official email/in person.
2. Solvency Certificate should be on letter head of the Bank addressed to WAPCOS Limited, 76-C, Institutional Area, Sector-18, Gurugram, Haryana.
3. In case of partnership firm, certificate should include name of all partners as recorded with the Bank.
4. Bank may do the minor changes in the format as per the approved format of bank without changing the gist of content.

Form-B1: FORM OF BANKERS' CERTIFICATE FROM A COMMERCIAL BANK

(To be obtained from Issuing Bank and submitted on Bank's original letter head)

This is to certify that to the best of our knowledge and information that M/s/Sh. ……. having marginally noted address, ……. as a customer of our bank are/is respectable and can be treated as good for any engagement upto a limit of Rs……..……. (Rupees…….……..)

This certificate is issued without any guarantee or responsibility on the bank or any of the officers.

Name of Bank Official: _____ Designation: _____

Bank Branch: _____ Date: _____

Signature & Seal of Bank Official: _____

NOTE:

1. Note: This certificate will be verified by WAPCOS from the issuing branch by official email/in person.
2. In case of partnership firm, certificate should include name of all partners as recorded with the Bank.
3. Bank may do the minor changes in the format as per the approved format of bank without changing the gist of content.

Form-B2: FORM FOR CERTIFICATE OF NET WORTH FROM CHARTERED ACCOUNTANT

It is to certify that as per the audited balance sheet and profit & loss account during the financial year ……., the Net Worth of M/s ……. (Name & Registered Address of individual/firm/company), as on …….. (the relevant date) is Rs ..... after considering all liabilities.

It is further certified that the Net Worth of the company has not eroded by more than 30% in the last three years ending on (the relevant date).

Unique Document Identification Number
(UDIN) ……..

Signature of Chartered Accountant …….

Name of Chartered Accountant …… ..
Membership No. of ICAI
Date and Seal

Form-C: Correspondence Details of Issuing Authorities

(On bidder's letter head — all contact details must be active and verified by bidder)

Name of Work: "[_____]"

1. EMD submitted in form of Bank Guarantee/ FDR

Present address of the Issuing Branch	Official Email Id	Landline no	Other Contact no.

2. Solvency Certificate / Banker's Certificate

Present address of the Issuing Branch	Official Email Id	Landline no	Other Contact no.

3. Completion Certificate

Present address of the Issuing Authority	Official Email Id	Landline no	Other Contact no.

This is to certify that above information is correct and is gathered from the Issuing Authorities by us for the verification of concerned documents. We understand that if the documents is not verified by the issuing authority within 5 working days, then our bid is liable to be rejected.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

Form-D: Bid Capacity

(On Statutory Auditor of Bidder's Letter Head)

Name of Work: "[_____]"

Available Bid Capacity = (A × 1.5 × N) – B
A = Maximum value of Civil/Electrical/Mechanical works executed in any ONE year in last 5 years, updated @7% p.a. simple rate: Rs. _____ Cr.
N = Completion period for this work (in years): ____ years
B = Value of existing commitments and ongoing works to be completed in next N years, updated @7% p.a.: Rs. _____ Cr.
Available Bid Capacity = _____ × 1.5 × _____ – _____ = Rs. _____ Cr.
(Available Bid Capacity must be ≥ Estimated Cost of Rs. _____ Cr.)

Existing Commitments and Ongoing Works:

Description of Work	Location	Contract No.	Client	Contract Value (Rs. Cr.)	Stipulated Completion	Remaining Value (Rs. Cr.)

Unique Document Identification Number
(UDIN) ……..

Signature of Chartered Accountant …….
Name of Chartered Accountant …… ..
Membership No. of ICAI
Date and Seal

Form-E: Structure and Organisation

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: ……

S.No.	Particulars	Details
1.	Name & Registered Address of the Bidder	
2.	Address and Email on which Correspondence will be made during Tendering & after Award of Work	
3.	Telephone no./Telex no./Fax no.	
4.	Legal status of the Bidder (attach copies of original document defining the legal status) (a) A Proprietary Firm (b) A Partnership Firm I A Limited Company or Corporation (d)A Company registered under company's Act 1956/2013	
5.	Particulars of Registration with various Government Bodies (Attach attested photocopy) **Organization/Place of Registration** 1. 2. 3.	**Registration No**. 1. 2. 3.
6.	Names and Titles of Directors with designation as per Legal Status of Company	
7.	Designation of Senior Level Officers authorized to act for this work	
8.	Any other information considered necessary but not included above.	

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

Form-F: Undertaking for Manpower Deployment

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: (Name of the Work/ Project)

1. This is to certify that We, M/s ……,in submission of this offer confirm that: -

2. Our tender is offered taking due consideration of all factors including site requirements information and conditions stated in the detailed Instructions to Bidders to execute the work up to the standards as laid out in Employer's Requirements and other sections of Tender Document.

3. We agree to employ the number of technical staff during the execution of this work as defined in the tender document. We shall deploy additional manpower as deemed fit and required to complete the project within stipulated completion period, without any additional cost to the Employer.

4. The Employer/ PMC shall have full power and without giving any reason to us, immediately to get removed any representative, staff and workmen or employees on account of misconduct negligence or incompetence or whose continued employment may in his opinion be undesirable. We shall not claim any compensation on this account.

5. In case we fail to deploy the technical staff as mentioned in the tender document, we shall be liable to pay recovery for each month of default as mentioned in Tender Documents. The details of Deployment of Technical Staff will be submitted with each Bill duly certified by the Employer or its representatives. We shall not raise any objection if deduction is made for the same from Running Bills.

Date:

Place:

(Signature, Name, Designation
of the Authorized signatory with Seal)

Form-G: No Conviction Certificate

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: (Name of the Work/ Project)

This is to certify that _____ (Name of the organization), having registered office at _____ (Address of the registered office) has never been convicted or blacklisted or restricted to apply for any such activities by any Central / State Government Department or Court of law anywhere in the country as on Bid Submission Date.

This is also to certify that we are not involved in any form of Corrupt and Fraudulent Practices in past and will never be involved in future.

Date:

Place:

(Signature, Name, Designation
of the Authorized signatory with Seal)

Form-H: No Deviation Certificate

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: ……

This is to confirm that as per Tender conditions we have visited site before submission of our Offer and noted the job content and site condition etc. We also confirm that we have not changed/modified the above tender document and in case of observance of the same at any stage it shall be treated as null and void.

We hereby also confirm that we have not taken any deviation from Tender Clause together with other reference as enumerated in the above referred Notice Inviting Tender and we hereby convey our unconditional acceptance to all terms & conditions as stipulated in the Tender Document.

In the event of observance of any deviation in any part of our offer at a later date whether implicit or explicit, the deviations shall stand null and void.

Date:

Place:

(Signature, Name, Designation
of the Authorized signatory with Seal)

Form-I: Non-Blacklisting Undertaking

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: ……

This is to certify that we have taken the cognizance of Blacklisting Policy of WAPCOS Ltd. Further, we hereby Confirm and declare that we, M/s_____ , is not blacklisted/De-registered/debarred by any Government Department/Public Sector Undertaking /Private Sector/ or any other agency for which we have Executed / Undertaken the works/ Services during the last 3 Years.

Date:

(Signature, Name, Designation of the Authorized signatory with Seal)

Place:

Form-J: GFR Rule 144(xi) Compliance Undertaking

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: ……

I / we ……(Name of the Firm) well aware about the Restrictions under RULE 144 (XI) In General Financial Rules (GFR), 2017 on procurement from country which shares a land border with India.. I/ we hereby certify that we are eligible to participate in the tender as per Rule 144 (xi) In the General Financial Rules (GFR), 2017

Date:

(Signature, Name, Designation of the Authorized signatory with Seal)

Place:

Form-K: Preference to Make in India - Local Content Undertaking

FORM-K1: UNDERTAKING REGARDING PERCENTAGE OF LOCAL CONTENT

(TO BE SUBMITTED ON BIDDER ORIGINAL LETTER HEAD)

Name of Work: ……

We…… (Name of Firm) hereby confirm that we will follow the Make in India Policy and its Guidelines at the time of execution of subjected work. We have understood the provisions of Public Procurement (Preference to make in India) Local content Policy and will achieve the minimum local content target of 50%.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

OR

[TO BE SUBMITTED ON ORIGINAL LETTER HEAD OF STATUTORY AUDITOR OF BIDDER]

FORM-K2: UNDERTAKING REGARDING PERCENTAGE OF LOCAL CONTENT

We, …… , a Chartered Accountant firm having our registered office address…… hereby state that, we are Statutory Auditor of the Company M/s…… (CIN : ……..).

The Bidder is bidding for the "..…… (Name of work)

We have understood the provisions of Public Procurement (Preference to make in India) Local content Policy against WAPCOS Tender NIT No. …… Date -……..

We on the basis of the bidder's representation received, hereby confirm that, offer is achieving the minimum local content target as per of above Policy shall be **50%.**

Date:

Place:

(Signature of Statutory Auditor with Seal)
UDIN No. :

Note: The format K1 will be required from bidder if the estimated cost of work is up to Rs. 10.0 Crore (excluding GST) and form k2 will be used for estimated cost of work is in excess of Rs. 10.0 Crore (excluding GST)

Form-L: Performance in other WAPCOS Projects or Delhi Law Department Projects

(If not engaged in any such project, submit NIL declaration on bidder's letter head)

Name of Project	Location & State	Date of Award	Award Value (Rs. Cr.)	Status (On-going/Complete)	WAPCOS/PSU Contact for Verification

Note: If Contractor is engaged in other works with Delhi Law Department or any other WAPCOS project with any other client, performance will be verified from concerned PSU/WAPCOS official.
If performance is found unsatisfactory in any parameter, the bid will not be considered for evaluation.
Date: _____ Signature & Stamp of Authorised Signatory:
_____

Form-L (A): Performance in other WAPCOS Projects or Delhi Law Department Projects

[To be submitted by Bidders on Letter Head of Concerned PSU]

Date:

Name of Work: ……

Performance Certificate

1.	Name of work / project & Location		
2.	NIT Cost excluding GST	Rs.	
2.	Awarded Cost excluding GST	Rs.	
3.	Date of Start		
4.	Stipulated date of completion		
5.	Physical Progress of work (%)		
6.	Extended date of completion		
7	Any Litigation during execution of project		
8.	**Performance Report :**		
	a) Quality of work	Satisfactory	Not satisfactory
	b) Progress of work	Satisfactory	Not satisfactory
	c) Technical Proficiency	Satisfactory	Not satisfactory
	d) Resourcefulness	Satisfactory	Not satisfactory
	e) Timely Execution	Satisfactory	Not satisfactory

(Signature, name and designation)

Official Email :-
Official Contact Number:
Address of Client:

*** The Certificate shall be issued by the officer not below the rank of Executive Engineer.**

Form-M: Understanding the Project Site

Name of Work: "[_____]"
Date of Site Visit: _____ Name of Person who Visited: _____

I/we hereby certify that I/we have examined & inspected the site & its surrounding satisfactorily, where the project is to be executed. I/ We are well aware about the following:

1. Location of the land demarcated for the execution of work and approach/ accessibility to the site.
2. The present condition of site including the Natural Ground level / backfill to be removed / additional filling required etc.
3. Any services which may be passing through the project land.
4. Availability of all construction material required for the execution of work.
5. Location of the proposed buildings and its allied works on demarcated land.
6. Sources from where electric connection is to be taken by contractor at the time of mobilization or other arrangements for electricity are to be made.
7. Sources from where suitable water for construction is to be arranged.
8. Site clearance and location of matured trees.
9. Awareness about the surrounding local conditions, villagers etc.
10. Topography, contouring and any other relevant feature like Pond, nallah etc. of the land where the project is to be executed.
11. Nature of the ground & sub-soil of the site and accessibility to the site.
12. Location of local electrical supply line/ Overhead Transmission lines and other relevant services
13. Hindrances / dispute, if any, which may arise during the execution of work

I / We hereby submit our BID considering above all facts gathered during site visit and each & every aspect has been considered in the Quoted Rates / price.

Date:

Place:

(Signature, Name, Designation
of the Authorized signatory with Seal)

Form-N: Handing Over Undertaking

We, M/s _____, undertake that at the time of handing over the project, we shall deliver the following complete handing over package to WAPCOS/Principal Employer:

1. As-Built Drawings - 3 complete sets (Civil/Structural, Electrical, Plumbing/Fire/MEP) - Hard + Soft copies
2. Inventory List of all installed equipment, fixtures, and fittings
3. Bank Guarantee and Warranty Bonds for: (i) Waterproofing works - 10 years; (ii) Anti-Termite treatment - 10 years;
4. All installed equipment - as per manufacturer warranty or DLP, whichever is more
5. Equipment Certificates, Test Reports, and Original Invoices for all installed equipment
6. Keys to all rooms, stores, panels, pump rooms, substations, and all areas
7. Occupancy Certificate / Completion Certificate from Local Urban Body / Municipal Corporation
8. NOC from Fire Department (final, post-installation)
9. NOC from Chief Electrical Inspector / Electrical Department
10. NOCs from all other Statutory Authorities as applicable (Forest, Pollution Control, Lift, etc.)
11. No Claim Certificate duly signed by our authorised representative
12. Solar Net Metering approval (if solar installation is part of scope)
13. DG Set / Transformer test certificates and load sanction order from Electricity Board

We understand that partial handing over is not acceptable and the Defect Liability Period shall commence only after the complete package above is delivered.

Date:

Place:

(Signature, Name, Designation
of the Authorized signatory with Seal)

Form-O: LITIGATION HISTORY, LIQUIDATED DAMAGES, DISQUALIFICATION

[TO BE SUBMITTED BY BIDDER ON THEIR ORIGINAL LETTER HEAD]

Subject: The Bidders should provide information as per this Performa for the firm/company on any history of litigation or arbitration (on-going or concluded) resulting from contracts executed in the last 5 years ending 31.03.2026 or currently in execution (including with WAPCOS)

1. ARBITRATION CASES

Year	Name of work	Name and address of Client / PSU	Cause of litigation and matter in dispute	Disputed amount in Rs.	Actual Award amount in Rs.

2. COURT CASES

Year	Name of work	Name and address of Client /PSU	Cause of litigation and matter in dispute	Name of court	If judgment given whether for or against the Tenderer

3. Information Regarding Current Litigation, Debarring / Expelling of Tenderer or Abandonment of Work by Tenderer.

a) i) Has the Bidder consistent history of Litigation…...Yes/No
ii) If yes, give details:

b) i) Has the Bidder been debarred/ expelled by any Agency in India, during the last 5 years on the date of application except on account of reasons other than non- performance, ….. Yes/No
ii) If yes, give details:

c) i) Has the Bidder abandoned any contract work during the last 5 years…Yes/No
ii) If yes, give details:

d) i) Has the Bidder been declared bankrupt during the last 5 years…Yes/No
ii) (If yes, give details, including present status:

e) i) Has the Bidder been debarred by client or by any Department… Yes/No
ii) If yes, give details:

Note: i) Separate sheet may be used for giving detailed information.

If any information in this schedule is found to be incorrect or concealed, pre- Qualification of bidder will be summarily rejected.

Yours faithfully,

Date:

(Signature, name and designation of the Authorized signatory)

Place:

Name and seal of Bidder

Form-P: LETTER FOR INTEGRITY AND INTEGRITY AGREEMENT

To,
WAPCOS Limited,
76-C, Sector 18,
Institutional Area
Gurgaon, Haryana-122015

Sub: Integrity Pact for ------ (Name of Work / Project)

Dear Sir,

I/We acknowledge that WAPCOS is committed to follow the principles thereof as enumerated in the Integrity Agreement enclosed with the tender/bid document at **Appendix-I.**

I/We agree that the Notice Inviting Tender (NIT) is an invitation to offer made on the condition that I/We am/are signing the enclosed integrity Agreement, which is an integral part of tender documents, failing which I/We will stand disqualified from the tendering process. I/We acknowledge that THE MAKING OF THE BID SHALL BE REGARDED AS AN UNCONDITIONAL AND ABSOLUTE ACCEPTANCE of this condition of the NIT.

I/We confirm acceptance and compliance with the Integrity Agreement in letter and spirit and further agree that execution of the said Integrity Agreement shall be separate and distinct from the main contract, which will come into existence when tender/bid is finally accepted by WAPCOS. I/We acknowledge and accept the duration of the Integrity Agreement, which shall be in the line with Article 1 of the enclosed Integrity Agreement.

I/We acknowledge that in the event of my/our failure to sign and accept the Integrity Agreement, while submitting the tender/bid, WAPCOS shall have unqualified, absolute and unfettered right to disqualify the tenderer/bidder and reject the tender/bid is accordance with terms and conditions of the tender/bid.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

ENCLOSURE-1

INTEGRITY AGREEMENT

[Will be submitted on non-judicial Stamp paper of Rs.100 duly attested by notary/Magistrate]

This Integrity Agreement is made at ..... on this ..... day of ..... 20.....

BETWEEN

WAPCOS Limited, New Delhi (Hereinafter referred as the **'**EMPLOYER'**,** which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

AND

..... (Name and Address of the Individual/firm/Company) through ..... (Hereinafter referred to as the (Details of duly authorized signatory)

"Bidder/Contractor" and which expression shall unless repugnant to the meaning or context hereof include its successors and permitted assigns)

PREAMBLE

'The Employer' intends to award, under laid down organizational procedures, contract/ s for _____, 'The Employer' values full compliance with all relevant laws of the land, rules, regulations, economic use of resources and of fairness/ transparency in its relations with its Bidder(s) and/ or Contractor(s).

In order to achieve these goals, the Employer shall appoint Independent External Monitors (IEMs) who shall monitor the tender process and the execution of the contract for compliance with the principles mentioned above.

Section 1 – Commitments of the 'The Employer'

1) 'The Employer' commits itself to take all measures necessary to prevent corruption and to observe the following principles: -
   (a) No employee of the Employer, personally or through family members, shall in connection with the tender for, or the execution of a contract, demand, take a promise for or accept, for self or third person, any material or immaterial benefit which the person is not legally entitled to.
   (b) The Employer shall, during the tender process, treat all Bidder(s) with equity and reason. The Employer shall in particular, before and during the tender process, provide to all Bidder(s) the same information and shall not provide to any Bidder(s) confidential/ additional information through which the Bidder(s) could obtain an advantage in relation to the tender process or the contract execution.
   (c) The Employer shall exclude from the process all known prejudiced persons.

2) If the Employer obtains information on the conduct of any of its employees, which is a criminal offence under the IPC/ PC Act, or if there be a substantive suspicion in this regard, the Employer shall inform the Chief Vigilance Officer and, in addition, can initiate disciplinary actions.

Section 2 – Commitments of the 'Bidder/ Contractor'

3) The 'Bidder/ Contractor' commit themselves to take all measures necessary to prevent corruption. The 'Bidder/ Contractor' commit themselves to observe the following principles

during participation in the tender process and during the contract execution.

a) The 'Bidder/ Contractor' shall not, directly or through any other person or firm, offer, promise, or give to any of the Employer's employees involved in the tender process or the execution of the contract or to any third person any material or other benefit which he is not legally entitled to, in order to obtain in exchange any advantage of any kind whatsoever during the tender process or during the execution of the contract.

b) The 'Bidder/ Contractor' shall not enter with other Bidders info any undisclosed agreement or understanding, whether formal or informal. This applies in particular to prices, specifications, certifications, subsidiary contracts, submission or non-submission of bids or any other actions to restrict competitiveness or to cartelize in the bidding process.

c) The 'Bidder/ Contractor' shall not commit any offence under the relevant IPC/ PC Act; further, the 'Bidder/ Contractor' shall not use improperly, for purposes of competition or personal gain, or pass on to others, any information or document provided by the Employer as part of the business relationship, regarding plans, technical proposals, and business details, including information contained or transmitted electronically.

d) The 'Bidder/ Contractor' of foreign origin shall disclose the name and address of the Agents/ representatives in India if any. Similarly, the Bidder/ Contractors of Indian Nationality shall furnish the name and address of the foreign Employers, if any. Further details as mentioned in the "Guidelines on Indian Agents of Foreign Suppliers" shall be disclosed by the Bidder/ Contractor. Further, as mentioned in the Guidelines, all the payments made to the Indian agent/ representative have to be in Indian Rupees only. Copy of the "Guidelines on Indian Agents of Foreign Suppliers" is placed in Appendix to this agreement.

e) The 'Bidder/ Contractor' shall, when presenting their bid, disclose any and all payments made, is committed to, or intends to make to agents, brokers, or any other intermediaries in connection with the award of the contract.

f) Bidder/ Contractor who have signed the Integrity Pact shall not approach the Courts while representing the matter to IEMs and shall wait for their decision in the matter.

4) The 'Bidder/ Contractor' shall not instigate third persons to commit offences outlined above or be an accessory to such offences.

Section 3 – Disqualification from tender process and exclusion from future contracts

If the 'Bidder/ Contractor', before award or during execution, has committed a transgression through a violation of Section 2, above or in any other form such as to put their reliability or credibility in question, the Employer is entitled to disqualify the 'Bidder/ Contractor' from the tender process or take action as per the procedure mentioned in the "Guidelines on Banning of business dealings".

Section 4 – Compensation for Damages

5) If the Employer has disqualified the 'Bidder/ Contractor' from the tender process prior to the award according to Section 3, the Employer is entitled to demand and recover from 'Bidder/ Contractor' the damages equivalent to Earnest Money Deposit/ Bid Security.

6) If the Employer has terminated the contract according to Section 3, or if the Employer is entitled to terminate the contract according to Section 3, the Employer shall be entitled to demand and recover from the contractor liquidated damages of the contract value or the amount equivalent to Performance Bank Guarantee.

Section 5 – Previous transgression

1) Bidder declares that no previous transgressions occurred in the last three years with any other Company in any country conforming to the anti-corruption approach or with any Public Sector Enterprise in India that could justify his exclusion from the tender process.

2) If Bidder makes an incorrect statement on this subject, he can be disqualified from the tender process, or action can be taken as per the procedure mentioned in "Guidelines on Banning of business dealings".

Section 6 – Equal treatment of all Bidders/ Contractors/ Subcontractors

7) In the case of Sub-contracting, the Principal Contractor shall take responsibility for the adoption of the Integrity Pact by the Sub-contractor.
8) The Employer shall enter into agreements with identical conditions as this one with all Bidders and Contractors.
9) The Employer shall disqualify from the tender process all bidders who do not sign this Pact or violate its provisions.

Section 7 – Criminal charges against violating Bidder(s)/ Contractor(s)/ Subcontractor(s)

If the Employer obtains knowledge of the conduct of a Bidder, Contractor or Subcontractor, or of an employee or a representative or an associate of a Bidder, Contractor or Subcontractor which constitutes corruption, or if the Employer has substantive suspicion in this regard, the Employer shall inform the same to the Chief Vigilance Officer.

Section 8 – Independent External Monitor

10) The Employer appoints a competent and credible Independent External Monitor for this Pact after approval by Central Vigilance Commission. The task of the Monitor is to review independently and objectively whether and to what extent the parties comply with the obligations under this agreement.
11) The Monitor is not subject to instructions by the representatives of the parties and performs his functions neutrally and independently. The Monitor would have access to all Contract documents whenever required. It shall be obligatory for him/ her to treat the information and documents of the Bidders/ Contractors as confidential. He/ she reports to the Head of the Organisation.
12) The Bidder(s)/ Contractor(s) accepts that the Monitor has the right to access without restriction to all Project documentation of the Employer, including that provided by the contractor. The Contractor shall also grant the Monitor, upon his request and demonstration of a valid interest, unrestricted and unconditional access to their project documentation. The same is applicable to Sub-contractors.
13) The Monitor is under contractual obligation to treat the information and documents of the Bidder/ Contractor(s)/ Sub-contractor(s) with confidentiality. The Monitor has also signed declarations on 'Non-Disclosure of Confidential Information and of 'Absence of Conflict of Interest'. In case of any conflict of interest arising at a later date, the IEM shall inform the Head of the Organisation and recuse himself/ herself from that case.
14) The Employer shall provide to the Monitor sufficient information about all meetings among the parties related to the Project provided such meetings could have an impact on the contractual relations between the Employer and the contractor. The parties offer the Monitor the option to participate in such meetings.
15) As soon as the Monitor notices, or believes to have noticed, a violation of this agreement, he shall so inform the Management of the Employer and request the Management to discontinue or take corrective action or to take other relevant action. The monitor can, in this regard, submit non-binding recommendations. Beyond this, the Monitor has no right to demand from the parties that they act in a specific manner, refrain from action, or tolerate action.
16) The Monitor shall submit a written report to the Head of the Organisation within 8 to 10 weeks from the date of reference or intimation to him by the Employer and, should the occasion arise, submit proposals for correcting problematic situations.

17) If the Monitor has reported to the Head of the Organisation, a substantiated suspicion of an offence under relevant IPC/ PC Act, and Head of the Organisation has not, within the reasonable time, taken visible action to proceed against such offence or reported it to the Chief Vigilance Officer, the Monitor may also transmit this information directly to the Central Vigilance Commissioner.
18) The word 'Monitor' would include both singular and plural.

Section 9 – Pact Duration

This Pact begins when both parties have legally signed it. It expires for the contractor 12 months after the last payment under the contract and for all other Bidders 6 months after the contract has been awarded. Any violation of the same would entail disqualification of the bidders and exclusion from future business dealings.

If any claim is made/ lodged during this time, the same shall be binding and continue to be valid despite the lapse of this pact as specified above unless it is discharged/ determined by the Head of the Organization.

Section 10 – Other provisions

19) This agreement is subject to Indian Law. The place of performance and jurisdiction is the Registered Office of the Employer, i.e., New Delhi.
20) Changes and supplements, as well as termination notices, need to be made in writing. Side agreements have not been made.
21) If the contractor is a partnership or a consortium, this agreement must be signed by all partners or consortium members.
22) Should one or several provisions of this agreement turn out to be invalid, the remainder of this agreement remains valid. In this case, the parties shall strive to come to an agreement with their original intentions.
23) Issues like Warranty/ Guarantee etc. shall be outside the purview of IEMs.
24) In the event of any contradiction between the Integrity Pact and its Appendix, the Clause in the Integrity Pact shall prevail.
25) For and on behalf of the Employer

SIGNED, SEALED AND DELIVERED

For and on behalf of the WAPCOS Contractor	**For and on behalf of the**
NAME _____	NAME _____
DESIGNATION	DESIGNATION
In the presence of witness:	**In the presence of Witness**
1_____	1_____
2 _____	2 _____

Form-Q: Undertaking for Non-Demolition of Executed Works due to Structural Failure/Deficiency

(TO BE SUBMITTED ON BIDDER'S ORIGINAL LETTER HEAD)

Name of Work: (Name of the Work/Project) .....

1. This is to certify that We, M/s ……, in submission of this offer/bid, confirm and undertake as under:-

2. We have not executed any work, in India or abroad, which was subsequently demolished, dismantled, or ordered to be demolished/reconstructed on account of structural failure, structural unsafety or instability, non-compliance with the applicable Indian Standard (IS) Codes/National Building Code, or any other similar deficiency in design, materials, or workmanship.

3. We further confirm that no such deficiency, defect, or non-conformance has been recorded against any work executed by us, either during construction or thereafter, by any Employer, Client, Project Management Consultant, or Statutory/Regulatory Authority, which has resulted in demolition, dismantling, reconstruction, or rejection of the structure or any part thereof.

4. We understand and accept that in the event any such demolition, dismantling, or reconstruction as stated above has been carried out or ordered against any work executed by us, We shall not be eligible to participate in, or be considered for, this Bid/Tender, and our Bid/Tender shall be liable for outright rejection on this ground alone.

5. We further understand and accept that this undertaking forms an integral part of our Bid/Tender, and that in the event any suppression of facts, concealment, or misrepresentation in this regard is detected at any stage - whether before award of contract, during execution, or after completion - our Bid/Tender shall be liable for rejection, or the Contract, if already awarded, shall be liable for termination, with forfeiture of EMD/Performance Security and Bid Security, besides blacklisting/debarment and such other action as the Employer may deem fit, without prejudice to any other right or remedy available to the Employer under the Contract or under law.

6. We further undertake to keep the Employer indemnified against any loss, damage, claim, or liability that may arise on account of any incorrect, false, or misleading statement made in this undertaking.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

Form-R: Undertaking for Non-Demolition of Executed Works due to Structural Failure/Deficiency

(TO BE SUBMITTED ON BIDDER'S ORIGINAL LETTER HEAD)

Name of Work: (Name of the Work/Project) .....

We hereby undertake and confirm that, in the event of award of the work to us, we shall submit, within Forty-Five (45) days from the date of award of work, original undertakings from the respective Original Equipment Manufacturers (OEMs) for all specialized Electro-Mechanical (E&M) systems, including but not limited to:

- Substation
- Sewage Treatment Plant (STP)
- Diesel Generator (DG) Set
- Lifts
- Fire Fighting System
- Fire Alarm System
- Ventilation System
- EPABX System
- CCTV System
- Solar Photovoltaic (PV) System
- UPS System
- Water Supply System
- Any other specialized E&M system covered under the contract.

The OEM undertaking shall unequivocally state that:

"*The OEM shall unconditionally support the Contractor technically throughout the execution of the contract as well as during the Maintenance/Comprehensive Maintenance Contract for the useful life of the system. The OEM shall also provide all genuine spare parts required for the healthy functioning of the equipment for a minimum period of Seven (07) years from the date of supply of the equipment."*

We further undertake that:

1. The OEMs proposed by us shall be the manufacturers of the respective equipment/systems to be supplied under the contract and shall meet all eligibility requirements specified in the tender documents.
2. We shall be solely responsible for obtaining and submitting the OEM undertakings within the stipulated period.
3. Failure to submit the required OEM undertakings within the prescribed time shall constitute a breach of the contractual obligations and shall entitle the Employer to take appropriate action as per the provisions of the Contract, including rejection of the proposed make/OEM, withholding of payments, or any other action deemed appropriate.
4. We shall ensure close coordination with the respective OEMs throughout the execution of the work and during the warranty, defect liability, and maintenance periods to ensure satisfactory performance of all specialized E&M systems.

We hereby certify that the above undertaking is unconditional, irrevocable, and shall form an integral part of our bid and, upon award, the Contract Agreement.

Date:

Place:

(Signature, Name, Designation of the Authorized signatory with Seal)

SECTION IV - GENERAL CONDITIONS OF CONTRACT (GCC)

1.0 General Rules and Directions

General Rules & Directions	1.	All works proposed for execution by contract will be notified in the form of invitation to tender posted on website. This form will state the work to be carried out, as well as the date for submitting and opening tenders and the time allowed for carrying out the work, also the amount of earnest money to be deposited with the tender, and the amount of the security deposit and Performance guarantee to be deposited by the successful tenderer and the percentage, if any, to be deducted from bills. Copies of the specifications, designs, drawings and any other document applicable to the work shall be open for inspection by the contractor in the office of officer inviting tender during office hours. The work involves execution as per name of work under EPC Mode as specified in Special Conditions of Contract. The Type of building i.e. Permanent or Semi-Permanent, based on the expected economic life of the building, shall be as specified in SCC.
	2.	In the event of tender being submitted by a firm/company, it must be signed separately by each partner/director thereof or in the event of the absence of any partner/director, it must be signed on his behalf by a person holding a power of attorney authorizing him to do so, such power of attorney to be produced with the tender, and it must disclose that the firm/company is duly registered under the applicable Indian Partnership Act 1932/ Companies Act 2013.
	3.	Receipts for payment made on account of work, when executed by a firm/company, must also be signed by all the partners/directors, except where contractors are described in their tender as a firm/company, in which case the receipts must be signed in the name of the firm by one of the partners/directors (duly authorized by the firm/company), or by some other person having due authority to give effectual receipts for the firm/company.
Applicable for Item Rate EPC Tender	4	The rate(s) must be quoted in decimal coinage. Amounts must be quoted in full rupees by ignoring (less than and equal to) fifty paisa and considering more than fifty paisa as rupee one. In case the lowest tendered amount (worked out on the basis of quoted rate of Individual items) of two or more contractors is same, then such lowest contractors may be asked to submit sealed revised offer quoting rate of each item of the schedule of quantity for all sub sections/sub heads as the case may be, but the revised quoted rate of each item of schedule of quantity for all sub sections/sub heads should not be higher than their respective original rate quoted already at the time of submission of tender. The lowest tender shall be decided on the basis of revised offer. If the revised tendered amount (worked out on the basis of quoted rate of individual items) of two or more contractors received in revised offer is again found to be equal, then the lowest tender, among such contractors, shall be decided by draw of lots, In case of any such lowest contractor in his revised offer quotes rate of any item more than their respective original rate quoted already at the time of submission of tender, then such revised offer shall be treated as invalid. Such case of revised offer of the lowest contractor or case of refusal to submit revised offer by the lowest contractor shall be treated as withdrawal of his tender before acceptance and 50% of his earnest money shall be forfeited.

		In case all the lowest contractors those have same tendered amount (as a result of their quoted rate of individual items), refuse to submit revised offers, then tenders are to be recalled after forfeiting 50% of EMD of each lowest contractors. Contractor, whose earnest money is forfeited because of non-submission of revised offer, or quoting higher revised rate(s) of any item(s) than their respective original rate quoted already at the time of submission of his bid shall not be allowed to participate in the retendering process of the work.
Applicable for Percentage Rate EPC Tender only	4A	In case of Percentage Rate EPC tenders, contractor shall fill up percentage below/ above (in figures as well as in words) the total estimated cost given in Schedule of Quantities, he will be willing to execute the work. The tender submitted shall be treated as invalid if :- i. The contractor does not quote percentage above/below on the total amount of tender or any section/sub head of the tender. ii. The percentage above/below is not quoted in figures & words both on the total amount of tender or any section/sub head of the tender. iii. The percentage quoted above/below is different in figures & words on the total amount of tender or any section/sub head of the tender. Tenders, which propose any alteration in the work specified in the said form of invitation to tender, or in the time allowed for carrying out the work, or which contain any other conditions of any sort including conditional rebates, will be summarily rejected.
	4B	In case the lowest tendered amount (estimated cost + amount worked on the basis of percentage above/below) of two or more contractors is same, such lowest contractors will be asked to submit sealed revised offer in the form of letter mentioning percentage above/ below on estimated cost of tender including all sub sections/sub heads as the case may be, but the revised percentage quoted above/below on tendered cost or on each sub section/ sub head should not be higher than the percentage quoted at the time of submission of tender. The lowest tender shall be decided on the basis of revised offers. In case any of such contractors refuses to submit revised offer, then it shall be treated as withdrawal of his tender before acceptance and 50% of earnest money shall be forfeited. If the revised tendered amount of two or more contractors received in revised offer is again found to be equal, the lowest tender, among such contractors, shall be decided by draw of lots & the lowest contractors those have quoted equal amount of their tenders. In case all the lowest contractors those have quoted same tendered amount, refuse to submit revised offers, then tenders are to be recalled after forfeiting 50% of EMD of each contractor. Contractor(s), whose earnest money is forfeited because of non-submission of revised offer, shall not be allowed to participate in the re-tendering process of the work.
	5.	The officer inviting tender or his duly authorized representative will open tenders in the presence of any intending contractors who may be present at the time of opening of tenders

	6.	The officer inviting tenders shall have the right of rejecting all or any of the tenders and will not be bound to accept the lowest or any other tender.
	7.	The receipt of an accountant or clerk for any money paid by the contractor will not be considered as any acknowledgment or payment to the officer inviting tender and the contractor shall be responsible for seeing that he procures a receipt signed by the officer inviting tender or a duly authorized Cashier.
Applicable for Item Rate EPC Tender only	8.	In the case of Item Rate EPC Tenders, only rates quoted shall be considered. Any tender containing percentage below/above the rates quoted is liable to be rejected. Rates quoted by the contractor in item rate EPC tender in figures and words shall be accurately filled in so that there is no discrepancy in the rates written in figures and words. However, if a discrepancy is found, the rates which correspond with the amount worked out by the contractor shall unless otherwise proved be taken as correct. If the amount of an item is not worked out by the contractor or it does not correspond with the rates written either in figures or in words, then the rates quoted by the contractor in words shall be taken as correct. Where the rates quoted by the contractor in figures and in words tally, but the amount is not worked out correctly, the rates quoted by the contractor will unless otherwise proved be taken as correct and not the amount. In event no rate has been quoted for any item(s), leaving space both in figure(s), word(s), and amount blank, it will be presumed that the contractor has included the cost of this/these item(s) in other items and rate for such item(s) will be considered as zero and work will be required to be executed accordingly. However, if a tenderer quotes nil rates against any item in item rate EPC tender, the tender shall be treated as invalid and will not be considered as lowest tenderer and earnest money deposited shall be forfeited.
Applicable for percentage Rate EPC Tender only	9.	In case of Percentage Rate EPC Tenders only percentage quoted shall be considered. Any tender containing item rates is liable to be rejected. Percentage quoted by the contractor in percentage rate EPC tender shall be accurately filled in figures and words, so that there is no discrepancy.
Applicable for Percentage Rate EPC Tender only	10.	In Percentage Rate EPC Tender, the tenderer shall quote percentage below/above (in figures as well as in words) at which he will be willing to execute the work. He shall also work out the total amount of his offer and the same should be written in figures as well as in words in such a way that no interpolation is possible. In case of figures, the word 'Rs.' should be written before the figure of rupees and word 'P' after the decimal figures, e.g. 'Rs. 2.15P and in case of words, the word 'Rupees' should precede and the word 'Paisa' should be written at the end
	11.	i. The Contractor, whose tender is accepted, will be required to furnish performance guarantee at specified percentage of the tendered amount as mentioned in NIT and within the period specified in SCC. This guarantee shall be in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee of any Commercial Bank. ii. The contractor whose tender is accepted will also be required to furnish by way of Security Deposit for the fulfilment of his contract, an amount equal to 5% of the tendered amount of the work. The Security deposit will be collected by deductions from the running bills as well as final bill of the contractor at the rates mentioned above. The Security amount will also be accepted in the shape of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the

		Commercial Banks will be accepted for this purpose provided confirmatory advice is enclosed.
	12.	On acceptance of the tender, the name of the accredited representative(s) of the contractor who would be responsible for taking instructions from the Engineer-in-Charge shall be communicated in writing to the Engineer-in-Charge.
	13.	GST or any other tax applicable in respect of inputs procured by the contractor for this contract shall be payable by the Contractor and Government will not entertain any claim whatsoever in respect of the same. However, component of GST at time of supply of service (as provided in CGST Act 2017) provided by the contract shall be varied if different from that applicable on the last date of receipt of tender including extension if any. Accordingly payment or recovery shall be done.
	14.	The contractor shall give a list of WAPCOS and Delhi Law Department employees related to him.
	15.	The tender for composite work includes, in addition to building work, all other works such as sanitary and water supply installations drainage installation, electrical work, horticulture work, roads and paths etc. as mentioned in the scope of work.
	16.	The contractor shall comply with the provisions of the Apprentices Act 1961, and the rules and orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the contract and WAPCOS may in his discretion, without prejudice to any other right or remedy available in law, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

2.0 Conditions of Contract

Definitions	1.	The EPC Contract means the documents forming the tender and acceptance thereof and the formal agreement executed between the WAPCOS and the Contractor, together with the documents referred to therein including conditions, specifications, designs, drawings and instructions issued from time to time by the Engineer-in- Charge and all these documents taken together, shall be deemed to form one contract and shall be complementary to one another.
	2.	In the contract, the following expressions shall, unless the context otherwise requires, have the meanings, hereby respectively assigned to them:- i. The expression, works or work shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional ii. The **Site** shall mean the land, places on, into or where work is to be executed under the contract or any adjacent land, path or street or where work is to be executed under the contract or any adjacent land, path or street which may be temporally allotted or used for the purpose of carrying out the contract. iii. The **Bidder** / **Contractor** shall mean the individual, firm or company, whether incorporated or not, undertaking the works and shall include the legal personal representative of such individual or the persons composing such firm or company, or the successors of such firm or

		company and the permitted assignees of such individual, firm or company. iv. "**Employer**" shall mean "WAPCOS Limited", A Government of India undertaking- Ministry of Jal Shakti, for execution of the Work / Project as mentioned in NIT. Having their Registered office at 5th floor, Kailash building, 26-Kasturba Gandhi Marg, New Delhi-110001, India & include their successors & permitted assigns as well as their authorized officer / representatives. v. **'Principal Employer / Owner'** means Department of Law, Justice and Legislative Affairs, Govt. of National Capital Territory (NCT) of Delhi - that has appointed WAPCOS as PMC for the work mentioned in the NIT. vi. The PMC / Company / WAPCOS or WAPCOS Limited or shall mean WAPCOS Limited, A Government of India undertaking- Ministry of Jal Shakti appointed as a Project Management Consultant by the Principal Employer. vii. Owner / Client / Principal Employer means Department of Law, Justice and Legislative Affairs, Govt. of National Capital Territory (NCT) of Delhi. viii. The expression **works or Project** shall, unless there be something either in the subject or context repugnant to such construction, be construed and taken to mean the works by or by virtue of the contract contracted to be executed whether temporary or permanent, and whether original, altered, substituted or additional ix. **'Contract'** means the documents forming the tender and acceptance thereof and the formal Agreement executed between WAPCOS and the Contractor, together with GCC, SCC, Specifications, Designs, Drawings, BoQ/SoQ, and instructions issued from time to time by the Engineer-in-Charge — all read as one complementary contract. x. The **Engineer-in-Charge** means the Engineer Officer who shall supervise and be in charge of the work and who shall sign the contract on behalf of the WAPCOS as mentioned in Special Conditions of Contract. xi. **'Project Manager / Project Engineer'** means the officer appointed by WAPCOS to supervise works at site and authorised by the EIC. xii. **Accepting Authority** shall mean the authority mentioned in Special Conditions of Contract. xiii. **Tenderer / Bidder** shall mean the firm/party who intends to participate in this Notice Inviting Tender xiv. **Excepted Risk** are risks due to riots (other than those on account of

		contractor's employees), war (whether declared or not) invasion, act of foreign enemies, hostilities, civil war, rebellion revolution, insurrection, military or usurped power, any acts of Government, damages from aircraft, acts of God, such as earthquake, lightening and unprecedented floods, and other causes over which the contractor has no control and accepted as such by the Accepting Authority or causes solely due to use or occupation by Government of the part of the works in respect of which a certificate of completion has been issued or a cause solely due to Government's faulty design of works. xv. **Market Rate** shall be the rate as decided by the Engineer-in-Charge on the basis of the cost of materials and labour at the site where the work is to be executed plus the percentage mentioned in Special Conditions of Contract to cover, all overheads and profits. Provided that no extra overheads and profits shall be payable on the part(s) of work assigned to other agency(s) by the contractor as per terms of contract. xvi. **Schedule(s)** referred to in these conditions shall mean the relevant schedule(s) annexed to the tender papers or the standard Schedule of Rates of the government mentioned in Special Conditions of Contract hereunder, with the amendments thereto issued upto the date of receipt of the tender. xvii. **District Specifications** means the specifications followed by the State Government in the area where the work is to be executed. xviii. The **Contractor/Successful Bidder** shall mean the firm or company whose bid has been accepted by WAPCOS. xix. **Consultant** shall mean any consultant nominated by the WAPCOS xx. **Tendered value** means the value of the entire work as stipulated in the letter of award – excluding GST. xxi. **'Contract Price'** means the total value of work executed under the contract including Tendered Value, Extra Items, Substituted Items, Deviated Items - including applicable GST. xxii. **Date of commencement of work:** The date of commencement of work shall be the date of start as specified in Special Conditions of Contract or the first date of handing over of the site, whichever is later, in accordance with the phasing if any, as indicated in the tender document. xxiii. **GST** shall mean Goods and Service Tax - Central, State and Inter State.
Scope and Performance	3.	Where the context so requires, words imparting the singular only also include the plural and vice versa. Any reference to masculine gender shall whenever required include feminine gender and vice versa.
	4.	Headings and Marginal notes to these General Conditions of Contract shall not

		be deemed to form part thereof or be taken into consideration in the interpretation or construction thereof or of the contract.
	5.	The contractor shall be furnished, free of cost one certified copy of the contract documents except standard specifications, and such other printed and published documents, together with all drawings as may be forming part of the tender papers. None of these documents shall be used for any purpose other than that of this contract.
Works to be carried out	6.	The work to be carried out under the Contract shall, except as otherwise provided in these conditions, include all labour, materials, tools, plants, equipment and transport which may be required in preparation of and for and in the full and entire execution and completion of the works. The descriptions given in the Schedule of Quantities/ Building Components shall, unless otherwise stated, be held to include wastage on materials, carriage and cartage, carrying and return of empties, hoisting, setting, fitting and fixing in position and all other labours necessary in and for the full and entire execution and completion of the work as aforesaid in accordance with good practice and recognized principles.
Sufficiency of Tender	7.	The Contractor shall be deemed to have satisfied himself before tendering as to the correctness and sufficiency of his tender for the works and of the cost quoted in the Schedule of Quantities/ Building Components, which rates and prices shall, except as otherwise provided, cover all his obligations under the Contract and all matters and things necessary for the proper completion and maintenance of the works.
Discrepancies and Adjustment of Errors	8.	The several documents forming the Contract are to be taken as mutually explanatory of one another, detailed drawings being followed in preference to small scale drawing and figured dimensions in preference to scale and special conditions in preference to General Conditions.
	8.1	In the case of discrepancy between the schedule of Quantities/Building Components, the Specifications and/ or the Drawings, the following order of preference shall be observed:- i. Description of Schedule of Quantities ii. Particular Specification and Special Condition, if any. iii. Tender Drawings. iv. Standard Specifications. v. CPWD specifications / publications up to date correction slips vi. Indian Standard Specifications of B.I.S. vii. National Building Code 2016 with up to date correction slips viii. GRIHA/IGBC guidelines
	8.2	If there are varying or conflicting provisions made in any one document forming part of the contract, the Accepting Authority shall be the deciding authority with regard to the intention of the document and his decision shall be final and binding on the contractor.
	8.3	Any error in description, quantity or rate in Schedule of Quantities or any omission therefrom shall not vitiate the Contract or release the Contractor from the execution of the whole or any part of the works comprised therein according to drawings and specifications or from any of his obligations under the contract.
Signing of Contract	9.	The successful tenderer/contractor, on acceptance of his tender by the Accepting Authority, shall, within 15 days from the stipulated date of start of the work, sign the contract consisting of:-

		i. The notice inviting tender, all the documents including drawings, if any, forming the tender as issued at the time of invitation of tender and acceptance thereof together with any correspondence leading thereto. ii. Special Conditions of Contract consisting of: a) Various standard clauses with corrections up to the date stipulated in Special Conditions of Contract along with annexures thereto. b) Safety Code. c) Model Rules for the protection of health, sanitary arrangements for workers employed WAPCOS or its contractors. d) Contractor's Labour Regulations. e) List of Acts and omissions for which fines can be imposed. iii. No payment for the work done will be made unless contract is signed by the contractor.

3.0 Clauses of Contract

CLAUSE 1: PERFORMANCE SECURITY (PERFORMANCE BANK GUARANTEE)

i. The contractor shall submit an irrevocable **Performance Guarantee of 5% (Five percent) of the tendered amount** in addition to other deposits mentioned elsewhere in the contract for his proper performance of the contract agreement, (not withstanding and/or without prejudice to any other provisions in the contract) within period specified in Special Conditions of Contract from the date of issue of letter of acceptance. This period can be further extended by the Engineer-in-Charge up to a maximum period as specified in Special Conditions of Contract on written request of the contractor stating the reason for delays in procuring the Performance Guarantee, to the satisfaction of the Engineer-in-Charge. This Guarantee shall be in the form of Insurance Surety Bonds, Account Payee Demand Draft, Fixed Deposit Receipt or Bank Guarantee from any of the Commercial Banks. In case a fixed deposit receipt of any Bank is furnished by the contractor to the Government as part of the performance guarantee and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to the Government to make good the deficit.

ii. **The Performance Guarantee shall be initially valid up to the stipulated date of completion plus 1 year claim period beyond** the date of completion of all contractual obligations of the contractor, including Defect Liability Period (DLP). In case the time for completion of work gets enlarged, the contractor shall get the validity of Performance Security extended to cover such enlarged time. The performance Security shall be refunded to the contractor without interest, after he duly performs and completes all obligations under the contract not later than 365 days of completion of the Defect Liability Period.

iii. Bank Guarantee for Performance Security must be confirmed through SFMS (Structured Financial Messaging System) from WAPCOS's banker - Indian Overseas Bank, NHB Branch, Gurugram, Branch Code: 1935, IFSC: IOBA0001935, Beneficiary: WAPCOS Limited. SFMS confirmation must be obtained for any extension of BG validity as well.

iv. The Engineer-in-Charge shall make a claim under the performance guarantee except for amounts to which the WAPCOS is entitled under the contract (not withstanding and/or without prejudice to any other provisions in the contract agreement) in the event of:

   a. Failure by the contractor to extend the validity of the Performance Guarantee as described herein above, in which event the Engineer-in-Charge may claim the full amount of the Performance Guarantee.
   b. Failure by the contractor to pay WAPCOS any amount due, either as agreed by the contractor or determined under any of the Clauses/Conditions of the agreement, within 30 days of the service of notice to this effect by Engineer in-Charge.

v. In the event of the contract being determined or rescinded under provision of any of the Clause/Condition of the agreement, the performance guarantee shall stand forfeited in full and shall be absolutely at the disposal of the WAPCOS.

vi. The performance Guarantee shall be refunded without interest to the contractor after completing all duties and obligations under the contract and recording successful Completion of Defect Liability Period.

CLAUSE 1A: SECURITY DEPOSIT / RETENTION MONEY

The Bidder whose tender(s) may be accepted (hereinafter called the contractor) shall permit WAPCOS at the time of making any payment to him for work done under the contract to deduct a sum at the rate of 5% of the gross amount of each running and final bill till the sum deducted will amount to security deposit of 5% of the tendered value of the work. Such deductions will be made and held by WAPCOS by way of Security Deposit unless he/they has/have deposited the amount of Security at the rate mentioned above in cash or in the form of Government Securities or fixed deposit receipts. In case a fixed deposit receipt of any Bank is furnished by the contractor to WAPCOS as part of the security deposit and the Bank is unable to make payment against the said fixed deposit receipt, the loss caused thereby shall fall on the contractor and the contractor shall forthwith on demand furnish additional security to WAPCOS to make good the deficit.

All compensations or the other sums of money payable by the contractor under the terms of this contract may be deducted from, or paid by the sale of a sufficient part of his security deposit or from the interest arising there from, or from any sums which may be due to or may become due to the contractor by WAPCOS on any account whatsoever and in the event of his Security Deposit being reduced by reason of any such deductions or sale as aforesaid, the contractor shall within 10 days make good in cash or fixed deposit receipt tendered by the State Bank of India or by Scheduled Banks endorsed in favour of WAPCOS, any sum or sums which may have been deducted from, or raised by sale of his security deposit or any part thereof. The security deposit shall be collected from the running bills and the final bill of the contractor at the rates mentioned above.

The Security Deposit as deducted above shall be released within 60 days of successful completion of Warranty/Defect Liability as Certified by the Engineer-in-Charge or till the final bill has been prepared and passed whichever is later.

The contractor may, at his option, replace the security deposit amount with an unconditional BG/ Insurance Surety Bonds from a bank acceptable to WAPCOS at the following stages:

a) After the amount reaches half the value of the limit of retention money; and

b) After the amount reaches the maximum limit of retention money. One-half of the retention money (or BG, which replaced retention money) shall be released on the issue of the taking-over certificate; if the Taking Over Certificates (TOCs) are issued in parts, then in such proportions as the engineer may determine, having regard to the value of such part or section. The other half of the retention money (or BG, which replaced the retention money) shall be released upon expiration of 60 (sixty or any other period mentioned in the tender document) days after the DLP/ warranty period of the works or final payment, whichever is earlier, on certification by the engineer. In the event of different defect liability periods/ warranty period being applicable to different sections or parts or equipment incidental to works, the expiration of defect liability period/ warranty period shall be the latest of such periods.

CLAUSE 2: COMPENSATION FOR DELAY - LIQUIDATED DAMAGES (LD)

If the contractor fails to maintain the required progress in terms of clause 5 or to complete the work and clear the site on or before the stipulated completion date or justified extended date of completion

determined as per clause 5 (excluding any extension under clause 5.5) also considering any extension granted under clauses 12 and 15, he shall, without prejudice to any other right or remedy available under the law to the Government on account of such breach, pay as compensation, the amount calculated as below :

(i) **Compensation for delay of work @ 0.75% of accepted tendered amount per month of delay (to be computed on per day basis)**

Provided further that the total amount of compensation for delay to be paid under this condition **shall not exceed 10% (Ten percent) of the accepted Tendered Value of work** or of the accepted Tendered Value of the Sectional part of work as mentioned in Special Conditions of Contract for which a separate period of completion is originally given.

The period of delay solely attributable to contractor shall be computed as the time taken by contractor going beyond the 'justified date of completion' as determined by the authority specified in SCC under clause 5. Further, in case where the contractor is entitled to additional time under clause 12 and /or clause 15, that shall also be accounted for while deciding the net period of delay. In case, Engineer-in-charge decides to levy compensation during the progress of work, the period of delay attributable to contractor shall be computed (by such authority) as the period by which the progress is behind the schedule on date of such decision, after due consideration of justified extension at that stage of work.

In case no compensation has been decided by the Engineer-in-Charge during the progress of work, this shall be no waiver of right to levy compensation by the said authority if the work remains incomplete on final justified extended date of completion.

In case action under clause 2 has not been finalized and the work has been determined under clause 3, the right of action under clause 2 shall remain post determination of contract and in such case the levy of compensation shall be for days the progress is behind the schedule on date of determination, as assessed by the Engineer-in-charge, after due consideration of justified extension. The compensation for delay, if not decided before the determination of contract, shall be decided after of determination of contract. Further, in such case where the contract has been determined, the total amount of recovery against compensation under clause 2 plus that under clause 3 (i.e. forfeiture of security deposit, performance guarantee) shall not exceed 13% of the accepted tendered value of work.

The amount of compensation may be adjusted or set-off against any sum payable to the Contractor under this or any other contract with the Government.

In case, the contractor does not achieve a particular milestone mentioned in SCC, or the re-scheduled milestone(s) in terms of Clause 5, the amount shown against that milestone shall be withheld, to be adjusted against the compensation levied as above. With-holding of this amount on failure to achieve a milestone, shall be automatic without any notice to the contractor. However, if the contractor catches up with the progress of work on the subsequent milestone(s), the withheld amount shall be released. In case the contractor fails to make up for the delay in subsequent milestone(s), amount mentioned against each milestone missed subsequently also shall be withheld. The amount so withheld can be released against BG/ FDR from a commercial bank of equivalent amount. Further, no interest, whatsoever, shall be payable on such withheld amount.

If the Engineer in Charge decides to give further extension of time allowing performance of work beyond the justified extended date the contractor shall be liable to pay compensation for such extended period. The levy of compensation under this clause shall be without prejudice to the right of action by the Engineer-in-charge under clause 3 or any other clause in contract.

If the Principal Employer imposes LD on WAPCOS/the project at any point, the full amount of LD (up to 10% of Contract Price) shall be recovered from forthcoming RA Bills. If the RA Bill amount is insufficient, the balance shall be recovered from Performance Security, Security Deposit, and any other financial deposits of the Contractor with WAPCOS.

Note: Actions under Clause 2 (LD) and Clause 3 (Determination) are independent. WAPCOS is entitled to claim LD for delay and also take action for determination for non-performance — these are not mutually exclusive remedies.

Clause 2A Denial Clause

If delay in works is attributable to the contractor, WAPCOS / Employer shall not be responsible for any extra expenditure during the extended period. Any increase in statutory duties and/ or upward rise in prices and/ or any adverse fluctuation in foreign exchange are to be borne by the contractor during the extended delivery period, while WAPCOS / employer reserves his right to get any benefit of a downward revisions in statutory duties, and foreign exchange rate.

CLAUSE 3: WHEN CONTRACT CAN BE DETERMINED

Subject to other provisions contained in this clause, the Engineer-in-Charge may, without prejudice to his any other rights or remedy against the contractor in respect of any delay, inferior workmanship, any claims for damages and/or any other provisions of this contract or otherwise, and whether the date of completion has or has not elapsed, by notice in writing absolutely determine the contract in any of the following cases:

i. If the contractor having been given by the Engineer-in-Charge a notice in writing to rectify, reconstruct or replace any defective work or that the work is being performed in an inefficient or otherwise improper or unworkman like manner shall omit to comply with the requirement of such notice for a period of seven days thereafter.

ii. If the contractor has, without reasonable cause, suspended the progress of the work or has failed to proceed with the work with due diligence so that in the opinion of the Engineer-in-Charge (which shall be final and binding) he will be unable to secure completion of the work by the date for completion and continues to do so after a notice in writing of seven days from the Engineer-in-Charge.

iii. If the contractor fails to complete the work or section of work with individual date of completion on or before the stipulated or justified extended date, on or before such date of completion; and the Engineer-in-charge without any prejudice to any other right or remedy under any other provision in the contract has given further reasonable time in a notice given in writing in that behalf as either mutually agreed or in absence of such mutual agreement by his own assessment making such time essence of contract and in the opinion of Engineer-in-Charge the contractor will be unable to complete the same or does not complete the same within the period specified.

iv. If the contractor persistently neglects to carry out his obligations under the contract and/ or commits default in complying with any of the terms and conditions of the contract and does not remedy it or take effective steps to remedy it within 7 days after a notice in writing is given to him in that behalf by the Engineer-in-Charge.

v. If the contractor shall offer or give or agree to give to any person in WAPCOS service or to any other person on his behalf any gift or consideration of any kind as an inducement or reward for doing or forbearing to do or for having done or forborne to do any act in relation to the obtaining or execution of this or any other contract for WAPCOS.

vi. If the contractor shall enter into a contract with WAPCOS in connection with which commission has been paid or agreed to be paid by him or to his knowledge, unless the particulars of any such commission and the terms of payment thereof have been previously disclosed in writing to the Engineer-in-Charge.

vii. If the contractor had secured the contract with WAPCOS as a result of wrong tendering or other non-bonafide methods of competitive tendering or commits breach of Integrity Agreement.

viii. If the contractor being an individual, or if a firm, any partner thereof shall at any time be adjudged insolvent or have a receiving order or order for administration of his estate made against him or shall take any proceedings for liquidation or composition (other than a voluntary liquidation for the purpose of amalgamation or reconstruction) under any Insolvency Act for the time being in force or make any conveyance or assignment of his effects or composition or arrangement for the benefit of his creditors or purport so to do, or if any application be made under any Insolvency Act for the time being in force for the sequestration of his estate or if a trust deed be executed by him for benefit of his creditors.

ix. If the contractor being a company shall pass a resolution or the court shall make an order that the company shall be wound up or if a receiver or a manager on behalf of a creditor shall be appointed or if circumstances shall arise which entitle the court or the creditor to appoint a receiver or a manager or which entitle the court to make a winding up order.

x. If the contractor shall suffer an execution being levied on his goods and allow it to be continued for a period of 21 days.

xi. If the contractor assigns (excluding part(s) of work assigned to other agency(s) by the contractor as per terms of contract), transfers, sublets (engagement of labour on a piece-work basis or of labour with materials not to be incorporated in the work, shall not be deemed to be subletting) or otherwise parts with or attempts to assign, transfer, sublet or otherwise parts with the entire works or any portion thereof without the prior written approval of the Engineer -in-Charge.

xii. When the contractor has made himself liable for action under any of the cases aforesaid, the Engineer-in-Charge on behalf of the WAPCOS shall have powers:

(a) To determine the contract as aforesaid so far as performance of work by the Contractor is concerned (of which determination notice in writing to the contractor under the hand of the Engineer-in-Charge shall be conclusive evidence). Upon such determination, Security Deposit already recovered, Security deposit payable and Performance Security under the contract shall be liable to be forfeited and shall be absolutely at the disposal of the Government.

(b) After giving notice to the contractor to measure up the work of the contractor and to take such whole, or the balance or part thereof, as shall be un-executed out of his hands and to give it to another contractor to complete the work. The contractor, whose contract is determined as above, shall not be allowed to participate in the tendering process for the balance work including any new items needed to complete the work. In the event of above courses being adopted by the Engineer-in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reasons of his having purchased or procured any materials or entered into any engagements or made any advances on account or with a view to the execution of the work or the performance of the contract. And in case action is taken under any of the provision aforesaid, the contractor shall not be entitled to recover or be paid any sum for any work thereof or actually performed under this contract unless and until the Engineer-in-Charge has certified in writing the performance of such work and the value payable in respect thereof and he shall only be entitled to be paid the value so certified.

Note:

Actions under Clause 2 and 3 are independent.

The compensation under Clause 2 is for loss caused due to delay in performance, whereas, the compensation under Clause 3 is for consequential losses due to non-performance of the Contract. Hence, the Employer is entitled to compensation under Clause 3 and Clause 2 independently. Hence, the Employer is empowered to take action under Clause 2 for levy of compensation depending on liability of Contractor under Clause 2 based on the delay at the stage of Clause 3 action, before determination.

Clause 3A - Contract Closure Where Work Cannot Start – Not Applicable

In case, the work cannot be started due to reasons not within the control of the contractor within 1/6th of the stipulated time for completion of work or one month whichever is higher, either party may close the contract. In case contractor wants to close the contract, he shall give notice to the WAPCOS stating the failure on the part of WAPCOS. In such eventuality, the Performance Security of the contractor shall be refunded within 30 days of the closing of the contract.

Neither party shall claim compensation in such eventuality. This clause is not applicable for any breach by either party.

CLAUSE 4: Contractor Liable For Compensation Even If Clause 3 Not Invoked

In any case in which any of the powers conferred upon the Engineer-in-Charge by Clause-3 thereof,shall have become exercisable and the same are not exercised, the non-exercise thereof shall not constitute a waiver of any of the conditions hereof and such powers shall notwithstanding be exercisable in the event of any future case of default by the contractor and the liability of the contractor for compensation shall remain unaffected. In the event of the Engineer-in-Charge putting in force all or any of the powers vested in him under the preceding clause he may, if he so desires after giving a notice in writing to the contractor, take possession of (or at the sole discretion of the Engineer-in-Charge which shall be final and binding on the contractor) use as on hire (the amount of the hire money being also in the final determination of the Engineer-in-Charge) all or anytools, plant, materials and stores, in or upon the works, or the site thereof belonging to the contractor, or procured by the contractor and intended to be used for the execution of the work/or any part thereof, paying or allowing for the same in account at the contract rates, or, in the case of these not being applicable, at current market rates to be certified by the Engineer-in-Charge, whose certificate thereof shall be final, and binding on the contractor, clerk of the works, foreman or other authorized agent to remove such tools, plant, materials, or stores from the premises (within a time to be specified in such notice) in the event of the contractor failing to comply with any such requisition, the Engineer-in-Charge may remove them at the contractor's expense or sell them by auction or private sale on account of the contractor and his risk in all respects and the certificate of the Engineer-in-Charge as to the expenses of any such removal and the amount of the proceeds and expenses of any such sale shall be final and conclusive against the contractor.

CLAUSE 5: TIME AND EXTENSION FOR DELAY

The time allowed for execution of the Works as specified in the Special Conditions of Contract or the extended time in accordance with these conditions shall be the essence of the Contract. The execution of the work shall commence from such date as mentioned in Special Conditions of Contract or from the date of handing over of the site, as notified by the Engineer-in-Charge, whichever is later. If the Contractor commits default in commencing the execution of the work as aforesaid and such default continues even after 10 days after a notice in writing has been given by the Engineer in charge, the performance guarantee shall be forfeited by the Engineer in Charge and shall be absolutely at the disposal of the WAPCOS without prejudice to any other right or remedy available in law. The contract shall stand determined when such decision regarding the forfeiture of the performance guarantee is communicated to the contractor.

5.1 As soon as possible after the Contract is concluded, the Contractor shall submit a Time and Progress Chart for each mile stone and get it approved by the WAPCOS. The Chart shall be prepared in direct relation to the time stated in the Contract documents for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessary by agreement between the Engineer-in-Charge and the Contractor within the limitations of time imposed in the Contract documents, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special

jobs for which a separate programme has been agreed upon) complete the work as per mile stones given in Special Conditions of Contract.

(a) Project Management shall be done by using project management software for works costing more than Rs. 5 Crore.
(b) The project management shall be done using M.S. Project software for works costing more than Rs. 5 Crore and up to Rs. 20 Crore.
(c) For works costing more than Rs. 20 Crore, Project management shall be done using Primavera Software.

PROGRAMME CHART

(i) The Contractor shall prepare an integrated programme chart in MS Project/ Primavera software for the execution of work, showing clearly all activities from the start of work to completion, with details of manpower, equipment and machinery required for the fulfillment of the programme within the stipulated period or earlier and submit the same for approval to the Engineer-in- Charge within ten days of award of the contract. A recoveryof Rs. 2500/- (for works costing upto Rs. 20 Crores) / Rs. 5000/- (for works costing more thanRs. 20 Crores) shall be made on per day basis in case of delay in submission of the above programme.

(ii) The programme chart should include the following:
(a) Descriptive note explaining sequence of the various activities.
(b) Network (PERT / CPM / BAR CHART).
(c) Programme for procurement of materials by the contractor.

Programme of procurement of machinery / equipment's having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor. In addition to above, to achieve the progress of Work as per programme, the contractor must bring at site adequate shuttering material required for cement concrete and R.C.C. works etc. for three floors within one month from the date of start of work till the completion of RCC work as per requirement of work. The contractor shall submit shuttering schedule adequate to complete structure work within laid down physical milestone.

(iii) If at any time, it appears to the Engineer-in-Charge that the actual progress of work does not conform to the approved programme referred above or after rescheduling of milestones, the contractor shall produce a revised programme within 7 (seven) days, showing the modifications to the approved programme to ensure timely completion of the work. The modified schedule of programme shall be approved by the Engineer in Charge. A recovery of Rs. 2500/- (for works costing upto Rs. 20 Crores) / Rs. 5000/- (for works costing more than Rs. 20 Crores) shall be made on per day basis in case of delay in submission of the modified programme.

(iv) The submission for approval by the Engineer-in-Charge of such programme or such particulars shall not relieve the contractor of any of the duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-Charge to take action against the contractor as per terms and conditions of the agreement.

(v) The contractor shall submit the progress report using MS Project/ Primavira software with base line programme referred above for the work done during previous month to the Engineer-in-charge on or before 5th day of each month failing which a recovery Rs. 2500/ - (for works costing upto Rs. 20 Crores) / Rs. 5000/- (for works costing more than Rs. 20 Crores) shall be made on per day basis in case of delay in submission of the monthly progress report.

5.2 **If the work(s) be delayed by:-**

(i) force majeure, or
(ii) abnormally bad weather, or
(iii) serious loss or damage by fire, or
(iv) civil commotion, local commotion of workmen, strike or lockout, affecting any of the trades employed on the work, or
(v) delay on the part of other contractors or tradesmen engaged by Engineer-in- Charge in executing work not forming part of the Contract, or
(vi) any other cause which, in the absolute discretion of the Engineer-in-Charge is beyond the Contractor's control.

then upon the happening of any such event causing delay, the Contractor shall immediately give notice thereof in writing to the authority, but shall nevertheless use constantly his best endeavours to prevent or make good the delay and shall do all that may be reasonably required to the satisfaction of the Employer/ Principal Employer to proceed with the works. The Employer will give the "Extension of Time" only after the approval of the same from Principal Employer.

If, Employer/Principal Employer are not satisfied with the reasons stated by the contractor for delay then, Provision Extension of Time shall be granted to complete the balance works and keep the contract alive. In the period of Provisional Extension of time, Employer shall have the right to impose Liquidity damage as per above Clause 2, if Principal Employer impose the Liquidity Damage to the project at any point of time.

During the granted provisional extension of time, 10% amount of bill amount excluding GST, shall be withheld from each running bill as per the discretion of the Engineer-in-charge. The withheld amount will be accountable to Liquidity damage as per clause-2 and shall only be released to the contractor, if work is completed within the given Provisional Extension of time and Principal Employer didn't impose the Liquidity Damage to the project.

The contractor shall have no claim of damages for extension of time granted or rescheduling of milestone/s for above events listed.

5.3 **Delays attributable to the WAPCOS / Principal Employer and the Concurrent delays:** In case the work is hindered by the Employer/ Principal Employer for any reason / event, the Engineer-in-Charge, if justified, give a fair and reasonable extension of time and reschedule the mile stones for completion of work. Such extension of time or rescheduling of milestone/s shall be without prejudice to any other right or remedy of the parties in contract or in law; provided further that for concurrent delays under this sub-clause and sub-clause 5.2 to the extent the delay is covered under sub-clause 5.2 the Contractor shall be entitled to only extension of time and no compensation/damages.

5.4 **Rescheduling of milestones and 'Justified extended date':** Request for rescheduling of Milestones and extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay on the prescribed form to the Engineer-in-Charge. The Contractor may also, if practicable, indicate in such a request the period for which extension is desired. The Contractor shall indicate in such a request the period by which rescheduling of milestone/s or extension of time is desired. With every request for rescheduling of milestones, or if at any time the actual progress of work falls behind the approved programme by more than 10% of the stipulated period of completion of contract, the Contractor shall produce a revised programme which shall include all details of pending drawings and decisions required to complete the contract and also the target dates by which these details should be available without causing any delay in execution of the work. An amount as deemed appropriate by the Engineer-in-Charge shall be deducted on per day basis in

case of delay in submission of the revised programme.

5.4.1 In any such case the Engineer-in-Charge may give a fair and reasonable extension of time for completion of work or reschedule the mile stones. Engineer-in-Charge shall finalize/ reschedule a particular mile stone before taking an action against subsequent mile stone. Such extension or rescheduling of the milestones shall be communicated to the Contractor by the Engineer-in-Charge in writing, within 21 days of the date of receipt of such request from the Contractor in prescribed form. In event of non-application by the Contractor for extension of time Engineer-in-Charge after affording opportunity to the Contractor, may give, supported with a programme, a fair and reasonable extension within a reasonable period of occurrence of the event.

5.5 **Delays beyond the 'justified extended date':** In case the work is delayed by any reasons, in the opinion of the Engineer-in-Charge, by the Contractor for reasons beyond the events mentioned in sub clause 5.2 and beyond the justified extended date; without prejudice to right to take action under Clause 3, the Engineer-in-Charge may grant extension of time required for completion of work without rescheduling of milestones. The Contractor shall be liable for levy of compensation for delay for such extension of time.

5.6 It is a term of contract that the authority indicated in Special Conditions of Contract while deciding the extension of time case as per clause 5.1 to 5.5, shall also segregate the overall period of delay in following categories :

a) delays due to reasons beyond the control of both parties (under clause 5.2)
b) delays attributable solely to the WAPCOS (under clause 5.3)
c) concurrent delays (under clause 5.3)
d) delays solely attributable to contractor (under clause 5.5)

5.7 **Online record of hindrances:** The Engineer-in-Charge may require the contractor to give notice of hindrances on any online system devised by him. All the notices of hindrances have to be submitted through such online system by the contractor timely to claim extension of time/ rescheduling of milestone(s). The contractor shall not be entitled for any damages incase such online notices are not given timely by the contractor.

1. Request for rescheduling of Mile stones and extension of time, to be eligible for consideration, shall be made by the Contractor in writing within fourteen days of the happening of the event causing delay. The Contractor may also, if practicable, indicate in such a request the period for which extension is desired.

2. In any such case the Engineer-in-charge may give a fair and reasonable extension of time and reschedule the mile stones for completion of work. Such extension or rescheduling of the milestones shall be communicated to the Contractor in writing, within 3 months or 4 weeks of the date of receipt of such request respectively. Non application by the contractor for extension of time/ rescheduling of the milestones shall not be a bar for giving a fair and reasonable extension/ rescheduling of the milestones by the authority as indicated in SCC and this shall be binding on the contractor.

CLAUSE 6: COMPUTERISED MEASUREMENT BOOK (CMB)

Engineer-in-charge shall, except as otherwise provided, ascertain and determine by measurement the value of work done in accordance with the contract.

All measurements of all items having financial value shall be entered by the contractor and compiled in the shape of the Computerized Measurement Book having pages of A-4 size as per the format of the WAPCOS so that a complete record is obtained of all the items of works performed under the contract.

All such measurements and levels recorded by the contractor or his authorized representative from time to time, during the progress of the work, shall be got checked by the contractor from the Engineer-in-Charge or his authorized representative as per interval or program fixed in consultation with Engineer-in-Charge or his authorized representative. After the necessary corrections made by the Engineer-in-Charge, the measurement sheets shall be returned to the contractor for incorporating the corrections and for resubmission to the Engineer-in- Charge for the dated signatures by the Engineer-in- Charge and the contractor or their representatives in token of their acceptance.

Whenever bill is due for payment, the contractor would initially submit draft computerized measurement sheets and these measurements would be got checked/test checked from the Engineer-in-Charge and/or his authorized representative. The contractor will, thereafter, incorporate such changes as may be done during these checks/test checks in his draft computerized measurements, and submit to the WAPCOS a computerized measurement book, duly bound, and with its pages machine numbered. The Engineer-in-Charge and/or his authorized representative would thereafter check this MB, and record the necessary certificates for their checks/test checks.

The final, fair, computerized measurement book given by the contractor, duly bound, with its pages machine numbered, should be 100% correct, and no cutting or over-writing in the measurements would thereafter be allowed. If at all any error is noticed, the contractor shall have to submit a fresh computerized MB with its pages duly machine numbered and bound. The contractor shall submit two spare copies of such computerized MB's for the purpose of reference and records.

The contractor shall also submit to the WAPCOS separately his computerized Abstract of Cost and the bill based on these measurements, duly bound, and its pages machine numbered along with two spare copies of the bill. Thereafter, this bill will be processed by the Engineer-In-Charge.

The contractor shall, without extra charge, provide all assistance with every appliance, labour and other things necessary for checking of measurements/levels by the Engineer-in- Charge or his representative.

Except where any general or detailed description of the work expressly shows to the contrary, measurements shall be taken in accordance with the procedure set forth in the specifications notwithstanding any provision in the relevant Standard Method of measurement or any general or local custom. In the case of items which are not covered by specifications, measurements shall be taken in accordance with the relevant standard method of measurement issued by the Bureau of Indian Standards and if for any item no such standard is available then a mutually agreed method shall be followed.

The contractor shall give not less than seven days' notice to the Engineer-in-Charge or his authorized representative in charge of the work before covering up or otherwise placing beyond the reach of checking and/or test checking the measurement of any work in order that the same may be checked and/or test checked and correct dimensions thereof be taken before the same is covered up or placed beyond the reach of checking and/or test checking measurement and shall not cover up and place beyond reach of measurement any work without consent in writing of the Engineer-in-Charge or his authorized representative in charge of the work who shall within the aforesaid period of seven days inspect the work, and if any work shall be covered up or placed beyond the reach of checking and/or test checking measurements without such notice having been given or the Engineer-in-Charge's consent being obtained in writing the same shall be uncovered at the Contractor's expense, or in default thereof no payment or allowance shall be made for such work or the materials with which the same was executed.

Engineer-in-Charge may cause either themselves or through another officer of the WAPCOS to check the measurements recorded by contractor and all provisions stipulated herein above shall be applicable to such checking of measurements or levels.

It is also a term of this contract that checking and/or test checking the measurements of any item of work in the measurement book and/or its payment in the interim, on account of final bill shall not be considered as conclusive evidence as to the sufficiency of any work or material to which it relates nor shall it relieve the contractor from liabilities from any over measurement or defects noticed till completion of the defects liability period.

CLAUSE 7: PAYMENT ON INTERMEDIATE CERTIFICATE TO BE REGARDED AS ADVANCE

The running account bills shall be submitted by the contractor for the work executed on the basis of such recorded measurements as per Clause 6 on the format of the WAPCOS/ PMC in triplicate on or before the date of every month fixed for the same by the Engineer-in-Charge. The contractor shall not be entitled to be paid any such interim payment if the gross work done together with net payment/ adjustment of advances for material collected, if any, since the last such payment is less than the amount specified in Special Conditions of Contract, in which case the interim bill shall be prepared on the appointed date of the month after the requisite progress is achieved. Engineer-in-Charge shall arrange to have the bill verified In the event of the failure of the contractor to submit the bills, no claims whatsoever due to delays on payment including that of interest shall be payable to the contractor. Payment on account of amount admissible shall be made by the Engineer-in-Charge certifying the sum to which the contractor is considered entitled by way of interim payment at such rates as decided by the Engineer-in-Charge.

An amount of ad-hoc payment not less than 75% of the net amount of the bill under check, shall be made within 20 working days of submission of the bill. The remaining payment is also to be made after final checking of the bill within 28 working days of submission of bill by the contractor.

Payment on account of amount admissible shall be made by the Engineer-in-Charge certifying the sum to which the Contractor is considered entitled by way of interim payment at such rates as decided by Engineer-in-Charge. The amount shall be paid by 45 working days after the day of presentation of the corrected bill by the Contractor to the Engineer-in-Charge or his representative, or 45 days after receive of the payments from Principal Employer whichever is later. As bidder/Contractor acknowledges that under the present Contract agreement, the Employer is only working as intermediary between Principal Employer and Contractor. Thus, the Contractor unconditionally acknowledges that the payments under the present Contract shall be made proportionately by the Employer only on back-to-back basis i.e., after 45 days subject to receipt of payment from Principal Employer. The Contractor also unconditionally agree that in the event the payment or part thereof, under the present Contract is not received from Principal Employer, then WAPCOS and/or any of its Employee/Officer shall not be responsible to pay any amount to Contractor. The said condition shall supersede any and all other conditions of Contract/ Agreement/Work Order/Arrangement between the parties.

All such interim payments shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate given by the Engineer-in-Charge relating to the work done or materials delivered forming If the revised tendered amount (worked out on the basis of quoted rate of individual items) part of such payment, may be modified or corrected by any subsequent such certificate(s) or by the final certificate and shall not by itself be conclusive evidence that any work or materials to which it relates is/are in accordance with the contract and specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or affect in any way powers of the

Engineer-in-Charge under the contract or any of such payments be treated as final settlement and adjustment of accounts or in any way vary or affect the contract.

Pending consideration of extension of date of completion, interim payments shall continue to be made as herein provided without prejudice to the right of the WAPCOS to take action under the terms of this contract for delay in the completion of work, if the extension of date of completion is not granted by the competent authority.

It is clearly agreed and understood by the Contractor that notwithstanding anything to the contrary that may be stated in the agreement between Employer and the Contractor; the Contractor shall become entitled to payment only after Employer has received the corresponding payment(s) from the Principal Employer for the work done by the Contractor. Any delay in the release of payment by the Principal Employer to Employer leading to a delay in the release the corresponding payment by Employer to the Contractor shall not entitle the Contractor to any compensation/interest from Employer.

All payments shall be released by way of e-transfer through RTGS in India directly at their Bank account by Employer.

Clause 7A

No Running Account Bill shall be paid for the work till the applicable labour licenses, registration with EPFO, ESIC / BOCW Welfare Board, whatever applicable are submitted by the Contractor to the Project Manager, WAPCOS.

Clause 7B - Payment to third party

If the exigencies of the work so demand, the engineer-in-charge may allow payment to a third party, who is creditor to the contractor, after fulfilling the following conditions.

(a) The contractor gives an authority letter addressed to the engineer-in-charge on a non- judicial stamp paper of Rs.100 in the format given below.
I/We authorize the WAPCOS to pay directly on my/our behalf to (name of the third party) an amount of Rs.....(Rupees in words) for the work done or supplies made by (name of the third party). I/We shall be responsible for the quality and quantity of the same under the provisions of agreement number.....

Signature of the contractor

(b) The total payment to third party (or parties) shall not exceed 10% of the agreement cost of the work. Full reasons for proposing such third party payment shall be recorded and prior written approval of the next higher authority shall be obtained before making such payment.

CLAUSE 8: COMPLETION CERTIFICATE AND COMPLETION PLANS

Within ten days of the completion of the work or on part completion of one or more building(s) out of independent building in a project or infrastructure project, as per requirement of client or otherwise specified in SCC, the contractor shall give notice of such completion to the Engineer-in-Charge and the Engineer-in-Charge within seven days of receipt of intimation of completion from contractor will inspect the work and satisfy himself about completion of part /full work, then intimate to the concerned authorities as mentioned in SCC for issuance of part/final completion certificate. The concerned authorities will inspect the work and issue par/ final completion certificate within thirty days of the receipt of such intimation. The Engineer-in-Charge shall furnish to the contractor a part/ final completion certificate as the case may be, indicating defects

(a) to be rectified by the contractor and/or
(b) for which payment will be made at reduced rates.

But no final certificate of completion shall be issued, nor shall the work be considered to be complete until the contractor shall have removed from the premises on which the work shall be executed all scaffolding, surplus materials, rubbish and all huts and sanitary arrangements required for his/their work people on the site in connection with the execution of the works as shall have been erected or constructed by the contractor(s) and cleaned off the dirt from all wood work, doors, windows, walls, floor or other parts of the building, in, upon, or about which the work is to be executed or of which he may have had possession for the purpose of the execution; thereof, and not until the work shall have been measured by the Engineer-in-Charge. If the contractor shall fail to comply with the requirements of this Clause as to removal of scaffolding, surplus materials and rubbish and all huts and sanitary arrangements as aforesaid and cleaning off dirt on or before the date fixed for the completion of work, the Engineer-in-Charge may at the expense of the contractor remove such scaffolding, surplus materials and rubbish etc., and dispose of the same as he thinks fit and clean off such dirt as aforesaid, and the contractor shall have no claim in respect of scaffolding or surplus materials or final cleaning works as aforesaid except for any sum actually realized by the sale thereof.

CLAUSE 8A: COMPLETION PLANS TO BE SUBMITTED BY THE CONTRACTOR

The contractor shall submit completion plans for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work, provided that the service plans having been issued for execution, unless the contractor, by virtue of any other provision in the contract, is required to prepare such plans. The "As Built" Drawings and completion report shall be submitted by the Contractor within 30 days from the date of completion works in 3 sets.

In case, the contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a sum of 1 %(one percent) of Tendered Value or limit prescribed in SCC whichever is more as may be fixed by Engineer-in-charge and in this respect the decision of the that authority shall be final and binding on the contractor.

CLAUSE 9: PAYMENT OF FINAL BILL

(i) The final bill shall be submitted by the contractor to the Engineer-in-Charge in the same manner as specified in interim bills within three months of physical completion of the work or within one month of the date of the final completion certificate furnished by the Engineer-in-Charge whichever is earlier. At the time of submission of the final bill, receipt will be given by the O/o Engineer-in-Charge.

(ii) In case of correction / rejection / short documents, the Engineer-in- Charge will give recorded reasons for correction / rejection / submission of additional documents within fifteen days after submission of final measurement and/or final bill by the contractor.

(iii) Final bill will be accepted with all pre- requisite documents such as sanctioned copies of extra items and deviation in quantities, escalation statements, recovery statement, theoretical statement, final completion certificate, final extension of time case, mandatory tests statements, dismantled materials account and other documents as mentioned in clause-7A etc.

(iv) An undertaking along the final bill will be submitted by the contractor that, “I/we hereby undertake that all the measurements/ claims payable under this contract have been included in the final bill and will not submit any other bill/ claims in future under this agreement thereafter”.

(v) No further claims shall be entertained from the contractor after submission of the final bill and these shall be deemed to have been waived off and extinguished. Payments of those items of the bill in respect of which there is no dispute and of items in dispute, for quantities and rates approved by Engineer-In-Charge, will be made within the period of Three months. The period of three months will

be reckoned from the date of receipt of the bill in complete shape after necessary corrections / additional documents, by the Engineer-in-Charge.

(vi) In case of foreclosure / determination of contract, if the contractor fails to submit the EOT case and final measurements /bill within 30 days of foreclosure/ determination of contract, the EOT case and final bill will be prepared and decided by the department. The final bill shall only be paid after withholding amount equivalent to maximum compensation to be levied on the contractor.

(vii) If the final bill, in complete shape, is submitted by the contractor within the period specified above and delay in payment of final bills is made by the department after prescribed time limit, a simple interest @ 5% (five percent) per annum may be paid to the contractor from the date of expiry of prescribed time limit, provided the final bill submitted by the contractor contains all the documents as mentioned in para - (iii) & (iv) above.

CLAUSE 9A: PAYMENT OF CONTRACTOR'S BILLS TO BANKS

Payments due to the contractor may, if so desired by him, be made to his bank, registered financial, co-operative or thrift societies or recognized financial institutions instead of direct to him provided that the contractor furnishes to the Engineer-in-Charge (1) an authorization in the form of a legally valid document such as a power of attorney conferring authority on the bank; registered financial, co-operative or thrift societies or recognized financial institutions to receive payments and (2) his own acceptance of the correctness of the amount made out as being due to him by WAPCOS or his signature on the bill or other claim preferred against WAPCOS before settlement by the Engineer- in-Charge of the account or claim by payment to the bank, registered financial, co-operative or thrift societies or recognized financial institutions.

While the receipt given by such banks; registered financial, co-operative or thrift societies or recognized financial institutions shall constitute a full and sufficient discharge for the payment, the contractor shall whenever possible present his bills duly receipted and discharged through his bank, registered financial, co-operative or thrift societies or recognized financial institutions.

Nothing herein contained shall operate to create in favour of the bank; registered financial, co- operative or thrift societies or recognized financial institutions any rights or equities vis-à-vis the WAPCOS.

CLAUSE 10A: MATERIALS TO BE PROVIDED BY CONTRACTOR

The contractor shall, at his own expense, provide all materials, required for the works.

The contractor shall, at his own expense and without delay, supply to the Project Manager, WAPCOS samples of materials to be used on the work and shall get these approved in advance. All such materials to be provided by the Contractor shall be in conformity with the specifications laid down or referred to in the contract. The contractor shall, if requested by the Engineer-in-Charge furnish proof, to the satisfaction of the Engineer-in-Charge that the materials so comply. The Project Manager, WAPCOS shall within thirty days of supply of samples or within such further period as he may require intimate to the Contractor in writing whether samples are approved by him or not. If samples are not approved, the Contractor shall forthwith arrange to supply to the Project Manager, WAPCOS for his approval, fresh samples complying with the specifications laid down in the contract. When materials are required to be tested in accordance with specifications, approval of the Engineer-in-Charge/ Principal Employer shall be issued after the test results are received.

The Contractor shall at his risk and cost submit the samples of materials to be tested or analyzed and shall not make use of or incorporate in the work any materials represented by the samples until the required tests or analysis have been made and materials finally accepted by the Engineer-in-Charge/ Principal Employer.

The Contractor shall not be eligible for any claim or compensation either arising out of any delay in the work or due to any corrective measures required to be taken on account of and as a result of testing of materials.

The contractor shall, at his risk and cost, make all arrangements and shall provide all facilities as the Project Manager, WAPCOS may require for collecting, and preparing the required number of samples for such tests at such time and to such place or places as may be directed by the Project Manager, WAPCOS and bear all charges and cost of testing unless specifically provided for otherwise elsewhere in the contract or specifications. The Engineer-in- Charge or his authorized representative shall at all times have access to the works and to all workshops and places where work is being prepared or from where materials, manufactured articles or machinery are being obtained for the works and the contractor shall afford every facility and every assistance in obtaining the right to such access.

The Engineer-in-Charge or his authorized representative shall have full powers to require the removal from the premises of all materials which in his opinion are not in accordance with the specifications and in case of default, the Engineer-in-Charge shall be at liberty to employ at the expense of the contractor, other persons to remove the same without being answerable or accountable for any loss or damage that may happen or arise to such materials. The Engineer-in-Charge or his authorized representative shall also have full powers to require other proper materials to be substituted thereof and in case of default, the Engineer-in-Charge or his authorized representative may cause the same to be supplied and all costs which may attend such removal and substitution shall be borne by the Contractor.
The Contractor shall at his own expense, provide a material testing lab at the site for conducting routine field tests. The lab shall be equipped at least with the testing equipment as specified in Contract.

If the Engineer-in-Charge or his authorized representative instructs the Contractors to carry out a test not specified in the Specification to check whether any work has a Defect. Such tests are to be carried out by the Contractor by deploying agencies and paying all the cost for such tests.

CLAUSE 10B:

i. SECURED ADVANCE ON NON-PERISHABLE MATERIALS AND RECOVERY

The contractor, on signing an indenture in the form to be shall be entitled to be paid during the progress of the execution of the work up to 75% of the assessed value of any materials which are in the opinion of the Project Manager, WAPCOS non-perishable, non-fragile and non-combustible and are in accordance with the contract and which have been brought on the site in connection therewith and are adequately stored and/or protected against damage by weather or other causes but which have not at the time of advance been incorporated in the works. When materials on account of which an advance has been made under this sub-clause are incorporated in the work, the amount of such advance shall be recovered/ deducted from the next payment made under any of the clause or clauses of this contract.

Such secured advance shall also be payable on other items of perishable nature, fragile and combustible with the approval of the Engineer-in-Charge provided the contractor provides a comprehensive insurance cover for the full cost of such materials. The decision of the Engineer-in-Charge shall be final and binding on the contractor in this matter. No secured advance, shall however, be paid on high-risk materials such as ordinary glass, sand, petrol, diesel etc.

The secure Advance shall be recovered as per consumption of material from the contractor which secure advance is given to the contractor. If any value of secure advance is remaining to recover, then it will be fully recovered after completion of 80% work of the Tendered Value.

ii. MOBILISATION ADVANCE

On request of contractor, the Employer shall make interest bearing advance payment for mobilization of labour, stores and workshops including camps, labour sheds, machineries and construction plant, etc. for preliminary and enabling Works, after the signing of Contract agreement to the extent of 10 (ten) per cent of the Tendered Value of an unconditional BG. Such BG shall remain effective until the advance payment has been fully repaid.

The aforesaid advance of 10 (ten) per cent shall be paid in two instalments, each of five per cent. The first one shall be paid on commencement of the work and on submission of unconditional BG in respect of the advance.

The second instalment shall be paid on certification by the engineer in charge for achieving a financial progress of 10 (ten) per cent of the Tendered Value, as also provision of a BG by the contractor for this part of the advance. Mobilisation expenditure mentioned herein shall not include the margin money and bank commission, and so on, paid by the contractor for procurement of BGs against performance security and mobilisation advance.

The request of contractor for aforesaid mobilization advance will be considered within 3 (three) months from the commencement of work.

iii. INTEREST & RECOVERY OF MOBILISATION ADVANCE

The mobilization advance bears simple interest at the rate 10 % and shall be calculated from the date of payment to the date of recovery (365 days in a year) both days inclusive, on the outstanding amount of advance.

Before any instalment of advance is released, the contractor shall execute a one single Bank Guarantee Bond from Scheduled Bank for the amount equal to 110% of the amount of mobilization advance and valid up to stipulated period of completion as mentioned in NIT. This (Bank Guarantee from Scheduled Bank for the amount equal to 110% of the balance amount of advance) shall be kept renewed from time to time to cover the balance amount and likely period of complete recovery.

Recovery of such sums advanced shall be made by the deduction from the contractor's bills commencing after first 10% of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time 80% of the gross value of the contract is executed and paid, together with interest due on the entire outstanding amount up to the date of recovery of the instalment. Along with aforesaid condition of recovery of mobilization advance, if contractor wants to recover more or full mobilization advance from the interim bills, then accordingly mobilization advance may be recovered by Employer. The said request will be given by the contractor along with the interim bill to the Engineer-In-Charge. The Bank Guarantee will be returned after recovery of the mobilization advance against particular Bank guarantee.

CLAUSE 10C: PAYMENT ON ACCOUNT OF INCREASE IN PRICE / WAGES DUE TO STATUTORY ORDER - NOT APPLICABLE

CLAUSE 10CA: PAYMENT DUE TO VARIATION IN PRICES OF MATERIALS AFTER RECEIPT OF TENDER - NOT APPLICABLE

CLAUSE 10CC: PRICE ADJUSTMENT FOR WORKS

If the prices of materials and/or wages of labour required for execution of the work increase, the contractor shall be compensated for such increase as per provisions detailed below and the amount of the contract

shall accordingly be varied, subject to the condition that such compensation for escalation in prices and wages shall be available only for the work done during the stipulated period of the contract including the justified period extended under the provisions of clause 5 of the contract without any action under clause 2. Such compensation for escalation in the prices of materials and labour, when due, shall be worked out based on the following provisions:

(i) The base date for working out such escalation shall be the last stipulated date of receipt of tenders including extension, if any.

(ii) The cost of work on which escalation will be payable shall be reckoned as below :
- (a) Gross value of work done up to this quarter : (A)
- (b) Gross value of work done up to the last quarter : (B)
- (c) Gross value of work done since previous quarter (C)= (A-B)
- (d) Full assessed value of Secured Advance fresh paid in this quarter : (D)
- (e) Full assessed value of Secured Advance recovered in this quarter : (E)
- (f) Full assessed value of Secured Advance for which escalation Payable in this quarter, (F)= (D-E)
- (g) Advance payment made during this quarter: (G)
- (h) Advance payment recovered during this quarter: (H)
- (i) Advance payment for which escalation is payable in this Quarter (I)= (G-H)
- (j) Amount paid based on prevailing market rates due to deviations/variations as per clause 12 during this quarter:(J)

Then, M = C+F+I-J

Cost of work for which escalation is applicable (W) = 0.85M

Components for materials, labour, etc. shall be pre-determined for every work and incorporated in the conditions of contract attached to the tender documents included in SCC. The decision of the Engineer-in-Charge in working out such percentage shall be binding on the contractors.

(iii) The following principles shall be followed while working out the payment/recovery on account of variation of prices of materials and/ or wages of labour.
- (a) The compensation for escalation shall be worked out at quarterly intervals and shall be with respect to the cost of work done as per bills paid during the three calendar months of the said quarter. The date of submission of bill by the contractor to the department shall be the guiding factor to decide the bills relevant to the quarterly interval. The first such payment shall be made at the end of three months after the month (excluding the month in which the letter of commencement of work is issued by the Engineer-in-Charge) and thereafter at three months' interval. At the time of completion of the work, the last period for payment might become less than 3 months, depending on the actual date of completion.
- (b) The indices as defined below (excluding LI) relevant to any quarter/period for which such compensation is to be paid shall be the arithmetical average of the indices relevant to the three calendar months. If the period up to the date of completion after the quarter covered by the last such installment of payment, is less than three months, the indices shall be the average of the indices for the months falling within that period.
- (c) The minimum wage of an unskilled Mazdoor shall be the higher of the wage notified by Government of India, Ministry of Labour and that notified by the local administration both relevant to the place of work and the period of reckoning.
- (d) The escalation for labour also shall be paid at the same quarterly intervals when escalation due to increase in cost of materials is paid under this clause. If such revision of minimum wages

takes place during any such quarterly intervals, the escalation compensation shall be payable at revised rates only for work done in subsequent quarters;

(e) Irrespective of variations in minimum wages of any category of labour, for the purpose of this clause, the variation in the rate for an unskilled Mazdoor alone shall form the basis for working out the escalation compensation payable on the labour component.

(iv) In the event the price of materials and/or wages of labour required for execution of the work decreases, there shall be a downward adjustment of the cost of work so that such price of materials and/or wages of labour shall be deductible from the cost of work under this contract and in this regard the formula herein stated below under this Clause 10CC shall mutatis mutandis apply.

(v) The contract price shall be adjusted for increase or decrease in rates and prices of labour, cement, steel reinforcement bar, fuel and lubricants and other input materials as per percentage of materials/labour specified in SCC and in accordance with the principles, procedures and formulae specified below:

(a) Price adjustment for change in cost shall be paid in accordance with the following formulae:

(i) For Construction:

$$V_W = W*(1/100)*[C_P * (C_I-C_O)/C_O + L_P* (L_I-L_O)/L_O+CM_P*(CM_I-CM_O)/CM_O+EM_P*(EM_I-EM_O)/EM_O +F_P* (F_I-F_O)/F_O+S_P* (S_I- S_O)/S_O+ B_p *(B_I- B_o)/B_O]$$

(ii) For Maintenance:

$$V_W = W*(1/100)*[L_P* (L_I-L_O)/L_O +CM_P* (CM_I-CM_O)/CM_O+EM_P* (EM_I-EM_O)/EM_O + B_p*(B_I- B_o)/B_O]$$

Where, W=cost of work done as per para (ii) above.

V_W (Variation of cost of Work) =Increase or decrease in the cost of works during the period under consideration due to change in the rates for relevant components.

Percentage components of materials & labour as specified in the SCC are defined as under:-

C_P - Cement component,
L_P - Labour component,
CM_P - Civil component of other construction materials,
EM_P - E & M component of construction materials
F_P - POL (Diesel) component
S_P - Reinforcement steel bars/TMT bars/structural steel (including strands and cables) component
B_P - Bitumen component

Indices for various components of materials & labour to be used for the purpose of this Clause are defined as under:

C_o = Wholesale Price Index for Pozzolana Cement published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of last date of receipt of tender including extension, if any.

C_I = Wholesale Price Index for Pozzolana Cement published byoffice of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

L_O = Minimum daily wage in rupees of an unskilled adult mazdoor, fixed under any law, statutory rule or order as on the last date of receipt of tender including extension, if any.

L_I = Minimum wage in rupees of an unskilled adult mazdoor, fixed under any law, statutory rule or order as applicable on the last date of the quarter previous to the one under consideration.

CM_O = Price Index for civil components of other construction materials valid for the month of the last date of receipt of tender including extension, if any, as issued by the office of CE CSQ (Civil) or successor.

CM_I = Price Index for civil components of other construction materials for the period under consideration and as issued by the office of CE CSQ (Civil) or successor.

EM_O = Price Index for E & M components of construction materials valid for the month of the last date of receipt of tender including extension, if any, as issued by the office of CE CSQ (Electrical) or successor.

EM_I = Price Index for E & M components of construction materials for the period under consideration and as issued by the office of CE CSQ (Electrical) or successor.

F_O = Wholesale Price Index of HSD (High Speed Diesel)published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any.

F_I = Wholesale Price Index of HSD (High Speed Diesel) published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

S_O = Wholesale Price Index of Mild Steel-long products published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any

S_I = Wholesale Price Index of Mild Steel-long products published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

B_O = Wholesale Price Index of Bitumen published by office of the Economic Adviser, Ministry of Industry & Commerce valid for the month of the last date of receipt of tender including extension, if any

B_I = Wholesale Price Index of Bitumen published by office of the Economic Adviser, Ministry of Industry & Commerce for the period under consideration.

(vi) No upward price variation will be admissible beyond the original scheduled delivery date for defaults on the part of the supplier. However, a downward price variation would be availed by the purchaser as per the denial clause in the letter of extension of the delivery period

CLAUSE 10D: DISMANTLED MATERIAL PROPERTY

The contractor shall treat all materials obtained during dismantling of a structure, excavation of the site for a work, etc. as WAPCOS/Government/Principal Employer property and such materials shall be disposed off to the best advantage of WAPCOS according to the instructions in writing issued by the Engineer-in-Charge or his authorized representative.

CLAUSE 11: WORKS TO BE EXECUTED IN ACCORDANCE WITH SPECIFICATIONS, DRAWINGS, AND ORDERS

The Contractor shall execute the work as per the sequence submitted by Contractor and approved by Engineer-in-Charge from time to time so that all other items of the work to be executed by other agencies are completed progressively along with the main work.

The contractor shall execute the whole and every part of the work in the most substantial and workmanlike manner both as regards materials and otherwise in every respect in strict accordance with the specifications. The contractor shall also conform exactly, fully and faithfully to the design, drawings and instructions in writing in respect of the work and the contractor shall be furnished free of charge one copy of the contract documents together with specifications, designs, drawings and instructions as are not included in the standard specifications or in any Bureau of Indian Standard or any other, published standard or code or, Schedule of Rates or any other printed publication referred to elsewhere in the contract.

The contractor shall comply with the provisions of the contract and with the care and diligence execute and maintain the works and provide all labour and materials, tools and plants including for measurements and supervision of all works, structural plans and other things of temporary or permanent nature required for such execution and maintenance in so far as the necessity for providing these, is specified or is reasonably inferred from the contract. The Contractor shall take full responsibility for adequacy, suitability and safety of all the works and methods of construction.

At least to 10% of prescribed Tests as per Central Public Works Department Manual/IS Codes of construction materials shall be carried out from the outside approved/NABL recognized Laboratory as may be approved by Engineer-In-Charge without any extra expenditure to Employer.

The Contractor shall establish a field test laboratory on the site with latest equipment's for carrying out field tests of construction materials and will maintain proper records of all the test results.

CLAUSE 12: DEVIATIONS / VARIATIONS - EXTENT AND PRICING

The Engineer-in-Charge shall have power (i) to make alteration in, omissions from, additions to, or substitutions for the original specifications, drawings, designs and instructions that may appear to him to be necessary or advisable during the progress of the work, and (ii) to omit a part of the works in case of non-availability of a portion of the site or for any other reasons and the contractor shall be bound to carry out the works in accordance with any instructions given to him in writing signed by the Engineer-in-Charge and such alterations, omissions, additions or substitutions shall form part of the contract as if originally provided therein and any altered, additional or substituted work which the contractor may be directed to do in the manner specified above as part of the works, shall be carried out by the contractor on the same conditions in all respects including price on which he agreed to do the main work except as hereafter provided.

12.1 The time for completion of the works shall, in the event of any deviations resulting in additional cost over the Tendered Value sum being ordered, be extended, if requested by the contractor, as follows:

(i) In the proportion which the additional cost of the altered, additional or substituted work, bears to the original Tendered Value plus

(ii) 25% of the time calculated in (i) above or such further additional time as may be considered reasonable by the Engineer-in-Charge.

12.2 Payment of deviations/variations beyond 0.25% of the accepted tendered amount.

In case there is any change in scope as defined in the contract, the contractor shall carry out the changes as per direction of Engineer in Charge and nothing extra shall be payable to the contractor on account of same if the additional cost of such work is up to 0.25% (zero point two five percent) of the accepted tendered amount and worked out as per sub-clause 12.3 below. Variations/deviations upto 0.25% (zero

point two five percent) of the accepted tendered amount shall be deducted from overall variations/ deviations for making payment.

12.3 DETERMINATION OF RATES

In the event, there is any deviations/variations in work as defined in the contract, the contractor shall submit the complete proposal to Engineer-in-charge within 15 days duly supported with:-

(a) Analysis of rates for items involved, along with relevant documents, rates of materials, tools/plants and labour, etc.

(b) The impact, if any, which the deviations/variations is likely to have on the project completion schedule,

On receipt of such proposal, either individually or covering group of items, the Engineer- in-charge shall examine the proposal regarding its admissibility and finalize the proposal/rates within 45 days after receipt of proposal with all requisite details and documents from the contractors, after giving due consideration to the proposal, analysis and rates of materials and labours, etc.

12.3.1 The increase/decrease in the rates due to deviations/variations shall be decided based on the following criteria:-

(i) Pricing of deviations

(a) If the item of work as stipulated in the schedule of quantity/scope of work deviates on plus side, then the rate for the deviated quantity shall be paid at the agreement rate upto the deviation limit as specified in SCC with the same terms & conditions of the contract. Beyond deviation limit as specified in the SCC, rate shall be payable on market rates to be determined based on the relevant documents and prevailing market rates, as per Para (ii) below

(b) If the item of work as stipulated in the schedule of quantity/scope of work deviates on minus side, then the amount for such deviated quantity shall be deducted proportionately at the agreement rate.

(ii) Pricing of variations

If there are changes in the quantity/specifications/ alterations/ substitutions/additions, etc. in the items, other than mentioned in para- (i) above, the rates shall be determined based on detailed analysis of rates with original stipulated scope of items & newly proposed/provided items. The difference of rates so determined shall be payable to/ recoverable from the contractor. The rates for both the components i.e. materials & labour shall be based on prevailing market rates. The rate finalized by the Engineer-in-Charge shall be final and binding.

12.3.2 In case of either non-submission of timely proposal or incomplete proposal by the contractor for deviations/variations, the Engineer-in-Charge shall give final opportunity to the Contractor to submit the complete proposal for change of cost within next 15 days. In case of non-submission or further incomplete submission by the contractor within the stated period, the Engineer-in-Charge shall initiate the proposal and decide the change of cost. In such case the proposal finalized by the Engineer-in-Charge shall be final and binding on the contractor.

12.4 Restrictions on Deviations/Variations

(i) Work(s) due to deviations/variations shall be executed only after getting the instructions of Engineer-in-charge, save except to meet any work of emergent nature.

(ii) Notwithstanding anything to the contrary in this clause 12, any change arising from default of the contractor in the performance of his obligations under this agreement shall not be deemed to be deviations/variations, and shall not result in any adjustment of the contract price or the project completion schedule.

12.5 Incidental Operations

Any operation incidental to or necessarily implied in execution of an item in the contract - whether or not specifically described - shall be deemed included in the quoted rates. Nothing extra shall be admissible for such operations.

CLAUSE 13: FORECLOSURE OF CONTRACT - ABANDONMENT OR REDUCTION IN SCOPE

If at any time after acceptance of the tender, Engineer-in-charge shall decide to abandon or reduce the scope of the works for any reason whatsoever and hence not require the whole or any part of the works to be carried out, the Engineer-in-Charge shall give notice in writing to that effect to the contractor and the contractor shall act accordingly in the matter. The contractor shall have no claim to any payment of compensation or otherwise whatsoever, on account of any profit or advantage which he might have derived from the execution of the works in full but which he did not derive in consequence of the foreclosure of the whole or part of the works.

The contractor shall be paid at contract rates, full amount for works executed at site and, in addition, a reasonable amount as certified by the Engineer-in-Charge for the items hereunder mentioned which could not be utilized on the work to the full extent in view of the foreclosure;

(i) Any expenditure incurred on preliminary site work, e.g. temporary access roads, temporary labour huts, staff quarters and site office; storage accommodation and water storage tanks.

(ii) Employer shall have the option to take over contractor's materials or any part thereof either brought to site or of which the contractor is legally bound to accept delivery from suppliers (for incorporation in or incidental to the work). For materials taken over or to be taken over by WAPCOS, cost of such materials as detailed by Engineer-in- Charge shall be paid. The cost shall, however, take into account purchase price, cost of transportation and deterioration or damage which may have been caused to materials whilst in the custody of the contractor.

(iii) Reasonable compensation for transfer of T & P from site to contractor's permanent stores or to his other works, whichever is less. If T & P are not transported to either of the said places, no cost of transportation shall be payable.

The contractor shall, if required by the Engineer- in-Charge, furnish to him, books of account, wage books, time sheets and other relevant documents and evidence as may be necessary to enable him to certify the reasonable amount payable under this condition.

The reasonable amount of items on (i), (iv) and (v) above shall not be in excess of 2% of the cost of the work remaining incomplete on the date of closure, i.e. total stipulated cost of the work as per accepted tender less the cost of work actually executed under the contract and less the cost of contractor's materials at site taken over by the WAPCOS as per item (ii) above. Provided always that against any payments due to the contractor on this account or otherwise, the Engineer-in-Charge shall be entitled to recover or be credited with any outstanding balances due from the contractor for advance paid in respect of any tool, plants and materials and any other sums which at the date of termination were recoverable by the WAPCOS from the contractor under the terms of the contract.

In the event of action being taken under Clause 13 to reduce the scope of work, the Contractor may furnish fresh Performance Security on the same conditions, in the same manner and at the same rate for the balance tendered value and initially valid up to the extended date of completion or stipulated date of completion if no extension has been granted plus minimum 60 days beyond that. Wherever such a fresh Performance Security is furnished by the Contractor the Engineer-in-Charge may return the previous Performance Security.

CLAUSE 13 A: CARRYING OUT PART WORK AT RISK AND COST OF CONTRACTOR

If contractor:

(i) At any time makes default during currency of work or does not execute any part of the work with due diligence and continues to do so even after a notice in writing of 7 days in this respect from the Engineer-in-Charge; or

(ii) Commits default in complying with any of the terms and conditions of the contract and does not remedy it or takes effective steps to remedy it within 7 days even after a notice in writing is given in that behalf by the Engineer-in-Charge; or

Fails to complete the work(s) or items of work with individual dates of completion, on or before the date(s) so determined, and does not complete them within the period specified in the notice given in writing in that behalf by the Engineer-in-Charge.

(iii) The Engineer- in-Charge without invoking action under clause 3 may, without prejudice to any other right or remedy against the contractor which have either accrued or accrue thereafter to WAPCOS, by a notice in writing to take the part work / part incomplete work of any item(s) out of his hands and shall have powers to:

(a) Take possession of the site and any materials, constructional plant, implements, stores, etc., thereon; and/or

(b) Carry out the part work / part incomplete work of any item(s) by any means at the risk and cost of the contractor.

The Engineer-in-Charge shall determine the amount, if any, is recoverable from the contractor for completion of the part work/ part incomplete work of any item(s) taken out of his hands and execute at the risk and cost of the contractor, the liability of contractor on account of loss or damage suffered by WAPCOS because of action under this clause shall not exceed 10% of the Contract Price.

In determining the amount, credit shall be given to the contractor with the value of work done in all respect in the same manner and at the same rate as if it had been carried out by the original contractor under the terms of his contract, the value of contractor's materials taken over and incorporated in the work and use of plant and machinery belonging to the contractor.

The certificate of the Engineer-in-Charge as to the value of work done shall be final and conclusive against the contractor provided always that action under this clause shall only be taken after giving notice in writing to the contractor. Provided also that if the expenses incurred by the WAPCOS are less than the amount payable to the contractor at his agreement rates, the difference shall not be payable to the contractor.

Any excess expenditure incurred or to be incurred by WAPCOS in completing the part work/ part incomplete work of any item(s) / rectification works during Defect Liability Period or the excess loss of damages suffered or may be suffered by WAPCOS as aforesaid after allowing such credit shall without prejudice to any other right or remedy available to WAPCOS in law or per as agreement be recovered from any money due to the contractor on any account, and if such money is insufficient, the contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

If the contractor fails to pay the required sum within the aforesaid period of 30 days, the Engineer-in-Charge shall have the right to sell any or all of the contractors' unused materials, constructional plant, implements, temporary building at site etc. and adjust the proceeds of sale thereof towards the dues recoverable from the contractor under the contract and if thereafter there remains any balance outstanding, it shall be recovered in accordance with the provisions of the contract.

In the event of above course being adopted by the Engineer-in-Charge, the contractor shall have no claim to compensation for any loss sustained by him by reason of his having purchased or procured any materials or entered into any engagements or made any advance on any account or with a view to the execution of the work or the performance of the contract.

Clause 14 - Pre-Construction Activities

The data supplied by the Department, if any, are for General Guidance only. The contractor shall be responsible for carrying out pre- construction activities for construction of work as defined in the tender documents. The contractor shall also carry out site investigations to verify site details / Data at his own cost.

Since start of pre-construction activities contractor has to deploy Building Information Model (BIM) professional having knowledge of using Building Information Model (BIM) of minimum LOD 350.

CLAUSE 15: SUSPENSION OF WORK

(i) The contractor shall, on receipt of the order in writing of the Engineer-in-Charge, (whose decision shall be final and binding on the contractor) suspend the progress of the works or any part thereof for such time and in such manner as the Engineer-in-Charge may consider necessary so as not to cause any damage or injury to the work already done or endanger the safety thereof for any of the following reasons:

(a) on account of any default on the part of the contractor or;

(b) for proper execution of the works or part thereof for reasons other than the default of the contractor; or

(c) for safety of the works or part thereof.

The contractor shall, during such suspension, properly protect and secure the works to the extent necessary and carry out the instructions given in that behalf by the Engineer-in-Charge.

(ii) If the suspension is ordered for reasons (b) and (c) in sub-para (i) above:

(a) the contractor shall be entitled to an extension of time equal to the period of every such suspension PLUS 25%, for completion of the item or group of items of work for which a separate period of completion is specified in the contract and of which the suspended work forms a part, and;

(b) If the total period of all such suspensions in respect of an item or group of items or work for which a separate period of completion is specified in the contract exceeds thirty days, the contractor shall, in addition, be entitled to such compensation as the Engineer-in- Charge may consider reasonable in respect of salaries and/or wages paid by the contractor to his employees and labour at site, remaining idle during the period of suspension, adding thereto 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer-in-Charge within fifteen days of the expiry of the period of 30 days.

(iii) If the works or part thereof is suspended on the orders of the Engineer-in-Charge for more than three months at a time, except when suspension is ordered for reason (a) in subpara (i) above, the contractor may after receipt of such order serve a written notice on the Engineer-in-Charge requiring permission within fifteen days from receipt by the Engineer-in-Charge of the said notice, to proceed with the work or part thereof in regard to which progress has been suspended and if such permission is not granted within that time, the contractor, if he intends to treat the suspension, where it affects only a part of the works as an omission of such part by WAPCOS or where it affects whole of the works, as an abandonment of the works by WAPCOS, shall within ten days of expiry of such period of 15 days give notice in writing of his intention to the Engineer-in-Charge. In the event of the contractor treating the suspension as an abandonment of the contract by WAPCOS, he shall have no claim to payment of any compensation on account of any profit or advantage which he might have derived from the execution of the work in full but which he could not derive in consequence of the abandonment. He shall, however, be entitled to such compensation, as the Engineer-in-Charge

may consider reasonable, in respect of salaries and/or wages paid by him to his employees and labour at site, remaining idle in consequence adding to the total thereof 2% to cover indirect expenses of the contractor provided the contractor submits his claim supported by details to the Engineer-in-Charge within 30 days of the expiry of the period of 3 months.

CLAUSE 16: ACTION IN CASE WORK NOT DONE AS PER SPECIFICATIONS

All works under or in course of execution or executed in pursuance of the contract, shall at all times be open and accessible to the inspection and supervision of the Project Manager, WAPCOS and all the superior officers, officer of the Quality Assurance Unit of the WAPCOS or any organization engaged by the WAPCOS for Quality Assurance and of the Chief Technical Examiner's Office, and the contractor shall, at all times, during the usual working hours and at all other times at which reasonable notice of the visit of such officers has been given to the contractor, either himself be present to receive orders and instructions or have a responsible agent duly accredited in writing, present for that purpose. Orders given to the Contractor's agent shall be considered to have the same force as if they had been given to the contractor himself.

If it shall appear to the Engineer-in-charge or his authorized subordinates incharge of the work or to the Engineer-in-charge of Quality Assurance or Project Manager, WAPCOS or his subordinate officers or the officers of the organization engaged by the WAPCOS for Quality Assurance or to the Chief Technical Examiner or his subordinate officers, that any work has been executed with unsound, imperfect, or unskillful workmanship, or with materials or articles provided by him for the execution of the work which are unsound or of a quality inferior to that contracted or otherwise not in accordance with the contract, the contractor shall, on demand in writing which shall be made within twelve months (six months in the case of work costing Rs. 10 Lac and below except road work) of the completion of the work from the Engineer-in-Charge specifying the work, materials or articles complained of notwithstanding that the same may have been passed, certified and paid for forthwith rectify, or remove and reconstruct the work so specified in whole or in part, as the case may require or as the case may be, remove the materials or articles so specified and provide other proper and suitable materials or articles at his own charge and cost. In the event of the failing to do so within a period specified by the Engineer-in- Charge in his demand aforesaid, then the contractor shall be liable to pay compensation at the same rate as under clause 2 of the contract (for non-completion of the work in time) for this default.

In such case the Engineer-in-Charge may not accept the item of work at the rates applicable under the contract but may accept such items at reduced rates as the authority specified in Special Conditions of Contract may consider reasonable during the preparation of on account bills or final bill if the item is so acceptable without detriment to the safety and utility of the item and the structure or he may reject the work outright without any payment and/or get it and other connected and incidental items rectified, or removed and re-executed at the risk and cost of the contractor. Decision of the Engineer-in-Charge to be conveyed in writing in respect of the same will be final and binding on the contractor.

CLAUSE 17: DEFECT LIABILITY PERIOD - CONTRACTOR LIABLE FOR DAMAGES AND DEFECTS

The Warranty (on site)/Defect Liability Period shall be 24 (Twenty-Four) Months.

The contractor will deploy sufficient manpower (i.e. Technical Supervisor, Mason, Electrician, Plumber etc.) and materials, accessories tools and plants required for the maintenance of the buildings, services, landscaping works, external development works during defect liability period. No extra charge in this account shall be paid to the contractor. Therefore, contractor is advised to quote the cost accordingly.

The Warranty/Defect Liability Period shall commence from the date of issue of the Taking Over Certificate by Principal Employer or issue of Completion Certificate by Principal Employer or agreed date of start of Defect

Liability Period by the Principal Employer whichever is later. The Warranty period of equipment/items shall be provided as per the manufacturer norms or up to end of Defect liability period whichever is more. When the equipment is under Warranty/Defect Liability Period, it shall be the sole responsibility of the Contractor/Supplier to rectify defect of equipment, spare parts, replacement equipment as deemed necessary by the Employer/Owner and install the same without any cost implications to Employer/ Owner.

If the contractor or his working people or servants shall break, deface, injure or destroy any part of building in which they may be working, or any building, road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass or grassland, or cultivated ground contiguous to the premises on which the work or any part is being executed, or if any damage shall happen to the work while in progress, from any cause whatever or if any defect, shrinkage or other faults appear in the work within twelve months (six months in the case of work costing Rs. Ten lacs and below except road work) after a certificate final or otherwise of its completion shall have been given by the Engineer-in- Charge as aforesaid arising out of defect or improper materials or workmanship the contractor shall upon receipt of a notice in writing on that behalf make the same good at his own expense or in default the Engineer-in-Charge cause the same to be made good by other workmen and deduct the expense from any sums that may be due or at any time thereafter may become due to the contractor, or from his security deposit or the proceeds of sale thereof or of a sufficient portion thereof.

Contractor shall take required works / rectification of defects immediately after receiving of complaints from Principal Employer / Employer. If Contractor fails to attend the complaints within the given time frame by Engineer-in-charge, then any expenditure incurred by WAPCOS in completing works / rectification of defects shall be recovered from any money due to the contractor on any account, and if such money is insufficient, the contractor shall be called upon in writing and shall be liable to pay the same within 30 days.

17.1 During progress of work

If the contractor or his working staff or workers damage any part of the work in the scope of contract, or any building, road, road kerb, fence, enclosure, water pipe, cables, drains, electric or telephone post or wires, trees, grass, grassland, cultivated ground, etc. contiguous to the premises on which the work or any part of it is being executed, the contractor shall make good the same at his own cost.

Contractor shall repair/replace and restore the damaged structures/services in a time bound manner as required and as directed by the Engineer-in-Charge. Contractor shall not be given any benefit of hindrance caused in the execution of the work owing to such damaged structure/service and time taken in its restoration by the contractor.

17.2 During defect liability period

The contractor shall be responsible for all the defects and deficiencies in the work within the scope of this contract, during the defect liability period which shall be for 3 (three) years after the date of actual completion of work as recorded by the Engineer- in-Charge. The liability of contractor for defects and deficiencies may arise due to:

a) Improper planning and design of the project, if in the scope of contract.
b) Works, Tools, Plant & Machinery, Materials or Workmanship not being in accordance with this contract.
c) Improper upkeep & maintenance during construction of the work.
d) Improper upkeep, operation and/or maintenance during defect liability period, if these are in the scope of this contract.
e) Failure by the contractor to comply with any other obligation under this contract.

Such defects and deficiencies shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice.

However, contractor need not wait for instructions/notice from Engineer-in-Charge for rectification of defects in work which come to his notice and he should initiate action for needful rectification of defect on priority, under intimation to Engineer-in-Charge, to avoid any untoward incident.

17.3 Structural soundness

The contractor shall follow the good engineering practice for safety, serviceability and structural soundness of the building/ structure/road work etc. as covered in the scope of contract.

17.3.1 Structure design in the scope of contract

The contractor shall have obligation to rectify all defects in the structural elements or any other part of building/structure/road etc. due to design deficiency at his own cost for 10 (ten) years from the date of completion as recorded in the completion certificate by the Engineer-in-Charge. Such defects shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice and as per the methodology duly approved by the Engineer-in-Charge.

17.3.3 Liability for execution

The contractor shall be fully liable for any deficiency in structural soundness of work owing to execution of the work under the scope of this contract. The contractor shall have obligation to rectify all defects in the structural elements owing to any deficiency in execution of work at his own cost for 10 (ten) years from the date of completion as recorded in the completion certificate by Engineer-in-Charge. Such defects shall be made good by the contractor at his own cost after getting instructions/notice from the Engineer-in-Charge within the time period specified in such instructions/notice and as per methodology duly approved by the Engineer-in-Charge.

17.4 Methodology for rectification of defects

The design, methodology and quality of rectification of defects carried out by the contractor shall be as per sound engineering practice.

17.5 Contractor's failure to rectify defects as defined in the sub-clauses 17.1, 17.2, 17.3 & 17.4.

In the event that the contractor fails to repair or rectify the defect or deficiency within the period specified by the Engineer-in-Charge, the Engineer-in-Charge shall be entitled to get the same repaired, rectified or remedied at the contractor's cost and recover such amount from any dues like performance guarantee, security deposits etc. available with Engineer-in-Charge. Engineer-in-Charge may take action for debarment of contractor from tendering in the department by following due process. For inaction or failure to rectify the defects covered under sub clause 17.3 within specified time limit, the Engineer-in-Charge may also initiate legal and/or other actions under other applicable laws in addition to other remedies available in the contract.

17.6 Release of security deposit

Fifty percent (50%) of the security deposit of the contractor shall be retained for a period of 18 (eighteen) months from the date of completion of work as per completion certificate issued by the Engineer-in-Charge or till the final bill has been passed whichever is later. This balance fifty percent (50%) security deposit shall be released after completion of defect liability period.

Provided further, that the security deposit shall be released within a month of its due date as stated above only if satisfactory performance is observed during the said period and after deduction of Government dues from the contractor, if any.

CLAUSE 18: CONTRACTOR SUPPLY TOOLS & PLANTS ETC.

The contractor shall provide at his own cost all materials, machinery, tools & plants as specified in tender. In addition to this, appliances, implements, other plants, ladders, cordage, tackle, scaffolding and temporary works required for the proper execution of the work, whether original, altered or substituted and whether included in the specifications or other documents forming part of the contract or referred to in these conditions or not, or which may be necessary for the purpose of satisfying or complying with the requirements of the Engineer-in-Charge as to any matter as to which under these conditions he is entitled to be satisfied, or which he is entitled to require together with carriage therefore to and from the work. The contractor shall also supply without charge the requisite number of persons with the means and materials, necessary for the purpose of setting out works, and counting, weighing and assisting the measurement for examination at any time and from time to time of the work or materials. Failing his so doing, the same may be provided by the Engineer-in-Charge at the expense of the contractor and the expenses may be deducted, from any money due to the contractor, under this contract or otherwise and/or from his security deposit or the proceeds of sale thereof, or of a sufficient portions thereof.

CLAUSE 18A: RECOVERY OF WORKMEN'S COMPENSATION

In every case in which by virtue of the provisions sub-section (1) of Section 12, of the Workmen's Compensation Act, 1923, WAPCOS is obliged to pay compensation to a workman employed by the contractor, in execution of the works, WAPCOS will recover from the contractor, the amount of the compensation so paid; and, without prejudice to the rights of the WAPCOS under sub-section (2) of Section 12, of the said Act, WAPCOS shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by WAPCOS to the contractor whether under this contract or otherwise. WAPCOS shall not be bound to contest any claim made against it under sub-section (1) of Section 12, of the said Act, except on the written request of the contractor and upon his giving to WAPCOS full security for all costs for which WAPCOS might become liable in consequence of contesting such claim.

CLAUSE 18B: ENSURING PAYMENT AND AMENITIES TO WORKERS IF CONTRACTOR FAILS

In every case in which by virtue of the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and of the Contract Labour (Regulation and Abolition) Central Rules, 1971, WAPCOS is obliged to pay any amounts of wages to a workman employed by the contractor in execution of the works, or to incur any expenditure in providing welfare and health amenities required to be provided under the above said Act and the rules under Clause 19H or under the C.P.W.D. Contractor's Labour Regulations, or under the Rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by C.P.W.D. Contractors, WAPCOS will recover from the contractor, the amount of wages so paid or the amount of expenditure so incurred; and without prejudice to the rights of the WAPCOS under sub-section(2) of Section 20, and sub-section (4) of Section 21, of the Contract Labour (Regulation and Abolition) Act, 1970, WAPCOS shall be at liberty to recover such amount or any part thereof by deducting it from the security deposit or from any sum due by WAPCOS to the contractor whether under this contract or otherwise WAPCOS shall not be bound to contest any claim made against it under sub-section (1) of Section 20, sub-section (4) of Section 21, of the said Act, except on the written request of the contractor and upon his giving to the WAPCOS full security for all costs for which WAPCOS might become liable in contesting such claim.

CLAUSE 19: LABOUR LAWS TO BE COMPLIED BY CONTRACTOR

The contractor shall obtain a valid license under the Contract Labour (R&A) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, before the commencement of the work, and continue to have a valid license until the completion of the work.

The contractor shall also comply with provisions of the Inter-State Migrant Workmen (Regulation of Employment and Conditions of Service) Act, 1979.

The contractor shall also abide by the provisions of the Child Labour (Prohibition and Regulation) Act, 1986.

The contractor shall also comply with the provisions of the building and other Construction Workers (Regulation of Employment & Conditions of Service) Act, 1996 and the building and other Construction Workers Welfare Cess Act, 1996.

Any failure to fulfill these requirements shall attract the penal provisions of this contract arising out of the resultant non-execution of the work

CLAUSE 19A

No labour below the age of fourteen years shall be employed on the work.

CLAUSE 19B: PAYMENT OF WAGES

i. The contractor shall pay to labour employed by him either directly or through subcontractors, wages not less than fair wages as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970 and the contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

ii. The contractor shall, notwithstanding the provisions of any contract to the contrary, cause to be paid fair wage to labour indirectly engaged on the work, including any labour engaged by his sub-contractors in connection with the said work, as if the labour had been immediately employed by him.

iii. In respect of all labour directly or indirectly employed in the works for performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with the Contractor's Labour Regulations made by WAPCOS from time to time in regard to payment of wages, wage period, deductions from wages recovery of wages not paid and deductions unauthorizedly made, maintenance of wage books or wage slips, publication of scale of wages and other terms of employment, inspection and submission of periodical returns and all other matters of the like nature or as per the provisions of the Contract Labour (Regulation and Abolition) Act, 1970, and the Contract Labour (Regulation and Abolition) Central Rules, 1971, wherever applicable.

iv. (a) The Engineer-in-Charge concerned shall have the right to deduct from the moneys due to the contractor any sum required or estimated to be required for making good the loss suffered by a worker or workers by reason of non-fulfilment of the conditions of the contract for the benefit of the workers, non-payment of wages or of deductions made from his or their wages which are not justified by their terms of the contract or non-observance of the Regulations.

(b) Under the provision of Minimum Wages (Central) Rules, 1950, the contractor is bound to allow to the labours directly or indirectly employed in the works one day rest for 6 days continuous work and pay wages at the same rate as for duty. In the event of default, the Engineer-in-Charge shall have the right to deduct the sum or sums not paid on account of wages for weekly holidays to any labours and pay the same to the persons entitled thereto from any money due to the contractor by the Engineer-in-Charge concerned.

In the case of Union Territory of Delhi, however, as the all-inclusive minimum daily wages fixed under Notification of the Delhi Administration No.F.12(162)MWO/DAB/ 43884-91, dated 31-12-1979 as amended from time to time are inclusive of wages for the weekly day of rest, the question of extra payment for weekly holiday would not arise.

v. The contractor shall comply with the provisions of the Payment of Wages Act, 1936, Minimum Wages Act, 1948, Employees Liability Act, 1938, Workmen's Compensation Act, 1923, Industrial Disputes Act, 1947, Maternity Benefits Act, 1961, and the Contractor's Labour (Regulation and Abolition) Act 1970, or the modifications thereof or any other laws relating thereto and the rules made thereunder from time to time.

vi. The contractor shall indemnify and keep indemnified WAPCOS against payments to be made under and for the observance of the laws aforesaid without prejudice to his right to claim indemnity from his sub-contractors.

vii. The laws aforesaid shall be deemed to be a part of this contract and any breach thereof shall be deemed to be a breach of this contract.

viii. Whatever is the minimum wage for the time being, or if the wage payable is higher than such wage, such wage shall be paid by the contractor to the workmen directly without the intervention of Jamadar and that Jamadar shall not be entitled to deduct or recover any amount from the minimum wage payable to the workmen as and by way of commission or otherwise.

ix. The contractor shall ensure that no amount by way of commission or otherwise is deducted or recovered by the Jamadar from the wage of workmen.

CLAUSE 19C

In respect of all labour directly or indirectly employed in the work for the performance of the contractor's part of this contract, the contractor shall at his own expense arrange for the safety provisions as per Safety Code framed from time to time and shall at his own expense provide for all facilities in connection therewith. In case the contractor fails to make arrangement and provide necessary facilities as aforesaid, he shall be liable to pay a penalty of Rs.500/- for each default and in addition, the Engineer-in- Charge shall be at liberty to make arrangement and provide facilities as aforesaid and recover the costs incurred in that behalf from the contractor.

CLAUSE 19 D

The contractor shall submit by the 4th and 19th of every month, to the Engineer-in-Charge, a true statement showing in respect of the second half of the preceding month and the first half of the current month respectively:-

(1) The number of labourers employed by him on the work,

(2) Their working yours,

(3) The wages paid to them,

(4) The accidents that occurred during the said fortnight showing the circumstances under which they happened and the extent of damage and injury caused by them, and

(5) The number of female workers who have been allowed maternity benefit according to Clause 19F and the amount paid to them.

Failing which the contractor shall be liable to pay to WAPCOS, a sum not exceeding Rs.500/- for each default or materially incorrect statement. The decision of the Engineer-In-Charge shall be final in deducting from any bill due to the contractor; the amount levied as fine and be binding on the contractor.

CLAUSE 19 E

In respect of all labour directly or indirectly employed in the works for the performance of the contractor's part of this contract, the contractor shall comply with or cause to be complied with all the rules framed by Government from time to time for the protection of health and sanitary arrangements for workers employed by the WAPCOS and its contractors.

CLAUSE 19 F

Leave and pay during leave shall be regulated as follows:-

1. Leave :

(i) in the case of delivery - maternity leave not exceeding 8 weeks, 4 weeks up to and including the day of delivery and 4 weeks following that day,

(ii) in the case of miscarriage - upto 3 weeks from the date of miscarriage.

2. Pay :

(i) in the case of delivery - leave pay during maternity leave will be at the rate of the women's average daily earnings, calculated on total wages earned on the days when full time work was done during a period of three months immediately preceding the date on which she gives notice that she expects to be confined or at the rate of Rupee one only a day whichever is greater.

(ii) in the case of miscarriage - leave pay at the rate of average daily earning calculated on the total wages earned on the days when full time work was done during a period of three months immediately preceding the date of such miscarriage.

3. Conditions for the grant of Maternity Leave:
No maternity leave benefit shall be admissible to a woman unless she has been employed for a total period of not less than six months immediately preceding the date on which she proceeds on leave.

4. The contractor shall maintain a register of Maternity (Benefit) in the Prescribed Form as shown in Appendix -I and II, and the same shall be kept at the place of work.

CLAUSE 19 G

In the event of the contractor(s) committing a default or breach of any of the provisions of the WAPCOS, Contractor's Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and' Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the Government a sum not exceeding Rs.500/- for every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of the contractor(s) defaulting continuously in this respect, the penalty may be enhanced to Rs.500/- per day for each day of default subject to a maximum of 5 per cent of the estimated cost of the work put to tender. The decision of the Engineer-in-Charge shall be final and binding on the parties.

Should it appear to the Engineer-in-Charge that the contractor(s) is/are not properly observing and complying with the provisions of the Labour Regulations and Model Rules and the provisions of the Contract Labour (Regulation and Abolition) Act 1970, and the Contract Labour (R& A) Central Rules 1971, for the protection of health and sanitary arrangements for work-people employed by the contractor(s) (hereinafter referred as "the said Rules") the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said Rules be complied with and the amenities prescribed therein be provided to the work-people within a reasonable time to be specified in the notice. If the contractor(s) shall fail within the period specified in the notice to comply with and/observe the said Rules and to provide the amenities to the work-people as aforesaid, the Engineer-in-Charge shall have the power to provide the amenities hereinbefore mentioned at the cost of the contractor(s). The contractor(s) shall erect, make and maintain at his/their own expense and to approved standards all necessary huts and sanitary arrangements required for his/their work-people on the site in connection with the execution of the works, and if the same shall not have been erected or constructed, according to approved standards, the Engineer-in-Charge shall have power to give notice in writing to the contractor(s) requiring that the said huts and sanitary arrangements be remodelled and/or reconstructed according to approved standards, and if the contractor(s) shall fail to remodel or reconstruct such huts and sanitary arrangements according to approved standards within the period

specified in the notice, the Engineer-in-Charge shall have the power to remodel or reconstruct such huts and sanitary arrangements according to approved standards at the cost of the contractor(s).

CLAUSE 19 H

The contractor(s) shall at his/their own cost provide his/their labour with a sufficient number of huts (hereinafter referred to as the camp) of the following specifications on a suitable plot of land to be approved by the Engineer-in-Charge.

(i) (a) The minimum height of each hut at the eaves level shall be 2.10m (7 ft.) and the floor area to be provided will be at the rate of 2.7 sq.m. (30 sq.ft.) for each member of the worker's family staying with the labourer.

(b) The contractor(s) shall in addition construct suitable cooking places having a minimum area of 1.80m x 1.50m (6'x5') adjacent to the hut for each family.

(c) The contractor(s) shall also construct temporary latrines and urinals for the use of the labourers each on the scale of not less than four per each one hundred of the total strength, separate latrines and urinals being provided for women.

(d) The contractor(s) shall construct sufficient number of bathing and washing places, one unit for every 25 persons residing in the camp. These bathing and washing places shall be suitably screened.

(ii) (a) All the huts shall have walls of sun-dried or burnt-bricks laid in mud mortar or other suitable local materials as may be approved by the Engineer-in-Charge. In case of sun-dried bricks, the walls should be plastered with mud gobri on both sides. The floor may be kutcha but plastered with mud gobri and shall be at least 15 cm (6") above the surrounding ground. The roofs shall be laid with thatch or any other materials as may be approved by the Engineer-in-Charge and the contractor shall ensure that throughout the period of their occupation, the roofs remain water-tight.

(b) The contractor(s) shall provide each hut with proper ventilation.

(c) All doors, windows, and ventilators shall be provided with suitable leaves for security purposes.

(d) There shall be kept an open space of at least 7.2m (8 yards) between the rows of huts which may be reduced to 6m (20 ft.) according to the availability of site with the approval of the Engineer-in-Charge. Back to back construction will be allowed

(iii) **Water Supply** - The contractor(s) shall provide adequate supply of water for the use of labourers. The provisions shall not be less than two gallons of pure and wholesome water per head per day for drinking purposes and three gallons of clean water per head per day for bathing and washing purposes. Where piped water supply is available, supply shall be at stand posts and where the supply is from wells or river, tanks which may be of metal or masonry, shall be provided. The contractor(s) shall also at his/ their own cost make arrangements for laying pipe lines for water supply to his/ their labour camp from the existing mains wherever available, and shall pay all fees and charges therefore.

(iv) The site selected for the camp shall be high ground, removed from jungle.

(v) **Disposal of Excreta** - The contractor(s) shall make necessary arrangements for the disposal of excreta from the latrines by trenching or incineration which shall be according to the requirements laid down by the Local Health Authorities. If trenching or incineration is not allowed, the contractor(s) shall make arrangements for the removal of the excreta through the Municipal Committee/authority and inform it about the number of labourers employed so that arrangements may be made by such Committee/authority for the removal of the excreta. All charges on this account shall be borne by the contractor and paid direct by him to the Municipality/authority. The contractor shall provide one sweeper for every eight seats in case of dry system.

(vi) **Drainage** - The contractor(s) shall provide efficient arrangements for draining away sullage water so as to keep the camp neat and tidy.

(vii) The contractor(s) shall make necessary arrangements for keeping the camp area sufficiently lighted to avoid accidents to the workers.

(viii) **Sanitation -** The contractor(s) shall make arrangements for conservancy and sanitation in the labour camps according to the rules of the Local Public Health and Medical Authorities.

CLAUSE 19 I

The Engineer-in-Charge may require the contractor to dismiss or remove from the site of the work any person or persons in the contractors' employ upon the work who may be incompetent or misconduct himself and the contractor shall forthwith comply with such requirements. In respect of maintenance/repair or renovation works etc. where the labour have an easy access to the individual houses, the contractor shall issue identity cards to the labourers, whether temporary or permanent and he shall be responsible for any untoward action on the part of such labour.

CLAUSE 19J

It shall be the responsibility of the contractor to see that the building under construction is not occupied by anybody unauthorizedly during construction, and is handed over to the Engineer-in-Charge with vacant possession of complete building. If such building though completed is occupied illegally, then the Engineer-in-Charge shall have the option to refuse to accept the said building/buildings in that position. Any delay in acceptance on this account will be treated as the delay in completion and for such delay, a levy upto 5% of Contract Price of work may be imposed by the WAPCOS whose decision shall be final both with regard to the justification and quantum and be binding on the contractor.

However, Employer, through a notice, may require the contractor to remove the illegal occupation any time on or before construction and delivery.

CLAUSE 19K: Employment of Skilled / Semi Skilled Workers

The contractor shall, at all stages of work, deploy skilled/semi-skilled tradesmen who are qualified and possess certificate in particular trade from Industrial Training Institute/National Institute of construction Management and Research (NICMAR)/ National Academy of Construction, CIDC or any similar reputed and recognized Institute managed/ certified by State/Central Government. The number of such qualified tradesmen shall not be less than 20% of total skilled/semi-skilled workers required in each trade at any stage of work. The contractor shall submit number of man days required in respect of each trade, its scheduling and the list of qualified tradesmen along with requisite certificate from recognized Institute to Engineer-in-charge for approval. Notwithstanding such approval, if the tradesmen are found to have inadequate skill to execute the work of respective trade, the contractor shall substitute such tradesmen within two days of written notice from Engineer-in-Charge. Failure on the part of contractor to obtain approval of Engineer-in-Charge or failure to deploy qualified tradesmen will attract a compensation to be paid by contractor at the rate of Rs. 100 per such tradesman per day. Decision of Engineer-in-charge as to whether particular tradesman possesses requisite skill and amount of compensation in case of default shall be final and binding.

Provided always, that the provisions of this clause, shall not be applicable for works with estimated cost put to tender being less than Rs. 5 crores.

For work costing more than Rs. 10 Crores, and upto Rs. 50 Crores, the Contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 20% of the unskilled workers engaged in the project in co-ordination with the Employer & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi-skilled tradesmen.

For works costing more than Rs. 50 Crores, the Contractor shall arrange on site training as per National Skill Development Corporation (NSDC) norms for at least 30% of the unskilled worker engaged in the project in co-ordination with the Employer & National Skill Development Corporation (NSDC) for certification at the level of skilled/semi-skilled tradesmen. The cost of such training as stated above shall be borne by the Government. The necessary space and workers shall be provided by the Contractor and no claim what so ever shall be entertained.

Clause 19L

Contribution of EPF and ESI

The ESI and EPF contributions on the part of employer in respect of this contract shall be paid by the contractor. These contributions on the part of the employer paid by the contractor shall be reimbursed by the Engineer-in-charge to the contractor on actual basis. The verification of deployment of labour will be done through biometric attendance system or any other suitable method by the Engineer-in-charge. The applicable and eligible amount of EPF & ESI shall be reimbursed preferably within 7 days but not later than 30 days of submission of documentary proof of payment provided same are in order.

Clause 19L

Sexual Harassment of Women at Workplace

The contractor shall comply with all provision(s) and guideline(s) of Sexual Harassment of Women at Workplace (Prevention Prohibition and Redressal) Act, 2013 and amendment thereafter time to time or any other rules framed under any labour law affecting women worker(s).

CLAUSE 20: MINIMUM WAGES ACT COMPLIANCE

The contractor shall comply with all the provisions of the Minimum Wages Act, 1948, and Contract Labour (Regulation and Abolition) Act, 1970, amended from time to time and rules framed thereunder and other labour laws affecting contract labour that may be brought into force from time to time.

CLAUSE 21: WORK NOT TO BE SUBLET / ACTION IN CASE OF INSOLVENCY

The contract shall not be assigned or sublet without the written approval of the Engineer-in Charge. And if the contractor shall assign or sublet his contract, or attempt to do so, or become insolvent or commence any insolvency proceedings or make any composition with his creditors or attempt to do so, or if any bribe, gratuity, gift, loan, perquisite, reward or advantage pecuniary or otherwise, shall either directly or indirectly, be given, promised or offered by the contractor, or any of his servants or agent to any public officer or person in the employ of WAPCOS in any way relating to his office or employment, or if any such officer or person shall become in any way directly or indirectly interested in the contract, the Engineer-in-Charge on behalf of the WAPCOS shall have power to adopt the course specified in Clause 3 hereof in the interest of WAPCOS and in the event of such course being adopted, the consequences specified in the said Clause 3 shall ensue.

Clause 22: QUALITY ASSURANCE AND SUPERVISION FOR EXECUTION PART of WORK

22.1 Quality of Materials and Workmanship

(i) The Contractor shall ensure that the Materials and workmanship are in accordance with the requirements specified in this Agreement, Specifications and Standards and Sound Engineering practice. The work shall be of the specified quality and standard, both in respect of ingredients as well as the intended functions it is supposed to perform for service life.

(ii) The Contract warrants that all Materials shall be new, unused, not reconditioned, unless otherwise allowed as per contract or by Engineer-in-Charge, and in conformity with Specification and Standards, Applicable Laws and Sound Engineering Practice, and that the Contractor shall not use any materials which are generally recognized as being deleterious under Sound Engineering Practice.

All sums payable by way of compensation under these conditions shall be considered reasonable compensation applied to the use of WAPCOS, without reference to actual loss or damage — whether or not any damage has been sustained.

22.2 Quality Assurance System

The Contractor shall devise a quality assurance mechanism to ensure compliance with the provisions of this Agreement (the "Quality Assurance Plan" or "QAP").

(i) The Contractor shall, submit to the Engineer-in-Charge, its Quality Assurance Plan 15 (fifteen) days in advance of start of the execution stage specified in the NIT. The Engineer-in-Charge shall convey its comments to the Contractor within a period of 7 (seven) days of receipt of the QAP stating the modifications, if any, required and the Contractor shall incorporate those in the QAP conforming with the provisions of this clause. The QAP shall include the following:

(a) Contractor's Organization & structure, duties and responsibilities of individual key personnel, quality policy of contractor, procedure for control of non-conformities and corrective action, inspections and documentation.

(b) Internal quality audit system.

(c) Machinery, Shuttering, other Tool & Plants, etc. required to be deployed at site.

(d) Method statement of important activities. These can be submitted as per the sequencing of the activities of the work.

(e) Quality control mechanism including sampling and testing of Materials, test frequencies, standards, acceptance criteria, testing facilities, reporting, recording and interpretation of test results, approvals, proforma for testing and calibration in accordance with the Specifications and Standards and Sound Engineering Practice; and Material Lot size, number of required tests and frequency of testing for different construction materials.

All the relevant and applicable codes, specifications and standards, as well as the acceptance criteria for various items of work, workmanship, materials and process employed needs to be mentioned.

(f) Check-list for various items and materials.

(g) Formats for site documentation, monthly reports on implementation of QAP.

(ii) **Sampling of materials**

All samples of materials including Cement Concrete Cubes shall be taken by the QA engineers deployed by the Contractor and shall be witnessed by the Engineer-in-Charge or his authorized representatives as specified in NIT. All the necessary assistance, facilities and safety shall be provided by the contractor. Cost of sample of materials and testing charges shall be borne by the contractor and he/she is responsible for safe custody of samples to be tested at site.

(iii) **Testing of Materials**

The contractor shall establish temporary field laboratory of adequate size with all necessary facilities. Field laboratory shall be equipped with the testing equipment for conducting routine field tests as per this contract. It will also have copies of standards, BIS codes, IRC codes, relevant publications.

All the tests in field lab setup at construction site shall be carried out by the QA Staff deployed by the contractor and shall be witnessed by the Engineer-in- Charge or his authorized subordinates as specified in NIT. The contractor shall provide all necessary facility to them for witnessing the tests in the field laboratory. In general, contractor shall carry out 90% of field tests in site laboratory and 10% tests shall be got carried out from outside laboratory as indicated below. Contractor shall endeavour to obtain test reports for tests conducted from outside laboratory in a reasonable time.

(iv) **Maintenance of Register of Test -**

- All the entries in the register of test are to be made by the designated QA Engineers of the contractor and same is to be regularly reviewed by the field officers as well as the Engineer-in-Charge. The contractor shall allow inspection of such records any time as desired by Engineer-in-Charge or his authorized representative.
- All the tests carried out at construction site or outside laboratories are to be maintained by the contractor in the prescribed format in the test registers provided by the contractor and duly authenticated by Engineer-in- Charge.The test reports shall also be maintained in hard file.
- Contractor is responsible for maintenance and safe custody of all the test registers and test records.
- Mandatory test conducted as per approved proforma shall be attached with each Running bill. Submission of copy of all test registers and material at site register along with each alternate Running Account Bill and with Final Bill is mandatory.
- All the Mandatory register to be maintained at site as per standard guidelines of CPWD Works manual, SOP and upto date guidelines amended time to time.

(v) **Maintenance of Material at Site (MAS) Register-**

MAS register of the key materials including Cement and Steel Registers shall be maintained in the proforma approved by Engineer-in-Charge. All the entries in the MAS registers are made by the designated staff of the contractor and same is regularly reviewed by the field officers as well as the Engineer-in-Charge. Contractor is responsible for maintenance and safe custody of MAS registers.

(vi) The Contractor shall procure all relevant codes, publications, apparatus and instruments, fuel, consumables, water, electricity, labour, materials, samples and qualified personnel as are necessary for examining and testing the Works, Materials and workmanship in accordance with the Quality Assurance Plan.

(vii) All the cost of testing including cost of samples, packaging, transportation, testing charges of Construction, Materials and workmanship under this clause shall be borne by the contractor.

(viii) The contractor shall submit monthly quality progress report on implementation of the provisions of Quality Assurance Plan on the format approved by the Engineer-in-Charge.

22.3 Samples

The Contractor shall, at its own expense and without delay, provide the samples of Materials and relevant information like Manufacturer's test reports, standard samples of manufactured Materials and Samples of such other Materials as the Engineer-in- Charge may require for review and approvals in accordance with Clause 10A of GCC before actual use.

22.4 Test

(i) For determining that the Works conform to the Specifications and Standards, the Engineer-in-Charge shall require the Contractor to carry out or cause to be carried out tests, at such time and frequency and in such manner as specified in this Agreement and in accordance with sound engineering practice for quality assurance. Frequency and the manner in which tests shall be conducted shall be in the following order of preference:

a) Contract provisions.
b) CPWD specifications.
c) BIS codes.

d) IRC codes.
e) MoRTH Specifications.
f) International Codes.
g) Manufacturer's specifications.

Outside tests shall be conducted at Government labs /IITs/NITs and other approved laboratories by the Engineer-in-Charge for testing of materials

(ii) The Contractor shall, with due diligence, carry out all the tests in accordance with the Agreement and furnish the results thereof to the Engineer-in-Charge. The Engineer-in-Charge or his authorized representative shall witness or participate during the testing as specified in NIT. The contractor shall provide all necessary assistance for witnessing/participating in the field tests.

(iii) In the event that results of any tests conducted under this clause establish any defects or deficiencies in the Works, the Contractor shall carry out remedial measures at its own cost and furnish a report to the Engineer-in-Charge in this regard. The Engineer-in-Charge shall require the Contractor to carry out or cause to be carried out tests to determine that such remedial measures have brought the works into compliance with the Specifications and standards and the procedure shall be repeated until such Works conform to the Specifications and Standards.

22.5 Method Statement

The 'Method statement' is a statement by which the construction procedures for important activities are stated, checked, and approved. The method statement shall be prepared for important activities as identified by the contractor as mentioned in QAP or any other activity as instructed by Engineer-in Charge.

The 'Method statement', should have a description of the item with elaborate procedure in steps to implement the same, the specifications of the materials involved, equipment to be deployed, measures for ensuring safety, their testing and acceptance criteria, precautions to be taken, mode of measurement, etc.

The Contractor shall, at least 15 (fifteen) days prior to the commencement of activities, submit to the Engineer-in-Charge for review, the method statements proposed to be adopted for executing the various items of work. The Engineer-in-Charge shall complete the review and convey its comments, if any, to the Contractor within a period of 07 (seven) days from the date of receipt of the proposed methodology from the Contractor.

22.6 Inspection & review by the Engineer-in-Charge and External Audit.

The Engineer-in-Charge, his authorized subordinates, senior officers of department, QA unit or any other third party may inspect and review the progress and quality of the work and issue appropriate directions to the Contractor for taking remedial action in the event the work is not in accordance with the provisions of this Agreement. The work may be inspected at any time/stage by external inspection teams like CTE or TE, Third Party Quality assurance agency, WAPCOS team etc. may conduct inspection of the quality of the works. The findings of the inspections shall be notified to the Contractor for taking remedial action in accordance with the agreement. The Contractor shall provide all assistance as may be required by the inspection teams in the conduct of its inspection here under.

Suitable actions shall be taken as per the provisions contained in the relevant clauses of the agreement, if the work is not found to be as per specifications or quality as specified in the agreement.

22.7 Inspection of records

The Engineer-in-Charge or his authorized representative shall have the right to inspect the records of the Contractor relating to the works.

22.8 Inspection of Works

(i) The Engineer-in-Charge and his authorized subordinates shall at all times;

(a) Have full access to all parts of the site and to all places from which natural materials are being obtained for use in the works; and

(b) During production, manufacture and construction at the site and at the place of production, be entitled to examine, inspect, measure and test the materials and workmanship and to check the progress of the manufacturer of Materials.

(ii) The Contractor shall give the Engineer-in-Charge and its authorized representative access, facilities and safety equipment for carrying out their obligations under this Agreement.

22.9 Examination of work before covering up/ Test Check of item of Work

In respect of the work which the Engineer-in-Charge or his authorized representatives are required to examine, inspect, measure or test before it is covered up or put out of view or any part of the work is placed thereon, the Contractor shall give notice to the Engineer-in-Charge whenever any such work is ready and before it is covered up. The Engineer-in-Charge shall then either carry out the examination, inspection or testing without unreasonable delay within 7 days, or promptly give notice to the Contractor that the Engineer-in-Charge does not require him to do so. Provided, however, that if any work is of a continuous nature where it is not possible or prudent to keep it uncovered or incomplete, the Contractor shall notify the schedule of carrying out such work to give sufficient opportunity, not being less than 3(three) business days' notice, to the Engineer-in-Charge to conduct its inspection, measurement or test while the work is continuing. Provided further that in the event the Contractor receives no response from the Engineer-in-Charge within a period of 3 (three) business days from the date on which the Contractor's notice hereunder is delivered to the Engineer-in- Charge, the Contractor shall be entitled to assume that the Engineer-in-Charge would not undertake the said inspections.

22.10 Rejection

(i) If, as a result of an examination, inspection, measurement or testing, any Plant, Materials, design or workmanship is found to be defective or otherwise not in accordance with the provisions of this Agreement, the Engineer-in-Charge may reject such piece of work, Plant, Materials, design or workmanship by giving notice to the Contractor, with reasons. The Contractor shall then promptly make good the defect and ensure that the rejected item complies with the requirements of this Agreement.

(ii) If the Engineer-in-Charge requires a Piece of work, Plant, Material, design or workmanship to be retested, the tests shall be repeated on the same terms and conditions, as applicable in each case. If the rejection and retesting cause the department to incur any additional costs, such costs shall be recoverable by the Engineer-in-Charge from the Contractor and may be deducted by the Engineer- in-Charge from any amount due to be paid to the Contractor.

(iii) The Contractor shall not be entitled to any extension of time on account of rectifying any defect or retesting as specified in this clause.

(iv) Examination, inspection, measurement or testing of any Plant, Material, design or workmanship by the Engineer-in-Charge or its failure to convey its observations or to examine, inspect, measure or test shall neither relieve the Contractor of its obligations and liabilities under this Agreement in any manner nor shall the Engineer-in-Charge be liable for the same in any manner.

22.11 Remedial work

(i) Notwithstanding any previous test or certification, the Engineer-in-Charge may instruct the Contractor to:

(a) remove from the site and replace any piece of work,plant or materials which are not in accordance with the provisions of this Agreement.

(b) remove and re-execute any work which is not in accordance with the provisions of this Agreement and the Specification and Standards; and execute any work which is urgently required for the safety of the Project, whether because of an accident, unforeseeable event or otherwise.

(ii) If the Contractor fails to comply with the instructions issued by the Engineer-in- Charge under aforesaid para, within the time specified in the notice or as mutually agreed, the Engineer-in-Charge may get the work executed by another agency. The cost so incurred by the Engineer-in-Charge for undertaking such work shall, without prejudice to the rights of the Engineer-in-Charge to recover damages in accordance with the provisions of this Agreement, be recoverable from the Contractor and may be deducted by the Engineer-in-Charge from any amount due to be paid to the Contractor.

22.12 Quality Control Records

The Contractor shall hand over authenticated copy of all its quality control records and documents to the Engineer-in-Charge before the Completion Certificate is issued.

22.13 Video recording

During the Construction Period, the Contractor shall provide to the Engineer-in- Charge for every calendar quarter, a video recording which will be compiled into a 15 (fifteen) minutes digital video covering the status and progress of work in that quarter. Video recording should show different activities, stage of work, quality assurance activities etc. including animation, graphs, digital maps, commentary, sub titles, etc. spread over the quarter. The video recording shall be provided to the Engineer- in-Charge no later than 15 (fifteen) days after the close of each quarter to be reckoned from next full month of date of start of work.

22.14 Suspension of unsafe Construction Works

(i) Upon recommendation of the Engineer-in-Charge to this effect, or on his own volition in cases of emergency or urgency, the Engineer-in-Charge may by notice require the Contractor to suspend forthwith the whole or any part of the Works if, in the reasonable opinion of Engineer-in-Charge, as the case may be, such work threatens the safety of the Users and or other persons on or about the Project. Provided, however, that in case of an emergency, the Engineer-in-Charge may suo-moto issue the notice referred to hereinabove.

(ii) (ii) The Contractor shall, pursuant to the notice under above para, suspend the Works or any part thereof for such time and in such manner as may be specified by the Engineer-in-Charge and thereupon carry out remedial measures to secure the safety of suspended works, the Users, other persons and vehicles on or about the Project. The Contractor by notice require the Engineer-in-Charge to inspect such remedial measures forthwith and request for revocation of suspension. Upon reviewing the remedial measures, the Engineer-in-Charge shall either revoke such suspension or instruct the Contractor to carry out such other and further remedial measures as may be necessary and reasonable and the procedure set forth in this Clause shall be repeated until the suspension hereunder is revoked.

(iii) Subject to other provisions of the agreement, all reasonable cost incurred for maintaining and protecting the Works or part thereof during the period of suspension (the "Preservation Costs") shall be borne by the contractor, if in the opinion of Engineer-in-Charge suspension is on account of reasons attributable to the contractor.

(iv) If suspension of Work is for reasons not attributable to the Contractor, the Engineer-in-Charge shall determine any Time Extension, if required, in accordance with the provisions of clause-5.

22.15 Online maintenance of Site records including testing records.

(i) The Engineer-in-Charge may require the contractor to upload all the site records in any online system devised by him. The contractor shall have to ensure that all the required site records, as desired by the Engineer-in-Charge shall be uploaded in this online system. Nothing extra on this account shall be payable to the contractor. In case these records are to be maintained in any online module then contractor shall comply with this.

CLAUSE 23: CHANGES IN FIRM'S CONSTITUTION TO BE INTIMATED

Where the contractor is a partnership firm, the previous approval in writing of the Engineer-in-Charge shall be obtained before any change is made in the constitution of the firm. Where the contractor is an Proprietor Firm, such approval as aforesaid shall likewise be obtained before the contractor enters into any partnership agreement where under the partnership firm would have the right to carry out the works hereby undertaken by the contractor. If previous approval as aforesaid is not obtained, the contract shall be deemed to have been assigned in contravention of Clause 21 hereof and the same action may be taken, and the same consequences shall ensue as provided in the said Clause 21.

CLAUSE 24: LIFE CYCLE COST — STRUCTURAL SOUNDNESS OBLIGATION - Deleted

The contractor shall be responsible for safety, quality and soundness of the buildings including structural elements beyond maintenance period. The contractor shall have obligation to rectify such defects minimum up to 5 (five) years from the date of completion of work. The defects have to be rectified within a reasonable time not exceeding forty five days after issue of notice by Engineer- in- Charge. If contractor does not take corrective action within 45 days, then action for debarring of the agency shall be taken by the appropriate authority.

CLAUSE 25: SETTLEMENT OF DISPUTES AND ARBITRATION

25.1 Governing Law, Jurisdiction & Waiver of Alternative Remedies

25.1.1 Governing Law: This Contract shall be governed and interpreted strictly in accordance with the laws of India. No foreign law, conflict-of-laws principle, or external rule shall apply, unless expressly mandated by a funding agency and separately approved in writing by the Competent Authority.

25.1.2. Exclusive Jurisdiction: Subject to prior exhaustion of the internal dispute-resolution tiers stipulated in this Contract, the Parties agree that all suits, actions, or proceedings arising out of or in connection with this Contract, including its formation, validity, performance, breach, or termination, shall be instituted exclusively before the competent civil courts at Delhi, being the place where the Company's Registered Office is situated, to the exclusion of all other courts. The Parties irrevocably waive any objection relating to forum non conveniens, place of suing, or inconvenience.

25.1.3. Exclusion of arbitration & consensual ADR: The Parties unequivocally agree that no dispute shall be referred to arbitration, conciliation, expert determination, Dispute Review Board, or any other form of consensual alternative dispute resolution, except where statutorily mandated (eg., MSMED Act). This exclusion is without prejudice to the mandatory pre-litigation mediation process stipulated in Clause 25.2.3 below.

25.1.4. The parties expressly agree that there is no arbitration agreement between them and they irrevocably waive any right to invoke arbitration under the Arbitration and Conciliation Act, 1996 or to constitute an arbitral tribunal in any manner whatsoever.

25.2. STRUCTURED INTERNAL DISPUTE RESOLUTION MECHANISM (SIDRM)

25.2.1. Tier-I: Dispute resolution by Engineer-in-Charge (EIC)

25.2.1a. Notice of Dispute: Any Dispute must be notified in writing to the EIC within 21 days from the date on which the aggrieved Party became, or ought reasonably to have become, aware of the event giving rise to the Dispute.

25.2.1b. Contents of Notice: The notice shall contain (i) complete facts and chronology; (ii) precise contractual clauses invoked; (iii) a quantified claim with calculations; and (iv) full supporting records such as drawings, DPRs, MBs, photographs, test results, correspondence, and site registers, vague, omnibus, or un-particularised notices shall be summarily rejected without prejudice to WAPCOS.

25.2.1c. EIC's Decision: The EIC shall examine the matter, including through joint site verification of expert inputs as needed, and shall issue a speaking order within 30 days of receiving a complete notice.

25.2.1d. Binding Effect: The EIC's decision shall bind both Parties unless a written request seeking escalation to Tier-II is filed within 15 days from the date of issuance of EIC's decision. Absence of a timely request shall render the EIC decision final.

25.2.2 Tier-II: Departmental Review Committee (DRC)

25.2.2a Constitution: A standing Departmental Review Committee, consisting of three senior officers including two Technical and one Finance/ Account officer, shall independently review disputes escalated from Tier-I.

25.2.2b. Review Process: The DRC shall conduct a record-based administrative review of the Tier-I file, supplemented by written submissions from the Contractor. The committee may permit oral hearings if it deems them necessary for a fair decision.

25.2.2c. Decision & Finality: The DRC shall deliver reasoned determination within 30 days of referral, extendable once by 30 days for, if resolution takes time, with reasons recorded. This determination shall constitute the final administrative decision of WAPCOS.

25.2.3 MANDATORY PRE-LITIGATION MEDIATION

25.2.3a. Obligation to Mediate: Following the DRC decision (or deemed decision), either Party may initiate pre-litigation mediation. Where the dispute qualifies as a 'commercial dispute' under the Commercial Courts Act, 2015, this mediation shall satisfy the mandatory pre-litigation requirement under Section 12A of the said Act.

25.2.3b. Mediation Parameters: Mediation shall be conducted by a mediator empanelled with the High Court or a Government-notified mediation service provider in accordance with the Mediation Act, 2023. The timelines and extension provisions stipulated in the Act shall apply.

25.2.3c. Approval of Settlement: Any mediated settlement agreement shall be subject to final written approval and execution by the Competent Authority of WAPCOS. The mediator shall be informed at the outset that the authorized representative of WAPCOS does not have the inherent power to bind WAPCOS to a settlement without such approval. If such approval is not granted within 30 days of the settlement terms being presented, the settlement shall be deemed not concluded, and the mediation shall be treated as unsuccessful.

25.2.3 CIVIL COURT JURISDICTION & CONSEQUENCES OF BREACH

25.2.4a. Exhaustion of Remedies: A Party may file a civil suit only after (a) obtaining a DRC decision or deemed decision, and (b) participating in the mandatory mediation process and obtaining a failure report.

25.2.4b. Mandatory Pleadings: Every plaint shall specifically demonstrate compliance with Tier-I, Tier-II, and Tier-III requirements. Failure to do so shall render the plaint liable to rejection.

25.2.4c. Any attempt to initiate arbitration or file a civil suit without first exhausting the mandatory tiers stipulated above shall constitute a material breach of contract. WAPCOS shall be entitled to seek appropriate relief from the court, including but not limited to an injunction to restrain such proceedings, and to recover all associated costs and expenses.

25.2.4 GENERAL PROVISIONS

25.2.5.1. Severability: If any portion of this Clause is invalidated by a court, the remaining parts shall remain in force.

25.2.5.2. Amendment: This Clause may be amended only by a written instrument signed by the CMD or an expressly authorized officer of WAPCOS.

25.2.5.3. Failure to continue performance shall constitute a material breach entitling WAPCOS to terminate the Contract without prejudice to its other right.

CLAUSE 26: CONTRACTOR TO INDEMNIFY EMPLOYER AGAINST PATENT RIGHTS

The contractor shall fully indemnify and keep indemnified the WAPCOS against any action, claim or proceeding relating to infringement or use of any patent or design or any alleged patent or design rights and shall pay any royalties which may be payable in respect of any article or part thereof included in the contract. In the event of any claims made under or action brought against WAPCOS in respect of any such matters as aforesaid, the contractor shall be immediately notified thereof and the contractor shall be at liberty, at his own expense, to settle any dispute or to conduct any litigation that may arise therefrom, provided that the contractor shall not be liable to indemnify the WAPCOS if the infringement of the patent or design or any alleged patent or design right is the direct result of an order passed by the Engineer-in-Charge in this behalf.

CLAUSE 27: WITHOLDING AND LIEN IN RESPECT OF SUM DUE FROM CONTRACTOR

Whenever any claim or claims for payment of a sum of money arises out of or under the contract or against the contractor, the Engineer-in-Charge or the WAPCOS shall be entitled to withhold and also have a lien to retain such sum or sums in whole or in part from the security, if any deposited by the contractor and for the purpose aforesaid, the Engineer-in- Charge or the WAPCOS shall be entitled to withhold the security deposit, if any, furnished as the case may be and also have a lien over the same pending finalization or adjudication of any such claim. In the event of the security being insufficient to cover the claimed amount or amounts or if no security has been taken from the contractor, the Engineer-in-Charge or the WAPCOS shall be entitled to withhold and have a lien to retain to the extent of such claimed amount or amounts referred to above, from any sum or sums found payable or which may at any time thereafter become payable to the contractor under the same contract or any other contract with the Engineer-in-Charge of the WAPCOS or any contracting person through the Engineer-in-Charge pending finalization of adjudication of any such claim.

It is an agreed term of the contract that the sum of money or moneys so withheld or retained under the lien referred to above by the Engineer-in-Charge or WAPCOS will be kept withheld or retained as such by the Engineer-in-Charge or WAPCOS till the claim arising out of or under the contract is determined by the arbitrator(if the contract is governed by the arbitration clause) by the competent court, as the case may be

and that the contractor will have no claim for interest or damages whatsoever on any account in respect of such withholding or retention under the lien referred to above and duly notified as such to the contractor. For the purpose of this clause, where the contractor is a partnership firm or a limited company, the Engineer-in-Charge or the WAPCOS shall be entitled to withhold and also have a lien to retain towards such claimed amount or amounts in whole or in part from any sum found payable to any partner/limited company as the case may be, whether in his individual capacity or otherwise.

a) **WAPCOS or its nominated Representatives** shall have the right to cause an audit and technical examination of the works and the final bills of the contractor including all supporting vouchers, abstract, etc., to be made after payment of the final bill and if as a result of such audit and technical examination any sum is found to have been overpaid in respect of any work done by the contractor under the contract or any work claimed to have been done by him under the contract and found not to have been executed, the contractor shall be liable to refund the amount of over- payment and it shall be lawful for WAPCOS to recover the same from him in the manner prescribed in sub-clause (i) of this clause or in any other manner legally permissible; and if it is found that the contractor was paid less than what was due to him under the contract in respect of any work executed by him under it, the amount of such under payment shall be duly paid by WAPCOS to the contractor, without any interest thereon whatsoever.

b) Provided that WAPCOS shall not be entitled to recover any sum overpaid, nor the contractor shall be entitled to payment of any sum paid short where such payment has been agreed upon between the WAPCOS on the one hand and the contractor on the other under any term of the contract permitting payment for work after assessment by WAPCOS.

CLAUSE 28: LIEN IN RESPECT OF CLAIMS IN OTHER CONTRACTS

Any sum of money due and payable to the contractor (including the security deposit returnable to him) under the contract may be withheld or retained by way of lien by the Engineer-in-Charge or the WAPCOS or any other contracting person or persons through Engineer-in-Charge against any claim of the Engineer-in-Charge or WAPCOS or such other person or persons in respect of payment of a sum of money arising out of or under any other contract made by the contractor with the Engineer-in-Charge or the WAPCOS or with such other person or persons.

It is an agreed term of the contract that the sum of money so withheld or retained under this clause by the Engineer-in-Charge or the WAPCOS will be kept withheld or retained as such by the Engineer- in-Charge or the WAPCOS or till his claim arising out of the same contract or any other contract is either mutually settled or determined by the arbitration clause or by the competent court, as the case may be and that the contractor shall have no claim for interest or damages whatsoever on this account or on any other ground in respect of any sum of money withheld or retained under this clause and duly notified as such to the contractor.

CLAUSE 29: EMPLOYMENT OF COAL MINING OR CONTROLLED AREA LABOUR NOT PERMISSIBLE

The contractor shall not employ coal mining or controlled area labour falling under any category whatsoever on or in connection with the work or recruit labour from area within a radius of 32 km (20 miles) of the controlled area. Subject as above the contractor shall employ imported labour only i.e., deposit imported labour or labour imported by contractors from area, from which import is permitted.

Where ceiling price for imported labour has been fixed by State or Regional Labour Committees not more than that ceiling price shall be paid to the labour by the contractor.

The contractor shall immediately remove any labourer who may be pointed out by the Engineer-in-Charge as being a coal mining or controlled area labourer. Failure to do so shall render the contractor liable to pay to WAPCOS a sum calculated at the rate of Rs.100/- per day per labourer. The certificate of the Engineer-in-Charge about the number of coal mining or controlled area labourer and the number of days for which they worked shall be final and binding upon all parties to this contract.

It is declared and agreed between the parties that the aforesaid stipulation in this clause is one in which the public are interested within the meaning of the exception in Section 74 of Indian Contract Act, 1872.
Explanation: - Controlled Area means the following areas: Districts of Dhanbad, Hazaribagh, Jamtara - a Sub-Division under Santhal Pargana Commissionery, Districts of Bankuara, Birbhum, Burdwan, District of Bilaspur. Any other area which may be declared a Controlled Area by or with the approval of the Central Government.

CLAUSE 30: WATER FOR WORKS

The contractor(s) shall make his/their own arrangements for water required for the work and nothing extra will be paid for the same. This will be subject to the following conditions.

(i) That the water used by the contractor(s) shall be fit for construction purposes to the satisfaction of the Engineer-in-Charge.

(ii) The Engineer-in-Charge shall make alternative arrangements for supply of water at the risk and cost of contractor(s) if the arrangements made by the contractor(s) for procurement ofwater are in the opinion of the Engineer-in- Charge, unsatisfactory.

(iii) The water charges @ 1 % on tendered value shall be recovered if water supplied by Government/ Principal Employer is used by contractor.

CLAUSE 30A: ALTERNATE WATER ARRANGEMENTS

The contractor shall be allowed to construct temporary Tube wells in the proposed land for Construction for taking water for construction purposes only after he has got permission of the Engineer-in- Charge in writing. No charges shall be recovered from the contractor on this account, but the contractor shall be required to provide necessary safety arrangementsto avoid any accidents or damage to adjacent buildings, roads and service lines. He shall beresponsible for any accidents or damage caused due to construction and subsequent maintenance of the wells and shall restore the ground to its original condition after the wells are dismantled on completion of the work.

CLAUSE 31: HIRE OF PLANT & MACHINERY

The contractor shall arrange at his own expense all tools, plant, machinery and equipment (hereinafter referred to as T&P) required for execution of the work.

CLAUSE 32: EMPLOYMENT OF TECHNICAL STAFF AND EMPLOYEES

Contractors Superintendence, Supervision, Technical Staff & Employees

(i) The contractor shall provide all necessary superintendence during execution of the work and all along thereafter as may be necessary for proper fulfilling of the obligations under the contract.
As per tendered amount (worked out on the basis of quoted rate of individual items) and before commencement of the work, intimate in writing to the Engineer-in-Charge, the name(s), qualifications, experience, age, address(s) and other particulars along with certificates, of the principal technical representative to be in charge of the work and other technical representative(s) who will be supervising the work. Minimum requirement of such technical representative(s) and their qualifications and experience shall not be lower than specified in SCC. Even of the contractor (or partner(s) in case of firm/ company) is himself / herself an Engineers, it is necessary on the part of the contractor to Employ principal technical representative / technical representative (s) as per stipulation in Special Conditions of Contract.

The Engineer-in-Charge shall within 3 days of receipt of such communication intimate in writing his approval or otherwise of such a representative(s) to the contractor. Any such approval may at any time be withdrawn and in case of such withdrawal, the contractor shall appoint another such representative(s) according to the provisions of this clause. Decision of the tender accepting authority shall be final and binding on the contractor in this respect. Such a principal technical

representative and other technical representative(s) shall be appointed by the contractor soon after receipt of the approval from Engineer-in- charge and shall be available at site before start of work.

All the provisions applicable to the principal technical representative under the Clause will also be applicable to other technical representative(s) The principal technical representative and other technical representative(s) shall be present at the site of work for supervision at all times when any construction activity is in progress and also present himself/themselves, as required, to the Engineer-in-Charge and/or his designated representative to take instructions. Instructions given to the principal technical representative or other technical representative(s) shall be deemed to have the same force as if these have been given to the contractor. The principal technical representative and other technical representative(s) shall be actually available at site fully during all stages of execution of work, during recording/checking/test checking of measurements of works and whenever so required by the Engineer-in-Charge and shall also note down instructions conveyed by the Engineer-in-Charge or his designated representative(s) in the site order book and shall affix his/their signature in token of noting down the instructions and in token of acceptance of measurements/checked measurements/ test checked measurements. The representative(s) shall not look after any other work. Substitutes, duly approved by Engineer-in-Charge of the work in similar manner as aforesaid shall be provided in event of absence of any of the representative(s) by more than two days.

If the Engineer-in-Charge, whose decision in this respect is final and binding on the contractor, is convinced that no such technical representative(s) is/are effectively appointed or is/are effectively attending or fulfilling the provision of this clause, a recovery (non-refundable) shall be effected from the contractor as specified in SCC and the decision of the Engineer-In-Charge as recorded in the site order book and measurement recorded checked/test checked in Measurement Books shall be final and binding on the contractor. Further if the contractor fails to appoint suitable technical Principal technical representative and/or other technical representative(s) and if such appointed persons are not effectively present or are absent by more than two days without duly approved substitute or do not discharge their responsibilities satisfactorily, the Engineer-in-Charge shall have full powers to suspend the execution of the work until such date as suitable other technical representative(s) is/are appointed and the contractor shall be held responsible for the delay so caused to the work. The contractor shall submit a certificate of employment of the technical representative(s) (in the form of copy of Form-16 or CPF deduction issued to the Engineers employed by him) along with every on account bill/ final bill and shall produce evidence if at any time so required by the Engineer-in-Charge.

(ii) The contractor shall provide and employ on the site only such technical assistants as are skilled and experienced in their respective fields and such foremen and supervisory staff as are competent to give proper supervision to the work.
The contractor shall provide and employ skilled, semiskilled and unskilled labour as is necessary for proper and timely execution of the work.

The Engineer-in-Charge shall be at liberty to object to and require the contractor to remove from the works any person who in his opinion misconducts himself, or is incompetent or negligent in the performance of his duties or whose employment is otherwise considered by the Engineer-in-Charge to be undesirable. Such person shall not be employed again at works site without the written permission of the Engineer-in- Charge and the persons so removed shall be replaced as soon as possible by competent substitutes.

(iii) Building Information Model (BIM) professional shall be deployed by the contractor for the work wherever BIM is applicable. The BIM professional shall be available exclusively for this work from

stipulated date of start and till actual date of completion of project. The recovery shall be made from bill of contractor in case of non-deployment of BIM Professional without giving any notice in writing. The decision of Engineer-in-Charge in this respect shall be final and binding on the contractor.

CLAUSE 33: LEVY/TAXES PAYABLE BY CONTRACTOR

(i) GST, Building and other Construction Workers Welfare Cess or any other tax, levy or Cess in respect of input for or output by this Contract shall be payable by the Contractor and WAPCOS shall not entertain any claim whatsoever in this respect except as provided under Clause 34.

(ii) The Contractor shall deposit royalty and obtain necessary permit for supply of the red bajri, stone, kankar, etc. from local authorities. If pursuant to or under any law, notification or order any royalty, cess or the like becomes payable by the WAPCOS and does not any time become payable by the Contractor to the State Government, Local authorities in respect of any material used by the Contractor in the works, then in such a case, it shall be lawful to the WAPCOS and it will have the right and be entitled to recover the amount paid in the circumstances as aforesaid from dues of the Contractor.

(iii) The Current rate of GST @18% is included in the Estimated Cost put to tender. However, in case of any changes in GST rate on Work Contracts, the same shall be paid/ deducted accordingly as per prevailing GOI Norms. No additional claim by the contractor shall be entertained except for above.

CLAUSE 34: CONDITIONS FOR REIMBURSEMENT OF LEVY/TAXES IF LEVIED AFTER RECEIPT OF TENDERS

(i) All tendered rates shall be inclusive of any tax, levy or cess applicable on last stipulated date of receipt of tender including extension if any. No adjustment i.e. increases or decrease shall be made for any variation in the rate of GST, Building and Other Construction Workers Welfare Cess or any tax, levy or cess applicable on inputs.

However, effect of variation in rates of GST or Building and Other Construction Workers Welfare Cess or imposition or repeal of any other tax, levy or cess applicable on output of the works Contract shall be adjusted on side, increase or decrease.

Provided further that for Building and Other Construction Workers Welfare Cess or any tax (other than GST), levy or cess varied or imposed after the last date of receipt of tender including extension if any, any increase shall be reimbursed to the Contractor only if the Contractor necessarily and properly pays such increased amount of taxes/levies/cess.

Provided further that such increase including GST shall not be made in the extended period of Contract for which the Contractor alone is responsible for delay as determined by authority for extension of time**.**

(ii) The Contractor shall keep necessary books of accounts and other documents for the purpose of this condition as may be necessary and shall allow inspection of the same by a duly authorized representative of the Engineer-in-Charge and shall also furnish such other information/document as the Engineer-in-Charge may require from time to time.

(iii) The Contractor shall, within a period of 30 days of the imposition of any such further tax or levy or cess, or variation or repeal of such tax or levy or cess give a written notice thereof to the Engineer-in-charge that the same is given pursuant to this condition, together with all necessary information relating thereto

CLAUSE 35: TERMINATION OF CONTRACT ON DEATH OF CONTRACTOR

Without prejudice to any of the rights or remedies under this contract, in case of Individual/ Sole Proprietorship, if the contractor dies, the Engineer-In-Charge on behalf of the WAPCOS shall have the option of terminating the contract without compensation to the contractor.

CLAUSE 36: IF RELATIVE WORKING IN WAPCOS THEN THE CONTRACTOR NOT ALLOWED TO TENDER

The contractor shall not be permitted to tender for works in the WAPCOS responsible for award and execution of contracts in which his near relative is posted in WAPCOS. He shall also intimate the names of persons who are working with him in any capacity or are subsequently employed by him and who are near relatives to any Officer in the WAPCOS. Any breach of this condition by the contractor would render him liable to be debarred from tendering in WAPCOS any breach of this condition.

NOTE: By the term “near relatives” is meant wife, husband, parents and grandparents, children and grandchildren, brothers and sisters, uncles, aunts and cousins and their corresponding in-laws.

CLAUSE 37: NO GAZETTED ENGINEER TO WORK AS CONTRACTOR WITHIN ONE YEAR OF RETIREMENT

No engineer of gazetted rank or other gazetted officer employed in engineering or administrative duties in an engineering department of the Government of India shall work as a contractor or employee of a contractor for a period of one year after his retirement from government service without the previous permission of Government of India in writing. This contract is liable to be cancelled if either the contractor or any of his employees is found at any time to be such a person who had not obtained the permission of Government of India as aforesaid, before submission of the tender or engagement in the contractor’s service, as the case may be.

CLAUSE 38: THEORETICAL CONSUMPTION OF MATERIAL

i. After completion of the work and also at any intermediate stage in the event of Non reconciliation of materials issued theoretical quantity of materials used in the work shall be calculated on the basis and method given hereunder:
   a) Quantity of cement & bitumen shall be calculated on the basis of quantity of cement & bitumen required for different items of work as shown in the Schedule of Rates mentioned in Schedule 'F'. In case any item is executed for which standard constants for the consumption of cement or bitumen are not available in the above mentioned schedule/statement or cannot be derived from the same shall be calculated on the basis of standard formula to be laid down by the Engineer-in-Charge.
   b) Theoretical quantity of steel reinforcement or structural steel sections shall be taken as the quantity required as per design or as authorized by Engineer-in- Charge, including authorized lappages, chairs etc. plus 3% wastage due to cutting into pieces, such theoretical quantity being determined and compared with the actual, each diameter wise, section wise and category wise separately.
   c) Theoretical quantity of G.I. & C.I. or other pipes, conduits, wires and cables, pig lead and G.I./M.S. sheets shall be taken as quantity actually required and measured plus 5% for wastage due to cutting into pieces (except in the case of G.I./M.S. sheets it shall be 10%), such determination & comparison being made diameter wise & category wise.
   d) For any other material as per actual requirements.
   Over the theoretical quantities of materials so computed a variation shall be allowed as specified in SCC or non-scheduled items, the decision of the WAPCOS/ PMC regarding theoretical quantities of materials which should have been actually used, shall be final and binding on the contractor

ii. The said action under this clause is without prejudice to the right of the WAPCOS/ PMC to take action against the contractor under any other conditions of contract for not doing the work according to the prescribed specifications

CLAUSE 39: COMPENSATION DURING WARLIKE SITUATION

The work (whether fully constructed or not) and all materials, machines, tools and plants, scaffolding, temporary buildings and other things connected therewith shall be at the risk of the contractor until the work has been delivered to the Engineer-in-Charge and a certificate from him to that effect obtained. In the event of the work or any materials properly brought to the site for incorporation in the work being damaged or destroyed in consequence of hostilities or warlike operation, the contractor shall when ordered (in writing) by the Engineer-in-Charge to remove any debris from the site, collect and properly stack or remove in store all serviceable materials salvaged from the damaged work and shall be paid at the contract rates in accordance with the provision of this agreement for the work of clearing the site of debris, stacking or removal of serviceable material and for reconstruction of all works ordered by the Engineer-in-Charge, such payments being in addition to compensation upto the value of the work originally executed before being damaged or destroyed and not paid for. In case of works damaged or destroyed but not already measured and paid for, the compensation shall be assessed by the Engineer-In-Charge upto Rs. 2,00,000/- and by the next higher officer for a higher amount. The contractor shall be paid for the damages/destruction suffered and for restoring the material at the rate based on analysis of rates tendered for in accordance with the provision of the contract. The certificate of the Engineer-in-Charge regarding the quality and quantity of materials and the purpose for which they were collected shall be final and binding on all parties to this contract.

Provided always that no compensation shall be payable for any loss in consequence of hostilities or warlike operations (a) unless the contractor had taken all such precautions against air raid as are deemed necessary by the A.R.P. Officers or the Engineer-in-Charge (b) for any material etc. not on the site of the work or for any tools, plant, machinery, scaffolding, temporary building and other things not intended for the work.

In the event of the contractor having to carry out reconstruction as aforesaid, he shall be allowed such extension of time for its completion as is considered reasonable by the Engineer-In-Charge.

CLAUSE 40: APPRENTICES ACT PROVISIONS TO BE COMPLIED WITH

The contractor shall comply with the provisions of the Apprentices Act, 1961 and the rules and orders issued thereunder from time to time. If he fails to do so, his failure will be a breach of the contract and the WAPCOS may, in his discretion, cancel the contract. The contractor shall also be liable for any pecuniary liability arising on account of any violation by him of the provisions of the said Act.

CLAUSE 41: RELEASE OF SECURITY DEPOSIT AFTER LABOUR CLEARANCE

The Security Deposit of the work shall be refunded if no labour complaint has been received from the labour officer till the due date of its payment. If a labour complaint is received during this period, the Engineer-in-Charge shall, after issue of notice in this regard to the contractor, deduct the amount required to settle the complaint from his security deposit and refund the balance amount.

In case, if part completion certificate of work is recorded then security deposit shall be released only after recording final completion certificate of the work and after completion of defect liability period whichever is later or specified otherwise in the contract.

Release of Security Deposit of the work shall not be refunded till the contractor produces a clearance deposit after labour certificate from the Labour Officer. As soon as the work is virtually complete the contractor shall apply for the clearance certificate to the Labour Officer under intimation to the Engineer-in-Charge. The Engineer-in-Charge, on receipt of the said communication, shall write to the Labour Officer to intimate if any complaint is pending against the contractor in respect of the work. If no complaint is pending, on record till after 3 months after completion of the work and/or no communication is received

from the Labour Officer to this effect till six months after the date of completion, it will be deemed to have received the clearance certificate and the Security Deposit will be released if otherwise due.

CLAUSE 42: INSURANCE

1. Requirements

Before commencing execution of works, unless stated otherwise in the special conditions of contract, it shall be obligatory for the contractor to obtain at his own cost stipulated insurance cover under the following requirements:

a) Contractor's all risk and Third Party Cover.
b) Liability under the workmen's compensation Act, 1923, Minimum Wages Act, 1948 and Contract Labour (Regulation and Abolition) Act, 1970.
c) Accidents to staff, Engineers, Supervisors and others who are not governed by workmen's compensation Act.
d) Damage to material, machinery and works due to fire theft etc.
e) Any other risk to be covered by insurance as may be specified by the employer in the special conditions of contract.

2. Policy in Joint Names of Contractor and Employer

The policy referred to under sub-clause 46(1) above shall be obtained in the joint names of thecontractor and the employer and shall inter-alia provide coverage against the following, arisingout of or in connection with execution of works, their maintenance and performance of the contract.

a) Loss of life or injury involving public, employee of the contractor, or that of employer and Engineer, labour etc.
b) Injury, loss or damage to the works or property belonging to public, government bodies, local authorities, utility organizations, contractors, employer or others.

3. Currency of Policy

The policies shall remain in force throughout the period of execution of the works and till the expiry of the defect liability period. The contractor shall, whenever called upon, produce to the engineer or his representative the various insurance policies obtained by him as also the rates of premia and the premia paid by him to ensure that the polices indeed continue to be in force.If the contractor fails to effect or keep in force or provide adequate cover in the insurance policies mentioned in the sub clause 46(1) or any other insurance he might be required to effectunder the contract, then in such cases, the employer may effect and keep in force any such insurance or further insurance and the cost and expenses incurred by him in this regard shall be deductible from payments due to the contractor or from the contractor's performance security.

CLAUSE 43: PREFERENCE TO MAKE IN INDIA

The provisions of revised 'Public Procurement (Preference to Make in India) Order 2017-Revision' issued by Department of Industrial Policy and Promotion under Ministry of Commerce and Industry vide letter no.-P45021/2/2017-PP (BE-II) as amended on 16.09.2020 shall be applicable to the bidding process and award of the contract shall be done accordingly.

Verification of Local Content

i. The bidder at the time of tender, bidding or solicitation shall be required to indicate percentage of local content and provide self-certification that the item offered meets the local content requirement of the tender. They shall also give details of the location(s) at with the local value addition is made.
ii. In cases of procurement for a value in excess of Rs 10 Crores, the bidder shall be required to provide a certificate from the statutory auditor or cost auditor of the company (in the case of companies) or from a practicing cost accountant or practicing chartered accountant (in respect of suppliers other than

companies) giving the percentage of local content.

CLAUSE- 44: RULE 144 (XI) IN GENERAL FINANCIAL RULES (GFRS) 2017

i. Any bidder from a country which shares a land border with India will be eligible to bid in this tender only if the bidder is registered with the Competent Authority.

ii. The bidder from a country which shares a land border with India" for the purpose of this Order means:-
   a) An entity incorporated, established or registered in such a country; or
   b) A subsidiary of an entity incorporated, established or registered in such a country; or
   c) An entity substantially controlled through entities incorporated, established or registered in such a country; or
   d) An entity whose beneficial owner is situated in such a country; or
   e) An Indian (or other) agent of such an entity; or
   f) A natural person who is a citizen of such a country; or
   g) A consortium or joint venture where any member of the consortium or joint venture falls under any of the above

iii. The beneficial owner for the purpose of clause above will be as under:
   1. In case of a company or Limited Liability Partnership, the beneficial owner is the natural person(s), who, whether acting alone or together, or through one or more juridical person, has a controlling ownership interest or who exercise control through other means.
   2. "Controlling ownership interest" means ownership of or entitlement to more than twenty- five per cent. Of shares or capital or profits of the company;
   3. "Control" shall include the right to appoint majority of the directors or to control the management or policy decisions including by virtue of their shareholding or management rights or shareholders agreements or voting agreements;
   4. In case of a partnership firm, the beneficial owner is the natural person(s) who, whether acting alone or together, or through one or more juridical person, has ownership of entitlement to more than fifteen percent of capital or profits of the partnership;
   5. In case of an unincorporated association or body of individuals, the beneficial owner is the natural person(s), who, whether acting alone of together, or through one or more juridical person, has ownership of or entitlement to more than fifteen percent of the property or capital or profit of such association or body of individuals;
   6. Where no natural person is identified under (1) or (2) or (3) above, the beneficial owner is the relevant natural person who holds the position of senior managing official;
   7. In case of a trust, the identification of beneficial owner(s) shall include identification of the author of the trust, the trustee, the beneficiaries with fifteen percent or more interest in the trust and any other natural person exercising ultimate effective control over the trust through a chain of control or ownership.

iv. An Agent is a person employed to do any act for another, or to represent another in dealings with third person. The successful bidder shall not be allowed to sub-contract works to any contractor from a country which shares a land border with India unless such contractor is registered with the Competent Authority.

CLAUSE 45: PAYMENT

1. Payment Schedule

The Payment Schedule includes a schedule setting out each Milestone Event to be achievedin a month for the Works.

2. Contractor's Application for Payment

From the date of issue of the Notice to Proceed, on the 5th (fifth) Business Day of any month,the Contractor may submit a Request for Payment, to WAPCOS Representative in respect of the preceding month.

Within each Request for Payment the Contractor shall show separately:

(i) the amounts which the Contractor claims to be payable as the cost of the Works completed during that month; and

(ii) the cumulative amount of all prior payments made by WAPCOS; and

(iii) Any amounts to which the Contractor considers are due and payable to it inaccordance with the provisions of the Contract.

3. The Contractor's Request for Payment shall:

(i) be prepared on forms in the form and in a number advised by WAPCOS Representative; and

(ii) contain confirmation of the relevant Milestone Events which, in the opinion of the Contractor have been achieved in that month which applies to each such MilestoneEvent; and

(iii) be accompanied by:

- (a) Copy of relevant records of measurement of works, jointly taken and signed by both the parties;
- (b) A status report describing in such detail as may reasonably request, the percentage of any uncompleted Milestone Event for the month in question and the work to be undertaken by the Contractor prior to the next Request for Payment;
- (c) Certification by PMC/ WAPCOS Representative confirming that the Milestone Events referred to in the Request for Payment have been achieved.
- (d) Confirmation by the Contractor of any amounts due and owing from the Contractor to WAPCOS pursuant to the Contract;
- (e) The Contractor's certification that the quality of all completed Works accords with the requirements of the Contract;
- (f) The Contractor's certification that each obligation, item of cost or expense mentioned in that Request for Payment has not been the basis of any previous payment.
- (g) The Contractor's certification that it has reviewed all financial and budget data contained in the Request for Payment;
- (h) The Contractor's certification that the quality of all completed Works accords with the requirements of the Contract;
- (i) The Contractor's certification that each obligation, item of cost or expense mentioned in that Request for Payment has not been the basis of any previous payment; and
- (j) The Contractor's certification that each Subcontractor who performed part of theWorks which was included in the immediately preceding Certificates of Payment was paid all amounts then due to it for such Works
- (k) The Contractor providing evidence of the validity of the Contractor’s Insurances.

4. Certificates of Payment

Within [21 (Twenty-One)] Business Days of receipt of the Contractor's Request for Payment under Clause 48(2) [Contractor's Application for Payment], WAPCOS & its Representative shall review such request and, shall issue to the Contractor, a Certificate of Payment certifying what amounts WAPCOS shall pay. Each Certificate of Payment shall be for an amount which in the opinion of WAPCOS, is the basis of the Request for Payment and pursuant to the Contract, is properly due to the Contractor (the “Gross Certifiable Amount”) less (i) the cumulative amounts of payments previously certified as due to the Contractor, (ii) any deduction on account of recovery of Advance Payment, and (iii) Security Deposit.

In the event that the Contractor fails to achieve any Milestone Event specified in the Payment Schedule, the Contractor shall not be entitled to the payment value attributable to that Milestone Event until the relevant Milestone Event has been achieved. When the relevant Milestone Event is achieved, the

Contractor may include the payment value attributable to the Milestone Event in the next Request for Payment.

No sum shall be included in the Certificate of Payment in respect of Materials yet to be incorporated into the Permanent Works unless the WAPCOS is satisfied that:

(i) such Materials have been properly acquired and properly and not prematurely delivered to the Project Site;

(ii) such Materials have been properly stored on the Project Site and fully protected against loss, damage or deterioration;

(iii) the Contractor's records of the requisitions, orders, receipts and use of any Materials are kept in a form approved by the WAPCOS, and such records are available for inspection by the WAPCOS; and

(iv) The Contractor has submitted a proper statement of the cost of acquiring the Materials together with such documents as may be required for evidencing such cost.

Without prejudice to any other rights of WAPCOS to withhold payment to the Contractor, WAPCOS/ PMC Representative may withhold from any payment due to the Contractor such amount as WAPCOS/ PMC Representative deems reasonably necessary or appropriate:

(i) if in the opinion of the WAPCOS/ PMC Representative the progress of the Works at the time of the Request for Payment is behind the progress of the Works as set out in the Programme; and/or

(ii) to protect it from any losses, expenses, costs or liability because of any one or more of the following reasons:

(a) defects and deficiencies in any Works, whether or not payment has been made;

(b) unsatisfactory performance of the Contract;

(c) the filing of third party claims relating to the Works or any of its commitmentparts for which the Contractor is liable;

(d) the Contractor's failure to make payments to Subcontractors;

(e) failure by the Contractor to provide or procure replacement Performance Security in accordance with the Contract;

(f) failure by the Contract to provide evidence of insurance coverage in accordance with the Contract;

(g) reasonable evidence that Completion will not occur by the Time for Completion;

(h) any overpayments made by WAPCOS with respect to a previous payment;

(i) failure by the Contractor to submit a properly updated monthly Programme; and

(j) failure by the Contractor to provide satisfactory evidence that the costs of all labour and Materials and other obligations arising out of the Contract have been fully satisfied and discharged by the Contractor and/or to otherwise fail to submit adequate supporting documentation for any Request for Payment.

Any Provisional Sum Works shall only be executed in whole or part upon the WAPCOS's instruction. If the WAPCOS issues no suchinstruction, the Provisional Sum Works shall not form part of the Works and the Contractorshall not be entitled to payment for it. The Contractor shall be deemed to have allowed the necessary time and resources to enable design and Execution of the Provisional Sum Worksin so far as the scope and nature of the Provisional Sum Works was reasonably foreseeable.

The Contractor shall be entitled only to such amount in respect of the Provisional Sum Works as the WAPCOS determines in accordance with this Clause 48(3). The WAPCOS shall notify the Contractor of any such determination.The WAPCOS Representative shall have the authority to issue instructions to the Contractor for every Provisional Sum Works for which the Contractor shall be entitled to a part of the Provisional Sum as determined by the WAPCOS.

The Contractor shall produce to the WAPCOS all quotations, vouchers, invoices, accounts or receipts in connection with the expenditure in respect of the Provisional Sum Works, except where the Provisional Sum Works is valued in accordance with the item wise rates quoted by the Contractor in its bid submitted to the Employer.

In respect of every Provisional Sum the WAPCOS Representative shall have authority to issue instructions for the execution of work or for the supply of goods, materials, Plant Sums or services by the Contractor, in which case the Contractor shall be entitled to an amount equal to the value thereof determined in accordance with Clause 48(3).

5. Payment

The payment to the contractor shall be made on back to back basis, i.e., if the payment from the client / Principal Employer has been received by WAPCOS, only in that case WAPCOS shall be releasing the payment to the contractor, which shall be released within 45 (Forty-Five) days of certification and approval of the invoices **as per Schedule of Payments** defined in RFP Document.

SECTION V - SPECIAL CONDITIONS OF CONTRACT (SCC)

The Special Condition of Contract (SCC) shall be followed by the Contractor in addition to the General Condition of Contract (GCC) of tender document. The following General Condition of Contract of this tender are modified/added as detailed below. In case of any discrepancy between GCC and SCC, the SCC will succeed over GCC.

1.0 Definitions - Modifications to GCC

GCC Ref.	Parameter	SCC Value
2(ix)	Market Rate - overhead and profit %	15% (Fifteen Percent) on cost of materials and labour
2(x)	Schedule of Rates	Plinth Area Rates-2025 with up-to- date correction slips and Cost Index, Delhi Schedule of Rates2023 (Civil) with up-to-date correction slips and Cost Index, Delhi Schedule of Rates-2025 (E&M) with up-to-date correction slips and Cost Index CPWD DSR for Horticulture/Landscaping Works

2.0 Standard SCC Clause Table

GCC Clause	Subject	SCC Value / Modification
Clause 1	Performance Security deadline	**a)** Within 21 (Twenty one) days of receipt of the Letter of Award, but not later than the date of the signing of the Agreement, the successful bidder shall deliver to the Employer a Performance Security in any of the forms given below for an amount equivalent to **5% of the Tendered Value:** • a Bank Guarantee issued by a Scheduled Commercial Bank approved by Reserve Bank of India (RBI) as per Annexure-I of Bid document; or • a deposit receipt of a Scheduled Commercial Bank approved by Reserve Bank of India (RBI) in favour of WAPCOS Limited payable at Delhi/ Gurgaon. b) The bidder quoting below Minus (-) 10% of the estimated cost put to tender shall submit the additional performance guarantee of amount equal to the percentage of quoted amount by which the bidder has quoted below -10% of the estimated cost. For example: if the bidder quotes -10% of the estimated cost, then no additional performance guarantee is required. If the bidder quotes -11% of the estimated cost, then the bidder has to submit additional performance guarantee equal to 1% of the quoted amount. Similarly, if the bidder quotes -12% of the estimated cost, then the bidder has to submit additional performance guarantee equal to 2% of the quoted amount and so on. The validity of the Additional Performance Security shall be same as the original performance Security. The Additional Performance Security may be submitted in the same format of Performance Security or this additional amount may be added to the Performance Security.

		The conditions for Additional Performance Security shall be same as are for 5% Performance Security mentioned at Clause 1 in Section of General Condition of Contract. The confirmation of the Bank Guarantee shall be sought from the issuing bank through Structured Financial Messaging System (SFMS), from our banker Indian Overseas Bank, NHB, Gurugram, Branch Code: 1935, IFSC code: IOBA0001935 and Beneficiary as WAPCOS Limited. This shall also be applicable in respect of confirmation of any extension of the Bank Guarantee as and when required.
Clause 2	LD rate	0.50% of Tendered Value per week of delay computed on daily basis. The milestones and the payment to be withheld is mentioned in the table of milestones below.

Table of Milestones

S. No.	Description of Mile stone (For Guidance Purpose only)	Period of completion (From date of start) T is start of work	Amount to be withheld in case of Non-achievement of mile stone (% of Tendered Amount of the Building/ Part of work)
1	a) Appointment of Consultants for preparation of drawings. b) Conducting detailed Site Survey and Soil Investigation. c) Obtaining Mix Designs for concrete. d) Identifying sources and obtaining approval for samples of Masanory blocks and other bulk construction materials. e) Completion of all designs & drawings, including proof-checked structural drawings for all buildings, allied works & services as per the scope of work. f) Submission of proof-checked structural drawings for obtaining the approval of the Engineer in Charge. g) Submission of MEP GA Drawings. h) Submission of BOQs for all buildings, including services and development works. i) All Drawings shall be submitted on BIM Model. j) Submission of drawings and shifting of various services.	T+3 Months	0.05% of the total tendered amount

	k) Obtaining any other permission/ local body approval required to commence the works. l) Completion of Office setup, Labour Hutments, Field Laboratory, and mobilization of T & P and Manpower.		
2	Completion of 25% of Total work in Financial Terms.	T+ 40% of total Duration of project	1% of the total tendered amount subject to release.
3	Completion of 50% of Total work at in Financial Terms	T+60% of total Duration of project	1% of the total tendered amount subject to release.
4	Completion of 75% of Total work in Financial Terms	T+ 75% of total Duration of project	1% of the total tendered amount subject to release.
5	Completion of 90% of Total work in Financial Terms	T+ 90% of total Duration of project	1% of the total tendered amount subject to release.
6	All Civil, Electrical & Mechanical and Horticulture work completed in all aspects in the building with services, clearances from all local bodies, completion certificates, occupancy certificate, O & M Manuals, Warranty & Guarantee Certificates etc. required to declare buildings authorized for occupation.	T+ 100% of the Total Duration of project	0.95% of the total tendered amount subject to release.

NOTE:

Time Period allowed for execution of Complete Work: - Overall 21 Months

Defect Liability Period – 2 Years

1. Withheld amount shall be released if and when subsequent milestones are achieved within respective time specified. However, in case milestones are not achieved by the contractor for the work, the amount shown against milestones shall be withheld.
2. Intending bidder may submit phasing of activities/milestones based on their resources and methodology at the time of bidding corresponding to physical milestones/stages indicated in the above table. These shall be formed part of the agreement after approval of the accepting authority, otherwise it would be assumed that agency agrees with the above-mentioned physical milestones.
3. Monthly recovery for delay in submission of the monthly progress report within specified period - not exceeding Rs 50,000 per month for each month default.
4. Schedule of rate of recovery for delay in submission of the modified programme in terms of delay days @ Rs 5,000/- per day

Clause 3	Cure period before Determination	7 days as per GCC; 28-day notice for sustained LD-default-based termination
Clause 5	Schedule of	The Site is available and is encumbrance free. The site can be considered has

<table>
<tr><td></td><td>handing over of site</td><td>handed over immediately on award of work.</td></tr>
<tr><td>Clause 5</td><td>Schedule of issue of Designs</td><td>
<table>
<tr><th>Part</th><th>Portion of Site</th><th>Description</th><th>Time Period for issue of design reckoned from date of receiptof tenders</th></tr>
<tr><td rowspan="2">Part A</td><td rowspan="2">Portion already included in NIT</td><td>Detailed Architectural drawing</td><td>Already included in this bid document.</td></tr>
<tr><td>Detailed Structural Drawings</td><td>Already included in this bid document. The contractor needs to verify the structural design. If the contractor wishes to revise the design and / or technology of construction, he needs to submit the proposal to WAPCOS for approval. In that case the contractor needs to prepare and get the structural drawings vetted by IIT Delhi or any other IIT at his own cost.</td></tr>
<tr><td>Part B-1</td><td>Any other Architectural Designs</td><td>Architectural designs and GFC drawings</td><td>Within the scope of EPC Contractor and provide the duly proof checked to Engineer-in-charge. The drawings should be approved by Engineer-in-charge after review of PMC & architect.</td></tr>
<tr><td>Part B-2</td><td>Portions of Structural Designs to be issued</td><td>All structural designs and GFC drawings</td><td>Within the Scope of EPC contractor and provide the vetted drawings by IIT Delhi or any other IIT. The structural drawings should be approved by the Engineer-in-charge after review of PMC & Architect including revisions/ corrections if any before commencement of activity.</td></tr>
<tr><td>Part B-3</td><td>Portions of E&M Design to be issued</td><td>All E & M designs and GFC drawings</td><td>Within the Scope of EPC contractor and provide the duly proof checked by the third party to the Engineer-in-charge. The MEP drawings should be approved by the Engineer-in-charge after review of PMC & Architect including revisions/ corrections if any before commencement of activity.</td></tr>
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<tr><td></td><td></td><td></td></tr>
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<table>
<tr><td>Clause 5</td><td>Schedule of rate of recovery for delay in submission of the modified program in terms of delay days</td><td>
<table>
<tr><td>Schedule of rate of recovery for delay in submission of the modified program in terms of delay days</td><td>Rs. 5,000/- per day</td></tr>
<tr><td>Authority to decide:</td><td></td></tr>
<tr><td>(i) Extension of time</td><td>Competent Authority in WAPCOS Limited</td></tr>
<tr><td>(ii) Rescheduling of milestones</td><td>Competent Authority in WAPCOS Limited</td></tr>
<tr><td>(iii) Shifting of date of start in case of delay in handing over of site</td><td>Competent Authority in WAPCOS Limited</td></tr>
</table>
</td></tr>
<tr><td>Clause 7</td><td>Minimum RA Bill value</td><td>Rs. 2.0 Crore (Rupees Two Crores only)</td></tr>
<tr><td>Clause 7</td><td>Geo-tagged photographs</td><td>Mandatory with each RA bill - GPS-coordinates visible, sufficient angles to illustrate progress</td></tr>
<tr><td>Clause 7A</td><td>No RA bill shall be paid till submission of EPFO, ESIC and BOCW Welfare Board</td><td>Yes</td></tr>
<tr><td>Clause 10A</td><td>List of minimum testing equipment to be provided by the contractor at site lab will be as below and as per direction of Engineer-in-Charge.</td><td>
<table>
<tr><th>1</th><th>STANDARD SIEVES (INDIAN STANDARD)</th><th>Nos.</th></tr>
<tr><td>a)</td><td>Set of sieves 450 mm internal dia (GI sheet frames) of sizes (100 mm, 80mm, 63mm, 50mm, 40 mm, 25 mm, 20 mm, 12.5 mm, 10.0 mm, 6.3 mm, 1.75 mm complete with lid and pan)</td><td>2 sets</td></tr>
<tr><td>b)</td><td>Set of fine sieves 200 mm internal dia (brass frame) consisting of (2.36 mm, 1.18 mm, 600 mic, 425 microns, 300 mic, 212 microns, 150 mic, 90 microns, 75 mic with lid and pan)</td><td>2 sets</td></tr>
<tr><td>c)</td><td>Motorised sieve shaker for the above sieves</td><td>3 nos.</td></tr>
<tr><td>2</td><td>Compression Testing Machine with Electricity cum manually operated</td><td>2 nos.</td></tr>
<tr><td>3</td><td>Slump test apparatus complete</td><td>3 nos.</td></tr>
<tr><td>4</td><td>Concrete cube moulds 15x15x15cm</td><td>50 nos.</td></tr>
<tr><td>5</td><td>Pruning Rods 2 kg weight length 40 cm and ramming face 25 mm2</td><td>3 nos.</td></tr>
<tr><td>6</td><td>Ultrasonic Test Equipment (Procedure as per IS 516 Part 5))</td><td>2 nos.</td></tr>
<tr><td>6a</td><td>Rebound Hammer</td><td>02 nos.</td></tr>
<tr><td>7</td><td>Mortar Cube Moulds 7.07x7.07x7.07 cm</td><td>20 nos.</td></tr>
<tr><td>8</td><td>Standard Sand Grade I,II, III</td><td>100kg each</td></tr>
</table>
</td></tr>
</table>

9	Mortar Cube vibrator	1 no.
10	Vicate needle apparatus	2 nos.
11	Blaine's Apparatus	1 no.
12	Weighing platform capacity 100 kg (Digital)	1 no.
13	Weighing scale capacity 10 kg (Digital, least count 1 gram)	2 nos.
14	Hot air oven (temp range 50C to 300C, sensitivity 1 degree)	2 nos.
15	Enamel Trays	
a)	300 x 250 x 40 mm	4 nos.
b)	Circular plates of 250 mm dia	4 nos.
16	Hammer 1lb and 2 lb	2 nos. each
17	Wooden Hammer	2 nos.
18	Measuring tape 3 and 5 metre	5 nos. each
19	Depth gauge 20cm	1 no.
20	Steel Foot Plate	5 nos.
21	Vernier Caliper (Digital)	3 nos.
22	Screw gauge	2 nos.
23	Digital PH meter least count 0.01	2 nos.
24	Digital Micrometer least count. 0.01mm	2 nos.
25	Digital paint thickness meter for steel 500 microns	2 nos.
26	Distance Measuring Laser Apparatus	2 nos.
27	Measuring cylinder TPX or Poly propylene capacity 100 ml, 250 ml, 500 ml, 1000 ml	4 nos. each
28	Pyrex, corning or Borosil beakers with cover capacity 500 ml, 200 ml, 50 ml	3 nos. each
29	Thermometers 1-150 degree centigrade	5 nos.
30	Moisture Meter	1 no.
31	Dial Gauge, 25mm travel – 0.01 mm/division	2 nos.
32	Load frame – 5 tonnes capacity, electrically operated with speed control	1 no.
33	Aggregate impact test apparatus as per IS 2386-Part IV-1963	1 no.
34	Compaction apparatus (Proctor) as per IS 2720-PartVII -1974	1 no.
35	Modified ASHO compaction apparatus as per IS 2720 –Part-III-1974	1 no.
36	Sand pouring cylinder with control funnel and tube complete as per IS 2720- Part XXVIII-1974	1 no.
37	Penetrometer with automatic time controller and with adjustable weight accessories and needles as per IS 1203-1958	1 no.
38	Distant reading thermometers	1 no.
39	Any other equipment for site tests as outlined in BIS codes and as directed by the Engineer-in-Charge.	
40	Tongue Tester	2 Nos
41	Megger	2 Nos
42	Earth Tester	2 Nos

<table>
<tr><td></td><td></td><td>
<table>
<tr><td>43</td><td>Ladder of different size</td><td>1 Lot</td></tr>
<tr><td>44</td><td>Multimeter</td><td>2 Nos</td></tr>
<tr><td>45</td><td>Spanner Set</td><td>1 Set</td></tr>
<tr><td>46</td><td>Crimping Tools</td><td>2Nos</td></tr>
<tr><td>47</td><td>Chase cutting Machine</td><td>4 Nos</td></tr>
<tr><td>48</td><td>Any other machine/tool required for completion of work as per direction of Engineer-In-Charge</td><td>As per actual requirement.</td></tr>
</table>
</td></tr>
<tr><td>Clause 9</td><td></td><td>Add the following at the end of Clause 9: “The bill in relation to the work completed by the Agency against the Schedule of Quantities shall be provisionally finalized as per the aforesaid provisions. The final bill relating to the entire work under the agreement shall be prepared after the completion of construction work covered by the agreement in accordance with the aforesaid provisions."</td></tr>
<tr><td>Clause 10B</td><td>Mobilisation Advance</td><td>10% of Tendered Value in 2 equal instalments of 5% each; BG for 110% of advance mandatory</td></tr>
<tr><td>Clause 10B</td><td>MA Interest rate</td><td>10% per annum simple interest</td></tr>
<tr><td>Clause 10B</td><td>MA Recovery start</td><td>Recovery of Secured Advance:
Recovery shall be made by the deduction from the contractor’s bills commencing after first 10% of the gross value of the work is executed and paid, on pro-rata percentage basis to the gross value of the work billed beyond 10% in such a way that the entire advance is recovered by the time 80% of the gross value of the contract is executed and paid.</td></tr>
<tr><td>Clause 10CC</td><td>Price escalation</td><td>Following applicable percentage / Coefficients components of materials & labour for various categories of works are indicated below:
<table>
<tr><th>S. No.</th><th>Relevant component of Material /Labour for price escalation</th><th>Percentage of total value of work</th></tr>
<tr><td>1</td><td>Component of Cement.</td><td>15%</td></tr>
<tr><td>2</td><td>Component of Labour</td><td>25%</td></tr>
<tr><td>3</td><td>Civil Component of other Construction Materials</td><td>22%</td></tr>
<tr><td>4</td><td>Electrical and Mechanical (E&M) Component of Construction Materials</td><td>18%</td></tr>
<tr><td>5</td><td>Component of POL (Diesel)</td><td>NIL</td></tr>
<tr><td>6</td><td>Reinforcement steel bars/TMT bars/structural steels (including strands and cables).</td><td>20</td></tr>
<tr><td>7</td><td>Component of Bitumen</td><td>NIL</td></tr>
<tr><td></td><td>Total</td><td>100%</td></tr>
</table>
</td></tr>
<tr><td>Clause 11</td><td>Specifications to be followed for execution of work</td><td>(1) Technical specifications (Particular Specifications) included in this Bid document, Latest version of Energy Conservation Building Code (ECBC), NBC-2016 and Latest version of all relevant BIS codes of practice modified and corrected up to the last date of submission of Bids.
(2) CPWD Specifications 2019, Volume-I and II and DPAR-2025 with correction</td></tr>
</table>

<table>
<tr><td></td><td></td><td>slips upto last date of submission of tender and manufacturer's specification.
(3) CPWD General Specification: For electrical Works with correction slips up to last date of submission of tender.
a. Part I Internal 2013 with correction slips up to last date of submission of tender.
b. Part II (External) 1994
c. Part III – Lifts & Escalators) – 2003
d. Part IV (Sub Station) 2013
e. Part V (Wet Riser & Sprinkler system) 2020
f. Part VI Fire Detection and Alarm System 2018
g. Heating, Ventilation & Air Conditioning (HVAC)– 2017
(4) CPWD Handbook on Safety, Health and Environment
(5) CPWD Manual on Accessible Built Environment 2019.</td></tr>
<tr><td></td><td>(ii) Building Information Modelling is applicable.</td><td>Yes
Since the start of pre-construction activities contractor has to deploy Building Information Model (BIM) professional having knowledge of using Building Information Model (BIM) of minimum LOD 400. All the drawings shall be modelled on BIM with atleast LOD 400.</td></tr>
<tr><td>Clause 12</td><td>Deviation Limit beyond which clauses 12.2 shall apply for all types of works</td><td>In case there is any change in scope as defined in the contract, the contractor shall carry out the changes as per direction of Engineer in Charge and nothing extra shall be payable to the contractor on account of same if the additional cost of such work is up to 0.25% (zero decimal two five percent) of the accepted tendered amount and worked out as per sub-clause 12.3 below.

Variations/ deviations up to 0.25% (zero decimal two five percent) of the accepted tendered amount shall be deducted from overall variations/ deviations for making payment.</td></tr>
<tr><td></td><td>Deviation Limit beyond which clause 12.3 shall apply for all types of work</td><td>The limit of deviations/ Variations on account of changes i.e. alterations, omissions, additions or substitutions of any Building/ Services/ Works, change in Building area in the Scope of work shall be limited to 50% (Fifty percent).</td></tr>
<tr><td>Clause 17</td><td>DLP duration</td><td>24 months from issue of Taking Over Certificate by Principal Employer</td></tr>
<tr><td>Clause 18</td><td>List of machinery, tools & plants to be deployed by the contractor at site</td><td>
<table>
<tr><th>Sl. No.</th><th>Equipment</th><th>Numbers (Tentative)</th></tr>
<tr><td>1</td><td>Automatic batching Concrete Batch Plant fully Computerized (Capacity not less than 30 cum)</td><td>1</td></tr>
<tr><td>2</td><td>Fixed / Mobile Tower crane</td><td>4</td></tr>
<tr><td>3</td><td>Excavator cum loaders (JCB 3D model or equivalent).</td><td>3</td></tr>
<tr><td>4</td><td>Compressor machine minimum 200 cfm capacity.</td><td>2</td></tr>
<tr><td>5</td><td>DG set of minimum capacity 40 KVA n</td><td>3</td></tr>
<tr><td>6</td><td>Concrete Pumps</td><td>4</td></tr>
</table>
</td></tr>
</table>

7	Needle Vibrators	25
8	Plate Vibrators	3
9	Dumpers	6
10	Reinforcement bending machines	4
11	Reinforcement / Steel cutting machines	4
11(a)	Coupler threading machine	1
12	Power driven earth rammers (Soil compactors).	2
13	Real Time Kinematic (RTK) / Total station with distance meter	1
14	Tractor with trolley	3
15	Water tankers (minimum capacity 5000 litre)	4
16	Welding machines 400 Ampere	4
17	Screener for Coarse Sand and Fine Sand	8
18	Centrifugal Mono Block Water Pump suitable for minimum 60 m head	3
19	Transit Mixer	6
20	Concrete Mixer	6
21	Screed leveler	2
22	Good quality Camera for taking photographs and video recording of major activities for record purpose and for quality assurance.	2
23	Steel shuttering materials with necessary props	5000 sqm
24	Aluminium Shuttering with necessary props, (If required)	5000 Sqm
25	Double steel scaffolding and staging materials	5000 sqm
26	Road roller 8 to 10 tons	1
27	Vibratory roller	1
28	Drilling machine	5
29	Floor grinding/polishing machines	3
30	Granite cutting machine	4
31	Ceramic tile cutting machine	10
32	Granite polishing machine	4
33	Granite hand polishing machine	4
34	Concrete core cutting machine with required dia drill bits.	2
35	Any other machinery required for completion of the work as per decision of Engineer-in-Charge.	As per Actual requirement
Note: The above list is only indicative and not exhaustive. Any other machinery/equipment desired for required progress shall be arranged by the agency as per direction of Engineer-in-Charge		

Clause 19	ESI/EPF reimbursement	WAPCOS shall reimburse ESI/EPF to Contractor on actual proof of payment to beneficiary accounts - maximum 4% of Awarded Cost
Clause 19 C		Rs. 25,000/- each default Authority to decide penalty for each default: Engineer in charge of WAPCOS
Clause 19		Rs. 25,000/- each default

D		Authority to decide penalty for each default: Engineer in charge of WAPCOS
Clause 19 G		Rs. 25,000/- for each default. Rs. 50,000/- per day for continuous default. (Subject to a maximum of 5% of ECPT). Authority to decide penalty for each default: Engineer in charge of WAPCOS
Clause 19 K		Rs. 5,000/- per tradesman per day Authority to decide penalty for each default: Engineer in charge of WAPCOS

Clause 32

Requirement of technical representative(s) and recovery rate

S. No.	Designation	Department	Qualification	No.	Min. Experience	Rate of Recovery
A	**Core Team**					
1	Project Head	Team Leader	Degree in Civil Engineering	1	20 years	**1.50 Lacs Per Month**
2	Construction Manager	Civil Construction	Degree in Civil Engineering & Post Graduate in Construction Management	1	12 years	**1.00 Lacs Per Month**
3	MEP Manager	MEP	Degree in Electrical/ Mechanical Engineering	1	12 years	
4	Billing, Planning and Scheduling Manager	Billing & Planning	Degree in Civil Engineering with expertise in MS Projects/ Primavera	1	10 years	
B	**Design Team**					
5	BIM Modeller	Design	Expertise in BIM LOD 350	1	10 years	**1.00 Lacs per Month**
6	Structural Engineer	Design	Post Graduate in Structural Engineering	1	15 years	**Rs. 5000/- Per person per incident if fails to attend office whenever required.**
7	MEP Design Engineer- Plumbing & Fire-Fighting*	Design	Degree in Electrical/ Mechanical Engineering with Experience in Plumbing & Fire Fighting System Design	1	15 years	
8	MEP Design Engineer- Electrical*	Design	Degree in Electrical/ Mechanical Engineering with Experience in Electrical HT & LT System Design	1	15 years	
C	**Construction Team**					
9	Asst. Project Manager Civil	Civil Construction	Degree in Civil Engineering	1	8 years	**0.70 Lacs per Month**
10	Engineer Civil	Civil Construction	Degree or Diploma in Civil Engineering	2	5 years	**0.40 Lacs Per month**
11	Surveyor	Civil Construction	Similar Experience	1	7 years	
D	**MEP Team**					

12	Asst. Project Manager - Electrical*	MEP	Degree in Electrical Engineering	1	8 years	**0.70 Lacs per month**
13	Engineer MEP – Electrical*	MEP	Degree or Diploma in Electrical Engineering	1	5 years	**0.40 Lacs Per month**
E	**Quality Team**					
14	Lab Assistant	Quality	Diploma in Civil Engineering	1	7 years	**0.40 Lacs per Month**
15	Quality Engineer	Quality	Degree in Civil Engineering	1	10 years	
	Environment, Health, and Safety Team					
16	**Safety Engineer**	**EHS**	**OSHAS Certified.**	**1**	**7 years**	**0.40 Lacs per Month**

Note: * here means the staff highlighted shall be deployed as per the start of the specific activity. The EPC Contractor to submit a manpower deployment schedule in accordance with detailed Program Chart after award of work.

Note:

1) Sr. Project Manager/ Team Leader should not preferably be changed till the contract period is over & He / She should be deployed from the first day of the execution of contract.
2) The manpower proposed to be deployed on a full-time basis on site for proper and effective monitoring and shall be approved from WAPCOS/ PMC before deployment on site.
3) The above said manpower is minimum requirement for technical staff from EPC Contractor and shall not be limited to the same.
4) For any absenteeism of the aforesaid respective manpower during the execution of the contract period, the EPC Contractor to make sure the necessary alternative without any absenteeism. Any absenteeism more than a week shall be liable to penalize as per the recovery rate.
5) In case of Poor performance of any of the aforesaid manpower, action shall be taken by Authority Engineer as directed by WAPCOS.
6) Biometric attendance system to be installed by the contractor for Engineers as per the direction of Engineer-in-Charge.
7) Assistant Engineers retired from Government services that are holding Diploma will be treated at par with Graduate Engineers.
8) Diploma holder with minimum 10 year's relevant experience with a reputed construction company can be treated at par with Graduate Engineers for the purpose of such deployment subject to the condition that such diploma holders should not exceed 50% of requirement of degree engineers.

The contractor shall ensure that at least one deployed technical representative shall be trained in courses related to CPWD specifications, labour laws, safety rules etc. of duration not less than 5 working days either through National CPWD Academy (NCA) or National Institute of Construction Management and Research (NICMAR) or CIDC or any other similar reputed and recognized Institute managed or certified by State/Central Government. The training cost and other cost related to training shall be borne by the contractor. The Contractor shall ensure that at least one technical representative is trained within six months of start of work. The time period of six months can be relaxed by the Engineer-in-charge depending upon the frequency of training course organized by NCA. If the contractor fails to ensure that at least on technical representative is trained in the above-mentioned course till completion of

work or one year from start of work, whichever is earlier, then a non-refundable recovery of Rs. 50,000/- shall be made from the bill of the contractor. Decision of Engineer-in-charge in this regard shall be final and binding on the contractor.

Clause 38	Theoretical Consumption of materials	(i) (a) Schedule / statement for determining theoretical quantity of cement & bitumen on the basis of Delhi Schedule of Rates 2023 printed by C.P.W.D. with correction slips up to the last date of submission of bids.
		(ii) Variations permissible on theoretical quantities. a) Cement for works : 3% plus/minus b) Bitumen for all works : 2.5% plus only & nil on minus side c) Steel Reinforcement and structural steel sections for each diameter, Section and category: Nil d) All other materials : 2% plus/minus

3.0 Additional Conditions of Contract

1 Specifications & Order of preference

a) Except for the items, for which Particular Specifications are given or where it is specifically mentioned otherwise in the description of the items in the schedule of quantities, the work shall generally be carried out in accordance with the "CPWD Specifications 2019 Vol. I & II" with up-to-date correction slips, additional / Particular Specifications, Architectural / structural drawings and as per instructions of Engineer-in-Charge.

b) The several documents forming the tender are to be taken as mutually complementary to one another. Detailed drawings shall be followed in preference to small scale drawings and figured dimensions in preference to scaled dimensions.

c) If there is any difference or discrepancy between the description of items as given in the schedule of quantities, particular specifications for individual items of work (including special conditions) and I.S. Codes etc., the following order of preference shall be observed.

(i) The Detailed Scope of Work
(ii) Tender Drawings.
(iii) Particular Specifications, Special Conditions and Additional conditions, if any.
(iv) General conditions of contract
(v) CPWD Specifications.
(vi) Indian Standard Specifications of B.I.S., IGBC/ GRIHA Norms, ECBC & NBC Norms with latest circulars/upto date correction slips.
(vii) Manufacturers' specifications & as decided by Engineer-in-charge.
(viii) Sound Engineering practices.

In the event of any variation/ discrepancy in the drawings, specifications and tender documents etc. the decision of the Engineer-in-charge shall be final binding and conclusive on the contractor and in the case the contractor have any doubt and the same should be got clarified immediately from the Engineer-in-charge and no claim of the contractor shall be entertained thereafter. Moreover, the agency is not allowed to take benefit out of any clerical/ grammatical mistake in the standard clauses/Schedule of Quantities/Specifications etc. being used in the agreement

d) Any reference made to any Indian Standard Specifications, shall imply to the latest version of that standard, including such revisions / amendments as issued by the Bureau of Indian Standards up to last date of receipt of tenders. The Contractor shall keep at his own cost all such publications including relevant Indian Standard Codes applicable to the work at site.

2 Scope

a) The works to be governed by this contract shall cover delivery and transportation up to destination, safe custody at site, insurance, erection, testing and commissioning of the entire works.

b) The works to be undertaken by the contractor shall inter alia include the following:

- Preparation of detailed design and SHOP drawings and AS BUILT drawings wherever applicable using BIM Model LOD 400
- Obtaining of Statutory permissions wherever applicable and required.
- Pre-commissioning tests as per relevant standard specifications, code of practice, Acts and Rules wherever required.
- Warranty obligation for the equipment and/or fittings/fixtures supplied by the contractor.

c) Contractor shall provide all the shop drawings or layout drawings for all the coordinated services before starting any work or placing any order for any of the services etc. These shop drawings/layout drawings shall be got approved from Engineer-in-charge before implementation and this shall be binding on the contractor. The contractor shall submit material submittals along with material sample for approval of Engineer-in-charge prior to delivery of material at site.

d) All the hidden items such as water supply lines, drainage pipes, conduits, sewers etc. are to be properly tested as per the design conditions before covering and their measurements in computerized measurement book duly test checked shall be deposited with Engineer in charge or his authorized representative, prior to hiding these items.

3 Items/Materials to be used in Works:

a) The agency/contractor should use "Make-in-India' products as per the Govt. of India "Make in India" policy updated upto the last date of submission of bids. The agency should also consider the availability of spare parts/components for maintenance purposes while proposing any brand/manufacturer.

b) In case of non-availability of 'Make in India' brands then only the proposal for use of international brands is allowed with the prior approval of Engineer-in-Charge complying with all Government of India norms.

c) The contractor shall supply ISI marked item/material. In case ISI marked item/material is not available, First Quality item/material shall be accepted. The samples of the item/material shall in either case have to be got approved from Engineer-in-Charge before procurement by Contractor.

d) The agency shall submit at least three ISI marked or 1st Quality make/brand (in case ISI marked item/material is not available) along with the current rates (the difference in rates shall not be more than 10% of the average of three ISI marked or Ist Quality make/brand) and specifications for the approval of Engineer-in- charge before procurement.

e) The makes / brands / models of all the finishing items like tiles / sanitary fixtures / light fixtures etc. shall be finalized and approved by Engineer-in-charge with concurrence from the client. No such items shall be procured or used or installed without written approval from Engineer-in-charge.

f) The design of electrical equipments, wherever applicable, should be type tested by Central Power Research Institute (CPRI) / Electrical Research and Developments Associations (ERDA).

g) It will be contractor's responsibility to ensure timely submission of samples and relevant documents for approval of Engineer-in-Charge. Contractor will have to replace the defective and substandard materials at his own cost.The quality of work is of paramount importance. Contractor shall have to engage well experienced skilled labour and deploy modern T&P and other equipment to execute the work to provide the desired quality.

4 Deployment of Technical staff & skilled labour:

h) The quality of work is of paramount importance. Contractor shall have to engage well experienced skilled labour and deploy modern T&P and other equipment to execute the work to provide the desired quality.

The Contractor shall depute Site Engineer & skilled workers as required for the work. He shall submit organization chart along with details of Engineers and supervisory staff. It shall be ensured that all decision-making powers shall be available to the representatives of the contractor at site itself to avoid any likely delays on this account. The contractor shall also furnish list of persons for specialized works to be executed for various items of work. The Contractor shall identify and deploy key persons having qualifications and experience in the similar and other major works, as per the field of their expertise. If during the course of execution of work, the

Engineer-in-Charge is of the opinion that the deployed staff is not sufficient or not well experienced; the Contractor shall deploy more staff or better-experienced staff at site to complete the work with quality and in stipulated time limit. The Project Manager of the contractor along with all technical staff as mentioned in the clause 32 of the GCC, shall always be available at the site during execution of work.

i) The contractor shall deploy the resources at site to start the construction after clearance from the Employer of the project and subsequent written approval from WAPCOS/ PMC. No claim shall be entertained for idle labour, idle machinery, idle technical / non-technical staff, idle T&P if any, due to delay in start of the works.

j) Since the Buildings are to be constructed in Phase wise manner as per the availability of Campus and in view of the operational issues of the running campus, the contractor is expected to mobilize the resources for only the quantum of works for which the Notice of commencement is issued to the contractor. No claim for idle labour, idle machinery, idle technical / non-technical staff, idle T&P for part of scope for which the notice for commencement is not issued shall be accepted.

k) If any dispute/ hindrance may arise during construction due to any reason whatsoever, the contractor is not liable for any financial claim or damages due to such circumstances.

5 Removal of Machinery, Tools & Equipment:

Removal of machinery, tools & equipment shall be allowed to be moved away from the site only when, in written opinion of Engineer-in-Charge, the same are no longer required at site of work.

6 Soil conditions of site:

a) Contractor(s) shall study the preliminary soil investigation report for the site, which is a part of this document and satisfy himself about complete characteristics of soil and other parameters at site. **A detailed soil investigation shall be conducted by the contractor through a competent and expert soil consultant at each building location and submitted to the Engineer-in-charge before proceeding with the foundation design of buildings and roads.** No claim whatsoever on account of any discrepancy between the sub-surface strata conditions that may be actually encountered at the time of execution of the work and those given in soil report, in-accuracy or interpretation thereof shall be entertained from the Contractor under any circumstances. The ground water table is in variable condition and the information given in the report is only indicative and it may vary from time to time.

b) Tenderer may satisfy himself by conducting pre-soil tests if he so requires. However, an indicative soil investigation report is also uploaded with the tender for general guidance & awareness of the Bidders. This shall not absolve the responsibilities of the bidder to verify the soil properties through their own investigation before submission of the bids. Necessary permissions will be issued to all the agencies/prospective bidders who wish to conduct their own soil investigation before submission of their bid. The prospective bidders are also required to conduct detailed soil investigations through expert soil consultants for detection of any harmful chemicals for each land pocket (pertaining to each building proposed to be constructed) separately for carrying out structural design of each of the structures and also for taking required precautions to safeguard the structure against harmful chemical attacks and to ensure durability and longevity of the structures.

7 Site condition:

The tenderer shall acquaint himself with the site of work and see the approaches to the site. In case any approach from main road is required at site or existing approach is to be improved and maintained

for cartage of materials by the contractor, the same shall be provided, improved and maintained by the contractor at his own cost.

8 Precautionary measures:

a) Temporary barricading shall be provided at Site by the contractor at their own cost. The barricading physically define the boundaries of the plot for restricted entry to only those involved in the work and also to prevent any accident and also not causing any inconvenience to the traffic. The barricading panels shall be painted and "WAPCOS" mark should be made in suitable size, shapes and number as directed by Engineer-in-charge without any extra cost. It shall be dismantled and taken away by the contractor after completion of the work at his own cost with the permission of Engineer-in-charge.

b) Contractor shall take all precautionary measures to avoid any damage to adjoining property. All necessary arrangement shall be made at his own cost. The contractor shall take all precautions to prevent his workmen and employees from removing and damaging any Flora (plant/vegetation) from the campus/site.

c) The contractor shall take all precautions to avoid accidents by exhibiting necessary caution boards day and night, speed limit boards, red flags, red lights and providing barriers. He shall be responsible for all damages and accidents caused to work due to negligence on his part. No hindrances shall be caused to traffic, during the execution of the work. In case of any accident of the labourers/contractual staff, the entire responsibility will rest on the contractor and any compensation under such circumstances, if becomes payable, shall be entirely borne by the contractor.

d) The contractor, his authorized representative, workmen etc. shall strictly observe orders pertaining to fire precautions prevailing in the area.

e) The Contractor shall take all necessary precautions to prevent any nuisance or inconvenience to the owners, tenants or occupants of the adjacent properties and to the public in general. The Contractor shall take all care, as not to damage any other adjacent property or other services running adjacent to the plot. If any damage is done to property, the same shall be made good by the contractor at his own cost and to the entire satisfaction of the Engineer-in-Charge. The Contractor shall use such methodology and equipment for execution of the work, so as to cause minimum environmental pollution of any kind during construction, to have minimum construction time and minimum inconvenience to occupants and also to the occupants of the buildings on the adjacent plot and public in general, etc. He shall make good at his own cost and to the entire satisfaction of the Engineer in Charge any damage to roads, paths, cross drainage works or public or private property whatsoever caused, due to the execution of the work or by traffic brought thereon, by the Contractor. Failing to which the damage to property will be made good by the Engineer-in-charge at the risk and cost of the contractor. The risk and cost amount will be recovered from the next Running account bill of the contractor. Further, the contractor shall take all precautions to prevent any pollution of streams and waterways. All waste or superfluous materials shall be carted away by the Contractor, entirely to the satisfaction of the Engineer-in-Charge. Utmost care shall be taken to keep the noise level to the barest minimum so that no disturbance as far as possible is caused to the occupants / users of adjoining buildings.

f) No claim what so ever on account of site constraints mentioned above or any other site constraints not specifically stated here, shall be entertained from the Contractor. Therefore, the Contractors are advised to visit site and get first-hand information of site constraints. Accordingly, they should quote their tenders. Nothing extra shall be payable on this account.

9 General cleanliness of the site and Stacking & Storage of Materials:

a) The site of work shall be always kept clean in general strictly adhering to approved job layout and green building parameters. The Contractor shall take all care to prevent any water- logging at site. The waste water shall not be allowed to be collected at site. It may be directly pumped into the public drainage system with prior approval of the concerned authorities. For discharge into public drainage system, necessary permission shall be obtained from concerned authorities after paying the necessary charges, if any, directly to the authorities. The work shall be carried out in such a way that the area is kept clean and tidy. All the fees/charges in this regard shall be borne by the Contractor. Nothing extra shall be payable on this account.

b) The contractor shall take instructions from the Engineer-in-Charge regarding collection and stacking of materials at any place. No excavated earth or building rubbish shall be stacked on areas where other buildings, roads, compound wall, services, etc., are to be constructed.

c) For construction works which are likely to generate malba/rubbish, contractor shall dispose of malba, rubbish & other unserviceable materials and wastes at his own cost to the notified/specified dumping ground and under no circumstances these shall be stacked/dumped even temporarily, outside the construction premises.

d) The contractor shall construct suitable godowns, yard at the site of work for storing all other materials so as to be safe against damage by sun, rain, damages, fire, theft, etc., at his own cost and also employ necessary watch and ward establishment for the purpose at his cost.

10 Lab Equipment:

The contractor shall provide at his own cost suitable weighing, surveying and levelling and measuring arrangements as may be necessary at site for checking. All such equipment shall be got calibrated in advance from laboratory, approved by the Engineer-in-Charge. Nothing extra shall be payable on this account. A site laboratory with the minimum equipment as specified in the NIT shall be established, made functional and maintained within 90 days from the award of the work without any extra cost to the department.

11 Setting Out

a) The contractor shall establish, maintain and assume responsibility for grades, lines, levels and bench marks. He shall report any errors or inconsistencies regarding grades, lines, levels, dimensions to the Engineer-in-charge before commencing work. Commencement of work shall be regarded as the contractor's acceptance of such grades, lines, levels and dimensions and no claim shall be entertained at a later date for any errors found.

b) In order to set the alignment of buildings/foundations and to mark the same on the ground, the agency is to adopt "total station" surveying method. The agency is to engage a well versed and well experienced surveyor in "total station" survey. Nothing extra for this total station survey is payable.

If at any time, any error in the respect of setting out appears during the progress of the work, the contractor shall, at his own expense rectify such error if so required, to the satisfaction of the Engineer-in-Charge.

(i) Though the site levels are indicated in the drawings, the contractor shall ascertain himself and confirm the site levels with respect to GTS bench mark from the concerned authorities. The contractor shall protect and maintain temporary/ permanent benchmarks at the site of work throughout the execution of the work. These bench marks shall be got checked by the Engineer-in-Charge or his authorized representatives. The work at different stages shall be checked with

reference to bench marks maintained for the said purpose. Nothing extra shall be payable on this account.

(ii) The approval by the Engineer-in-Charge, of the setting out by the contractor, shall not relieve the contractor of any of his responsibilities and obligation to rectify the errors/defects, if any, which may be found at any stage during the progress of the work or after the completion of the work.

c) The contractor shall be entirely and exclusively responsible for the horizontal, vertical and other alignments, the level and correctness of every part of the work and shall rectify effectively any errors or imperfections therein. Such rectifications shall be carried out by the contractor at his own cost to the instructions and satisfaction of the Engineer-in-Charge.

d) The Contractor shall carry out survey of the work area, at his own cost, setting out the layout of building in consultation with the Engineer -in-Charge & proceed further. Any discrepancy between the architectural drawings and actual layout at site shall be brought to the notice of the Engineer -in-charge. It shall be responsibility of the Contractor to ensure correct setting out of alignment.

Total station survey instruments only shall be used for layout, fixing boundaries, and center lines, etc., along with the theodolites. Nothing extra shall be payable on this account.

e) Contractor shall provide permanent bench marks, flag tops and other reference points for the proper execution of work and these shall be preserved till the end of work. All such reference points shall be in relation to the levels and locations, given in the Architectural and plumbing drawings.

12 Temporary Water, Electricity & Telephone Connections:

a) The contractor shall make his own arrangements for water including boring of tube wells etc. if necessary and for electricity by obtaining electric connections and by providing diesel generators of adequate capacity if required and make necessary payments directly to the State Govt. departments concerned. Necessary approval shall be taken by the contractor from the ground water department for boring of tube wells. Nothing extra shall be paid on these accounts. Contractor shall get the water tested from laboratory approved by the Engineer-in-charge at regular interval as per the CPWD Specifications 2019. All expenses towards collection of samples, packing, transportation and testing charges etc. shall be borne by the contractor. The contractor shall obtain environmental and pollution clearance for the diesel generators. Nothing extra shall be paid on this account.

b) The Contractor shall arrange electricity at his own cost for testing of the various electrical installations as directed by Engineer-in-Charge and for the consumption by the contractor for executing the work. Also, all the water required for testing various electrical installations, fire pumps, wet riser / firefighting equipment, fire sprinklers etc. and also testing water supply, sanitary and drainage lines, water proofing of underground sump, overhead tanks, water proofing treatment etc. shall be arranged by the contractor at his own cost. Nothing extra shall be payable on this account.

c) Arrangement of temporary telephone connection, water and electricity required by Contractor, shall be made by him at his own cost and also necessary permissions shall be obtained by him directly from concerned authorities, under intimation to the Department. Also, all initial cost and running charges, and security deposit, if any, in this regard shall be borne by him. The Contractor shall abide by all the rules/ bye laws applicable in this regard and he shall be solely responsible for any penalty on account of violation of any of the rules / byelaws in this regard. Nothing extra shall be payable on this account.

d) The Contractor shall be responsible for maintenance and watch and ward of the complete installation and water / electricity meter and shall also be responsible for any pilferage, theft, damage, penalty etc. in this regard. The Contractor shall indemnify the Department against any claim arising out of pilferage, theft, damage, penalty, etc., whatsoever on this account. Security deposit for the work shall be released only after No Dues Certificates are obtained from the local Authorities from whom temporary electric/ water / telephone connection have been obtained by the Contractor. Nothing extra shall be payable on this account.

e) The Department shall in no way be responsible for either any delay in getting electric and/or water and/or telephone connections for carrying out the work or not getting connections at all. No claim of delay or any other kind, whatsoever, on this account shall be entertained from the Contractor. Also, contingency arrangement of stand-by water & electrical supply shall be made by the Contractor commencement and smooth progress of the work so that work does not suffer on account of power failure or disconnection or not getting connection at all. No claim of any kind whatsoever shall be entertained on this account from the Contractor. Nothing extra shall be payable on this account.

13 Supply of Water for Construction Purpose

Contractor shall make his own arrangement of water required for the work, at his own cost, subject to the approval of the Engineer-in-Charge. However, the Contractor will be permitted to drill bore well/s at site and the Contractor shall pay all charges to local bodies / authorities / royalty if any and obtain statutory approvals, geological survey provide pump, pipeline, casing with all accessories required for functioning of the bore well. The water should be tested in an approved laboratory and should be permitted to use in work if found suitable for construction. However, Contractor shall make alternate arrangements in case the water is not found fit for construction. After completion of work the Contractor will handover complete bore well/s with pump/s and accessories to the Employer at no cost. The water storage tanks should be leak proof and wastage and misuse of water is strictly prohibited, Contamination and pollution of water to be strictly avoided. Construction water should not be used for drinking or for domestic purpose.

14 Monthly Bill of Electricity & Water Department

The Contractor shall make his own arrangement for the Temporary connection for Supply of Electricity & Water for Construction Purpose as required at his own cost and pay their monthly bill. After getting permanent connection during final stage of construction for Principal Employer/ Project, contractor shall pay monthly billing charges of Permanent electric and water connection (taken by contractor on behalf of Principal Employer, to run project) up to the successful handing over of the project to Principal Employer, from the date of installation of connections. These charges will be borne by the contractor. Hence contractor shall quote the cost in tender accordingly

15 Architectural and structural Drawings:

a) The architectural drawings are uploaded in the web along with NIT for reference to the bidder and also made available in the office of the PMC office in WAPCOS. The detailed architectural drawings, detailed 3D views, Elevations, Sections drawings shall be provided by the WAPCOS through the Architect appointed by them within 15 days of issue of Letter of Commencement. The Detailed structural design and drawings, services design and drawings etc., shall be got prepared and submitted to the concerned Engineer-in-charge, after duly proof checked from Third Party as per tender conditions. It is the duty of the contractor to submit all the drawings reasonably well in advance wherever approvals are to be accorded by the department and no hindrance shall be allowed on this account.

b) The work shall be carried out in accordance with the concept architectural drawings uploaded with the tender by the Engineer-in-Charge and detailed Architectural drawings provided by and the structural drawings, Fabrication drawings, and services drawings, to be got prepared by the contractor as per Scope of Work from an expert Designers and submitted to the Engineer-in-charge. All the third-party proof checked drawings shall also be got NOC issued from Engineer-in-charge, by the contractor before proceeding with the execution of work.

Before the commencement of any item of work, the contractor shall correlate all the relevant architectural and structural drawings issued for the work, nomenclature of items, specifications etc. and satisfy himself that the information available therefrom is complete and unambiguous. The figures & the written dimensions of the drawing shall supersede the measurement by scale. The discrepancy, if any, shall be brought to the notice of the Engineer-in-Charge for immediate decision before execution of the work.

The contractor alone shall be responsible for any loss or damage occurring by the commencement of work on the basis of any erroneous and/ or incomplete information and no claim, whatsoever shall be entertained on this account. The delay caused on account of non-timely action by the contractor in resolution of the differences whatsoever shall not be considered as valid ground for extension of time unless otherwise accepted by the Engineer-in-charge.

c) The information and site data shown in the drawings and mentioned herein and also elsewhere in the tender documents are being furnished for general information and guidance only. The department shall not bear responsibility for lack of such knowledge and also the consequences thereof. The Engineer-in-charge in no case shall be held responsible for the accuracy thereof or any interpretation/ or conclusions drawn there from by the contractor.

16 Scaffolding & Staging:

a) Wherever required for the execution of work, all the scaffolding shall be provided and suitably fixed, by the contractor. The scaffolding shall be provided strictly with steel double scaffolding system, suitably braced for stability, with all the accessories, gangways, etc. with adjustable suitable working platforms to access the areas with ease for working and inspection. Single scaffolding system is strictly prohibited and shall invite necessary action. It shall be designed to take all incidental loads. It should cater to the safety features for workmen. Nothing extra shall be payable on this account. It shall be ensured that no damage is caused to any structure due to the scaffolding.

b) The contractor should submit the shop drawings of staging and shuttering for approval of Engineer-in-Charge before actually commencing the execution of work under the item. Nothing extra shall be payable on this account.

c) Contractor shall make necessary arrangements required for staging/scaffolding for execution of Residential & Non-Residential buildings with independent staging of required height including designing of staging where ever required and getting it proof checked by Govt. institute to ensure safety during construction. Nothing extra shall be payable for staging or its design / proof checking other than those provisions taken in the scope.

17 Work at Heights

a) During construction of buildings/towers safety net (horizontal and vertical) shall be used by Agency to check/control falling of any object. The Agency/vendor shall also take the other safety measures used during construction, for e.g. Personal Protective Equipment (PPEs), safety during working at heights etc.

b) The Agency shall provide proper scaffolding and working platforms with handrails to work at higher elevations and Tools and loose material should not be left on the scaffolding from where they are likely to fall. Persons should use safety belts while working near open edge where it is not possible to provide hand rails.
c) Things should not be thrown from heights and should be brought down or taken up with the help of ropes. While work is being carried on at higher elevations, warning notices should be posted below or barricade the area so as to draw the attention of persons and prevent them from coming under the falling objects.
d) Defective scaffoldings, damaged ladders, insufficient working platforms etc. shall not be permitted. Wherever necessary, light weight mobile tower scaffolds or hydraulic platforms should be used.
e) Proper access should be available to the work spot. Nobody should jump over open area between equipment, pipes and rails etc. from where they may slip. Walking over beams, narrow pipes etc. should be prohibited.
f) The area from where the materials are pulled up with ropes etc. should have hand railings and the person should keep firm footing. They should not lean over the handrails and should use safety belts to protect themselves from fall due to body imbalance.
g) The Agency should reduce the hazards associated with falls first through engineering controls and Have a formal fall protection program in accordance with Factories Act requirements. Agency should Institute personal fall arrest systems, administrative controls and training when engineering controls are not feasible.
h) The Agency shall have the necessary fall protection equipment to safely perform the job and properly train workers in the use of fall protection equipment and supervisors (or competent personnel) shall ensure the use of fall protection equipment as required. Agency shall obtain work permit from the Consultant prior to starting of activities requiring fall protection.
i) Should Use powered access safely and Protect holes and leading edges, e.g. with hand rails and toe boards
j) The construction waste from the height should be transferred through closed chutes
k) All other measures to be taken for the safety at project shall be ensured by the Agency.
l) It shall be deemed that rates quoted by the Agency are inclusive of all the expenditures incurred in the safety procedures. No extra payment on this account shall be payable to Agency.

18 Sanitation and Hygiene Measures

a) In order to provide adequate sanitary conditions for all personnel at site, the following provisions as a part of the temporary facilities to be provided by the Agency:
b) Provision for an adequate supply of potable water
c) Provision for toilets and hand wash basins
d) Garbage disposal and regular collection
e) Proper drainage and sewer disposal
f) Other special hygienic operations viz. Fumigation, pest controls etc.
g) Worker's Rest Space:
h) Smoking hut
i) Sunshade and/or site canteen
j) Smoking on site is not allowed, “No smoking” signs shall be displayed at prominent location including stores/ storage places.

19 Unforeseeable Difficulties

Except as otherwise specifically stated elsewhere in the Contract:

a) The Agency shall be deemed to have obtained all necessary information as to risks, contingencies and other circumstances which may influence or affect the Works;
b) By signing the Contract, the Agency accepts total responsibility for having foreseen all difficulties and costs of successfully completing the Works; and

c) The Contract Price shall not be adjusted to take account of any unforeseen difficulties or costs.
d) WAPCOS shall not provide any material either on chargeable or on free issue basis to the Agency for execution of the project.

20 Safety, Health and Environment (SHE)

a) The Agency shall take all reasonable steps to protect the environment on and off the Site and to avoid damage or nuisance to persons or to property of the public or other resulting from pollution, noise or other causes arising as a consequence of his methods of operation. The Agency shall be required to follow all the rules/norms of National Green Tribunal applicable to this work.
b) During continuance of the contract, the Agency and his sub-agencies shall at all times, abide by all existing enactments on environmental protection and rules made there under, regulations, notifications and bye-laws of the State or Central Government, or local authorities and any other law, by-law, regulations that may be passed or notification that may be issued in this respect in future by the State or Central Government or the local authority. However, Salient features of some of the major laws that are applicable are given below.
c) Water Pollution is to be prevented as per The Water (prevention and Control of Pollution) Act, 1974 which provides for the prevention and control of water pollution and the maintaining and restoring of wholesomeness of water. 'Pollution' means such contamination of water or such alteration of the physical, chemical or biological properties of water or such discharge of any sewage or trade effluent or of any other liquid, gaseous or solid substance into water (whether directly or indirectly) as may, or is likely to, create a nuisance or render such water harmful or injurious to public health or safety, or to domestic, commercial, industrial, agricultural or other legitimate uses, or to the life and health or animals or plants or of aquatic organisms.
d) Air Pollution is to be prevented as per The Air (prevention and Control of Pollution) Act, 1981 which provides for prevention, control and abatement of air pollution. 'Air Pollution' means the presence in the atmosphere of any 'air pollutant', which means any solid, liquid or gaseous substance (including noise) present in the atmosphere in such concentration as may be or tend to be injurious to human beings or other living creatures or plants or property or environment.
e) Environment is to be protected as per The Environment (Protection) Act, 1986 which provides for the protection and improvement of environment and for matters connected therewith, and the prevention of hazards to human beings, other living creatures, plants and property. 'Environment' includes water, air and land and the inter-relationship which exists among and between water, air and land, and human being, other living creatures, plants, micro-organism and property.
f) The public Liability Insurance Act, 1991: This provides for public liability insurance for the purpose of providing immediate relief to the persons affected by accident occurring while handling hazardous substances and for matters connected herewith or incidental thereto. Hazardous substance means any substance or preparation which is defined as hazardous substance under the Environment (Protection) Act 1986, and exceeding such quantity as may be specified by notification by the Central Government.

21 Co-operation & Co-ordination with other agencies:

a) The Contractor shall conduct his work so as not to interfere with or hinder the progress of the work being performed by other Contractors or by the Engineer-in- Charge. As far as possible, he shall arrange his work and place, so as not to interfere with the operations of other Contractors or shall arrange his work with that of the others, in an acceptable and coordinated manner and shall perform it in proper sequence.

b) Other agencies may also simultaneously execute and install the works and the contractor shall afford necessary facilities for the same. The contractor shall leave such recesses, holes, openings, trenches etc. as may be required for such related works (for which inserts, sleeves, brackets, conduits, base plates, clamps etc. shall be available as specified elsewhere in the contract) and the

contractor shall fix the same at the time of casting of concrete, stone work and brick work, if required, and nothing extra shall be payable on this account.

c) The Contractor shall have to make Coordination with other agencies engaged at the site by the Employer at no extra cost and share the Site with other Contractors/agencies, public authorities, utilities working in the area, if any. The Contractor will carry out the entire work in a planned manner by coordinating his work with other agencies, who will be simultaneously carrying out work in the same area and also co-ordinate in connection with the position of various fixtures, inserts, embedment's and other allied work connected with the completion of the building / subject work.

d) In case of any dispute between the agencies engaged on the same work, decision of Engineer-in-Charge shall be final and binding.

e) The Contractor shall cooperate with and provide the facilities to the associate- Contractors and other agencies working at site for smooth execution of the work. The Contractor shall –

a. Allow use of scaffolding already erected, toilets, sheds etc.
b. Properly co-ordinate their work with the work of other Contractors.
c. Provide control lines and benchmarks to his associate-Contractors and the other Contractors.
d. Provide electricity and water at mutually agreed rates.
e. Provide hoist and crane facilities for lifting material at mutually agreed rates.
f. Co-ordinate with other Contractors for leaving inserts, making chases, alignment of services etc. at site.
g. Adjust work schedule and site activities in consultation with the Engineer-in- Charge and other Contractors to suit the overall schedule completion.
h. Resolve the disputes with other Contractor amicably and the Engineer-in-Charge shall not be made intermediary or arbitrator. The contractor shall indemnify the Department against any claim(s) arising out of such disputes.

22 Procurement of materials:

a) All material shall only be brought at site as per program finalized with the Engineer- in-charge. Any pre-delivery of the material not required for immediate consumption shall not be accepted and thus not paid for.

b) The contractor shall procure the required materials in advance so that there is sufficient time for testing of the materials and approval of the same before use in the work.

23 Protection of Existing Services & buildings and Materials:

a) Existing drains, pipes, cables, over-head wires, sewer lines, water lines and similar services encountered in the course of the execution of work shall be protected against the damage by the contractor at his own expense. The contractor should take all safety precautions to prevent any accident or untoward incident as the High Voltage service lines are passing by the side of the site and Nothing extra is payable on this account

The contractor shall not store materials or otherwise occupy any part of the site in a manner likely to hinder the operation of such services. In case temporary supporting of such services is required to facilitate the work, the same shall be done by the contractor at no extra cost.

b) In case the existing services are to be shifted permanently, then before dismantling the existing services, alternate/diversion of service lines has to be laid by the contractor so that there is no interruption in use of existing services. The contractor has to plan the alternate suitable route for diversion/shifting of service lines and get the same approved from the Engineer-in-charge before

starting shifting of services. Nothing extra shall be paid except the payment of dismantling and laying of new service lines as per conditions of contract.

c) All fossils, coins, articles of value of antiquity, structures and other remains or things of geological or archaeological interest discovered on project location during excavation/construction shall be the property of the Government, and shall be dealt with as per provisions of the relevant legislation. The contractor will take reasonable precaution to prevent his workmen or any other persons from removing and damaging any such article or thing. He will, immediately upon discovery thereof and before removal acquaint the Engineer-in-charge of such discovery and carry out the official instructions of Engineer-in-charge for dealing with the same, till then all work shall be carried out in a way so as not to disturb/ damage such article or thing.

d) The contractor shall be responsible for the watch and ward / guard of the buildings, safety of all fittings and fixtures including sanitary and water supply fittings and fixtures provided by him against pilferage and breakage during the period of installations and thereafter till the building is physically handed over to the client department. No extra payment shall be made on this account.

e) The contractor shall be fully responsible for the safe custody of materials brought by him/ issued to him even though the materials may be under double lock key system.

24 Rates and other conditions for payment:

The rates quoted by the contractor are deemed to be inclusive of the following-

a) Site clearance, setting out work, profile, establishment of reference bench mark(s), taking spot levels, construction of all safety and protection devices, barriers, barricading, signage, labour safety, welfare & training measures, preparatory works, working during monsoon, working at all depths, height, lead, lift and location etc. until/unless specified otherwise, implementation of green building norms to achieve desired at least 4 star GRIHA rating, etc., and any other incidental works required to complete this work. Nothing extra shall be payable on this account.

b) For works below ground level the contractor shall keep that area free from water. If dewatering or bailing out of water is required, the contractor shall do it and nothing extra shall be paid except otherwise provided in the items of schedule of quantities.

c) Any legal or financial implications resulting out of disposal of earth shall be sole responsibility of the contractor. Nothing extra over the schedule shall be paid on this account.

d) All labour, material, tools and plants and other inputs involved in the execution of the item.

e) Providing sunk flooring in bath-rooms, kitchen, etc.

f) Performance test of the entire installation(s) before the work is finally accepted.

g) Any cement slurry added over base surface (or) for continuation of concreting for better bond is deemed to have been built in the items.

h) The percentage quoted by the tenderer, shall be inclusive of all taxes including GST and levies applicable in respect of this contract shall be payable by the contractor and Government will not entertain any claim whatsoever in respect of the same.

i) For completing the work in time, the Contractor might be required to work in two or more shifts (including night shifts). No claim whatsoever shall be entertained on this account, not with-standing the fact that the contractor may have to pay extra amounts for any reason, to the labourers and

other staff engaged directly or indirectly on the work according to the provisions of the labour and other statutory bodies regulations and the agreement entered upon by the contractor with them.

j) The contractor shall keep himself fully informed of all acts and laws of the Central & State Governments, all orders, decrees of statutory bodies, tribunals having any jurisdiction or authority, which in any manner may affect those engaged or employed and anything related to carrying out the work.

All the rules & regulations and bye-laws laid down by Collector/MC, etc., and any other statutory bodies shall be adhered to, by the contractor, during the execution of work. The Contractor shall also adhere to all traffic restrictions notified by the local authorities. It is clarified that the extra sewerage charges (one-time charges for commencement of work) required to be paid to the Municipal Corporation/other statutory bodies shall be paid by the department and need not be considered by the contractor.

The water charges (for municipal water connection as well as tanker water) shall be borne by the contractor. Also if the contractor obtains water connection for the drinking purposes from the municipal authorities or any other statutory body, the consequent sewerage charges shall be borne by the contractor.

All statutory taxes, levies, charges (including GST, water and sewerage charges, charges for temporary service connections and/or any other charges) payable to such authorities for carrying out the work, shall be borne by the Contractor. The Contractor shall arrange to give all notices as required by any statutory/ regulatory authority and obtain all requisite licenses wherever required and shall pay to such authority all the fees that are required to be paid for the execution of work.

He shall protect and indemnify the department and its officials & employees against any claim and /or liability arising out of violations of any such laws, ordinances, orders, decrees, by himself or by his employees or his authorized representatives. Nothing extra shall be payable on these accounts.

The fees payable to statutory authorities for obtaining the various permanent service connections and Occupancy Certificate for the building shall be borne by the Department.

k) Royalty at the prevalent rates shall have to be paid by the contractor on all the boulders, stone aggregate, coarse or fine sand, brick aggregate, shingle, coarse or fine sand, earth, gravel, bajri, etc., whichever applicable collected by him for the execution of the work, directly to the Revenue Authority or authorized agent of the State Government concerned or Central Government. Further, contractor needs to submit proof of submission of full royalty to the State Government or local authority along with the Running Bills. Nothing extra shall be payable on this account.

l) All ancillary and incidental facilities required for execution of work like labour camp, stores, fabrication yard, offices for contractor, watch and ward, temporary ramp required to be made for working at the basement level, temporary structure for plants and machineries, water storage tanks, installation and consumption charges of temporary electricity, telephone, water etc. required for execution of the work, liaison and pursuing for obtaining various No Objection Certificates, completion certificates from local bodies, etc., protection works, barricading, testing facilities / laboratory at site of work, facilities for all field tests and for taking samples etc. during execution or any other activity which is necessary (for execution of work and as directed by Engineer-in-charge), shall be deemed to be included in rates quoted by the contractor, for various items in the schedule of quantities. Nothing extra shall be payable on these accounts. Before start of the work, the Contractor shall submit to the Engineer- in-charge, a site/construction yard layout, specifying

areas for construction, site office, positioning of machinery, material yard, cement and other storage, steel fabrication yard, site laboratory, water tank, etc.

m) The Contractor shall assume all liability, financial or otherwise in connection with this contract and shall protect and indemnify the department from any and all damages and claims that may arise on any account. The Contractor shall indemnify the department against all claims in respect of patent rights, royalties, design, trademarks of name or other protected rights, damages to adjacent buildings, roads or members of public, in course of execution of work or any other reasons whatsoever, and shall himself defend all actions arising from such claims and shall indemnify the department in all respect from such actions, costs and expenses. Nothing extra shall be payable on this account.

n) The Contractor shall make all necessary arrangements for protecting from rain or likewise extreme weather conditions, the work already executed and for carrying out the further work, during monsoon including providing and fixing temporary shelters, protections etc. Nothing extra shall be payable on this account. Also, no claims for hindrance shall be entertained on this account.

o) In case of flooding of site on account of rain or any other cause and any consequent damage, whatsoever, no claim financially or otherwise shall be entertained not withstanding any other provisions elsewhere in the contract agreement. Also, the Contractor shall make good, at his own cost, the damages caused, if any. Further, no claims for hindrance shall be entertained on this account.

p) No payment shall be made for any damage caused by fire, rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The contractor shall be fully responsible for any damage to the govt. property and the work for which payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The contractor shall be fully responsible for safety and security of his material, T&P/Machinery brought to the site by him. The contractor shall maintain all the work in good condition at his own cost till the completion of the entire work.

q) In case the same item appears more than once in the schedule of work under the same sub head or among the different sub heads of works, the lowest rate quoted for that item shall be taken for other items also and tender will be evaluated accordingly.

r) The ESI and EPF contribution on the part of employer in respect of this contract shall be paid by the contractor. These contributions on the part of employer paid by the contractor shall be reimbursed by the Engineer in charge to the contractor on actual basis. The applicable and eligible amount of EPF& ESI shall be reimbursed preferably within 7 days but not later than 30 days of submission of documentary proof of payment indicating the names of workmen and their Aadhar numbers duly correlated with the Register of persons employed/Muster roll register/Wage Register as required under CPWD Contractors Labour Regulations.

25 Foreign Exchange:

a) No foreign exchange shall be made available by the Department for importing (purchase) of equipment, plants, machinery, materials of any kind or any other items if required to be carried out during execution of the work. No delay and no claim of any kind shall be entertained from the Contractor, on account of variation in the foreign exchange rate.

b) The contractors have to quote the corresponding imported items in “Indian Rupees” in the Schedule of Quantities which shall include all incidental charges including freight, taxes including

GST, import duties, fluctuations in currency rates. No extra payment will be made over and above the quoted rates.

26 Tools & Plant:

No tools and plants including any special T&P, etc., shall be supplied by the department and the Contractor shall have to make his own arrangements at his own cost. No claim of hindrance (or any other claim) shall be entertained on this account.

27 As Built & Service Drawings:

a) As per clause-8A of GCC:
The contractor shall submit completion plans (4 sets) for Internal and External Civil, Electrical and Mechanical Services within thirty days of the completion of the work.

In case, the contractor fails to submit the completion plan as aforesaid, he shall be liable to pay a sum of 0.1 % (zero decimal one percent) of Tendered Value or limit prescribed in SCC whichever is more as may be fixed by Engineer-in-charge and in this respect the decision of Engineer-In Charge shall be final and binding on the contractor.

28 Computerized MBs & SMBs:

a) The contractor shall make available four (4) sets of computerized Standard Measurement Books (SMBs) having measurement of all the permanent standing in a building.

b) The contractor will submit computerized bill with measurement sheet for the work carried out by him for making payment as per Clause – '6' of the General Conditions of Contract. For casting of RCC members and other hidden items the corrected and duly test checked measurement sheets of reinforcement or that of other hidden items shall be deposited with Engineer-in-charge or his authorized representative, before casting of RCC or other hidden items. The delay in submission of corrected and duly checked measurement sheet may, therefore, delay casting of RCC or execution of hidden item for which no hindrance shall be recorded.

c) Electronic measurement book is introduced. The contractor shall comply with the same as per the direction of Engineer-in-charge.

29 Water Supply & Sanitary Installations & Testing:

a) Water tanks, taps, sanitary, water supply and drainage pipes, fittings and accessories should conform to approved manufacturers specifications where CPWD Specifications are not applicable. The contractor should get the materials (fixtures/fittings) tested from approved labs wherever required at his own cost. The contractor shall submit for the approval of the Engineer-in-Charge, the name of the plumbing agency (along with their working experience in recent past) proposed to be engaged by him.

b) The contractor shall give performance test of the entire installation(s) as per the standing specifications before the work is finally accepted and nothing extra whatsoever shall be payable to the contractor for the test.

30 Conditions of National Green Tribunal

a) The agency shall not store/ dump construction material or debris on the metaled road.
b) The agency shall get prior approval from Engineer-in-Charge for the area where the construction material or debris can be stored beyond the metaled road. This area shall not cause any obstruction to the free flow of traffic /inconvenience to the pedestrians/public in general. It should be ensured by the agency that no accidents occur because of such permissible storage.

c) The agency shall take appropriate protection measures like raising wind breakers of appropriate height of minimum 10 m or higher as per NGT guidelines on all sides of the plot/area throughout construction to ensure that no construction material dust fly outside the plot area.
d) The agency shall provide mask to every worker on the construction site and involved in loading, unloading and carriage of construction material and construction debris to prevent inhalation of dust particles.
e) The agency shall compulsorily use wet jet in grinding and stone cutting.
f) The agency shall comply with all the preventive and protective environmental steps as stated in the MoEF guidelines, 2010.
g) The agency shall carry out on-Road-Inspection for black smoke generating machinery. The agency shall use cleaner fuel.
h) The agency shall ensure that all DG set comply emission norms notified by MoEF.
i) The agency shall use vehicles having pollution under control certificate. The emissions can be reduced by a large extent by reducing the speed of a vehicle to 20 Kmph. Speed bumps shall be used to ensure speed reduction. In case where reductions speed cannot effectively reduce fugitive dust, the agency shall divert traffic to nearby paved areas.
j) The agency shall ensure that the construction material in storage or transit is covered by tarpaulin. The agency shall take all other precaution to ensure that no dust particles are permitted to pollute air quality because of such storage/transportation.
k) The paving of the path for plying of vehicles carrying construction material is more permanent solution to dust control and suitable for longer duration projects.
l) As per EIA Notification of 2006, sufficient green belt around the building shall be provided. Such green belts shall be in existence prior to applying for occupancy certificate and handing it over.
m) Any violation of orders of MoEF including guidelines of State Government, SPCB or any officer of any department shall lead to stoppage of work for which Agency shall be responsible and no hindrance shall be accounted in this regard.

31 Prevention of Nuisance and Pollution

a) The Agency shall take all necessary precautions/temporary measures to prevent any nuisance or inconvenience to the owners, tenants or occupiers of adjacent properties and to the public in general and to prevent any damage to such properties and any pollution. He shall make good at his own cost and to the satisfaction of the Engineer-in-charge, any damage to roads, paths, underground/overhead services, drainage works or public or private property whatsoever caused by the execution of the work or by traffic brought thereon by the Agency.
b) Existing drains, pipes, cables, overhead wires, sewer lines, water lines and similar services encountered in the course of the execution of the work shall be protected/ maintained against the damage by the Agency. The Agency shall identify all underground / overhead services and take necessary measures to protect the services before starting any excavation / activity. All temporary supports and other measures required to protect and maintain the services during construction period as per direction of Engineer-in-charge, shall be deemed to be included in the quoted rate / amount of the Agency and nothing extra shall be paid on this account. For any permanent shifting, WAPCOS shall arrange to shift the services as and when required. However, in the interest of work, if WAPCOS decides to get it shifted by the Agency, then Agency shall be paid separately at the rates as decided by the Engineer-in-charge based on the actual quantum of the work involved in shifting such utilities/services. The decision of the Engineer-in-Charge in this regard shall be final and binding.
c) Agency shall manage all activities within the land portion. WAPCOS is not obliged to make any other land available for Batch Mix Plant, Store, Preserving Top Soil etc.
d) The site shall be kept clean of all debris, rubbish and dirt & surplus/waste material all the time. It also includes maintenance, cleaning & de-silting the pipe lines laid by the agency for all internal services etc. executed by the agency to the entire satisfaction of the Engineer-in-charge during the construction/maintenance periods. Cleaning and de-silting will also be done by the agency before

handing over the completed structures to WAPCOS. All machines, equipment and labour for this purpose will be arranged by Agency at no extra cost to WAPCOS.

32 Third Party Inspection of Works

Notwithstanding the any other conditions of Contract, the Employer shall get the work inspected by any third party (IIT/ NIT as appointed by WAPCOS/Client) during the progress of work or any time after the construction and development of project up to the defect liability period. The Contractor, his consultant, subcontractors of all tiers and suppliers thereof shall make available during the inspection with all records necessary to demonstrate that the Works have been executed in accordance with the Contract Agreement.

The Contractor shall also be responsible for consequential effects arising out during the inspection done by the third party from time to time and will take appropriate action for rectification of defective work. Rectification of defective works or replacement of sub-standard materials or articles, as pointed out by the third party authorized by Employer, will be carried out or replaced by the Contractor at his own risk and cost. The Employer will not pay any extra amount for such rectification or replacement.

The Contractor shall submit the Standard Operating Procedure (SOP) / Quality Control & Quality Assurance Plan as finalized by the Client / WAPCOS and submit to the WAPCOS & Third Party Quality Assurance Agency (TPQAA) for checking & verification during visit of TPQAA. The reports of TPQAA will be the part of the Running Account Bills which will be raised after completion of important milestones / critical activities as defined by Client / WAPCOS.

33 Inspection of the work by any Government Agency

The Contractor shall be responsible for consequential effects arising out during the inspection done by the Chief Technical Examiner Cell, Central Vigilance Commission or Committee constituted by the Principal Employer or construction site visiting team of Principal Employer or by the Building Works Committee or third party authorized by WAPCOS or any Statuary Committee or by any duly authorized representative of WAPCOS, during the progress or any time after the construction and development of project up to the defect liability period, and will take appropriate action for rectification of defective work and modifications as suggested by the above teams/ group/ individual. Rectification of defective works or replacement of sub-standard materials or articles or modifications, as pointed out by the Chief Technical Cell, Central Vigilance Commission, committee constituted by Principal Employer, construction site visiting team of Principal Employer, Building Works Committee or authorized representative of WAPCOS or third party authorized by Employer/ Principal Employer or any Statuary Committee, will be carried out or replaced/ modified by the Contractor at his own risk and cost.

34 Prior Approval from Fire Department & Electrical Department

Contractor shall take prior approval well in advance of electrical substation, layout, drawings, electrical equipment, solar installation drawings/documents etc. from concern Electrical Department/ local Authorities before order of procurement & commencing the Electric work.

Contractor shall take prior NOC from Local Fire Department & submit the project drawings to the Fire Department before commencing the construction works for checking and verification of fire department as per the fire norms of that particular region. After the completion of work, Contractor shall apply and provide final fire department NOC.

35 PROGRESS AND MONITORING OF WORK:

a) The progress report shall contain the following, apart from whatever else may be required as specified: -
   (i) The Contractor should submit a monthly progress report to the Engineer-in- charge by 5th of every month.
   (ii) Progress chart of the various components of the work that are planned and achieved, for the month as well as cumulative up to the month, with reason for deviations, if any in a tabular format.
   (iii) Construction schedule of the various components of the work through a bar chart for the next three months (or as may be specified), showing the micro milestones, targeted tasks and up to date progress. At least 10 digital photographs showing all the parts of construction site along with at least 5 minutes video of executions of different items in soft copy has to be submitted in every monthly progress report.
   (iv) Plant and machinery statement, indicating those deployed in the work.
   (v) Man-power statement, indicating individually the names of all the staff deployed on the work, along with their designations. Number of skilled workers and unskilled workers deployed on the work and their location of deployment.
   (vi) Financial statement, indicating the broad details of all the running account payment received up to date, such as gross value of work done, advances taken, recoveries effected, amount withheld, net payments details of Cheque payment received, extra /substituted /deviations items if any, etc.

b) For completing the work in time, the Contractor might be required to work in two or more shifts (including night shifts). No claim whatsoever shall be entertained on this account, not with-standing the fact that the Contractor may have to pay extra amounts for any reason, to the labourers and other staff engaged directly or indirectly on the work according to the provisions of the labour and other statutory bodies regulations and the agreement entered upon by the Contractor with them.

c) The work should be planned in a systematic manner so that chase cuttings in the walls, ceilings and floors is minimized. Wherever absolutely essential, the chase shall be cut using chase cutting machines. Chases will not be allowed to be cut using hammer / chisel. The electrical boxes should be fixed in walls simultaneously while raising the brick work. The contractor shall ensure proper co-ordination of various disciplines viz. building works, sanitary & water supply & electrical installations etc.

d) The contractor shall conduct his work, so as not to interfere with or hinder the progress or completion of the work being performed by other contractor(s) or by the Engineer-in-Charge and shall as far as possible arrange his work and shall place and dispose of the materials being used or removed so as not to interfere with the operations of other contractor or he shall arrange his work with that of the others in an acceptable and coordinated manner and shall perform it in proper sequence to the complete satisfaction of Engineer-in-charge.

e) The Contractor shall do proper sequencing of the various activities by suitably staggering the activities within various pockets in the plot so as to achieve early completion. The agency may deploy adequate equipment, machinery and labour as required for the completion of the entire work within the stipulated period specified. Also, ancillary facilities shall be provided commensurate with requirement to complete the entire work within the stipulated period. Nothing extra shall be payable on this account. Adequate number/sets of equipment in working condition, along with adequate stand-by arrangements, shall be deployed during entire construction period. It shall be ensured by the Contractor that all the equipment, Tools & Plants, machineries etc. provided by him are maintained in proper working conditions at all times during the progress of the work and till the completion of the work. Further, all the constructional tools,

plants, equipment and machineries provided by the Contractor, on site of work or his work shop for this work, shall be exclusively intended for use in the construction of this work and they shall not be shifted/ removed from site without the permission of the Engineer-in-Charge.

f) All material shall only be brought at site as per program finalized with the Engineer- in-Charge. Any pre-delivery of the material not required for immediate consumption shall not be accepted and thus not paid for.

36 Office Infrastructure & Inspection Vehicles

a) For Quality Control Measures and Monitoring the Quality of work, Maintenance of Test Registers, Progress reports and related documents the contractor shall provide, within 30 days from the date of issue of commencement order of work, Two (2) HP/Dell desktop/ LAPTOP (all in one) Computers having Intel core i7 processor, MS-Windows-11, One Xerox WorkCentre with A3 & A4 colour & B/W Printing, Photocopy and Scanning facility & Two A-4 size HP B/W LaserJet Printer (All in One), One 2KVA UPS, etc., with two Nos. of computer data entry operators with Diploma in Engineering and adequate knowledge in MS Office & MS Project (as minimum qualification) in the site office of Engineer-in-Charge at construction Site. The data entry operators will be at the disposal of the Engineer-in-charge. The contractor shall replace the data entry operators in case found unfit by the Engineer-in-charge on performance & behavioral grounds. Nothing extra shall be paid on this account and the quoted rates of the contractor are inclusive of the salaries and other perks payable to the data entry operators. As specified at SCC under clause 32 failure of the contractor to deploy the data entry operators at the disposal of the Engineer-in-charge will attract a penalty of Rs. 25,000/- per each data entry operator which is non-refundable.

b) The IT hardware shall be maintained (repair/ maintenance/ replacement of parts/ cartridge including consumables) by the contractor during the entire period of contract. The same shall be the property of WAPCOS after completion of work. An amount equal to 50,000/- per Month will be deducted, if above facilities are not provided at site

c) The Agency shall construct site office (semi-permanent structure) for PMC officers and staff in the project site premises, which should be equipped with all necessary equipment required for functioning the office. The area of this office should not be less than 250 Sqm with pantry, conference room, toilets and other requisite facilities. A proposal of site office shall be submitted by the agency within 15 days after award of work. This office shall be constructed and made functional within 45 days after approval of the proposal of site office made by the agency and accepted by Engineer-in-Charge.

d) The office should have Engineered marble flooring in common areas and vitrified tiles in rooms with UPVC windows and laminated flush door shutters. The toilet fixtures and specifications to be adopted as mentioned in this document for club house.

e) The Agency shall provide necessary Air Conditioners, lighting and fixtures i/c fan, water dispenser, oil heaters, microwave etc. Two (02) office attendants and Two (02) data entry operators shall also be provided by the agency during the whole agreement period. AMC charges, Electricity bill, water supply bills, drinking water bills etc. shall be borne by the agency. The agency shall provide the following furniture (new) for use of WAPCOS / Client staff at site office.

S.No.	Articles	Quantity
1.	Executive table (wooden) with side racks	8 Nos.
2.	Executive Chair	8 Nos.
3.	Office Tables	10 Nos.

4.	Office Chairs	10 Nos.
5.	Steel Almirah	15 Nos.
6.	Conference table (for 30 seats)	1 Nos.
7.	Conference chairs	40 Nos.
8.	Digital display arrangement & sound system	1 set

f) The contractor shall make arrangement for Helmets and leather shoes (meant of construction work at sites) for all field staff of the department during the entire period of construction for safety reasons. One helmet and two pairs of shoes and one Rain Coat in Monsoon Season per staff member (maximum twelve members) of the departments per year shall be arranged by the contractor.

g) The contractor shall also provide 2 inspection vehicles (Innova Crysta or equivalent) for the use of client and PMC during the progress of the work i.e. from date of Commencement to completion of entire work, at disposal of Engineer-in-Charge. Vehicles are to be provided to facilitate work inspection, quality control, coordination with multiple agencies and better liasioning. The average mileage of each inspection vehicle may be approx. 1800 km per month. The inspection vehicle should be in good condition and should not be more than one year old. Agency will provide inspection vehicle for all the times (including night hours during work at site) as and when required at site/office work as per direction of Engineer-in-Charge. The inspection vehicle shall make available for 12 hours per day on daily basis i/c holidays as per direction of the Engineer-in-Charge. The running cost of inspection vehicles along with all incidental charges i.e. cost of fuels, lubricant, services /maintenance of vehicles, pay of driver etc. will be borne by the agency and nothing will be paid by the Employer or its representatives. An amount equal to 60,000/- per vehicle per Month will be deducted, if above facilities are not provided at site.

h) The Contractor shall provide at his own cost, One Site sign Board, at directed location of overall size 2.40 metres wide and 1.50 metres height and of approved design. The names of the Project, Employer, Consultants, Engineer and Contractor etc. shall be exhibited as directed

i) The Contractor has to make own security arrangement. Contractor shall maintain upto date record of in & out of the material & labour / staff at the security gate of campus at its own expenses.

j) The Contractor shall provide safety equipment to the Employers/officers (whenever required).

k) Contractor shall deploy security/ watchmen for 24 hours on site at entire execution period and up to successful handing over of the project to the Principal Employer.

l) Contractor shall properly cover up & protect all the work throughout the duration of work at his cost until successful handing over to the Principal Employer, particularly flooring, risers, mouldings, steps, terrace or special floor finishes (by a layer of 25 mm thick Plaster of Paris over Polyethylene sheet as approved by Engineer-in-Charge) staircases and balustrades, doors and glass, paint work, furniture and all finishing

m) An amount equal to 1% of the gross amount of running account bills and final bill will be deducted, if above facilities are not provided at site.

37 Approach Roads and Transportation of Equipment & Materials

Contractor will be permitted to use the existing roads in the establishment area for the purpose of transporting equipment and materials and for use of labour etc. if Principal Employer permits the same. The Engineer-in-Charge, however, will not undertake to provide any approach roads to the actual site of work. It shall be the entire responsibility of the Contractor to provide and maintain such temporary approach roads including cross drainage works if any at his own cost for the purpose of movement of men, materials and equipment.

38 Handing Over of the Project

Contractor shall apply/ laison, well before the completion of project, for permanent electricity connection, Electric load enhancement, solar net metering from concerned Electrical Departments for Permanent supply of electricity to the project within the completion period of the project. After completion of installation of electric equipment's & connections, Contractor shall arrange necessary testing of equipment, panels, transformer, DG set, solar installation etc. at site as per norms and provide test reports to Employer/local Authorities. After that Contractor will arrange all necessary approval/NOC from Chief Electrical Inspector Department/ local Authorities etc. to submit further to the electricity department for getting permanent electrical supply to the project.

Contractor shall apply/ laison, well before the completion of project, permanent water connection & Sewerage Connection, gas connection, etc. from concerned Departments/ Government Authorities which are mandatory to make the project operational and get the connection within the completion period of the project.

Contractor shall provide necessary Statutory Approvals/NOCs/ License from all local Government/ Statuary Authorities including Fire, Forest, Electrical, Pollution, Environment, Lift, DG Set, final Occupancy Certificate required before handing over the project to the Principal Employer.

Contractor will hand over the project to Employer/Principal Employer after successful completion of each component of the project along with submission of all the required documents i.e. As- built drawings, Inventory list, guarantee / warranty bonds, certificates & invoices of equipment, lock and key of each room, NoCs form various Departments and final Occupancy Certificate from Local Body with complete satisfaction and acceptance by Principal Employer within the completion period of the project.

The statutory fees, if any will be deposited by the contractor for the above will be reimbursable to the contractor by Employer after providing the original receipt of the concern department. No other amount will be paid to the contractor for above works.

The partial handing over of works components shall not be considered. The Warranty/Defect Liability Period shall commence from the date of issue of the Taking Over Certificate by Principal Employer or issue of Completion Certificate by Principal Employer or agreed date of start of Defect Liability Period by the Principal Employer whichever is later along with submission of all the required documents i.e. As-built drawings, Inventory list, guarantee / warranty bonds, certificates & invoices of equipment, lock and key of each room and NoCs form various Departments.

39 Ceremony/Inaugural Function

The contractor shall make all arrangements for Foundation Stone/ Ground Breaking Ceremony/Inaugural Function etc. for the project as required and the cost towards it deemed to be included in quoted cost by the contractor. Any expenditure already incurred/to be incurred by Employer on account of ground breaking ceremony/inaugural function etc, shall be recovered from the Contractor.

40 Operations and Storage Areas

All operations of the Contractor shall be confined to areas authorized by the Project Manager, WAPCOS and storage of materials shall be over the areas specially indicated by the Project Manager, WAPCOS, which are to be arranged by the contractor at no extra cost to the project. Materials like sand and metal of different sizes shall be stored in properly constructed bins with hard floor to avoid inter mixing as well as mixing with objectionable materials. The Contractor shall be obliged to keep the premises in hygienic conditions by proper drainages of the area provided with suitable approaches throughout the period of Contract. He shall rectify all damages caused to the Government property within the areas thus allotted. He shall be responsible to clear all rank, vegetation at site at his own cost.

41 Contractor's Storage and Site Office

The Contractor shall make own arrangement including space for storing his equipment, plant, materials etc. and for his site office and cement godown. While planning the location of storage and plants, the contractor has to keep in mind the available space at the project site. No additional space shall be provided to the contractor for all these activities by WAPCOS / client. The Contractor be solely responsible for watching or guarding his property and materials. Contractor shall cover all materials at site with requisite insurance against theft, larceny, dacoits, fire tempest and flood. The Contractor, however, shall have to dismantle the shed and vacate the land after the receipt of due notice from the Project Manager, WAPCOS if the same is obstructing any work. The Contractor should obtain necessary permission / approval from Statutory Authorities such as Municipal corporations / Local bodies etc. for construction of temporary structures at site of work such as cement godown, stores, site office etc. It will be responsibility of the Contractor to prepare proper plans, to pay any requisite fees to statutory authorities and to execute the work for the temporary structure at their own cost as per the conditions and rules laid by statutory authorities.

The Engineer-in-Charge or his authorized representative shall have a right at any time to inspect and examine any stores and materials intended to be used in or on the works either on the site or at any factory or workshops or other places where such stores or materials are being constructed or manufactured or processed or any place from where they are being obtained and the Contractor shall give such facilities as required to be given for such inspection and examination.

The Engineer-in-Charge or his authorized representative shall be entitled to have tests made without any extra cost to the Employer at the laboratory selected by the Employer for any stores and or materials supplied by the Contractors, who shall provide at his own expense all the facilities which the Engineer-in-Charge may require for this purpose.

Any stores and materials brought to site for use on the work and which has been rejected by Engineer-in-Charge shall be immediately removed off the site by Contractor at his own expenses and intimate in writing accordingly to the Engineer-in-Charge. The rejected materials shall not be used in any manner in the construction of the project.

42 Temporary Buildings

Any temporarily buildings and office facilities as required by the Contractor shall be arranged by the Contractor at his own expense. Area for the same will be made available by the Employer, if available. After the work is over, all these temporary facilities shall be removed by the Contractor at his own expense within 10 days from the date of completion.

Labour Camp is permitted at site after approval of Principal Employer. However, no labour shall be permitted to stay in the partly completed building at any time. Unauthorized occupation of any area/partly completed building by the Contractor's labourer will be treated as trespass and action will be taken to evict them including termination of Contract if deemed fit. Sanitary as well as water supply and drainage

facilities as required by the labour laws in force, are to be provided by the Contractors at his own cost. The labour camp should be dismantled by the Contractor before handing over the buildings.

43 Traffic Interference & Inconvenience to the Public

The Contractor shall so conduct his operations as to interfere as little as possible with the traffic/public. When interference to traffic is inevitable, a notice of such interference shall be given to the Project Manager, WAPCOS well in advance (at least 2 days) at any stage, if it becomes necessary to divert the traffic, the Contractor shall obtain permission from the local traffic authorities at his own expense. The Employer will render reasonable assistance in the matter. The Contractor shall take all precautionary and other measure, such as providing warning signals, temporary diversion etc. all as directed by the Project Manager, WAPCOS.

The Contractor shall not deposit materials anywhere at work site which will seriously inconvenience the public. The Project Manager, WAPCOS may require the Contractor to remove any materials which are considered to be a danger or inconvenience to the public or cause them to be removed at the Contractor's cost.

The Contractor shall exercise full care to ensure that no damage is caused by him or his workmen, during the operation to the existing water supply and power lines. The cost of any such damage and risks arising out of this shall be entirely borne by the Contractor.

44 Drainage around the Buildings and Foundation for other Works

The Contractor shall be entirely responsible for the provision and maintenance of efficient drainage arrangements in the work site to lead all water whatsoever pumped out from the excavations on account of rains, floods, springs or any other source whatsoever. The foundation trenches shall be kept free from water while all the works below ground level are in progress.

Flooding or ponding of water in the work site shall not be permitted under any circumstances whatsoever and the Contractor shall take all necessary precautions to prevent the same by providing suitable pumps and other dewatering arrangement.

The cost of repairing damages if any, to the work under execution or to any government property in and around the site shall be entirely borne by the Contractor where such damages are due to his non-compliance with the above conditions.

45 Maintenance of Entire Electrical Installation

As mentioned above, the Contractor shall maintain his entire electrical installation, appliances etc. in good and safe condition as required under relevant rules and BIS codes of practice etc. till completion of works at his own cost. However, the following precautions and directives shall be followed in addition to observing other essential rules:

a. The minimum clearance (measured at the lowest sag point) to be maintained for all overhead lines shall be 4 Mtrs. cross country or along roads and 6.1 metres across roads.
b. Metallic poles as a general rule should be avoided and if used should be earthed individually.
c. All loose hanging of wires and cables should be avoided. The line wires should be properly supported and an approved method of fixing shall be adopted.
d. Installation shall not cause any hindrance to the normal movement of men and materials at site.
e. All cables and wires should be adequately protected against mechanical damage during construction activity of all Contractors, working at site.
f. In case the cable is required to be laid in ground, it should be adequately protected by covering the same with bricks, R.C.C. tiles or any other approved means and cable markers provided at

suitable intervals as per approval of the Engineer-in-Charge.

g. Laying of cable and wires direct on floor shall not be allowed but if absolutely necessary for some very short lengths, the same shall be taken through suitable mechanical covering like G.I. / M.S. Pipes etc.

h. All the cut door switch boards, equipment etc., should be adequately protected against rain or preferably they should not be exposed to weather.

i. If overhead lines using bare conductors are installed, a guard wire system of adequate size shall run along the cables / wires and earthed effectively.

j. The connection for portable machines shall be taken only through suitably rated 3 pin socket points. Iron clad industrial type outlets are preferred. While taking supply through socket outlet a plug top must be used, avoiding inserting of loose wires in the sockets. The third pin of the plug shall invariably be earthed and 3 core wire of appropriate specifications and capacity shall be used.

k. All three- p h a s e equipment shall be provided with duplicate earthing. All metallicframes, light fixtures, portable equipment's etc. should be effectively earthed to main earthing.

l. Duly authorized persons having valid wireman's license / competence certificate must be employed under the supervision of a qualified and experienced Electrical Supervisor for carrying out electrical work and repair of electrical equipment, installation and maintenance etc. at site.

m. Special precaution shall be taken by the Contractor not to disturb the sapling/trees recently planted by the side of the compound wall. The sapling/trees fall within the building/road etc. shall be transplanted to suitable place with written approval of the Engineer-in-Charge and maintained by the Contractor till completion of works at his own cost.

46 Proper drawings and instructions

The Contractor shall provide shop drawings and other drawings to the Engineer-in-Charge in line with the requirement of contract agreement from time to time for approval for the purpose of proper and adequate execution and maintenance of the work and the Contractor shall carry out the work and be bound by the same.

Copies of the drawings approved by the Engineer-in-Charge and the construction drawings issued shall be kept by the Contractor at the site and the same shall at all reasonable times be made available for inspection and use by the Engineer-in-Charge and any other person authorized by the Engineer-in-Charge.

47 Employment of Staff for Plumbing & Electrical Works

- Employment of certified plumber: Certified plumbers should be employed by the Contractor on the work for main sewer, filtered and unfiltered main.
- Employment of licensed electrical foreman: The Contractor should employ a licensed electrical foreman to supervise the Electrical works.

48 Urgent repairs

If by reason of any accident or failure or other event occurring to or in connection with the work or any part thereof either during the period of construction or maintenance, any remedial or other work or repair shall in the opinion of the Project Manager, WAPCOS be urgently necessary for security etc. and the Contractor is unable or unwilling, at once, to do such work or repair, the Project Manager, WAPCOS may be his own or other workmen do such work or repair as he may consider necessary. If the work or repair so done which in the opinion of the Project Manager, WAPCOS, the Contractor was liable to do at his own expenses under the Contract and all cost and charges properly incurred by the Project Manager, WAPCOS in so doing shall on demand be paid by the Contractor or may be deducted from any sum due or which may become due to the Contractor provided always that the Project Manager, WAPCOS shall soon after the occurrence of any such emergency as may be reasonable, practicable, notify the Contractor thereof in writing.

49 Security Regulations

The Contractor has to strictly follow the security regulations at the work site regarding entry of personnel, material etc. and any other regulation that might be enforced from time to time.
All materials and articles brought by the Contractor to the work site shall have to be declared at the security gate. Similarly, no materials shall be taken out from the premises without proper gate pass.

The Contractors, Suppliers, vendors, workers engaged in work/business will be issued with renewable entry permit to avoid unauthorized entry in the work site on scrutiny of applications in prescribed form.

For working on Sundays, Holidays and late hours, even though permission will be accorded by the Engineer-in-Charge, the Contractor will have to make application to the Engineer-in-Charge also and keep them informed well in advance.

The area where the proposed work is to be carried is residential / non-residential area under the control of Security authorities, entry to the site of work shall be through the main gate only. The Contractor shall follow strictly the security regulations at site of work regarding entry of personnel, materials etc. and other regulations that might be enforced from time to time at the work site and also in the campus for smooth and efficient operation. The Contractors, his agents, representatives, workmen etc. and his materials, carts, trucks or other means of transport etc. will be allowed to enter through and leave from such point of entry/exit at such times, the authorities in charge of the area, at their sole discretion, may permit.

The Contractors, his agents and representatives are required to be in possession of the individual identity / muster cards or passes. The muster cards or passes are examined by the security staff at the time entry / exit inside the premises and also at any time or number of times within such area.

The Contractor will have to apply for entry/muster permits of likely number of labour to be engaged during the week for the workers and authorize their representatives to collect the entry permits for labour from the Employer’s Security Authorities.

It will be the responsibility of the Contractor to maintain the list of laborers permitted to work inside the premises in a register and the representative of Contractor’s labour will have to issue entry pass to each labour after making necessary entry in the registers.

The Contractor, his agents, representatives, workmen shall strictly observe the orders pertaining to prevailing fire precautions.

In addition to the above, other security regulations as may be imposed by the Security authorities / Project Manager, WAPCOS shall be complied with / observed by the Contractor and his workmen, in addition to the above.

Any breach of above security regulations and rules in force from time to time will be viewed seriously. No claim whatsoever will be entertained by the Employer on account of the observation of the Security regulations.

50 Watch and Ward and Lighting

The Contractor shall in connection with the works provide and maintain at his own cost all lights, guards, fencing and watching when and where necessary or as required by the Project Manager, WAPCOS and duly constituted authority for the protection of the workers or for safety and convenience of the public or others. The Contractor shall be responsible for all damages and accidents caused due to negligence in this regard.

It will be the entire responsibility of the Contractor to protect the work(s) carried out by them including the fittings, fixtures and other accessories provided by them till the entire work is satisfactorily handed over to the Employer.

51 Removal of rejected/sub-standard materials.

The following procedure shall be followed for the removal of rejected/sub-standard materials from the site of work:

(i) Whenever any material brought by the contractor to the site of work is rejected, entry thereof should invariably be made in the Site Order Book under the signature of the Project Manager, WAPCOS, giving the approximate quantity of such materials.

(ii) As soon as the material is removed, a certificate to that effect shall be recorded by the Project Manager, WAPCOS against the original entry, giving, the date of removal and mode of removal, i.e., whether by truck, carts, or by manual labour. If the removal is by truck, the registration number of the truck should be recorded.

(iii) When it is not possible for the Project Manager, WAPCOS to be present at the site of work at the time of actual removal of the rejected/sub-standard materials from the site, the required certificate should be recorded by the Authorized Representative of WAPCOS, and the Project Manager, WAPCOS should countersign the certificate recorded by the Authorized Representative.

52 Recording of Hindrances: -

(i) A Physical Hindrance register will be maintained at site. Whenever any hindrance comes to the notice of the contractor he should at once bring it to the notice of Engineer-in-charge & PMC who will resolves the same at the earliest.

(ii) The Contractor shall apply for EOT if the date of completion is to be extended because of such hindrance.

53 Secrecy

(i) The contractor shall take all steps necessary that all persons employed on any work in connection with the contract have noticed that the Indian Official Secrets Act 1923 applies to them & will continue so to apply even after the execution of such works under the contract.

(ii) **The contract is confidential** and must be strictly confined to the contractor's own use (except so far as confidential disclosure to sub-contractors or suppliers as necessary) and to the purpose of the contract.

(iii) All documents, copies thereof & extracts there from furnished to the contractor shall be returned to the Engineer-in-Charge on the completion of the work/works or the earlier determination of the contract.

54 Labour and Security

(i) In the event of the contractor(s) committing a default or breach of any of the provisions of the Central Public Works Department, Contractor's Labour Regulations and Model Rules for the protection of health and sanitary arrangements for the workers as amended from time to time or furnishing any information or submitting or filing any statement under the provisions of the above Regulations and' Rules which is materially incorrect, he/they shall, without prejudice to any other liability, pay to the Government a sum not exceedingRs.500/- for every default, breach or furnishing, making, submitting, filing such materially incorrect statements and in the event of the contractor(s) defaulting continuously in this respect, the penalty may be enhanced to Rs.1000/- per day for each day of default subject to a maximum of 5 per cent of the estimated cost of the work put to tender. The decision of the Engineer-in- Charge shall be final and binding on the parties.

(ii) No payment shall be made for construction of labour housing.

(iii) Some restrictions may be imposed by the security staff etc. on the working and for movement for labour materials etc. The contractor shall be bound to follow all such restrictions / instructions and nothing extra shall be payable on this account.

(iv) The Contractor shall display all permissions, licenses, registration certificates, bar charts, other statements etc. under various labour laws and other regulations applicable to the works, at his site office.

(v) Contractor should provide his plan for labour huts as per his requirement and get it approved from the Engineer-in-Charge. Due to limited space availability at site, the site may not be made available to the contractor and the arrangement for establishing the labour huts shall be made by the contractor at its own cost outside the campus.

(vi) The contractors are required to provide such accommodation for workmen as is acceptable to local bodies & Green building norms and nothing extra shall be paid on this account.

(vii) Due to limited space availability at site, the site may not be made available to the contractor. In case no site is available for labour huts. The contractor shall have to have his own arrangements for hiring land for setting up labour huts. The contractor will be provided space for watchman huts, site office etc. to a very limited extent inside the campus but the space requirement and location, as assessed by Engineer-in-Charge shall be final and binding.

(viii) Contractor has to follow the security requirement of the campus and obtain necessary entry passes for the labour and vehicles and follow security checks at entry/exit gates, restriction on movement of vehicle, restricted timings of working. etc. The department however shall assist the contractor in obtaining such passes for movement of vehicles and labour. No claim whatsoever shall be entertained on account of delay in entry of vehicles and labour including restrictions in working hours, if there is any.

(ix) The contractor shall employ only Indian Nationals after verifying their antecedents and loyalty. The contractor shall, on demand submit list of his agents, employees and work people concerned & shall satisfy as to the Bonafide's of such people. The contractor at his own cost shall get the antecedents of his workmen verified from the jurisdictional Police Station and submit the same to the Engineer-in-charge. Nothing extra shall be paid on this account.

(x) The contractor & his work people shall observe all relevant rules regarding security promulgated in which work is to be carried out by the Controlling Administrative Authority of the campus/area (hereinafter referred to as "Administrator").

(xi) The contractor, his representative, workman shall be allowed to enter through specified gates & timing as laid down by the controlling authority. They shall be issued an identity card or an individual pass in accordance with the standing rules & regulations & they should possess the same while working. The cost of such ID cards and Passes should be borne by the contractor. The contractor shall be responsible for the conduct & actions of his workmen, agents/ representatives.

(xii) Normally contractor shall be allowed to carry out work between 7 AM to 6 PM.

(xiii) However, he may also be allowed to carry out the work beyond 6 PM & upto 7 AM, if the site conditions/circumstances so demand with prior written permission from the "Administrator".

However, if the work is carried out in more than one shift or at night, no claim on this account shall be entertained.

(xiv) Normally contractor's material/vehicles etc. Shall be allowed to move in/go-out between 7 AM to 7 PM only & no movement of material/vehicles out of the site of work shall be allowed during night hours unless specific permission is obtained from the Engineer-in-charge.

(xv) In case if a separate entry has been allowed, the contractor has to make all arrangement for making a separate entry gate and barricading of the working area to segregate/separate the same from other areas. All these have to be done by the contractor at his own cost including safeguarding any untoward incident in the restricted area due to separate entry gate and barricading arranged by the contractor. No extra amount on this account shall be payable by the department.

(xvi) In the event of any restrictions being imposed by the Security agency, WAPCOS, Traffic or any other authority having jurisdiction in the area on the working or movement of labour /material, the contractor shall strictly follow such restrictions and nothing extra shall be payable to the contractor on such accounts. The loss of time on these accounts, if any, shall have to be made up by augmenting additional resources whatever required. Nothing extra shall be payable on this account.

55 Documentation

(i) The Contractor shall render all help and assistance in documenting the total sequences of this project by way of photography, slides, audio / video recording & other records etc. Nothing extra shall be payable to Contractor on this account. However, cost of photographs, slides, audio / video graph etc. shall be borne by the Department. The original films shall be the property of the Department. No copy shall be prepared without the prior approval of the Engineer- in – Charge.

(ii) The Contractor shall develop and provide a robust documentation management system for the use of PMC, Architect and WAPCOS.

56 Progress Chart: -

(i) The contractor shall submit a Time and Progress Chart for each mile stone as per clause 5 of the GCC within 7 days from the date of award of work. The Engineer-in- charge may within 30 days thereafter, if required modify, and communicate the program approved to the contractor failing which the program submitted by the contractor shall be deemed to be approved by the Engineer-in-charge. The work programme shall include all details of any drawings and decisions required to complete the contract with specific dates by which these details are required by contractor without causing any delay in execution of the work. The chart shall be prepared in direct relation to the time stated in the Contract documents for completion of items of the works. It shall indicate the forecast of the dates of commencement and completion of various trades of sections of the work and may be amended as necessary by agreement between the Engineer-in-charge and the Contractor within the limitations of time imposed in the Contract documents, and further to ensure good progress during the execution of the work, the contractor shall in all cases in which the time allowed for any work, exceeds one month (save for special jobs for which a separate programme has been agreed upon) complete the work as per mile stones.

(ii) In case of non-submission of construction programme by the contractor the Program approved by the Engineer-in-charge shall be deemed to be final.

(iii) The approval by the Engineer-in-charge of such programme shall not relieve the contractor of any of the obligations under the contract.

(iv) The contractor shall submit the Time and Progress Chart and monthly progress report using the mutually agreed software or in other format decided by the Engineer-in-charge for the work done during the previous month to the Engineer-in- charge on or before the 5th day of each month, failing which recovery of as specified in SCC shall be made in case of delay in submission of the monthly progress report.

(v) The program chart should include the following: -

a) Descriptive note explaining sequence of various activities.
b) BAR CHARTS prepared in mutually agreed software or in other format decided by Engineer-in-charge which will indicate resources in financial terms, manpower and specialized equipment for every important stage.
c) Program for procurement of materials by the contractor.
d) Program for arranging and deployment of manpower both skilled and unskilled so as to achieve targeted progress.
e) Program of procurement of machinery / equipment having adequate capacity, commensurate with the quantum of work to be done within the stipulated period, by the contractor. In addition, to the above to achieve the progress of work as per programme, the contractor must bring at site adequate shuttering material required for cement concrete and RCC works etc. The contractor shall submit shuttering schedule adequate to complete the structure work within the laid down physical milestones.
f) Programme for achieving milestones.

(vi) The submission for approval by the Engineer-in-charge of such programme or such particulars shall not relieve the contractor of any of the duties or responsibilities under the contract. This is without prejudice to the right of Engineer-in-charge to take action against the contractor as per terms and conditions of the agreement.

57 Project Review Meetings:

(i) The contractor, immediately on award of work shall submit details of his key personnel to be engaged for the work at site. In addition, he shall furnish the Engineer-in-charge detailed organization involved with the work.

(ii) The contractor shall present the programme and status at various review meetings as required.

(iii) **Monthly Review Meetings:** Shall be attended by Project-in- charge and the Management Representative who can take independent decisions along with WAPCOS, client's representatives.

Agenda

a. Progress Status/Statistics.
b. Completion Outlook.
c. Major holdups/slippages.
d. Assistance required.
e. Critical issues.
f. Any decision on queries raised either by Contractor/PMC.
g. Anticipated cash flow requirement for next two months.

58 Engaging Specialized Agencies for Works: -

(i) The Contractor shall engage specialized agencies having adequate technical capability and experience of having executed at least one work of similar items for executing the following

items of the work and/or any other items of work where specialized firm is required to be engaged as per contract conditions.

(ii) The Specialized agency for the work shall be got approved from the Engineer-in- Charge well before actual commencement of the item of work. The contractor shall submit the list of specialized agencies proposed to be engaged by him along with their technical capability and necessary performance certificates, within 30 days of the stipulated date of start to substantiate technical capability and experience of the agency for prior approval of the Engineer-in-Charge.

(iii) It shall be the responsibility of main contractor to sort out any dispute / litigation with the Specialized Agencies without any time & cost overrun to the Department. The main contractor shall be solely responsible for settling any dispute / litigation arising out of his agreement with the Specialized Agencies. The contractor shall ensure that the work shall not suffer on account of litigation/ dispute between him and the specialized agencies/sub-contractor(s). No claim of hindrance in the work shall be entertained from the Contractor on this account. No extension of time shall be granted and no claim what so ever, of any kind, shall be entertained from the Contractor on account of delay attributable to the selection/rejection of the Specialized Agencies.

59 Safety Measures

(i) The issue of construction safety & standards has gained utmost importance in recent times. This subject is to be dealt with in an integrated manner with an approach to developing and establishing a safety culture at work sites. Broadly, its components are:

(i) Creating awareness.
(ii) Education.
(iii) Training.
(iv) Implementation.
(v) Enforcement measures.

All workers of contractor and associate agencies, invariably and at all the times, must follow all safety norms, adopt safe construction practices and use all required safety gadgets in their working throughout the project duration.

(ii) The contractor shall issue ***Photo Identity Cards*** with unique numbers containing salient information of workers for the labour & his staff.

(iii) The Contractor shall monitor and achieve the objectives of construction safety continuously, progressively and through affirmative action, and shall oversee implementation of safety program over the entire construction period.

(iv) Warning / Caution Boards

All temporary warning/caution boards/glow signage display such as “Construction Work in Progress”, “Keep Away”, “No Parking”, Diversions & protective Barricades etc. shall be provided and displayed during day time by the Contractor, wherever required and as directed by the Engineer-in-Charge. These glow signage and red lights shall be suitably illuminated during night also. The Contractor shall be solely responsible for damage and accident caused, if any, due to negligence on his part. Also he shall ensure that no hindrance, as far as possible, is caused to general traffic during execution of the work. This signage shall be dismantled & taken away by the Contractor after the completion of work, only after approval of the Engineer – in – Charge. Nothing extra shall be payable on this account.

(v) Sign Boards

- The Contractor shall provide and erect a display board of size and shape as required and paint over it, in a legible and workman like manner, the details about the salient features of the project, as required by the Engineer-in-Charge. The Contractor shall fabricate and put up a sign board in an approved location and to an approved design indicating name of the project, client/owner, architects, structural consultants, Department etc. besides providing space for names of other Contractors, Associate contractors and specialized agencies. Nothing extra shall be payable on this account.
- A display board shall be kept at site which would list the names of workers, teams and agencies following safety program in the best manner. This would be updated weekly.
- Necessary protective and safety equipment shall be provided to the Site Engineer, Supervisory staff, labour and technical staff of the contractor by the Contractor at his own cost and used at site.
- No inflammable materials including P.O.L shall be allowed to be stored in huge quantity at site. Only limited quantity of P.O.L may be allowed to be stored at site subject to the compliance of all rules/instructions issued by the relevant authorities and as per the direction of Engineer -in-Charge in this regard. Also, all precautions and safety measures shall be taken by the Contractor for safe handling of the P.O.L products stored at site. All consequences on account of unsafe handling of P.O.L shall be borne by the Contractor.

60 Insurance Policies:

(i) Before commencing the execution of work, the Contractor shall, without in any way limiting his obligations and liabilities, insure at his own cost and expense against any damage or loss or injury, which may be caused to any person or property, at site of work. The Contractor shall obtain and submit to the Engineer-in-Charge proper Contractor **All Risk Insurance Policy for an amount equivalent to 110% of the contract amount for this work**, with Engineer-in-Charge as the first beneficiary. The insurance shall be obtained in joint names of Engineer-in-Charge and the Contractor (who shall be second beneficiary). Also, he shall indemnify the Department from any liability during the execution of the work. Further, he shall obtain and submit to the Engineer-in-Charge, **a third-party insurance policy for maximum Rs. 25 lakh for each accident or any other incident or act of God or health hazard or biological attack**, with the Engineer-in-Charge as the first beneficiary. The insurance shall be obtained in joint names of Engineer-in-Charge and the Contractor (who shall be second beneficiary).

(ii) The Contractor shall, from time to time, provide documentary evidence as regards payment of premium for all the Insurance Policies for keeping them valid till the completion of the work. The Contractor shall ensure that Insurance Policies are also taken for the workers of his Sub-Contractors/specialized agencies also. The contractor including subcontractors shall provide comprehensive group insurance cover for all the workers and their supervisory staff deployed at site. The details of insurance cover to be provided shall be submitted by the contractor/associate agencies within 20 days of date of start. In case of a default, appropriate policy shall be got done by the safety monitoring committee and double the fee of the policy shall be recovered from the next bill of the contractor.

(iii) Without prejudice to any of its obligations and responsibilities specified above, the Contractor shall within 15 days from the date of letter of acceptance of the tender and thereafter at the end of each quarter submit a report to the Department giving details of the Insurance Policies along with Certificate of these insurance policies being valid, along with documentary evidences as required by the Engineer-in-Charge.

(iv) **No work shall be commenced by the Contractor unless he obtains the Insurance Policies as mentioned above.** Also, no payment shall be made to the Contractor on expiry of

insurance policies unless renewed by the Contractor. Nothing extra shall be payable on this account. No claim of hindrance (or any other claim) shall be entertained from the contractor on these accounts.

61 Applicable Permits:

(i) The contractor(s) shall give to the Municipality, police and other authorities all necessary notices etc. that may be required by law and obtain all requisite licenses for temporary obstructions, enclosures etc. and pay all fee, taxes including GST and charges which may be levied on account of these operations in executing the contract. He shall make good any damage to **the** adjoining property whether public or private and shall supply and maintain lights either for illumination or for cautioning the public at night.

(ii) The contractor shall ensure that applicable permits mandated by the local bodies and in case warranted for this work are obtained as required under the Applicable Laws.

62 Local Bye-Laws:

(i) The building work shall be carried out in the manner complying in all respects with the requirements of relevant bye-laws of the local body under the jurisdiction of which the work is to be executed or as directed by the Engineer-in-Charge and nothing extra shall be paid on this account.

(ii) Some restrictions may be imposed by the local police etc. on the working time and for movement of labour, materials etc. the contractor shall be bound to follow all such restrictions/instructions and nothing extra shall be payable on this account.

(iii) The contractor shall not stack building material/ malba on the road or on the land owned by any other authority, as the case may be. In case, the Contractor is found stacking the building material/ malba as stated above, he shall be liable to pay the stacking charges as may be levied by local body or authority and also to face penal action as per the rules, regulations and bye-laws of the said body or authority.

(iv) The Engineer-in-Charge shall be at liberty to recover the sums due but not paid to the concerned authorities on the above counts from any sums due to the contractor including amount of the Security Deposit or Retention Money in respect of this contract or any other contract.

63 Final Testing of The Installation:

The Contractor shall demonstrate trouble free functioning of all the Civil and E & M installations and services. The Engineer-in-Charge or his authorized representatives shall carry out final inspection of the various Civil and E & M services and installations. Any defect(s) noticed during demonstration shall be rectified by the Contractor at his own cost to the entire satisfaction of the Engineer-in-Charge. Nothing extra shall be payable on this account.

64 Local Body Approvals:

(i) WAPCOS shall get the architectural schemes/plans approved from all the local bodies whatever required before commencement of the construction work. The Contractor shall obtain the approvals & certificates required from local bodies & Fire safety department after completion of the work.

(ii) The contractor shall obtain all mandatory approvals and No Objection Certificate/ Consent for Establishment from local body authorities like local Fire department, local town planning authority, local ground water authority, local electricity supply authority, local pollution control board, Tree officers/ Authorities, Lift inspectorate, Central Electricity Authority etc., at his own cost required during construction/ Post construction

(iii) The contractor shall obtain Consent for establishment (CFE) and Consent for Operation (CFO) for the project, as well as for STP from Maharashtra state Pollution Control Board.

(iv) The contractor must prepare all the documents as required and submit them to the local statutory bodies under intimation to the Engineer-in-charge.

(v) The contractor shall at his own cost collect field samples and carry out all necessary tests required for submission of necessary applications.

(vi) The contractor must comply and, if necessary, resubmit applications as required by the local bodies.

(vii) All the statutory payments or fees made to all local bodies & other authorities will be reimbursed by the department on production of proof of such payments.

(viii) Two final copies/ sets of the documents prepared for submission to local bodies shall also be submitted to Engineer-in-Charge for record.

(ix) All the documents, designs, drawings created out of the contract work will become the sole property of the Department. The contractor should not use them anywhere else.

(x) The contractor shall obtain Completion certificates, Fire clearance certificates and occupancy certificate after completion of the project from statutory / local bodies before handing over of the completed buildings to the Department.

65 Occupation Certificate:

The contractor shall obtain occupation certificates/completion certificates from local bodies including getting the required site visits conducted by such authorities with a view to obtain the same. The final payment will be released to contractor as after submission of Occupancy Certificate from the local Municipal Corporation. This activity also including obtaining Fire Clearance Certificate for the completed building and services from the concerned Fire Services Department.

66 Dewatering:

(i) De-watering required, if any, shall be done conforming to BIS Code IS: 9759 (guide lines for de-watering during construction) and/or as per the specifications approved by the Engineer-in-Charge. Design of an appropriate and suitable dewatering system shall be the Contractor's responsibility. Such scheme shall be modified/augmented as the work proceeds based on fresh information discovered during the progress of work, at no extra cost. At all times during the construction work, efficient drainage of the site shall be carried out by the Contractor and especially during the laying of plain cement concrete, taking levels etc.

(ii) The Contractor shall also ensure that there is no danger to the nearby properties and installations on account of such lowering of water table. If needed, suitable precautionary measures shall be taken by the Contractor. Also, the scheme of dewatering adopted shall have adequate built in arrangement to serve as stand-bye to attend to repair of pumps etc. and disruption of power/fuel supply. Nothing extra shall be payable for all the operations described in this para.

(iii) In trenches where surface water is likely to get into cut/trench during monsoons, a ring bund of puddle clay or by any other means shall be formed outside, to the required height, and maintained

by the Contractor. Also, suitable steps shall be taken by the Contractor to prevent back flow of pumped water into the trench. Nothing extra shall be payable on this account.

a. For works below ground level the contractor shall keep that area free from water. If dewatering or bailing out of water is required, the contractor shall do the same at his own cost and nothing extra shall be paid except otherwise provided in the items of Schedule of Quantities.

b. The Contractor shall make all necessary arrangements for protecting from rains, fog or likewise extreme weather conditions, the work already executed and for carrying out further work, during monsoon including providing and fixing temporary shelters, protections etc. Nothing extra shall be payable on this account and also no claims for hindrance shall be entertained on this account.

c. In case of flooding of site on account of rain or any other cause and any consequent damage, whatsoever, no claim financially or otherwise shall be entertained notwithstanding any other provisions elsewhere in the contract agreement. Also, the Contractor shall make good, at his own cost, the damages caused, if any. Further, no claims for hindrance shall be entertained on this account.

d. The contractor will take reasonable precautions to prevent his workman and employees from removing and damaging any flora (plant/vegetation) from the project area.

67 ROAD

(i) The contractor shall at his own expense and risk arrange for construction of approach roads to the site of the work including land required for carrying out of all jobs connected with the execution & completion of the work. If during construction, it becomes necessary to remove or shift the stored materials shed, workshop, access roads, etc., to facilitate execution of any other work by any other agency, the contractor shall carry out the removal of shifting as directed by the Officer–in–charge and no claim whatsoever, shall be entertained on this account.

(ii) The site shall be handed over on as is where is basis and it shall be deemed that the contractor has satisfied himself as to the nature and location of the work, transport facilities, availability of land for setting up of camp, etc. the department will bear no responsibility for lack of such knowledge & the consequences thereof.

(iii) The available site for construction activities is very limited, and there is no surplus land available with the department for the construction of labour hutments, design mix plants, or the storage of bulk materials. The contractor is required to hire a suitable piece of land in the nearby areas for these purposes at their own cost and maintain it until the completion and handover of all project buildings.

(iv) The contractor must establish the labour camp according to the CPWD Model Rules, which include provisions for health and sanitary arrangements, as outlined in GCC-,along with CPWD specifications and the special conditions of the NIT. Stacking construction materials within the footprints of the buildings to be constructed is not permitted, as this would hinder the smooth progress and timely completion of the work. No claims for extensions of time (EOT) will be entertained regarding this matter.

(v) Contractor should maintain his labour camps at his own site, hired elsewhere close to the construction site, conforming to the Contract conditions and specifications/ Green building norms and Local body & health department regulations. No stagnant water leading to mosquito breeding shall be permitted at labour camps and contractor should ensure hygiene, health and sanitation of Workmen.

(vi) It shall be deemed that the contractor has satisfied himself as to the nature and location of the

work, transport facilities, availability of land for setting up of camp, etc. the department will bear no responsibility for lack of such knowledge & the consequences thereof.

68 Sample Room and Sample Toilets:

The Contractor is required to complete one sample room and one sample toilet block incorporating all relevant internal items including, painting, water supply and sanitary installations, electrical installations and services be completed for the approval of Engineer-in-charge within 9 (Nine) months from the date of start of work failing which a penalty of Rs. 50,000/- per day will be levied on the contractor which is non-refundable. All the material shall be approved within the sample room.

69 Please adhere to the following special conditions while executing the work:

(i) The preliminary Digital Survey, Geotechnical Investigation Survey and tree survey have already been carried out by WAPCOS, however, the contractor may carry out all above surveys for their own satisfaction including all the allied preliminary works before commencement of the work. If required, contractor shall carry out other surveys also.

(ii) Obtaining all Statutory Approvals for completion and occupation.

(iii) Consultancy Services for structural, landscaping and design of services for Civil, Electrical & Mechanical services etc. (MEP) as mentioned in details elsewhere in this tender document.

(iv) Tree Cutting/ transplantation of existing trees falling within the building foot prints and roads to be laid, after obtaining approval from tree authority/local body. The contractor shall also carry out the compensatory plantation in lieu of felled/cut trees as per requirement of tree authority and maintain these trees/plants at the location/site approved by tree authority till handing over of project to the client. Nothing extra shall be paid on this account. The quoted tendered amount is inclusive of all these operations.

(v) During construction phase the agency shall provide BIM (Building Information Model) 3D model of Minimum LOD 400. for Integration and Coordination of all services like plumbing, sanitary, Internal Electrical installations, Fire Fighting and Fire alarm, HVAC, LV services design, along with WBS (Work Breakdown Structure) for all buildings. The rates for the BIM software and manpower charges are inclusive of this and nothing extra shall be paid.

(vi) The responsibility of investigations, designing, planning, procurement, construction, safety, quality and risk of engineering rests with the contractor.

(vii) The buildings are to be designed and constructed conforming to Green Building norms in order to achieve and obtain best possible Green rating, i.e. At least Platinum rating as per latest IGBC norms or 4-star rating as per GRIHA norms.

(viii) The Agency shall obtain Electric Supply connection from power distributor and coordinate with the service provider for early granting of power connection to the campus. However, the payment to be made to power distributor will be done by the engineer-in-charge directly to power distributor.

(ix) The statutory payments or fees payable to the Local Bodies shall be reimbursed to the Contractor by WAPCOS upon production of proof of payment. Similarly, for E & M works all the statutory payments or fees payable to Government/Local body/Electricity Board shall also be reimbursed to the contractor upon production of proof of payment. The contractor shall obtain written prior permission

from the concerned Engineer-in-charge before making any such payments.

(x) The architectural drawings are prepared by the Architect appointed by WAPCOS and attached with tender documents. The Contractor shall prepare detailed drawings such as structural design & Drawings, furniture layout, and design & drawings of all services such as civil, electrical & mechanical services etc. complete as already mentioned elsewhere in this tender document.

(xi) All the above drawings shall be approved by the Competent Authority of WAPCOS after Review of PMC/ Architect and work shall be executed based on these drawings.

(xii) The scope of work shall include all activities/works starting from the given concept to Completion/ commissioning.

(xiii) The Contractor shall prepare and submit all As Built Drawings of buildings & services and other related documents both in hard copy and the soft copy after completion.

(xiv) The Contractor shall obtain Occupation Certificate from local body and hand over the completed project in habitable state to WAPCOS.

(xv) Structural design and preparation of drawings shall include Structural Planning, Framing and preparation of structural system. Structural analysis and design as per provisions contained in the latest and updated edition of all the relevant IS codes and submission of design calculations in hard as well as soft copies. Dynamic analysis shall be performed on approved software. Dynamic analysis, if required, shall be performed by Response Spectrum method using the design spectrum specified under relevant clause of IS code1893 (Latest and updated edition) & IS 16700. RC building frame system shall be designed to have a ductile failure and shall comply with the requirements given in IS 4326 and IS 13920. In the buildings with Dual frame system, the RC frame as well as the shear walls shall be designed and detailed to provide ductile behavior and comply with the requirements given in IS 4326 and IS 13920. Submission of design basis report and design calculation in hard as well as soft copy and preparation and supply of minimum 6 sets of GFC structural drawing.

(xvi) Proof Checking of the Structural Drawings shall be got carried out from Reputed Government Engineering Institutes like IITs, IISC as approved by the Engineer-in-charge. The fee for proof checking shall be paid by the Contractor directly to the Government Engineering College/Institute. All the submission of drawings, liaison & meetings with concerned officials shall be in the scope of Contractor.

(xvii) Scope of the work includes cost of labour, material, tools and plants and machinery required for execution of the whole project as per detailed design and Architectural drawings (supplied by WAPCOS) & (Structural and services) drawings developed by the contractor in accordance with the tender conditions. Details of the buildings to be constructed are given in Scope of work.

(xviii) The scope of work described here above provides, in general, the important activities of work but it is not exhaustive. There may be several incidental works, which are not specifically mentioned herein but will be necessary to complete the work in all respects. All such incidental works and cost thereof which are not mentioned specifically herein but are necessary to complete the work shall be deemed to have been included in the rate quoted by the agency. Nothing extra shall be payable beyond the rate quoted by the agency.

(xix) The design related documentation required to obtain green building rating shall be the responsibility of the Contractor. The contractor will establish coordination with the Architect appointed by WAPCOS and the authorities concerned for obtaining necessary IGBC/ GRIHA certification. Nothing extra shall

be paid by the department on this account.

(xx) All copyright and other proprietary rights in the works under this contract shall vest and stand assigned to the WAPCOS (Department). The department shall consequently own, absolutely and exclusively on a worldwide basis, the whole of property rights, title and interest including all copyright in the works, present or future, vested or contingent, generally and without limitation, for the whole term of the copyright, including the right to modify and/or make any alterations to the works and all the above rights shall not lapse even if such rights are not exercised by Department during the term of the copyright and the agency shall be required/obliged to execute any deeds/documents, as may be required or considered necessary, by Department to give effect to and secure the abovementioned rights of Department in the Works. For the purpose of this clause, the term "Works" shall include all "works" covered by the copyright Act 1957 including the design or documents prepared by the agency at the inception of, during the course of and until the completion of the Project and also includes any work created directly or indirectly in the performance of the obligations of the agency in connection with the Project.

(xxi) The agency shall not use or allow anyone to use these drawings, designs, documents, and software during and after the execution of this contract without the prior written permission of Department and any such act without the permission of Department shall constitute violation of Intellectual Property Rights.

(xxii) The rate quoted by the bidder is inclusive all the above operations and no additional claim will be admissible in this regard.

70 All payments in the form of Running Bills/ Final Bills Is are subjected to the submittal of the following documents to WAPCOS by the Contractor and verification of the said documents by owner/client of the respective billing month:

i. Compliance Reports to all Non-Compliance Reports (NCR), Red Flag Report or any such reports issued by Employer, PMC and/or the TPQA Consultant;
ii. All Quality Test Reports
iii. Monthly Progress Report (Physical and financial)
iv. Inspection reports towards site and material
v. Copy of Inspection Register
vi. Copy of Site Order Book
vii. All other relevant documents which shall be communicated by owner/client/PMC before commencement of any work

71 Other Conditions

a) Contractor shall use good quality Steel Props and steel shuttering material for RCC works. Use of wooden props and shuttering is affecting the line, level and alignment of RCC members. No payment shall be released for RCC work where use of wooden centering & shuttering material is noticed or reported.

b) All mass Reinforced Cement Concrete work shall be design mix concrete of specified grade and initial design mix shall be carried out from the NIT/IIT only immediately after award of work. The Design Mix report shall be submitted to WAPCOS before commencement of the RCC works at site.

c) The Contractor shall be responsible to co-ordinate with service provider/concerned authorities for cutting of trees, shifting of utilities and removal of encroachments etc. and making the site un-encumbered from the project construction area required for completion of work. This shall include initial and frequent follow up meetings/ actions/ discussions with each involved service provider/ concerned authorities. The contractor shall not be entitled for any additional compensation for delay in cutting of trees, shifting of utilities and removal of encroachments by the service provider/

concerned authorities.

d) Contractor shall provide R.O. Plant sufficient for workers employed at site, his technical staff and site staff.

e) Any cement slurry added over base surface (or) for continuation of concreting for better bond is deemed to have been in-built in the items and nothing extra shall be payable (or) extra cement considered in consumption on this account.

f) No payment shall be made for any damage caused by rain, snowfall, flood or any other natural calamity, whatsoever during the execution of the work. The Contractor shall be fully responsible for any damage to the govt. property and work for which the payment has been advanced to him under the contract and he shall make good the same at his risk and cost. The Contractor shall be fully responsible for safety and security of his material, T&P, Machinery brought to the site by him.

g) Wherever work is specified to be done or material procured through specialized agencies, their names shall be got approved well in advance from Engineer-in-Charge. Failure to do so shall not justify delay in execution of work. It is suggested that immediately after award of work, Contractor should negotiate with concerned specialist agencies and send their names for approval to Engineer-in-Charge. Any material procured without prior approval of Engineer-in-Charge in writing is liable to be rejected. Engineer-in-Charge reserves right to get the materials tested in laboratories of his choice before final acceptance. Nonstandard materials shall not be accepted.

h) The construction joints shall be provided in predetermined locations & as per the approved drawings only.

i) The Contractor shall invariably prepare the samples of finishing items i.e. flooring of different types, external & internal finishing i/c colour scheme of paint, tiles in dado, flooring in platforms & staircase, water supply & sanitary fittings and any other item as per direction of Project Manager, WAPCOS. The Contractor shall proceed with further finishing items only after getting the samples of these items approved in writing from Engineer-in-Charge. No extra claim whatsoever beyond the payments due at agreement rates will be entertained from the Contractor on this account.

j) Contractor shall not divert any advance payments or part thereof for any work other than that needed for completion of the contracted work. All advance payments received as per terms of the contract (i.e., mobilization advance, secured advance against materials brought at site, secured advance against plant & machinery and/or for work done during interim stages, etc.) are required to be re-invested in the contracted work to ensure advance availability of resources in terms of materials, labour, plant & machinery needed for required pace of progress for timely completion of work.

k) Any Circular/Guidelines/SOP issued by the Principal Employer/ Government during the progress/ execution of the construction work shall be followed by the contractor without any dispute. The contractor shall comply with proper and legal orders and directions of the local or public authority or municipality and abide by their rule and regulations and pay all fees and charges which he may be liable.

l) All the modifications and any additional works (basic requirement after use of premises by user) suggested by Principal Employer at the time of handing over of the project and after occupancy of premises by Principal Employer during Defect Liability Period must be taken up by contractor without any disputes.

m) If any dispute/ hindrance may arise during construction due to any reason whatsoever, the contractor is not liable for any financial claim or damages due to such circumstances.

n) If the work is carried out in more than one shift or during night, no claim on this account shall be entertained. The contractor has to take permission from the police & local authorities etc. if required for work during night hours. No claim / hindrance on this account shall be considered if work is not allowed during night time. The requisite supervision shall be made available by the WAPCOS along with necessary issue of material under joint custody.

o) In case of any inconsistency between clauses, the clause favourable/ beneficiary to the project will prevail that will be decided by the Principal Employer and Employer.

p) One sample room complete in all shape for each category, shall be prepared by the contractor and

got approved from Engineer-in-charge in writing. The contractor shall be allowed to proceed with further rooms only after getting the sample room approved in writing from Engineer-in-charge No extra claim whatsoever beyond the payments due at agreement rates will be entertained from the contractor on this account.

q) It must be ensure that all materials to be used in work bear BIS certification mark. In cases where BIS certification system is available for a particular material/product but not even a single producer has so far approached BIS for certification the material can be used subject to the condition that it should confirm to CPWD specification and relevant BIS codes. In such case written approval of the Engineer-In-Charge may be obtained before use of such material in the work.

r) In case of works where a ready mix concrete (RMC) is stipulated to be used from an approved source/manufacturer, cement register need not be maintained. However, the computerized dispatch slips that are sent with each dispatch of RMC shall be kept as record.

Special Conditions for Quality Assurance/Testing Of Materials

1. QUALITY ASSURANCE/TESTING OF MATERIALS:

1.1 Water tanks, taps, sanitary, water supply & drainage pipes, fittings & accessories should conform to bye-laws of local body/corporation, where CPWD specifications are not available. The Contractor (s) should engage approved, licensed plumbers for the work and get the materials (fixtures/fittings) tested, by the municipal Body/Corporation authorities wherever required at his own cost. The Contractor shall submit for the approval of the Engineer-in-Charge, the name of the plumbing agency (along with their working experience in recent past) proposed to be engaged by him.

1.2 With each Running Bill, the details of test carried out shall be submitted by the contractor as per Performa given in the tender document.

1.3 Samples of materials required for testing shall be provided free of charge by the contractor. The contractor shall provide at his own cost suitable weighing and measuring arrangements at site for checking the weight / dimension as may be necessary. As per Clause 10A of the GCC, the contractor shall be required to hand over sealed samples of testing materials, and payment of testing charges will be made to the testing laboratories. All expenditures to be incurred for testing of samples, including packing, sealing, transportation, loading, unloading, testing charges, etc., shall be borne by the Contractor. The Engineer-in-charge will not reimburse these expenditures, regardless of whether the tested material passes or fails.

1.4 The Contractor shall at his own risk and cost make all arrangements and shall provide all such facilities including material and labour, the Engineer-in-Charge may require for collecting, preparing, forwarding the required number of samples for testing as per the frequency of test stipulated in the contract specifications or as considered necessary by the Engineer-in-Charge, at such time and to such places, as directed by the Engineer-in-Charge. Nothing extra shall be payable for the above.

1.5 The Contractor or his authorized representative shall associate in collection, preparation, forwarding and testing of such samples. In case he or his authorized representative is not present or does not associate him, the result of such tests and consequences thereon shall be binding on the Contractor. The Contractor or his authorized representative shall remain in contact with the Engineer-in–Charge or his authorized representative associated for all such operations. No claim of payment or claim of any other kind, whatsoever, shall be entertained from the Contractor.

1.6 Maintenance of Register of Tests: -

(i) All the registers of tests carried out a Construction Site or in outside laboratories shall be maintained by the contractor which shall be issued to the contractor by Engineer-in-Charge.

(ii) All Samples of materials including Cement Concrete Cubes shall be taken jointly with Contractor by representative of the Engineer in Charge. All the assistance shall be provided by the

contractor. Cost of sample materials is to be borne by the contractor and he shall be responsible for safe custody of samples to be tested at site.

(iii) All the test in field lab setup at Construction Site shall be carried out by the Engineering Staff deployed by the contractor which shall be 100% witnessed by representative of the Engineer in Charge.

(iv) All the entries in the registers will be made by the designated Engineering Staff of the contractor and same should be regularly reviewed by Engineer in Charge or his representative.

(v) Contractor shall be responsible for safe custody of all the test registers.

1.7 Extensive testing of the materials used for construction is a pre-requisite for attaining high quality of the work. This shall also require specialized tests, physical, chemical, ultrasonic, x-ray and various other types of tests which cannot possibly be carried out in a site laboratory. These tests also require specialized personnel who regularly deal in such testing. Therefore the need arises for carrying out the tests in outside laboratories. These laboratories may be in the Govt. sector, Semi Govt. or Private sector. All Govt. Institutes, Indian Institute of Technology, National Institute of Technology, Central and State funded laboratories stands approved. No approval is required for testing in these laboratories/institutes.

At least 10% of sample as per frequency of tests as per standard Codes shall be tested from any IIT Lab/ NIT Lab/ Govt. Lab/ Govt. Engineering College approved by WAPCOS.

However, testing of material in any Govt. Lab / Public Undertaking Lab / IIT or NIT Lab / Govt. Engineering College may be allowed by WAPCOS, provided these labs have all necessary facility to carry out the required tests.

1.8 Ultrasonic pulse velocity test shall be conducted on at least 5% of the total number of RCC members in each category i.e., beam, column, slab and footing for ensuring quality of concrete as per directions of Engineer- in charge. The cost of the same shall be borne by the contractor.

1.9 In case there is any discrepancy in frequency of testing as given in list of mandatory tests and that in individual sub-heads of work as per CPWD Specifications higher of the two frequencies of testing shall be followed and nothing extra shall be payable on this account.

1.10 The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material / work beyond set out tolerance limit shall be summarily rejected by the Engineer-in-charge & contractor shall be bound to replace / remove such sub-standard / defective work immediately. If any material, even though approved by Engineer-In-Charge is found defective or not conforming to specifications shall be replaced / removed by the contractor at his own risk & cost.

1.11 Removal of rejected/sub-standard materials.

The following procedure shall be followed for the removal of rejected/sub-standard materials from the site of work:

(i) Whenever any material brought by the contractor to the site of work is rejected, entry thereof should invariably be made in the Site Order Book under the signature of the Engineer-In-Charge, giving the approximate quantity of such materials.

(ii) As soon as the material is removed, a certificate to that effect shall be recorded by the Engineer-In-Charge against the original entry, giving, the date of removal and mode of removal, i.e., whether by truck, carts, or by manual labour. If the removal is by truck, the registration number of the truck should be recorded.

(iii) When it is not possible for the Engineer-In-Charge to be present at the site of work at the time of actual removal of the rejected/sub-standard materials from the site, the required certificate should be recorded by the Authorized Representative of PMC, and the

Engineer-In-Charge should countersign the certificate recorded by the Authorized Representative.

1.12 In addition to the supervision of work by PMC engineers, the Architects deployed by the Client, and Third party Quality Control/Assurance Team shall also be carrying out regular and periodic inspection of the ongoing activities in the work and deficiencies, shortcomings, inferior workmanship pointed out by them shall be communicated by PMC engineers to the contractor. Upon receipt of instructions from Engineer in Charge these are also to be made good by necessary improvement, rectification, replacement upto his complete satisfaction.

1.13 Special attention shall be paid towards line and level of internal and external plastering, exposed smooth surface of RCC members by providing fresh shuttering plates, rubberized linings to all the shuttering joints, accurate joinery work in wooden doors and windows, thinnest joints in stone/tiling/cladding work, non-hollowness in floor and dado tiles work, protection of scratches over flooring by impounding layer of plaster of Paris, water tight pipe linings, absence of hollow vertical joints in brick masonry, proper compaction of filled up earth etc. to achieve an Institution of International standards and up keeping of quality assurance shall be of paramount importance, as such.

1.14 The Contractor shall submit, within 90 days after the date of award of work, a detailed and complete method statement for the execution, testing and Quality Assurance, of such items of works, as directed by the Engineer-in-Charge. All the materials to be used in the work, to give the finished work complete in all respects, shall comply with the requirements of the specifications and shall pass all the tests required as per specifications as applicable or such specifications/standards as directed by the Engineer-in-Charge. However, keeping the Quality Assurance in mind, the Contractor shall submit, on request from the Engineer-in-Charge, his own Quality Assurance procedures for basic materials and such items, to be followed during the execution of the work, for approval of the Engineer-in-Charge.

2. FIELD LABORATORY

The contractor has to establish within 90 days from the award of work a field laboratory at site including all necessary equipment and skilled manpower for the Field Tests as indicated in the tender document at his own cost to have proper quality control Rs. 10,000/- per day shall be recovered from the contractor for any delay beyond the specified period. If contractor fails to establish lab within additional period of 90 days, the Engineer in charge shall initiate action as deemed fit under relevant clauses of the agreement.

For performing the above tests, the Field Testing Equipment and Instruments as indicated in the tender document are to be arranged and maintained by the contractor at his own cost.

2.1 The contractor shall ensure quality construction in a planned and time bound manner. Any sub-standard material/work beyond set-out tolerance limit shall be summarily rejected by the Engineer-in-Charge & contractor shall be bound to replace/remove such sub-standard/defective work immediately.

2.2 The list of Laboratory/Field equipment referred above is to be arranged and maintained by the contractor at the site of work. In case the equipment required for any test is not available at site, the department shall get the test conducted from the third party. However, in that event, besides providing free materials of sample, the cost of taking of sample, packing, transportation, testing charges etc. shall be borne by the contractor irrespective of the results.

3. SAMPLE OF MATERIALS: -

3.1 All materials and fittings brought by the contractor to the site for use shall conform to the samples approved by the Engineer-in-Charge which shall be preserved till the completion of the work. If a particular brand of material is specified in the item of work in DBR/ Specifications, the same shall be used after getting the same approved from PMC & Engineer-In-Charge. The contractor shall submit the samples as per **Make approved by Engineer-in-charge** for

approval of PMC & Engineer-in-Charge. For all other items, ISI Marked materials and fittings shall be used with the approval of Engineer- in-Charge. Wherever ISI Marked material/fittings are not available, the contractor shall submit samples of materials/fittings manufactured by firms of repute conforming to relevant Specifications or IS codes for the approval of Engineer-in-Charge.

3.2 The Contractor shall procure and provide all the materials from the manufacturers/suppliers as per the list attached with the tender documents, as per the item description and particular specifications for the work. The equivalent brand for any item shall be permitted to be used in the work, only when the specified make is not available. This is, however, subject to documentary evidence produced by the contactor for non-availability of the brand specified and also subject to independent verification by the Engineer-in-Charge. In exceptional cases, where such approval is required, the decision of Engineer-in-Charge as regards equivalent make of the material shall be final and binding on the Contractor. No claim, whatsoever, of any kind shall be entertained from the Contractor on this account. Nothing extra shall be payable on this account. Also, the material shall be procured only after written approval of the Engineer-in-Charge.

3.3 To avoid delay, contractor should submit samples/as stated above well in advance so as to give timely orders for procurement. If any material, even though approved by Engineer-in-Charge is found defective or not conforming to specifications shall be replaced/removed by the contractor at his own risk &cost. Samples including brand/quality of materials and fittings to be used in the work shall be got approved from the Engineer-in-Charge, well in advance of actual execution and shall be preserved till the completion of the work.

3.4 BIS marked materials except otherwise specified shall also be subjected to quality test besides testing of other materials as per the specifications described for the item/material. Wherever BIS marked materials are brought to the site of work, the contractor shall, furnish manufacturer's test certificate or test certificate from approved testing laboratory to establish that the material procured by the contractor for incorporation in the work satisfies the provisions of specifications relevant to the material and / or the work done.

BIS marked items (except cement & steel for which separate provisions have been made) required on the work shall be got tested, for only important tests, which govern the quality of the product, as decided by the Engineer-in-Charge. The frequency of such tests (except the mandatory test) shall be 5% of the frequency as specified in BIS. For mandatory test, frequency shall be as specified in the CPWD Specifications.

3.5 For certain items, if frequency of tests is neither mentioned in the CPWD Specifications nor BIS, then tests shall be carried out as per directions of Engineer-in- Charge.

3.6 **PRE DISPATCH INSPECTION OF EQUIPMENTS/ MATERIALS**

3.6.1 Necessary dispatch clearance for all bought out items/ equipment's shall be accorded by executing site. Inspection of the items, based on the criticality, shall also be carried out by executing site.

3.6.2 The transformer and Diesel generator sets shall mandatorily be tested for routine and acceptance tests as per the relevant IS/IEC standards. Clients may witness the tests as per requirement.

3.6.3 The type test report for transformer, diesel engine and alternator as per relevant standards shall be submitted for purchaser's approval.

3.6.4 Employer/ PMC reserves the right to inspect all the material before dispatch. However, depending upon nature of material, waiver of inspection may be granted for which the Contractor shall take prior approval of the Employer. This will be done on case to case basis.

3.6.5 The Contractor shall submit the for the Items along with Technical Data Sheets for the items to be procured for the approval of Engineer-In-Charge (EIC). Upon the written approval of the EIC/ PMC, the contractor place the order for procurement. Whenever, the material is ready, the Contractor shall submit the Quality Assurance Plan (QAP) to EIC for approval and upon approval the date of factory inspection shall be scheduled.

3.6.6 Wherever items of Pipes/ Pumps/ Water Meters/ STP equipment's/ Electrical Panels/ Transformers/ HVAC/ Fire-fighting/ LV/ Cables etc. are involved in the tender, factory inspection shall be done by the department & PMC. The necessary arrangement for air travel, Lodging, Boarding, Local Vehicle for factory visit in India or abroad shall be made by the Contractor at his cost for the staff of PMC and Employer.

3.6.7 All the Items/ Equipment's shall be submitted with Third Party Inspection Reports.

2.0 CEMENT & STEEL REINFORCEMENT

Contractor has to procure Cement and Steel and has to produce manufacturers test certificate and challan for each lot of Cement & Steel Reinforcement procured at site.

2.1 CEMENT: -

The contractor shall procure 43 grade ordinary Portland Cement (OPC) conforming to latest version of relevant IS code/ Portland Pozzolana Cement (PPC) / Sulphate Resistant Cement (SRC) conforming to latest version of relevant IS code as required in the work as per specifications/particular specifications of buildings from reputed manufacturers of cement as per **Make approved by Engineer-in-charge** or from any other reputed cement manufacture having a production capacity not less than 1 million Ton per annum as approved by WAPCOS after review by PMC**.** The cement of approved make as aforesaid in 50 kg bags bearing manufacturer's name and ISI marking, along with manufacturers test certificate for each lot shall be procured by the contractor. Portland Pozzolana Cement is to be used for RCC works only subject to fulfillment of conditions of circular No. CDO/SE (RR)/Fly ash (MAN) 02 dated 09.04.09. However, if the contractor uses higher grade of cement or uses OPC only nothing extra shall be paid. The use of PPC shall be regulated as per the following conditions stipulated in the circular dated 09.04.2009: -

a. IS:456-2000 Code of Practice for Plain and Reinforced Concrete (as amended up to date) shall be followed in regard to Concrete Mix Portion and its production as under:
    1. The Concrete Mix Design shall be done as "Design Mix Concrete" as prescribed in clause-9 of IS 456 mentioned above.
    2. Concrete shall be manufactured in accordance with clause 10 of above mentioned IS:456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.
b. Minimum M-35 grade of concrete shall be used in all structural elements of RCC, both in load bearing and framed structure & Minimum M-30 grade Concrete in all other Works than Buildings.
c. The mechanical properties such as modulus of elasticity, tensile strength, creep and shrinkage of fly ash mixed concrete or concrete using fly ash blended cements (PPCs) are

not likely to be significantly different and their values are to be taken same as those used for concrete made with OPC.

d. To control higher rate of carbonation in early ages of concrete both in fly ash admixed as well as PPC based concrete, water/binder ratio shall be kept as low as possible, which shall be closely monitored during concrete manufacture.
e. If necessitated due to low water / binder ratio, required workability shall be achieved by use of Chloride free chemical admixtures conforming to IS: 9103. The compatibility of chemical admixtures and super plasticizers with each set of OPC, fly ash and / or PPC received from different sources shall be ensured by trails.
f. In environment subjected to aggressive chloride or sulphate attack in particular, use of fly ash admixed or PPC based concrete is recommended. In case, where structural concrete is exposed to excessive magnesium sulphate, fly ash substitution/content shall be limited to 18% by weight. Special type of cement with low C3A content may also be alternatively used. Durability criteria like minimum binder content and maximum water/binder ratio also need to be given due consideration in such environment.
g. Wet curing period shall be enhanced to a minimum of 10 days or its equivalent.
h. In hot & arid regions, the minimum curing period shall be 14 days or its equivalent.
i. Subject to General Guidelines detailed out as above, PPC manufactured conforming to IS:1489 (Part-I) shall be treated at par with OPC for manufacture of Design Mix Concrete for structural use in RCC.
j. Till the time, BIS makes it mandatory to print the %age of fly ash on each bag of cement, the certificate from the PPC manufacturer indicating the same shall be insisted upon before allowing use of such cements in works.
k. While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

- Samples of cement arranged by the contractor shall be taken by the Engineer-in- Charge and got tested in accordance with provisions of relevant BIS Codes. The cement for such testing purpose shall be supplied by the contractor free of charge. In case test results indicate that the cement arranged by the contractor does not conform to the relevant BIS Codes, the same shall stand rejected and shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-in-Charge or his authorized representative to do so. The cost of tests shall be borne by the contractor.
- Cement shall be brought at site in bulk supply of approximately 200 tones or as decided by the Engineer-in-Charge.
- OPC & PPC bags shall be stored in separate godowns. Separate godowns for tested cement and fresh cement (under testing) to be constructed by the contractor at his own cost as per sketches given in C.P.W.D Specifications having weather-proof roofs and walls. The size of the cement godown is indicated in the sketches for guidance. The actual size of godown shall be as per site requirements and nothing extra shall be paid for the same. Each godown shall be provided with a single door with two locks. The keys of one lock shall remain with Engineer-in-Charge or his authorized representative of the work and that of other lock with the authorized agent of the contractor at the site of work so that the cement is issued from godown according to the daily requirement with the knowledge of both parties.

The account of daily receipt and issue of cement shall be maintained in a register in the prescribed proforma and signed daily by the contractor or his authorized agent and Engineer-in-Charge or his authorized representative in token of its correctness. The day to day receipt and issue accounts of different grade/brand of cement shall be maintained separately in the standard proforma by the contractor or his authorized representative which shall be duly signed by the authorized representative of the Engineer-in-Charge before issue to the work on day to day basis.

Required number of cement godowns each having capacity as decided by the Engineer-in-Charge shall be constructed by the contractor at site of work for which no extra payment shall be made. The contractor shall be responsible for the watch and ward and safety of the cement go-downs. The contractor shall facilitate the inspection of the cement go-downs by the Engineer-in-Charge at any time.

The pages of the register should be machine numbered and each page initialed by the PMC In-charge. The cement godown and the register are required to be checked by the PMC In- charge of the work fortnightly.

- The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in the contract. The theoretical consumption of cement shall be worked out as per the procedure prescribed in Clause-38 of the contract and shall be governed by the conditions laid therein.

- If the quantity of cement actually used in the work is found to be more than the theoretical quantity of cement including authorized variation, nothing extra shall be payable to the contractor on this account. In the event of it being discovered that after the completion of the work, the quantity of cement used is less than the quantity ascertained as herein before provided (allowing variation on the minus side as stipulated in Clause- 38), the cost of quantity of cement not so used shall be recovered from the contractor as specified in schedule. Decision of the Engineer-in- Charge in regard to theoretical quantity of cement which should have been actually used as per the schedule and recovered at the rate specified, shall be final and binding on the contractor.

  For non-scheduled items, the decision of the Engineer-In-Charge regarding theoretical quantity of the cement, which should have been actually used, shall be final and binding on the contractor.

- Cement brought to site and cement remaining unused after completion of work shall not be removed from site without written permission of the Engineer-in-Charge.

- Damaged Cement shall be removed from site immediately by the contractor on receipt of notice in writing from the Engineer-in-charge. If he does not do so within three days of receipt of such notice, the Engineer-in-charge shall get it removed at the cost of the contractor.

- In case the contractor brings surplus quantity of cement the same shall be removed from the site after completion of work by the contractor at his own cost after approval of the Engineer-in-Charge.

- In case cement has been stored for over six (06) months from the date of manufacture or for any reason the stored cement shown sign of deterioration and contamination it shall be tested prior to use in the work.
- The sample shall be taken within three weeks of the delivery and all the tests shall be commenced within one week of sampling and not later than 03 months from the receipt of sample for testing.
- After completion of previous test if cement is stored more than 03 months, it shall be retested before use.

2.1.1 **Compressive Strength of Cement**

The average compressive strength of at least three mortar cubes (area of face 50 cm^2) composed of one part of cement, three parts of standard sand (conforming to IS 650:1996) by mass and P/4+3.0 percent (of combined mass of cement plus sand) water, and prepared, stored and tested in the manner described in IS 4031 (Part 6): 1988, shall be as follows:

a. 72±1 hour not less than 23 MPa

b.	168±2 hour not less than	33 MPa
c.	672±4 hour not less than	43 MPa

Compressive strength of PPC

a.	a) 72±1 hours, not less than	16 MPa
b.	b) 168±2 hours, not less than	22 MPa
c.	c) 672±4 hours, not less than	33 MPa

NOTE: - P is the percentage of water required to produce a paste of standard consistency (see as below)

Consistency of Standard Paste: -

The quantity of water required to produce a paste of standard consistency, to be used for the determination of the water content mortar for the compressive strength tests and for the determination of soundness and setting time, shall be obtained by the method described in IS 4031 (part 4) : 1988.

2.2 Sulphate Resisting Cement (SRC):-

SRC is a special type of cement designed to withstand the harmful effects of sulphate salts present in soil or water. These sulphates can react with ordinary cement and cause expansion, cracking, and deterioration of concrete over time. It has been provided in the project to enhance the durability and longevity of concrete in areas exposed to sulphate-bearing soil and groundwater. SRC is a specially manufactured cement with low tricalcium aluminate (C_3A) content, which minimizes the chemical reaction between cement and sulphates that typically leads to expansion, cracking, and structural deterioration.

Its use is particularly important for foundations, substructures, and other elements in contact with aggressive environments, as it significantly reduces the risk of sulphate attack and ensures long-term structural stability.

1.Scope

This specification covers the supply, testing, and use of Sulphate Resisting Cement for construction works exposed to sulphate-bearing soils, groundwater, sewage environments, marine conditions, and aggressive chemical exposure.

2. Applicable Standards

Sulphate Resisting Cement shall conform to the requirements of:

- IS 12330: Specification for Sulphate Resisting Portland Cement
- Relevant provisions of IS 456 (Plain and Reinforced Concrete – Code of Practice)
- IS 4031 (Methods of Physical Tests for Hydraulic Cement)
- IS 269 / IS 8112 (as applicable for base cement comparison)

3. Material Description

Sulphate Resisting Cement is a specially manufactured Portland cement with a low tricalcium aluminate (C_3A) content, typically not exceeding 5%, to enhance resistance against sulphate attack and prevent deterioration of concrete in aggressive environments.

4. Chemical Requirements

- Tricalcium aluminate (C_3A): ≤ 5%
- Loss on ignition: As per IS limits
- Insoluble residue: As per IS limits
- Magnesia content: ≤ 6%
- Sulphuric anhydride (SO_3): Within permissible limits as per IS 12330

5. Physical Requirements

- Fineness: Minimum 225 m²/kg (Blaine's air permeability method)
- Setting Time:
  - Initial setting time: Not less than 30 minutes
  - Final setting time: Not more than 600 minutes
- Soundness:
  - By Le Chatelier method: ≤ 10 mm
- Compressive Strength:
  - 3 days: ≥ 16 MPa
  - 7 days: ≥ 22 MPa
  - 28 days: ≥ 33 MPa

6. Properties and Performance

- High resistance to sulphate attack from soil and groundwater
- Reduced risk of expansion and cracking due to chemical reactions
- Improved durability in marine and sewage environments
- Lower heat of hydration compared to Ordinary Portland Cement
- Enhanced long-term structural integrity in aggressive conditions

7. Storage and Handling

- Cement shall be stored in dry, leak-proof godowns
- Bags shall be stacked on raised platforms and protected from moisture
- Different types of cement shall be stored separately and clearly identified
- Cement older than 3 months shall be retested before use

8. Application Guidelines

- Recommended for foundations in sulphate-bearing soils
- Suitable for sewage treatment plants, marine structures, basements, and substructures
- Proper water-cement ratio shall be maintained to ensure durability
- Adequate compaction and curing (minimum 7–10 days) shall be ensured
- Use of compatible admixtures may be allowed as per design requirements

9. Quality Control and Testing

- Each batch shall be accompanied by manufacturer's test certificate
- Random sampling and testing shall be carried out as per IS 4031
- Field tests for setting time and strength shall be conducted periodically
- Cement failing to meet specifications shall be rejected

10. Safety and Environmental Considerations

- Proper PPE (gloves, masks) shall be used during handling
- Avoid inhalation of cement dust
- Waste disposal shall comply with environmental regulations

3. Admixture – Bipolar Corrosion Inhibitor: -

Admixture - Bipolar Corrosion Inhibitor has been incorporated in the project in the concrete to enhance the durability and protection of embedded steel reinforcement. It is a specialized chemical admixture that provides dual (anodic and cathodic) protection by forming a protective molecular layer on

the steel surface, thereby reducing the electrochemical reactions responsible for corrosion. It limits the ingress and harmful effect of chlorides, moisture, and oxygen.
Its use is particularly important in structures exposed to moisture, chlorides, and other aggressive environmental conditions, where corrosion of reinforcement can lead to cracking, spalling, and reduction in structural strength. By minimizing corrosion risk, it significantly improves the service life and reliability of the structure.

1. Scope

The supply, testing, and use of bipolar corrosion inhibiting admixture in reinforced concrete to enhance durability and protect embedded steel reinforcement against corrosion in aggressive environments.

2. Description

Bipolar corrosion inhibitor is a **liquid chemical admixture** based on organic compounds (such as amino alcohols) that acts on both anodic and cathodic sites of steel reinforcement. It forms a protective molecular layer on the steel surface, reducing electrochemical corrosion reactions and delaying the onset of corrosion.

3. Applicable Standards

- IS 456: Plain and Reinforced Concrete – Code of Practice
- IS 9103: Specification for Concrete Admixtures
- ASTM C1582: Standard Specification for Admixtures to Inhibit Chloride-Induced Corrosion of Reinforcing Steel in Concrete
- Relevant clauses of IS 2645 (where applicable)

4. Material Requirements

Property	Specification
Type	Bipolar corrosion inhibiting admixture
Form	Liquid
Colour	As per manufacturer
Density	~1.00 – 1.10 kg/l
pH Value	8 – 11
Chloride Content	Nil or within permissible limits
Compatibility	Compatible with OPC, PPC, PSC, SRC and other admixtures

5. Functional Characteristics

- Dual action (anodic + cathodic) corrosion inhibition
- Reduces corrosion rate of reinforcement
- Delays initiation of chloride-induced corrosion
- Forms protective film on steel surface
- Improves durability and service life of concrete
- Does not adversely affect compressive strength when used as recommended

6. Dosage

- Typical Range: **1% to 3% by weight of cementitious material**
- Typical dosage: **10–12 kg/m³ of concrete**
- Exact dosage shall be determined through laboratory trials based on exposure conditions
- Higher dosage may be required in severe marine or sulphate environments

7. Method of Application

- Admixture shall be added to concrete during batching along with mixing water
- Can be added at batching plant or transit mixer
- Shall not be added to dry cement
- Proper mixing shall be ensured for uniform distribution
- Water-cement ratio shall be maintained as per design mix
- Minimum mixing time: **1 minute per m³**

8. Uses / Applications

Recommended for structures exposed to aggressive conditions such as:

- Marine and coastal structures
- Foundations in sulphate-bearing or contaminated soil
- Sewage treatment plants and drainage works
- Bridges, flyovers, and highways exposed to chlorides
- Basements, retaining walls, tunnels, and water-retaining structures

9. Performance Requirements

- Reduction in corrosion current density as per ASTM standards
- No significant adverse effect on setting time and workability
- Compressive strength shall meet design requirements
- Improved resistance to chloride ingress and moisture penetration

10. Storage and Handling

- Store in original sealed containers
- Protect from extreme temperatures and direct sunlight
- Shelf life: As per manufacturer (generally 12 months)
- Stir or agitate before use if required

11. Quality Control and Testing

- Manufacturer’s test certificate shall be provided for each batch
- Trial mixes shall be conducted before bulk use
- Regular testing of fresh and hardened concrete properties
- Corrosion performance may be verified by half-cell potential or other approved methods

12. Safety Precautions

- Use personal protective equipment (PPE) during handling
- Avoid inhalation and direct contact with skin/eyes
- Follow manufacturer’s Material Safety Data Sheet (MSDS)

4. Soil Stabilization:-

Soil Stabilization has been adopted in this project due to the prevailing poor subsoil conditions, which are unsuitable for directly supporting structural loads. The in-situ soil exhibited characteristics such as low bearing capacity, high plasticity, excessive compressibility, and moisture susceptibility, necessitating ground improvement measures.

The stabilization process involves mechanical and/or chemical modification of soil using suitable agents such as cement, lime, or approved chemical admixtures to enhance shear strength, California Bearing Ratio (CBR), compaction properties, and resistance to volumetric changes. This treatment ensures improved load distribution, reduced settlement potential, and enhanced durability of the foundation strata.

1. Scope

This specification covers the stabilization of in-situ soil using mechanical and/or chemical methods to improve its engineering properties such as strength, bearing capacity, durability, and resistance to moisture for use in foundations, pavements, and subgrades.

2. Applicable Standards

- IS 2720 (Relevant Parts): Methods of Test for Soils
- IS 4332 (Part 1 to 5): Soil Stabilization Guidelines
- IS 1498: Classification and Identification of Soils
- IS 456: Plain and Reinforced Concrete (where applicable for stabilized layers)
- IRC Guidelines for Road Construction (for subgrade and pavement works)

3. Materials

3.1 Soil

- Soil shall be free from organic matter, roots, and deleterious substances
- Classification shall be done as per IS 1498
- Soil suitability shall be verified through laboratory tests (CBR, Atterberg limits, gradation)

3.2 Stabilizing Agents

Depending on site conditions, one or a combination of the following may be used:

- Cement Stabilization: OPC/PPC conforming to relevant IS codes
- Lime Stabilization: Hydrated lime conforming to IS 712
- Fly Ash Stabilization: As per IS 3812
- Chemical Stabilizers: Approved proprietary products (enzymes, polymers, etc.)
- Bituminous Stabilization: For specific applications (roads)

4. Laboratory Investigation

Prior to execution, the following tests shall be conducted:

- Grain size analysis
- Atterberg limits (LL, PL, PI)
- Maximum Dry Density (MDD) and Optimum Moisture Content (OMC)
- California Bearing Ratio (CBR) test (soaked and unsoaked)
- Unconfined Compressive Strength (UCS), where applicable

Trial mixes shall be carried out to determine optimum dosage of stabilizing agent.

5. Equipment

- Mechanical mixer / rotavator
- Water tanker with sprinkler system
- Compaction equipment (roller: vibratory/sheepsfoot/pneumatic)
- Grader for leveling and shaping

6. Methodology of Execution

6.1 Site Preparation

- Clear site of vegetation and debris
- Scarify soil to required depth (generally 150 mm to 300 mm)
- Break clods to uniform size

6.2 Application of Stabilizer

- Stabilizing agent shall be spread uniformly as per approved dosage
- Dry mixing shall be carried out thoroughly

- Water shall be added to bring moisture content close to OMC

6.3 Mixing

- Mixing shall be done using mechanical means to achieve uniform blend
- Ensure no lumps or untreated pockets remain

6.4 Compaction

- Compaction shall be carried out immediately after mixing
- Achieve minimum **95% to 98% of MDD** as per IS standards
- Rolling shall continue till desired density is achieved

6.5 Finishing

- Surface shall be leveled and trimmed to required grade and camber
- Proper surface finish shall be ensured

6.6 Curing

- For cement/lime stabilization: curing shall be done for **7 days minimum**
- Moisture shall be maintained by sprinkling water or covering with polythene

7. Quality Control

- Field density test (sand replacement/core cutter method)
- Moisture content checks
- CBR tests on stabilized soil
- UCS test (if applicable)
- Thickness and level checks

8. Performance Requirements

- Increase in CBR value as per design requirement
- Reduction in plasticity index
- Improved load-bearing capacity
- Reduced settlement and swelling
- Enhanced durability under wet/dry cycles

9. Tolerances

- Thickness: ±10 mm
- Level: ±10 mm
- Density: Not less than specified percentage of MDD

5. STEEL REINFORCEMENT: -

(a) The Contractor shall procure ISI-marked Fe500-D grade/ CRS steel as per BIS 1786-2008 from the approved steel manufacturers as per Make approved by Engineer-in-charge forming part of this document

(b) The secondary producers must have valid BIS license to produce HSD bars conforming to IS 1786: 2008. In addition to BIS licence, the secondary producer must have valid license from either of the firms Tempcore, Thermex Evcon Turbo & Turbo Quench to produce TMT Bars/ CRS Steel.

(c) The TMT bars / CRS Steel procured form primary producers shall conform to manufacture's specifications.

(d) The TMT bars / CRS Steel procured form secondary producers shall conform to the specifications as laid by Tempcore, Thermex, Evcon Turbo & Turbo Quench as the case may be.

(e) TMT bars procured either from primary producers or secondary producers, the specifications shall meet the provisions of IS 1786: 2008 pertaining to Fe500-D grade/ CRS steel as per schedule as specified in the tender of steel as specified in the tender

(f) All TMT Bars/ CRS Steel to be duly factory coated against corrosion in coastal environments.

The Agency has to be procured the Bar Set – I steel bars of having the following qualities:

2. **Additional requirement**

2.1 Permissible limit for Manganese and Copper as follows:

Constituent	Permissible Limit (% of cast metal quantity)		
	Fe 415 D	Fe 500 D	Fe 550 D
Manganese (Mn)			
Maximum	1.60	1.60	1.60
Copper (Cu)			
Maximum	0.80	0.80	0.80
Minimum	0.20	0.20	0.20

Notes:

The above composition shall be obtained as per latest version of IS 228

1. Manganese using Periodate Spectrophotometric Method **(Part 12),** and
2. Copper using Thiosulphate Iodide Method (**Part 15)** or Spectrophotometric (Diethyl Dithiocarbonate) Method **(Part 21)**

2.2 Tempered Martensite Ring Test as per Annexure-I (d).

2.3 The process of manufacturing steel shall comply with the provisions of ISO9001: 2015 and ISO14001: 2004.

(B)FOR BAR SET-II

1. The test requirements given in para 1.1 and 1.2 above.

Annexure- I(c)

Testing requirement for individual reinforcement bar diameter of Particular Grade of steel:

Tests required for Fe 415D, Fe500D, Fe550D grade of steel and Low alloy steel reinforcement bars:

A. **FOR BAR SET- I**

1. Tests as per IS 1786 (latest version) and specified therein

1.1 Chemical Properties

Ladle analysis of steel for above grades for maximum percentage of constituents

i. Carbon (C), (ii) Sulphur (S) and (iii)Phosphorous (P) and (iv) Nitrogen and Carbon Equivalent

1.2 Physical Properties

(i) 0.2 percent proof stress / yield stress, minimum, N/mm2.

(ii) Ratio of Tensile Strength (Ts) to Actual Yield Strength (or 0.2 % of yield stress (Ys)) of the test piece N/mm2.

(iii) Elongation, percent, Minimum, on gauge length $5.65\sqrt{A}$, where *A* is the cross-sectional area of the test piece.

(iv) Total elongation at maximum force, percentage, minimum on gauge length $5.65\sqrt{A}$, where A is the cross-sectional area of the test piece.

(v) Bend test and re-bend test.

(vi) The mean area of ribs (in mm2) per unit length (in mm) above the coreof the bar, projected on a plane normal to the axisof the bar.

(vii) Pull-out testing in accordance with IS 2770 (Part 1)

Annexure-I(d)

1. CRITERIA FOR CLASSIFICATION OF BARS

The steel bars manufactured in India shall be classified as specified hereunder for the purposes of their use in works of CPWD.

1.1 Process of Classification

Steel Bars shall be classified as *Bar Set I* and *Bar Set II*. The bars shall be placed under one of these categories based on *Type Test* (the test performed to select the bars) performed as specified hereunder. These tests to be performed are those specified in the latest version of **IS 1786** published by the Bureau of Indian Standards, and the additional tests mentioned in Para **2** of this document.

The *Type Test* shall be performed at any one of the National Test Houses, IITs, NITs, and NCCBM, subject to:

(a)The test samples being collected from the manufacturing facility by the representative engineer of CPWD,

(b) The availability of the required test facility at the said laboratory, and

(c) The test being witnessed by representative engineer of CPWD.

1.2 Classification of Steel Bars

The bar shall be classified as:

(1) *Bar Set I*, if it complies with the requirements given in the latest version of **IS: 1786**, and those given in Para **2** of this document, and

(2) *Bar Set II*, if it complies with the requirements given in the latest version of **IS 1786**.

2. ADDITIONAL REQUIREMENTS

Four additional requirements as specified hereunder.

2.1 Chemical Composition Requirement

The permissible limits of additional elements shall be as per **Table 1**.

2.2 TM Ring Requirement

The following two requirements shall be met with:

(1) Does the *Tempered Martensite(TM) Ring* satisfy the visual analysis as per **Step 1** of **Table 2**; and

(2) The thickness of the TM Ring obtained as per **Step 2** of **Table 2** shall be between 0.07f and 0.15f, where f is the *original nominal diameter* of the bar.

(a) Test Procedure

The following is the procedure:

(1) The test setup to capture the *Cross-Sectional Phase Distribution (CSPD)* of the TMT bars shall be as shown in **Figure 1**.

(2) Steel bars may be cut using handsaw or an abrasive cutter with continuous supply of coolant to limit the temperature of steel, and thereby avoid any transition or changes in *Tempered Martensite(TM)* and *Ferrite-Pearlite (FP)* phases (**Figure 2**). The sharp edges of cut bars should be smoothened using silicon carbide abrasive sheets. A metal polishing machine can be used to achieve effective smoothening.

(3) The smoothened steel specimen shall be moulded in cold setting epoxy with good surface finish. Setting time of epoxy is about 10-15 minutes.

(4) The moulded specimen surface shall be course polished using abrasive sheets of 80, 150, 220, 320, and 600 grit sizes in sequence. Specimens shall be micro-etched using Nital (5% Nitric acid in alcohol) to capture the CSPD.

(b) Measurements

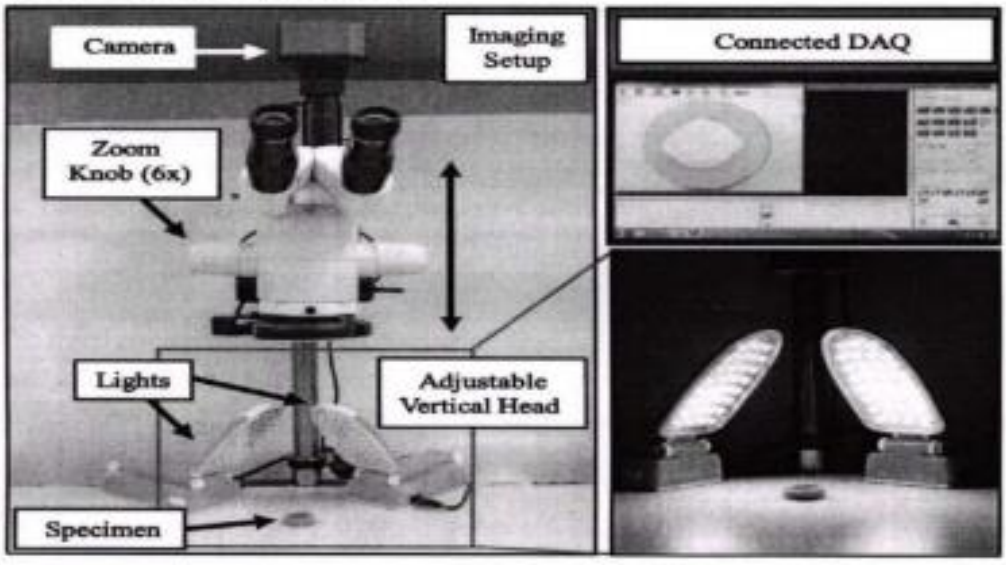
The procedure for obtaining the *CSPD* of the TM Ring along the perimeter shall be as per **Table 2**.

2.3 Marking Requirement

All bars shall have marks introduced during rolling, which indicate the *name of manufacturer* or *brand name*, and *grade of steel*.

2.4 Manufacturing Process Requirement

The process of manufacturing steel shall comply with the provisions of ISO 9001:2015 and ISO 14001:2004.



(a)

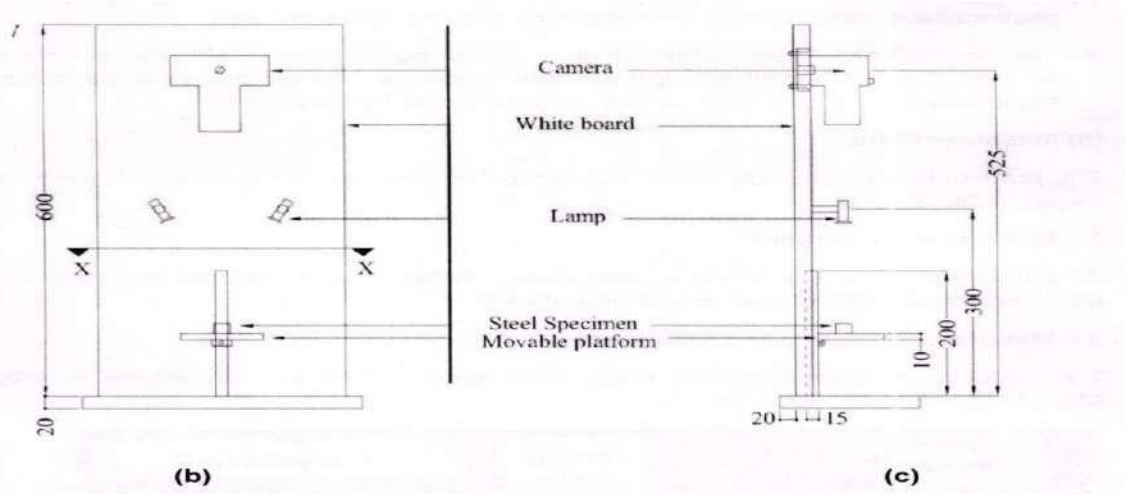


Figure 1: Test setup for CSPD of the TMT bars: (a) Imaging Setup, (b) Schematic Front View (c) Schematic Side View

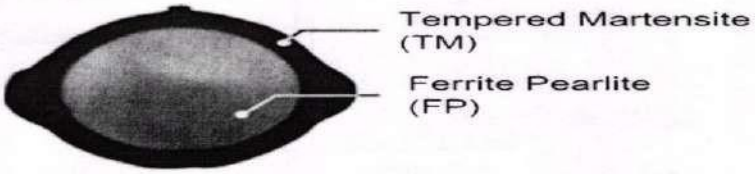
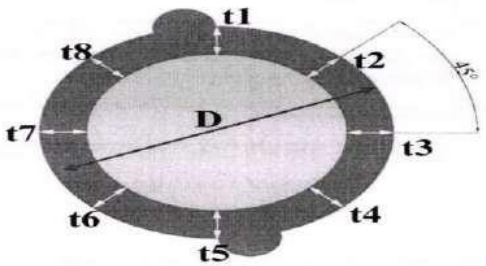


Figure 2: Cross-section of the steel bar showing the TM and FP areas

Table 2: Method of obtaining CSPD of TM Ring

Step 1: Visual Analysis of etched Cross-Section					
	A	B	C	D	
	Acceptable	*Not acceptable*	*Not acceptable*	*Not acceptable*	
1.	Is a dark grey peripheral region and light grey core seen as in Case A?				Yes/No
2.	Does the dark grey peripheral region form a continuous outer ring?				Yes/No
Step 2: Dimension Analysis of TM-Ring thickness					
3.	Diameter *D(mm)* of the steel bar				
4.	**Geometry** 			t_1	
				t_2	
				t_3	
				t_4	
				t_5	
				t_6	
				t_7	
				t_8	
				Measured t_{min} *(mm)*	
				Measured t_{max} *(mm)*	
5.	Is the measured $t_{min} \geq 0.07$ f ?			Yes / No	
	Is the measured $t_{max} < 0.15$ f ?			Yes / No	

3. GUIDELINES FOR USE OF STEEL BARS IN DIFFERENT PROJECTS

Considering the importance of quality in construction of public structures, the basis for use of bars in different projects of CPWD shall be as given in **Table 3**.

Table 3: Use of *Bar Sets I* and *II* in CPWD Projects

S.No.	*Consideration*	*Bar Set I*	*Bar Set II*
1.	**Earthquake Zones**	All zones	Only *Earthquake Zone II*
2.	**Environment Conditions**		
	(a) Coastline	All conditions	Beyond *10 km* from the coastline of India
	(b) Exposure Conditions	All exposure conditions as per **IS 456** (latest version)	Only *Mild* and *Moderate* Exposure Conditions as per **IS 456** (latest version)
3.	**Structure Category**	All categories	*OnlyNormal Buildings* as per **Table 4** and standalone *Normal Structures* as per **Table** 5.
4.	**Heights of Buildings and Structures**	All heights	Only structures up to 12 m height excluding *staircase headroom* and *liftmachine rooms*

Table 4: List of *Normal Buildings*

Residential or Non-Residential Buildings with occupancy less than 100 persons, *excluding*:

(1) Educational buildings,
(2) Buildings of strategic importance,
(3) Buildings and structures identified by Government of India and State Governments to be critical for governance or Disaster Management,
(4) Hospital buildings,
(5) Buildings that house the control or operations of utilities (for example, water, power, and sewage disposal), and lifeline (for example, communication and transportation facilities) structures,
(6) Buildings related to defense and space applications,
(7) Buildings identified by Government of India, State Governments and UT Administrations to be of *Special Importance*, and
(8) Any other building identified with the approval of DG, CPWD.

Table:5 List of Standalone Normal Structures

Water Tanks and Water Sumps up to 50,000 liters, and Pump Rooms of area less than 20 m2
Septic Tanks, Sewage Treatment Plants, and Effluent Treatment Plants up to 10,000 liters/day
Bridges and Culverts of spans up to 6 m
Earth Retaining Structures up to 4 m
Compound Walls, Entry Gates, and Small Reception Rooms
Storm Water Drains
Cable Trenches
Parking Structures of single storey
Security Cabins and Sentry Post
Any other structure identified with the approval of Technical Sanctioning Authority of CPWD

i. Excellent ductility, bendability and elongation of the finished product due to possible refining technology.
ii. Consumption of steel should be accurate as per design
iii. Steel should have no brittleness problem in the finished product.

5.2 The contractor shall have to obtain and furnish test certificates to the Engineer-in- charge in respect of all supplies of steel brought by him to the site of work.

5.3 Samples shall also be taken and got tested by the Engineer-in-charge as per the provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the contractor does not conform to the specifications, the same shall stand rejected, and it shall be removed from the site of work by the contractor at his cost within a week time on written orders from the Engineer-in-charge to do so. Else the department shall remove it and recover double the cost of removal from the contractor.

5.4 The steel reinforcement bars shall be brought to the site in bulk supply of 10 tonnes or more, or as decided by the Engineer-in-charge.

5.5 The steel reinforcement bars shall be stored by the contractor at site of work in such a way as to prevent their distortion and corrosion, and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.

5.6 For checking nominal mass, tensile strength, bend test, re-bend test etc. specimens of sufficient length shall be cut from each size of the bar at random, and at frequency not less than that specified below:

Size of bar	For consignment below 100tonnes	For consignment above 100tonnes
Under 10mm dia bars	One sample for each	One sample for each 40tonnes or

	25tonnes or par thereof.	part thereof.
10mm to 16mm dia bars	One sample for each 45tonnes or part thereof.	One sample for each 50tonnes or part thereof.
Over 16mm dia bars	One sample for each 50tonnes or part thereof.	One sample for each 75tonnes or part thereof.

5.7 The contractor shall supply free of charge the steel required for testing including its transportation to testing laboratories. The cost of tests shall be borne by the contractor.

5.8 The actual issue and consumption of steel on work shall be regulated and proper accounts shall be maintained as provided in clause 10 of the contract. The theoretical consumption of steel shall be worked out as per procedure prescribed in **clause 38** of the contract and shall be governed by conditions laid therein. In case the consumption is less than theoretical consumption including permissible variations leading to under designing of the structure, the work shall be summarily rejected, otherwise recovery at the rate so prescribed shall be made after ensuring structural soundness and stability.. In case of excess consumption, no adjustment needs to be made.

5.9 The steel brought to site and the steel remaining unused shall not be removed from site without the written permission of the Engineer-in-charge.

5.10 The contractor shall submit original vouchers from the manufacturer for the total quantity of steel supplied under each consignment to be incorporated in the work. All consignment received at the work site shall be inspected by the Site staff along with the relevant documents before acceptance. The contractor shall obtain Original Vouchers and Test Certificates and furnish the same to the Engineer-in-Charge in respect of all the lots of steel brought by him from approved supplier to the site of work. The original vouchers and test certificates shall be defaced by the Site staff and kept on record in the site office.

5.11 Reinforcement including authorized spacer bars and laps shall be measured in length of different diameters as actually (not more than as specified in the drawings) used in the work nearest to a centimeter. Wastage and unauthorized overlaps shall not be measured.

5.12 The standard sectional weights referred to as in Table 5.4 in para 5.3.4 in CPWD Specifications will be considered for conversion of length of various sizes of M.S. Bars, Steel Bars and T.M.T. bars into Standard Weight.

5.13 Records of actual Sectional weights shall also be kept dia-wise and lot-wise. The average sectional weight for each diameter shall be arrived at from samples from each lot of steel received at site. The decision of the Engineer-in-Charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute one single lot for the purpose. The weight of steel by conversion of length of various sizes of bars based on the actual weighted average sectional weight shall be termed as Derived Actual Weight. However, for the stipulated issue of steel reinforcement up to and including 10mm diameter bars, the actual weight of steel issued shall be modified to take into account the variation between the actual and the standard coefficients and the contractors' accounts will be debited by the cost of modified quantity.

5.14 (a) If the Derived Weight as in sub-para (2.3.13) above is less than the Standard Weight as in Sub-para (2.3.12) above then the Derived Actual Weight shall be taken for payment provided, if it is within the following tolerances specified in IS1786-2008, otherwise whole lot will be rejected.

Tolerances on Nominal Mass

Nominal Size in mm **Tolerance on Nominal mass Percent**

	Batch	**Individual Sample***	**Individual sample for coil****
Up to and including 10 a)	±7	-8	±8

Over 10 up to and Including 16	±5	-6	±6
b) Over 16	±3	-4	±4

* For individual sample plus tolerance is not specified.

**For coils batch tolerance is not specified.

b) If the Derived Actual Weight is found more than the Standard Weight, the Standard Weight as per in sub-para (2.3.12) above shall be taken for payment. In such case nothing extra shall be paid for the difference between the Derived Actual Weight and the Standard Weight.

6. Dewatering:-

Dewatering has been carried out in the project to control and lower the groundwater level at the construction site, ensuring safe and workable conditions for excavation and foundation activities. It involves the removal of accumulated groundwater and surface water using methods such as pumping, well points, or drainage systems.

This process is critically important in areas with high water table or waterlogged (foul) site conditions, where the presence of water can lead to soil instability, reduced bearing capacity, side wall collapse, and difficulty in achieving proper compaction and concreting. Effective dewatering ensures dry working conditions, maintains excavation stability, and allows proper placement of structural elements as per design specifications.

1. Scope

This specification covers the design, installation, operation, maintenance, and removal of dewatering systems required to lower and control groundwater levels and remove surface water to facilitate safe and dry excavation, foundation, and construction activities.

2. Applicable Standards & Guidelines

- IS 3764: Excavation Work – Code of Safety
- IS 9759: Guidelines for Dewatering During Construction
- IS 456: Plain and Reinforced Concrete (for works in dry conditions)
- Relevant CPWD Specifications and project-specific drawings

3. Objectives of Dewatering

- Lower groundwater table below formation level
- Provide dry and stable working conditions
- Prevent soil instability, piping, and base heave
- Protect adjacent structures and utilities
- Ensure proper placement and compaction of concrete

4. Types of Dewatering Systems

4.1 Open Pumping System

- Collection of water in sumps and pumping out using centrifugal pumps
- Suitable for shallow excavations and coarse-grained soils

4.2 Well Point System

- Series of closely spaced well points connected to a header pipe and vacuum pump
- Suitable for sandy soils and moderate depths (up to ~6 m per stage)

4.3 Deep Well System

- Bore wells fitted with submersible pumps
- Suitable for deep excavations and high water table conditions

4.4 Eductor System

- Uses high-pressure water to create vacuum for groundwater extraction
- Suitable for low permeability soils (silts, fine sands)

5. Materials and Equipment

- Dewatering pumps (centrifugal/submersible) of adequate capacity
- Well points, riser pipes, and header pipes
- Perforated casings and strainers
- Flexible hoses, valves, and fittings
- Power supply (diesel generator/electric panels)
- Standby pumps for emergency backup

6. Design Considerations

- Soil characteristics (permeability, gradation)
- Depth of excavation and water table level
- Rate of groundwater inflow
- Spacing and depth of wells/well points
- Discharge capacity of pumps
- Impact on adjacent structures and settlement control

7. Methodology of Execution

7.1 Installation

- Layout of dewatering system as per approved design
- Installation of well points/deep wells with proper spacing
- Placement of filter media around well screens
- Connection to header pipes and pumps

7.2 Operation

- Continuous pumping to maintain groundwater below formation level
- Monitoring of discharge rate and water levels
- Ensure uninterrupted operation (24×7 if required)

7.3 Disposal of Water

- Discharged water shall be conveyed to approved drainage system
- Proper channels/pipes shall be used to prevent erosion or flooding
- Compliance with environmental norms

7. Water Treatment During Construction:

Water Treatment Plant

It is required to provide Water Treatment Plant of suitable Capacity to meet the specified outlet parameters of water. The system shall consist of following components.

Water supply /filter feed pumps/ MoC preferably should be -SS-304/C.I casing, SS-304 /Brass /Bronze impeller & SS shaft suitable for operation 400/440 volts, 3 phase, 50 Hz, 2900 rpm, TEFC electric motor with best efficiency class preferably IE-3 complete with all accessories like flexible

rubber bellows, strainers, valves, pressure gauges etc. Suitable PCC/RCC foundation with plaster, MS channel plate with primer and two coats of paint, Anti-vibration arrangement of cushy foot mountings should be provided. Multi grade filter/dosing unit/activated carbon/ Softeners sized for optimum working pressure etc. Panels, Allied Equipment & Accessories (level controllers, probes, vibration eliminators, starters, valves, pressure gauges etc.)

All equipment shall be installed on suitable foundations underground pump house

Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.

Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.

The water treatment process shall be designed depending upon the quality of water. pH, TDS, Turbidity, Total Hardness & other biological factors shall conform to latest IS Codes/GRIHA Norms. Suitable nos. of Filters/Softeners shall be considered & sized taking into consideration the diameter, OBR, depth of filter media, backwash arrangement, interconnecting pipes of suitable material (GI/CPVC/UPVC/PVC) & grade, instruments, valves etc. One standby pump shall be provided considered for each type

- Sufficient maintenance space shall be provided inside the water treatment plant room for accessibility of various pumps, panels etc. during repair & maintenance activities.
- Water Treatment Plant Room shall be suitably ventilated considering adequate ACPH as per NBC 2016 code.
- Water treatment Pump Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.

It is proposed to provide all sanitary engineering services and specification which are:
- High standards of materials and workmanship.
- Provide leak proof plumbing.
- Reliable and dependable engineering systems.
- Provide adequate safety and means to egress easily in case of fire.
- To plan the system in such a way as to minimize the energy requirements.
- To create minimum nuisance and disturbance to the environment

Sizing of Pumps

The Flow Rate of Pumps shall be suitably selected to meet building‘s water demand & of Sufficient Head depending upon Building Height , Pipe Friction losses, Bends etc. and other relevant Site Conditions. One Standby Pump to be considered in each & every variant. The Pumps shall be sized so as to ensure approximately 4 hours of operation time to fill the treated water tank

Reverse Osmosis (RO) Plant – Description

A Reverse Osmosis (RO) Plant is an advanced water treatment system used for removal of dissolved salts, Total Dissolved Solids (TDS), chlorides, sulphates, hardness, heavy metals, and other dissolved impurities from water to produce high-quality treated water suitable for construction and utility applications.

The system works on the principle of reverse osmosis in which raw water is forced at high pressure through semi-permeable membranes. These membranes allow only water molecules

to pass while rejecting dissolved salts, minerals, and impurities. The rejected impurities are discharged through a reject line, while purified water is collected in the treated water tank.
Prior to entering the RO membranes, water is generally passed through pre-treatment units such as pressure sand filters, activated carbon filters, water softeners, and micron cartridge filters to remove suspended solids, chlorine, hardness, and fine particles, thereby protecting the RO membranes from damage and fouling.
The RO plant significantly reduces TDS, chloride content, sulphates, alkalinity, and turbidity, helping achieve water quality suitable for durable RCC construction works.
A typical RO Plant mainly consists of:

- Raw Water Feed Pump
- Pressure Sand Filter
- Activated Carbon Filter
- Water Softener
- Micron Cartridge Filter
- High Pressure Pump
- RO Membrane Housing with Membranes
- Control Panel and Instrumentation
- Treated Water Tank
- Reject Water Disposal Arrangement

These components work together to provide high-quality treated water with controlled chemical and physical parameters

Multi grade filter (Pressure Sand Filter - Dual Media Filter)

The water treatment technology, a Multi Grade Filter consists of vertical or horizontal pressure sand filters that contain multiple layers of coarse and fine sand (pebbles and gravels) in a fixed proportion. It is a kind of a deep filter bed with adequate pore dimensions for retaining both large and small suspended solids and un-dissolved impurities like dust particles. As compared to conventional sand water filter, this multigrade filtration system works on higher specific flow rates. It is also a low cost pre-treatment system for ion exchangers (deionizer and softener) and membrane systems such as reverse osmosis etc. With high throughputs, high dirt-holding capacity and capacity to reduce turbidity and TSS (< 5ppm) from water, it protects ion-exchange resins and membranes from physical fouling due to suspended impurities present in the water.

The working principle of a multigrade filter is quite straight forward. In a multigrade filter or pressure sand filter, water is passed through multi layers of filter media consisting graded sand, pebbles and gravels layers. The contaminants in the water are captured in the media bed and filtered water passes into the discharge manifold at the bottom of the tanks. The next and last step is backwashing, a process of effectively removal of captured contaminants from the media bed. After back-washing the filter is rinsed with raw water and after the required quality of water is achieved the filter is put back into service.

Activated Carbon Filter

Activated Carbon Filter is widely accepted system in water filtration techniques. The treated water is free from chloramines (chlorine and ammonia mixture) and organic compounds; therefore, best for discharge and production use. Activated Carbon Filter is also utilized in pre-treatment for ro water plant and dm plant as the treated water keeps these systems safe from oxidation or organic fouling.

An activated carbon filter (ACF) works on the principle of adsorption; filter medium adsorbs or reacts with a pollutant molecules then filtered water is drained out. Activated carbon which is used as medium to remove contaminants is natural material derived from coconut shell, lignite, bituminous coal etc

There are some limitations of activated carbon filters (ACF); uses are limited to wastes with low organic concentrations (< 5%) and very low inorganic concentrations (< 1%). Removing highly soluble organics or those with low molecular weights are also out of their capabilities. An activated carbon filtration system is unable to remove all of contaminants; such as, microbes, sodium, fluoride and hardness from water; however, special activated carbon water treatment is necessary for removing lead and other heavy metals. In addition, disposal process of contaminated carbon is complicated if not regenerated.

Water Softener with Brine tank

Water softeners work through a process called ion exchange which eliminates calcium and magnesium from the water. When the hard water enters into the mineral tank, it flows through a bed of spherical resin beads. These plastic beads, usually made from polystyrene, are charged with a sodium ion. The resin beads are anions, meaning they have a negative charge. The calcium and magnesium minerals have a positive charge, making them cations. Since opposite charges attract, the negative charge of the minerals is attracted to the positive charge of the resin beads. As the hard water passes through the resin, the beads grab a hold of the mineral ions and remove them from the water. When the bead seizes the mineral ion, the sodium ion is released. The column of resin strips all the hardness out of the water as it passes through the mineral tank, and softened water flows out into your treated water tank

A water softener is made up of three components: a control valve, a mineral tank, and a brine tank. These three work in conjunction to remove the minerals from hard water, monitor the flow of water, and periodically clean the system through a regeneration process.

Micron Cartridge Filter

A Micron Cartridge Filter is a fine filtration unit used for removal of very small suspended particles, dust, silt, fine sand, turbidity, and other impurities from water. The system works by passing water through specially designed cartridge elements having very fine micron ratings such as 10 micron, 5 micron, or 1 micron depending upon the required water quality.
As the water flows through the cartridge media, fine suspended particles are trapped within the filter material while clean filtered water passes through the outlet. The cartridge elements are generally made of polypropylene (PP), spun fiber, or pleated synthetic material designed for high filtration efficiency and low pressure drop.
Micron cartridge filters are commonly installed after pressure sand filters and activated carbon filters and before RO systems to protect downstream equipment and improve overall treatment efficiency. These filters help in reducing suspended solids, turbidity, and fine particulate matter from water.
The cartridge elements require periodic cleaning or replacement depending upon water quality and usage conditions.
A typical Micron Cartridge Filter system mainly consists of:

- Filter Housing
- Cartridge Elements
- Inlet and Outlet Connections
- Pressure Gauges
- Drain Arrangement

These components work together to provide fine filtration and protect the downstream water treatment system.

Mineral tank

The mineral tank is the chamber where the hard water is softened. The water supply line feeds the hard water into the tank. The water seeps through the bed of resin beads, depositing the water-hardening calcium and magnesium ions. The water exits the tank soft and flows through your pipes and out to your household appliances.

Control valve

The control valve measures the amount of water passing through the mineral tank and into your house. The valve houses a meter that tracks the volume of water entering the mineral tank. As hard water flows through the mineral tank, the resin beads exchange their sodium ions for hardness ions. Over time, this depletes the capacity of the resin to continue to effectively soften water. Before the beads become too burdened with mineral content to continue removing calcium and magnesium ions, the control valve automatically initiates a regeneration cycle. This maximum capacity is pre-programmed into the control valve's onboard computer and is based on a range of factors, like the size of your house, the number of occupants, and the hardness of your water. Control valves are demand-initiated controllers, which allow water softening units to be extremely efficient.

Brine tank

The brine tank aids the water softening system in regeneration. It is a shorter tank that sits adjacent to the mineral tank. The brine tank holds a highly concentrated solution of salt (or sometimes potassium) to restore the resin beads' positive charge. Salt is manually added to the brine tank in the form of pellets or blocks. These dissolve in the water at the bottom of the tank. When the control valve registers the softening capacity of the resin is diminishing, the heavy brine solution is drawn out of the tank and flushed through the resin in the mineral tank. If the brine tank runs out of salt, the water passing through the unit will no longer be softened.

Regeneration cycles inundate the resin beads with a highly concentrated brine solution, washing off the hardness minerals and draining them out of the system. The resin beads are recharged and primed to again eliminate the hardness minerals. Resin beads are extremely durable and can effectively soften your water for twenty years or longer. Water softeners regenerate by one of two methods: co-current or counter-current regeneration (also referred to as downflow brining and upflow brining.

Construction Water Quality Parameters for RCC Works		
SL NO	Parameters	Characteristics
1	pH	6. 5 – 7.5
2	Chloride (Cl^-)	Below 100 mg/L
3	Sulphate (SO_4)	Below 150 mg/L
4	Total Dissolved Solids (TDS)	Below 300 mg/L
5	Suspended Solids (SS)	Below 100 mg/L
6	Turbidity	Below 2 NTU

7	Organic Matter	Nil
8	Oil & Grease	Nil
9	Alkalinity	Below 200 mg/L
10	Hardness	Below 200 mg/L

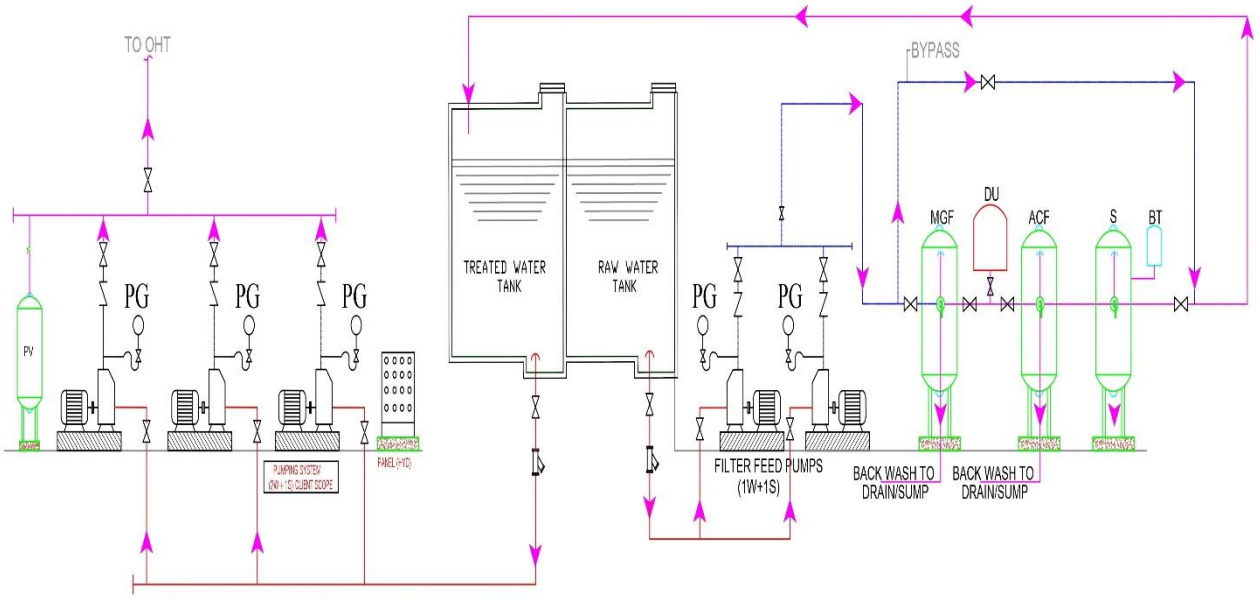
GENERAL REQUIREMENTS

All materials shall be new and of the best quality conforming to specifications and subject to the approval of Engineer.

1. All equipment shall be of best available make manufactured by reputed firms.
2. All equipment shall be installed on suitable foundations, true to level and in a neat work-man-like manner.
3. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
4. Piping within the pump houses shall be so done as to prevent any obstruction in the movement within the pump house.
5. Each pumping set shall be provided with a valve and a flap type non-return valve on the delivery side.

The contractor shall submit the following documents:

a. Process and hydraulic design calculations for all units.
b. Civil, Structural arrangement , design calculations if included in the scope of work.
c. Plant sld drawings
d. Process flow sheet
e. Design Philosophy
f. All technical brochures,
g. Operation and maintenance manuals and other details of the system offered.
h. Equipment's listing & list of consumables.



8. **SAFETY IN CONSTRUCTION**

- The contractor shall employ only such methods of construction, tools and plants as are appropriate.
- The contractor shall take all precautions and measures to ensure safety of works and work man and shall be fully responsible for the same.
- Safety pertaining to construction such as centering & shuttering, scaffolds, ladders, working platforms, gangway etc. shall be governed by CPWD safety code, relevant safety codes and the directions of Engineer in charge.
- All the staging to be either of tubular steel structure with adequate bracings as approved or made of built-up structural sections made from rolled structural steel sections.
- Form work shall be properly designed for self-weight, weight of reinforcement, weight of fresh concrete and in addition the various live loads likely to be imposed during construction process.
- The form work shall be designed & constructed so as to remain sufficiently rigid during placing & compaction of concrete & shall be such as to prevent loss of slurry from the concrete.
- The vertical supports shall be adequately braced or otherwise secured in position that these do not fall when the load gets released or the supports are accidentally hit.
- A thorough inspection of tubular steel centering is necessary before its erection and members showing evidence of excessive rusting, kinks, dents or damaged welds shall be discarded. Buckled or broken members shall be replaced. Care shall also be taken those locking devices are in good working order and that coupling pins are effectively aligned to frames. Tubes should have end to end joints in adjacent tubes staggered. Sleeve couplers should be used in preference to joint pins for axial connections.
- Inclined forms which give rise to very high horizontal forces should be taken care of by trussing and diagonal bracing.
- Vertical members should be placed centrally under the members to be supported and over the member supporting them with no eccentricity exceeding 25mm.
- The centering frames shall be tied together with sufficient braces to make a rigid and solid unit. It shall be ensured that struts and diagonal braces are in proper position and are secured so that frames develop full load carrying capacity. As erection progresses, all connecting devices shall be in place and shall be fastened for full stability of joints and units.
- Wedges under the supports shall be set on firm soil / PCC which assures adequate stability for all props. Care shall be taken not to disturb the soil under the supports. Adequate drainage shall be provided to drain away the water coming due to rains, easing of forms or during the curing of the concrete to avoid softening of the supporting soil strata.
- During pouring of the concrete the centering shall be constantly inspected and strengthened, if required wedges below the vertical supports tightened and adjustment screws properly adjusted as necessary.
- Only workmen actually engaged in the form work shall be allowed in the area during operations. Those engaged in removing the form work shall wear helmets, gloves and heavy soled shoes and approved safety belts etc.
- The safety code as lay down in respective clauses of Agreement shall be strictly followed.

9. Special Conditions for Waterproofing and Testing

The contractor shall associate himself with the specialized firm, to be approved by the Engineer-in-Charge in writing, for water proofing treatment as contractor shall provide Guarantee Bond in the prescribed format for 10 years. After laying and jointing of pipes for PHE works contractor shall carry out Pressure test as per CPWD Specification 2019 to check the leakage and sustainability of whole pipe network system. Similarly after water proofing works and finalization of roof top surface/exposed

surfaces, the entire surface thus treated shall be flooded with water by making kiaries with weak cement mortar, for a minimum period of two weeks.

10. Special Condition For Hardware And Sanitary Wares:

- Engineer-in-Charge/ PMC will take a decision regarding model numbers of equivalent Door/ window hard ware/sanitary ware at the time of execution, in case the material, from the manufacturer whose model number is mentioned, is not available.
- However, in case, the equivalent model so approved, is cheaper than the model already mentioned in item/approved makes list, the price adjustment will be made based on the difference in market rate. In case, the rate of subsequently approved model is more, no extra payment will be made on this account."
- The following procedure should be followed in case of removal of rejected/sub- standard materials from the site of work.
  - i) Whenever any material brought by the contractor to the site of work is rejected, entry thereof should invariably be made in the site order book under the signature of the PMC officials giving approximate quantity of such materials.
  - ii) As soon as the material is removed, a certificate to that effect may be recorded by the PMC officials against the original entry, giving the date of removal, mode of removal i.e. whether by truck, carts or by manual labour. If removal is by truck, the registration number of the truck should be recorded.

11. INSPECTION OF WORKS:

- In addition to the provisions of relevant clauses of the contract, the work shall also be open to inspection by the PMC/ Architect/ other Senior officials of WAPCOS in addition of the Engineer-in-charge, his authorized representatives, Authorities and Team of Third Party Quality Assurance (TPQA) consultant engaged for the work. The contractor shall at times during the usual working hours and at all times at which reasonable notices of the intention of the Engineer-in-charge or other officers as stated above to visit the works shall have been given to the contractor, either himself be present to receive the orders and instructions or have a responsible representative duly accredited in writing, to be present for that purpose.
- The committee/ PMC/TPQA consultant appointed by WAPCOS, shall be inspecting the works including workshops and fabrication factory to ensure that the works in general being executed according to the design, drawings and specifications laid down in the contract. Their observations shall be communicated by PMC and compliance is to be reported to PMC & WAPCOS. The committee/ consultant appointed by WAPCOS shall certify on completion of particular building that it has been constructed according to the approved drawings design and specifications.
- Senior Officers of WAPCOS, Dignitaries from Central Ministry/ Department, State Government and Client Department Authorities shall be inspecting the on-going work at site at any time with or without prior intimation. The contractor shall, therefore, keep updated the following requirements and detailing: -
  - (i) Display Board showing detail of work, weekly progress achieved with respect to targets, reason of shortfall, status of manpower, wages being paid for different categories of workers.
  - (ii) Entrance and area surrounding to be kept cleaned.
  - (iii) Display layout plan key plan, building drawings including plans, elevations and sections.
  - (iv) Up to date displays of programme chart (Bar charts).
  - (v) Keep details of quantities executed, balance quantities, deviations, possible Extra items, etc.
  - (vi) Keep plastic/cloth mounted one sets of building drawings.
  - (vii) Set of Helmets and safety shoes for safety.

SPECIAL CONDITIONS FOR GREEN BUILDING

The buildings are proposed to be designed for at least **Platinum Rated Green Building confirming to IGBC (Indian Green Building Council) or 4-star GRIHA Green building rating system**. The contractor is required to execute the work in a befitting manner to obtain the targeted **atleast PLATINUM rating/ 4-star GRIHA rating**.

Any failure on the part of the contractor to comply with any of the Green Building conditions laid down by IGBC/GRIHA & the below mentioned tender conditions of Green Building and if the contractor continues to neglect the Green Building conditions even after 7 days from the date of issue of a written Notice by Engineer-in-charge then the Contractor is liable to pay a penalty of Rs.1,00,000/- (Rupees One Lakh only) per day till the contractor starts complying the Green Building conditions and sets right the cause. The decision of Engineer-in-charge in this regard shall be final and binding on the Contractor and such penalties imposed by the Engineer-in-charge are Non-refundable.

The contractor shall abide by all the conditions regarding safety & security apart from all other Green Building norms.

1. **Special conditions for GRIHA rating:**
   i. The contractor shall prepare scheme for the approval of Engineer-in-charge for obtaining atleast **Platinum Rated Green Building confirming to IGBC (Indian Green Building Council) or 4-star GRIHA Green building rating system** in the criteria relevant to the execution of work
   ii. The contractor shall plan and execute the work in a manner to preserve and protect the landscape during construction and shall arrange the materials/equipment and follow the procedure as per **Platinum Rated Green Building confirming to IGBC (Indian Green Building Council) or 4-star GRIHA Green building rating system** as applicable.
   iii. All the mandatory criteria of IGBC/GRIHA and additional conditions for Green Building practices are to be necessarily followed.
   iv. The contractor shall comply with NBC norms on construction safety, health and sanitation as per at least **Platinum Rated Green Building confirming to IGBC (Indian Green Building Council) or 4-star GRIHA Green building rating system**.
   v. The construction activity shall be done in a befitting manner and the contractor shall adopt measures to prevent air pollution at site in compliance with criterion of at least **Platinum Rated Green Building confirming to IGBC (Indian Green Building Council) or 4-star GRIHA Green building rating system** as applicable.
   vi. The contractor shall comply with all the instructions and schemes for execution of green building.
   vii. Nothing shall be paid extra for all these conditions except for the items existing in the schedule of quantities. For such items work done shall be paid on the basis of the agreement rates.

2. **Pre-construction Stage:**

2.1 Construction Vehicles, Equipment and Machinery
   i. All vehicles, equipment and machinery to be procured for construction shall conform to the relevant Bureau of India Standard (BIS) norms.
   ii. Emission from the vehicles must conform to environmental norms.
   iii. Dust produced from the vehicular movement and other site activities is to be mitigated by sprinkling of water.
   iv. Noise limits for construction equipment shall not exceed 75 dB(A), measured at one meter from the edge of the equipment in free area, as specified in the Environment

Protection Act,1986, schedule VI part E, as amended on 9th May,1993. The maximum noise levels near the construction site should be limited to 65 dB (A) Leq (5 min) in project area.

3. **Construction Stage:**

3.1 Construction Wastes Disposal:

i. The pre-identified dump locations will be a part of solid waste management plan to be prepared by the Contractor in consultation with Engineer -in-charge.

ii. Contractor shall get approved the location of disposal site prior to commencement of the excavation on any section of the project location.

iii. Contractor shall ensure that any spoils of material / construction waste will not be disposed-off in any municipality solid waste collection bins.

3.2 Procurement of Construction Materials:

i. Vehicles delivering construction materials to the site shall be covered to avoid spillage of materials and maintain cleanliness of the roads.

ii. Wheel Tyres of all vehicles used by of the contractor, or any of his sub-contractor or materials suppliers shall be cleaned and washed clear of all dust/mud before leaving the project premises. This shall be done by routing the vehicles through tyre washing tracks.

iii. Contractor shall arrange for regular water sprinkling at least twice a day (i.e. morning and evening) for dust suppression of the construction sites and unpaved roads used by his construction vehicles.

3.3 Water Pollution:

i. The Contractor shall take all precautionary measures to prevent the wastewater during construction to accumulate anywhere.

ii. The wastewater arising from the project is to be disposed off in the manner that is acceptable to the CPCB/MPCB.

3.4 Air and Noise Pollution:

Contractor shall use dust screens and sprinkle water around the construction site to arrest spreading of dust in the air and surrounding areas.

i. Contractor shall ensure that all vehicles, equipment and machinery used for construction are regularly maintained and confirm that emission levels comply with environmental emission standards/norms.

ii. For controlling the noise from Vehicles, Plants and Equipment, the Contractor shall confirm the following:

(a) All vehicles and equipment used in construction will be fitted with exhaust silencers.

(b) Servicing of all construction vehicles and machinery will be done regularly and during routine servicing operations, the effectiveness of exhaust silencers will be checked and if found defective will be replaced.

(c) Noise emission from compactors(rollers) front loaders, concrete mixers, cranes(movable), vibrators and saws should be less than 75 dB(A).

(d) As per the standards/guidelines for control of Noise Pollution from Stationary Diesel Generator (DG) sets, noise emission in dB(A) from DG Sets (2-1010 KVA) should be less than 94+10 log 10 (KVA). The standards also suggest construction of acoustic enclosure around the DG Set and provision of proper exhaust muffler with insertion loss of minimum 25 dB (A) each as mandatory.

4. **Personal Safety Measures for Labour:**

Contractor shall provide the following items for safety of workers employed by contractor and associate agencies:

a) Protective footwear/ helmet and gloves to all workers employed for the work on mixing, cement, lime mortars, concrete etc. and openings in water pipeline/ sewer line.
b) Welder's protective eye-shields to workers who are engaged in welding works.
c) Safety helmet and Safety harness/ belt Provide adequate sanitation/safety facilities for construction workers to ensure the health and safety of the workers during construction, with effective provisions for the basic facilities such as sanitation, drinking water and safety equipment or machinery.
d) All the workers should be wearing helmet and shoes all the time on site.
e) Masks and gloves should be worn whenever and wherever required.
f) Adequate drinking water facility should be provided at site, adequate number of decentralized latrines and urinals to be provided for construction workers.
g) Full time workers (if any with the approval of Engineer-in-Charge) residing on site should be provided with clean and adequate temporary hutment.
h) First aid facility should also be provided.
i) Overhead lifting of heavy materials should be avoided. Barrow wheel and hand- lift boxes should be used to transport materials onsite.
j) Tobacco and cigarette smoking should be prohibited onsite.
k) All dangerous parts of machinery are well guarded and all precautions for working on machinery are taken.
l) Maintain hoists and lifts, lifting machines, chains, ropes and other lifting tackles in good condition. Provide safety net of adequate strength to arrest falling material down below.
m) Use of durable and reusable formwork systems to replace timber formwork and ensure that formwork where used is properly maintained.
n) Ensure that walking surfaces or boards at height are of sound construction and are provided with safety rails and belts. Provide protective equipments such as helmets.
o) Provide measure to prevent fire. Fire extinguisher and buckets of sand to be provided in fire-prone area and elsewhere.
p) Provide sufficient and suitable light for working during night.
q) Ensure that measures to protect workers from materials of construction, transportation, storage and other dangers and health hazards are taken.
r) Ensure that the construction firm/division/company have sound safety policies.
s) Comply with the safety procedure, norms and guidelines (as applicable) as outlined in NBC 2016 (BIS 2005).
t) Adopt additional best practices and prescribed norms as in NBC 2016 (BIS2005).

5. Identify roads on-site that would be used for vehicular traffic. Update vehicular roads (if these are unpaved) by increasing the surface strength by improving particle size, shape and mineral type that make up the surface base. Add surface gravel to reduce source of dust emission. Limit quantity of fine particles (smaller than 0.075mm) to 10-20%. Limit vehicular speed on site 10km/h. Nothing extra will be payable for this.
6. All material storages should be adequately covered and contained so that they are not exposed to situations where winds on site could lead to dust/particulate emissions.
7. Spills of dirt or dusty materials shall be cleaned up promptly so the spilled material does not become a source of fugitive dust and also to prevent of seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained/cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas.
8. Ensure that water spraying is carried out by wetting the surface by spraying water on:
   (i) Any dusty material.

(ii) Areas where demolition work is carried out.
(iii) Any unpaved main-haul road and.
(iv) Areas where excavation or earth moving activities are to be carried out.

9. The contractor shall ensure the following:

(i) Cover and enclose the site by providing dust screen, sheeting or netting to scaffold along the perimeter of a building.
(ii) Covering stockpiles of dusty material with impervious sheeting.
(iii) Covering dusty load on vehicles by impervious sheeting before they leave the site.
(iv) Transferring, handling/storing dry loose materials like bulk cement and dry pulverized fly ash inside a totally enclosed system.
(v) Spills of dirt or dusty materials shall be cleaned up promptly so that the spilled material does not become a source of fugitive dust and also to prevent seepage of pollutant laden water into the ground aquifers. When cleaning up the spill, ensure that the clean-up process does not generate additional dust. Similarly, spilled concrete slurries or liquid wastes should be contained / cleaned up immediately before they can infiltrate into the soil/ground or runoff in nearby areas.
(vi) Clear vegetation only from areas where work will start right away.

10. Adopt measures to prevent air pollution in the vicinity of the site due to construction activities. There is no standard reference for this. The best practices should be followed (as adopted from international best practice documents and codes).

11. Provide safety barricading of site by drawing ribbon band along the site boundary, next to a road or other public area.

12. The contractor shall provide experienced personnel with suitable training to ensure that these methods are implemented. Prior to the commencement of any work, the method of working, plant equipment and air pollution control system to be used on - site should be made available for the inspection and approval of the Engineer -in- Charge to ensure that these are suitable for the project.

13. Employ measures to segregate the waste on-site into inert, chemical or hazardous wastes. Recycle the unused chemical/hazardous wastes such as oil, paint, batteries and asbestos. As per 4 star GRIHA rating (inert and Hazardous waste must be collected and storied separately from site. Proper training must be given to all construction workers in order to train them to be able to handle different kind of waste on site. In addition to segregating the inert and hazardous waste, it is also important to either reuse the construction waste on site or safety dispose it off to designate agencies for recycling.

14. To preserve the existing landscape and protect it from degradation during the process of construction. Select proper timing for construction activity to minimize the disturbance such as soil pollution due to spilling of the construction material and its mixing with rainwater. The construction management plan including soil erosion control management plan shall be prepared accordingly for each month. The application of erosion control measures includes construction of gravel pits and tyre washing bays of approved size and specification for all vehicular site entry/exits, protection of slopes greater than 10%. Sedimentation Collection System and run-off diversion systems shall be in place before the commencement of construction activity. Preserve and protect the existing vegetation by not-disturbing or damaging to specified site areas during construction.

15. The Contractor should follow the construction plan as proposed by the Engineer-in- charge / landscape consultant to minimize the site disturbance such as soil pollution due to spilling. Use staging and spill prevention and control plan to restrict the spilling of the contaminating material on site.

16. Spill prevention and control plans should clearly state measures to stop the source of the spill. Measures to contain the spill and measures to dispose the contaminated material and

hazardous wastes. It should also state the designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners and petroleum products.

17. A **Soil Erosion and Sedimentation Control Plan (ESCP)** should be prepared prior to construction and should be applied effectively.

18. The contractor shall prepare and submit '**Spill prevention and control plans'** before the start of construction, clearly stating measures to stop the source of the spill, to contain the spill, to dispose the contaminated material and hazardous wastes, and stating designation of personnel trained to prevent and control spills. Hazardous wastes include pesticides, paints, cleaners, and petroleum products.

19. The contractor shall ensure that no construction leaches (Ex: cement slurry) is allowed to percolate into the ground. Adequate precautions are to be taken to safeguard against this including reduction of wasteful curing processes, collection, basic filtering and reuse. The contractor shall follow requisite measures for collecting drainage water run-off from construction areas and material storage sites and diverting water flow away from such polluted areas. Temporary drainage channels, perimeter dike/swale, etc. shall be constructed to carry the pollutant -laden water directly to the treatment device or facility (municipal sewer line).

20. All lighting installed by the contractor around the site and at the labour quarters during construction shall be energy efficient fixtures of the appropriate illumination levels.

21. All paints, adhesives and sealants should comply with the VOC limits prescribed as a green initiative as follows:

21.1 The VOC (volatile organic compound) content of adhesives and sealants used on the interior of the building must be less than VOC content limits mentioned below. A list of all the adhesives and sealants used for the project is to be submitted along with the manufacturer's certificate supporting the VOC content.

Architectural Applications	**VOC Limit(g/l minus water)**
Indoor Carpet Adhesives	50
Carpet Pad Adhesives	50
Wood Flooring Adhesives	100
Rubber Floor Adhesives	60
Sub floor Adhesives	50
Ceramic Tile Adhesives	65
VCT and Asphalt Tile Adhesives	50
Dry Wall and Panel Adhesives	50
Cove base adhesives	50
Structural Glazing Adhesives	100
Multipurpose Construction Adhesives	70
Substrate Specific Application	**VOC Limit(g/l minus water)**
Metal to Metal	30
Porous Material(except wood)	50
Plastic Foams	50

Wood	30
Fibreglass	80
Specialty Application	**VOC Limit(g/l minus water)**
PVC Welding	510
CPVC Welding	490
ABS Welding	325
Plastic cement welding	250
Adhesive primer for plastic	550
Top and Trim Adhesive	250
Contact Adhesive	80
Special purpose Contact Adhesive	250
Structural wood member adhesive	140
Sheet applied rubber lining operations	850
Sealants	**VOC Limit(g/l minus water)**
Architectural	250
Non-Membrane Roof	300
Roadway	250
Single-ply roof membrane	450
Other	420
Sealant Primers	
Architectural, nonporous	250
Architectural, porous	775
Other	750
Aerosol Adhesives	
General purpose mist spray	65% VOC's by weight
General purpose web spray	55% VOC's by weight
Special purpose aerosol adhesives (all types)	70% VOC's by weight

22. All the building materials and systems used on site must be as per the specifications and approved makes by the Engineer-In-Charge.
23. All required certificates explaining the properties of the building material/system needs to be obtained from the manufacturer/vendor as required by the green building rating authority. The final certificates would be produced after the approval of green building consultant with necessary due diligence. The purchase orders of all the materials made with the manufacturers / authorized vendors should be maintained and shall be provided for the process with due diligence upon request.
24. Water saving measures as suggested by the consultants need to be followed on site.

25. The contractor / subcontractor shall prepare and submit a Site **Management Plan (SMP)** within 60 days of start, for approval by the Engineer -in-charge. This SMP shall indicate the locations of godown, stockpiles, barricading, waste storage, offices, vehicular movement routes etc. In short this SMP would comprehensively represent how the site activities shall be managed conforming to ATLEAST GRIHA 4 Star guidelines. Contractor will be penalized @ **Rs. 1,00,000/-** (Rupees One Lakh only) per day of delay on non-submission of SMP beyond due date to be recovered from next RA bill.
26. Any other site management measures suggested by the Engineer-in-charge / green building consultant shall be followed on site.
27. The contractor shall submit to the Engineer -in-Charge after construction of the buildings, a detailed as built quantification of the following within 10 days of recording of completion. Contractor will be penalized @ Rs. 25,000/- (Rupees Twenty-Five Thousand only) per day of delay in submission of “detailed as built quantification”.
    (i) Total materials used
    (ii) Total waste generated,
    (iii) Total waste reused,
    (iv) Total water used,
    (v) Total electricity consumed, and
    (vi) Total diesel consumed.

28. Evidence for the implementation of the all the above required measures shall be provided to the Engineer-in-Charge in the form of photographs and templates as required which is required for the submission to the green building rating authority.
29. Nothing extra shall be payable for above provisions unless otherwise specified in Schedule of Quantity.
30. The project registration charges with Green Building Authority viz., IGBC/GRIHA shall be borne by the WAPCOS. The Quoted rate for design of buildings is inclusive Co-coordinating with the IGBC for obtaining the Platinum rating from IGBC. The contractor should provide all the design or other documents to the Architect for uploading all the relevant details from time to time on the website of the IGBC/GRIHA/ as the case may be for obtaining the Green Certification from IGBC on time without any undue delay. Nothing extra shall be paid on this account the quoted rates of the contractor are inclusive of all the above activities.

Special Condition for Rectification in Defects and Maintenance during Defect Liability Period.

GENERAL DETAILS

1) The Complete Scope of work covered under Main Contract, along with the mentioned services, are in the scope of work for **Rectification in Defects and Maintenance During Defect Liability Period of 24 Months.**

2) Contractor's Roles and Responsibilities in the Defect Liability Period: The Defect Liability Period (DLP) is the period after project completion during which the contractor is responsible for rectifying any defects or deficiencies that arise in the completed works.

3) The Contractor shall submit the Guarantee/ Warranty Certificates for all the Works/ E&M Equipment's for at least period of 2 Years. However, in case of additional years' warranty/ Guarantee offered on any E&M Equipment by the OEM by default, the same shall be pass on to WAPCOS. Further, the contractor shall submit the undertaking from OEM stating that they will make the spare parts available for the installed E&M Equipment's for atleast 10 years.

A) Rectification of Defects

- The contractor must promptly repair or replace any defects, faults, or damages identified during the DLP.
- Defects may include structural issues, faulty workmanship, defective materials, leaks, or non-performance of installed systems.
- Rectifications must be completed at no additional cost to the employer or client.
- Any MEP/civil/Low voltage or any other material or fixture, is required to change is cover under the defect liability period.

B) Periodic Inspections and Monitoring

- The contractor may be required to conduct periodic inspections of the works during the DLP to proactively identify and report any defects.
- Collaborate with the Project Management Consultant (PMC), Engineer, or Employer representatives during joint inspections.

C) Responding to Defect Notices

- Upon receiving a Defect Notice from the employer or PMC, the contractor must respond within a specified time frame (e.g., 7–14 days) mentioned in such notice.
- A detailed action plan, schedule for repair, and resource mobilization must be shared.
- In case of Urgent defects which affects the operations of Buildings such as Power failure, Leakages, plumbing issues, E&M issues etc., the Contractor shall rectify the defects within 24 hours of the Notice.
- If dampness, seepage, or leakage is found in buildings or premises, the contractor shall rectify the cause for the same and repair the affected area. Nothing extra shall be paid to the contractor in this respect.
- It shall be the responsibility of the contractor to check the healthiness of all the water Supply/drainage/Sump pumps, Bathroom Fixtures, Water Bodies, and OHT/UGT at regular intervals. In this regard, the contractor shall maintain the register and clearly mention the status and action taken and the date of inspection.
- The contractor shall maintain the drinking water supply, including rectification of minor defects.
- The Contractor shall also ensure that rectification of defects in the following Major equipment's shall be attended and rectify the same on priority basis.

S. No.	Description
1.	11 KV HT panel
2.	33/11 Kv, 11/0.433 KV Transformers
3.	LT Panels, LT rising mains
4.	Floor & Meter Panels
5.	Pump Room, WTP and allied services
6.	STP and allied services
7.	Lifts and allied services
8.	Firefighting system (Pump room) and terrace pumps
9.	UPS & UPS Panel
10.	All Low Voltage passive & active components (FAS/PA, FTTH, EPABX intercom, IBMS etc.)
11.	Internal & External lightings
12.	Chiller Plant, VRV/VRF, Split AC and ventilation systems
13.	Waste compactors and Composter system

D) Operation & Maintenance of Sewage Treatment Plant for 2 years.

- The contractor shall be responsible for Operation & Maintenance of STP during the Defect Liability Period from the date of Handing over.
- The contractor shall depute Operator (1) each for both STP during the entire period of DLP.
- The Contractor shall be responsible for maintenance/ replacement of parts/ equipment's during this period as well as the chemical consumables.
- In case of failure of operation of STP/ Pump room, a penalty of Rs. 10000/- per non-operational day shall be recoverable.
- It shall be the responsibility of the contractor to renew the CFO (Consent for Operation) or any other certificate, license, NOC required for the operation of STPs/WTPs from the concerned authority in case the same got expired. The cost of obtaining the NOCs shall borne by contractor.

E) Supply of Spare Parts or Materials (if applicable)

- Provide any necessary spare parts or materials required for defect repair, especially for specialized equipment or installations.
- Ensure that supplied parts meet the original specifications and standards.

F) Minimum Manpower to be deputed during DLP by the contractor

The contractor shall depute following manpower along with Non Skilled Workman as per requirement in the WAPCOS campus during the entire period of DLP.

S. No.	Manpower	Minimum Number	Period of Deployment	Rate of Recovery
1	Project Manager		As and When Required during the Defect Notification	
2	Site Engineer-Civil			
3	Site Engineer-MEP			
4	Carpenter			
5	Plumber	1	Full Time	Rs. 1000/- per day
6	Electrician	1	Full Time	Rs. 1000/- per day
7	HVAC Operator	1	Full Time	Rs. 1000/- per day
8	STP & OWC Operator	1	Full time	Rs. 1000/- per day

Note:

1. Any other Skilled/ Non-Skilled manpower as required, beyond the above staff to complete the work/complaints within specified time limits, will arranged by contractor at their own cost & Nothing extra shall be paid on this account.
2. On Sundays and National Holidays, all manpower will attend general services and repair. In case of an emergency during the night/ holiday/ rest day, requisite manpower, has to be engaged without any extra cost. In case of an incidence of a fire or any other mishap, all the manpower/ personnel of other trades shall be engaged.

G) Ensuring Performance and Quality Standards:

- All repairs must restore the works to the required performance standards and original specification.
- Ensure workmanship and materials used during defect rectification comply with contract and industry standards.

H) Coordination and Safety

- Coordinate with other contractors or subcontractors, if applicable, for efficient defect repair.
- Maintain site safety during the defect repair works to prevent any accidents.

I) Record Keeping and Reporting

- Maintain detailed records of defects reported, actions taken, materials used, and completion dates.
- Submit regular progress reports on defect rectification to the PMC/Engineer/Employer.

J) Liability for Recurring Defects

- If the same defect reappears during the DLP after being rectified, the contractor is responsible to permanently fix the underlying issue.
- In case, the contractor fails to fix the issue, Penalty from the Security deposit shall be applicable as decided by the Engineer-In-Charge.
- The Contractor is expected to maintain the Satisfactory level of service and shall collect feedback form after rectifying any defect notified to him.

K) Final Handover after DLP.

- Upon successful completion of defect rectifications and expiry of the DLP without outstanding defects, the contractor may assist in handing over the project fully defect-free.

SECTION VI - ANNEXURES

The following Annexures form an integral part of the Contract. Standard formats are enclosed as part of this SBD. Project-specific details (highlighted blanks) shall be filled before issuing.

Annexure	Title and Key Features
Annexure I	Format for Contract Agreement (on Non-Judicial Stamp Paper ≥ Rs. 100) and Letter of Award
Annexure II	Format for Performance Bank Guarantee
Annexure III	Format for Mobilisation Advance Payment Bank Guarantee
Annexure IV	Format for Indenture for Secured Advances on Non-Perishable Materials
Annexure V	Format for Bank Guarantee for EMD / Bid Security (on Non-Judicial Stamp Paper ≥ Rs. 100) —
Annexure VI	Format for Seeking Extension of Time (EOT)
Annexure VII	Format of Guarantee Bond / Affidavit for Works
Annexure VIII	Contract for Removal of Defects after Completion
Annexure IX	Format for Guarantee Bond for Anti-Termite Treatment
Annexure X	Safety Codes
Annexure XI	Model Rules for Protection of Health and Sanitary Arrangements for Workers
Annexure XII	Contractor's Labour Regulations
Annexure XIII	No Claim Certificate

ANNEXURE-I

(Format for "Contract" to be signed on Non-Judicial Stamp Paper of Rs. 100 by successful bidder)

CONTRACT AGREEMENT

This Contract made on the____ day of ___ 20____between WAPCOS Limited, a Company in corporate under Indian Company's Act and having its registered office at 5th floor, Kailash Building, 26, K. G. Marg, New Delhi (hereinafter called "WAPCOS" of the one part) and (Name of Contractor Firm & Address)_____ (hereinafter called "Contractor" of the other part).

WHEREAS the WAPCOS is desirous that Work known as "_____". (Herein after referred to as "Work/ Project") under the Tender no._____ dated_____ should be executed by the Contractor AND WHEREAS by a Letter of Award No._____ dated _____ issued by WAPCOS Limited and accepted by the contractor. WAPCOS Limited has accepted a Bid submitted by the Contractor for the execution and completion of such Work AND WHEREAS the Contractor has agreed to undertake such Work and furnish a Performance Security_____(details) pursuant to Tender conditions.

NOW THIS AGREEMENT WITNESSETH as follows;

In this Contract words and expressions shall have the same meanings as are respectively assigned to them in the Conditions of Contract hereinafter referred to.
The following documents shall be deemed to form and be read and construed as part of this Contract, viz;

a) Tender Document no._____dtd._____
b) Letter of Award to Contractor by WAPCOS
c) Documents furnished by the Contractor during Bidding process
d) Corrigendum/Amendments, if any
e) Clarifications / Correspondences, if any
f) Any other documents as forming part of the contract

1. The aforesaid documents shall be taken as complementary and mutually explanatory of one another.

2. In consideration of the payment to be made by WAPCOS to the Contractor as indicated in this Contract, the Contractor hereby covenants with WAPCOS to execute and complete the Works in conformity, in all respects, with the provisions of the Contract.

3. WAPCOS hereby covenants to pay the Contractor in consideration of the execution and completion of the Works and the remedying of defects therein the Contract Price or such other sum as may become payable under the provisions of the contract at the time and in the manner prescribed by the Contract.

IN WITNESS whereof the parties hereto have caused this Agreement to be executed in accordance with Laws of India on the day, month & year indicated above.

SIGNED, SEALED AND DELIVERED

For and on behalf of the WAPCOS

For and on behalf of the Contractor

NAME _____
Designation

in the presence of witness:

1_____

2 _____

NAME _____
Designation

in the presence of Witness

1_____

2 _____

NOTE: Contractor shall submit the Original Power of Attorney on Non-Judicial Stamp Paper for this particular Work / Project, in the name of Person who will sign the Contract with WAPCOS after award of Work.

FORMAT FOR LETTER OF AWARD

No. …… **Date:……**

M/s ……..(Name of successful bidder)
……. (Address of successful bidder)

Subject: Award Letter for ……..

Reference: Tender No. …….. ……

Dear Sir,

We are pleased to inform that work of "……." is awarded to your firm, in cost of Rs. ---------- excluding GST, according to submission of your technical & financial bids against referred tender for the subjected work.

Project	Awarded Cost excluding GST
……	Rs. ……..

1. The "Date of Commencement of Work" shall be 15 days after Date of Award or Handing over of Site whichever is later and accordingly, planning should be started for deploying manpower, resources as per Terms & Conditions of Tender document.
2. The tender document wholly accepted by you along with all related correspondences at the time of bidding shall form a part of this letter of award.
3. You are requested to submit the following as per Terms & Conditions of tender
   - Performance Security @5% of Tendered Value as per the form enclosed in the tender document before signing of the Agreement within 21 (Twenty One) days of the date of acceptance of the letter of award and sign the Contract Agreement.
   - Detailed Schedule Plan/ Bar chart of each component of work to complete the work in stipulated time period
   - Labour License from concerned Labour Department of State
   - Contractor All Risk (CAR) and Third Party Cover Policy.
   - Liability under the workmen's compensation Act, 1923, Minimum Wages Act, 1948
   - Details of manpower to be deployed at site along with CVs
   - List of Lab Equipment required for the work for approval of Engineer-in charge.

4. The terms & conditions of the Work will be governed as mentioned in the tender document.

This letter of award is being issued to you in duplicate. You are requested to return the duplicate copy of the letter of award immediately duly signed and stamped as a token of your unequivocal acceptance and confirmation of the same.

Thanking You,

Yours faithfully,

(Name & Designation)

Annexure – II

(To be submitted on non-judicial stamp paper of Rs. 100)

FORMAT FOR PERFORMANCE BANK GUARANTEE

To,

The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015.

In consideration of _____ (Employer's name) (hereinafter referred to as "the Employer") which expression shall, unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to _____ (Contractor's name & address) (hereinafter referred to as "the Contractor" which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) a contract, by issue of Employer's Notification of Award No. _____ dt. _____ and the same having been unequivocally accepted by the Contractor, resulting into a contract valued at Rs. _____(Rupees _____only) for **<Name of Work>** (hereinafter called "the contract") and the Contractor having agreed to provide a Contract Performance Security for the faithful performance of the entire contract equivalent to Rs. _____ (Rupees _____only) (5% of the said value of the Contract to the Employer).

We, _____ (name & address of bank) (hereinafter referred to as "the Bank" which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer, on demand any or, all monies payable by the Contractor to the extent of Rs. _____ (Rupees _____only) as aforesaid at any time upto _____ without any demur, reservation, contest , recourse or protest and/or without any reference to the Contractor or court. Any such demand made by the Employer on the bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. The Bank undertakes not to revoke this guarantee during its currency without previous consent of the Employer and further agrees that the guarantee herein contained shall continue to be enforceable till the Employer discharges this guarantee.

We the said Bank further agree that the guarantee herein contained shall remain in full force and effect during the period that would be taken for the performance of the said Contract and that it shall continue to be enforceable till all the dues of the Employer under or by virtue of the said contract have been fully paid and its claims satisfied or discharged or till the Employer certifies that the terms and conditions of the said Contract have been fully and properly carried out by the said Contractor and accordingly discharges the guarantee.

The Employer shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee, from, time to time to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor and to exercise the same at any time in any manner and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters aforesaid or any of them

or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under law would but for this provision, have the effect of relieving the Bank. The guarantee shall not be affected by a change in the constitution of the bank or of the employer.

The bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance, without proceeding against the Contractor and notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

We The Said Bank do hereby declare that we have absolute and unconditional power to issue this guarantee in your favour under the Memorandum and Articles of Association or such other constitutional documents of the Bank and the undersigned have full power to execute this guarantee under the Power of Attorney / Post Approval Authorization dated _____ of the bank granted to him / us by the Bank. We the said bank do hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the powers of the bank or its officials and the guarantee shall be deemed to have been issued as if the bank and its officials have all the powers and authorization to give this guarantee on behalf of the bank.

We the said bank do hereby certify the genuineness and appropriateness of the Stamp paper and stamp value used for issuing the guarantee. We the said bank do hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the stamp paper or its stamp value.

We the said bank do hereby declare that our payments hereunder shall be made to you , free and clear of and without and deduction, reduction on account of any reasons including any and all present and future taxes, levies, charges of withholding whatsoever imposed or collected with respect thereto.

Notwithstanding anything contained hereinabove our liability under this guarantee is restricted to Rs. _____(Rupees _____ only) and it shall remain in force upto and including _____ and shall be extended from time to time for such period as may be desired by M/s WAPCOS Limited to whom this bank guarantee has been given.

Notwithstanding anything contained herein

i) Our liability under this guarantee shall not exceed Rs. _____ (Rupees_____ only);
ii) This bank guarantee shall be valid upto _____; and
iii) our liability to make payment shall arise and we are liable to pay the guaranteed amount or any part thereof under this guarantee, only and only if you serve upon us a written claim or demand in terms of the guarantee on or before _____ **(indicate a date twelve month after validity of Guarantee**)

Dated this _____day of _____ at New Delhi.

Authorized Signatory of …… Bank

Signature	**Signature**
Name……..	**Name……..**
Signature Code/ S.S no. ……	**Signature Code/ S.S no. ……**

ANNEXURE – III

(To be submitted on non-judicial stamp paper of Rs. 100)

FORMAT FOR MOBILIZATION ADVANCE PAYMENT BANK GUARANTEE

To,
The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015

In consideration of WAPCOS LTD. (hereinafter referred to as "the Employer") which expression shall, unless repugnant to the context or meaning thereof include its successors, administrators and assigns) having awarded to _____ (Contractor's name) with its Registered /Head Office at _____(hereinafter referred to as "the Contractor" which expression shall unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) a contract, by issue of Employer's Notification of Award No. _____ dt. _____ and the same having been unequivocally accepted by the Contractor, resulting into a contract valued at Rs._____
(Rupees_____only) for _____ (hereinafter called "the contract") and the Employer having agreed to make an advance payment to the Contractor for performance of the above Contract amounting to Rs. _____ (Rupees _____only) as an advance against bank guarantee to be furnished by the Contractor.

We, _____ (name & address of bank) having its Head Office at _____ (hereinafter referred to as "the Bank" which expression shall, unless repugnant to the context or meaning thereof, include its successors, administrators, executors and assigns) do hereby guarantee and undertake to pay the Employer immediately on demand any or, all monies payable by the Contractor to the extent of Rs. _____ (Rupees _____only) as aforesaid at any time upto _____ without any demur, reservation, contest, recourse or protest and/or without any reference to the Contractor. Any such demand made by the Employer on the bank shall be conclusive and binding notwithstanding any difference between the Employer and the Contractor or any dispute pending before any Court, Tribunal, Arbitrator or any other authority. We agree that the Guarantee herein contained shall be irrevocable and shall continue to be enforceable till the Employer discharges this guarantee. We further agree that no change in the constitution of the Bank or of the Employer shall affect this guarantee.
The Employer shall have the fullest liberty without affecting in any way the liability of the Bank under this guarantee, from time to time, to vary the advance or to extend the time for performance of the Contract by the Contractor. The Employer shall have the fullest liberty without affecting this guarantee, to postpone from time to time the exercise of any powers vested in them or of any right which they might have against the Contractor and to exercise the same at any time in any manner, and either to enforce or to forbear to enforce any covenants, contained or implied, in the Contract between the Employer and the Contractor or any other course or remedy or security available to the Employer. The bank shall not be released of its obligations under these presents by any exercise by the Employer of its liberty with reference to the matters aforesaid or any of them or by reason of any other act or forbearance or other acts of omission or commission on the part of the Employer or any other indulgence shown by the Employer or by any other matter or thing whatsoever which under law would but for this provision, have the effect of relieving the Bank.

The bank also agrees that the Employer at its option shall be entitled to enforce this Guarantee against the Bank as a principal debtor, in the first instance without proceeding against the Contractor and

notwithstanding any security or other guarantee that the Employer may have in relation to the Contractor's liabilities.

We the Said Bank do hereby declare that we have absolute and unconditional power to issue this guarantee in your favour under the Memorandum and Articles of Association or such other constitutional documents of the Bank and the undersigned have full power to execute this guarantee under the Power of Attorney/ Post Approval Authorization dated _____ of the bank granted to him / us by the Bank. We the said bank do hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the powers of the bank or its officials and the guarantee shall be deemed to have been issued as if the bank and its officials have all the powers and authorization to give this guarantee on behalf of the bank.

We the said bank does hereby certify the genuineness and appropriateness of the Stamp paper and stamp value used for issuing the guarantee. We the said bank does hereby declare and undertake that your claim under the guarantee shall not be affected by any deficiency or other defect in the stamp paper or its stamp value.

We the said bank do hereby declare that our payments hereunder shall be made to you , free and clear of and without and deduction, reduction on account of any reasons including any and all present and future taxes, levies, charges of withholding whatsoever imposed or collected with respect thereto.

Notwithstanding anything contained hereinabove our liability under this guarantee is limited to Rs._____ (Rupees _____ only) and it shall remain in force upto and including _____ and shall be extended from time to time for such period (not exceeding one year), as may be desired by M/s _____ on whose behalf this bank guarantee has been given.

Notwithstanding anything contained herein

i) Our liability under this guarantee shall not exceed Rs._____(Rupees _____only);

ii) This bank guarantee shall be valid upto _____ and

iii) our liability to make payment shall arise and we are liable to pay the guaranteed amount or any part thereof under this guarantee, only and only if you serve upon us a written claim or demand in terms of the guarantee on or before _____ **(indicate a date twelve months after the validity of the guarantee).**

Dated this _____ day of _____ at……...

Authorized Signatory of …… Bank

Signature **Signature**

Name…….. **Name……..**

Signature Code/ S.S no. …… **Signature Code/ S.S no. ……**

ANNEXURE-IV

(On non-judicial stamp paper of Rs. 100 duly attested by Notary / Magistrate)

FORMAT FOR INDENTURE FOR SECURED ADVANCES

THIS INDENTURE made the…… day of ……..20……. BETWEEN …… (hereinafter called the Contractor which expression shall where the context so admits or implies be deemed to include his executors administrators and assigns) of the one part and the WAPCOS (hereinafter called the WAPCOS which expression shall where the context so admits or implies be deemed to include his successors in office and assigns) of the other part.

WHEREAS by an agreement dated…….. (hereinafter called the said agreement) the Contractor has agreed AND WHEREAS the Contractor has applied to the WAPCOS that he may be allowed advances on the security of materials absolutely belonging to him and brought by him to the site of the works the subject of the said agreement for use in the construction of such of the works as he has undertaken to execute at rates fixed for the finished work (inclusive of the cost of materials and labour and other charges) AND WHEREAS the WAPCOS has agreed to advance to the Contractor the sum of Rupees …… on the security of materials the quantities and other particulars of which are detailed in Accounts of Secured Advances attached to the Running Account Bill for the said works signed by the Contractor on ……and the WAPCOS has reserved to himself the option of making any further advance or advances on the security of other materials brought by the Contractor to the site of the said works. Now THIS INDENTURE WITNESSETH that in pursuance of the said agreement and in consideration of the sum of Rupees ……on or before the execution of these presents paid to the Contractor by the WAPCOS (the receipt whereof the Contractor doth hereby acknowledge) and of such further advances (if any) as may be made to him as aforesaid the Contractor doth hereby covenant and agree with the WAPCOS and declare as follows: -

(1) That the said sum of Rupees ……..so advanced by the WAPCOS to the Contractor as aforesaid and all or any further sum or sums advanced as aforesaid shall be employed by the Contractor in or towards expediting the execution of the said works and for no other purpose whatsoever.

(2) That the materials detailed in the said Account of Secured Advances which have been offered to and accepted by the WAPCOS as security are absolutely the Contractor's own property and free from encumbrances of any kind and the contractor will not make any application for or receive a further advance on the security of materials which are not absolutely his own property and free from encumbrances of any kind and the Contractor indemnifies the WAPCOS against all claims to any materials in respect of which an advance has been made to him as aforesaid.

(3) That the materials detailed in the said Account of Secured Advances and all other materials on the security of which any further advance or advances may hereafter be made as aforesaid (hereinafter called the said materials) shall be used by the Contractor solely in the execution of the said works in accordance with the directions of the Divisional Officer ……. Division (hereinafter called the Divisional Officer) and in the term of the said agreement.

(4) That the Contractor shall make at his own cost all necessary and adequate arrangements for the proper watch, safe custody and protection against all risks of the said materials and that until used in construction as aforesaid the said materials shall remain at the site of the said works in the Contractor's custody and on his own responsibility and shall at all times be open to inspection by the Divisional Officer or any officer authorised by him. In the event of the said materials or any part thereof being stolen, destroyed or damaged or becoming deteriorated in a greater degree than is due

to reasonable use and wear thereof the Contractor will forthwith replace the same with other materials of like quality or repair and make good the same as required by the Divisional Officer.

(5) That the said materials shall not on any account be removed from the site of the said works except with the written permission of the Divisional Officer or an officer authorised by him on that behalf.

(6) That the advances shall be repayable in full when or before the Contractor receives payment from the WAPCOS of the price payable to him for the said works under the terms and provisions of the said agreement. Provided that if any intermediate payments are made to the Contractor on account of work done than on the occasion of each such payment the WAPCOS will be at liberty to make a recovery from the Contractor's bill for such payment by deducting there from the value of the said materials then actually used in the construction and in respect of which recovery has not been made previously, the value for this purpose being determined in respect of each description of materials at the rates at which the amounts of the advances made under these presents were calculated.

(7) That if the Contractor shall at any time make any default in the performance or observance in any respect of any of the terms and provisions of the said agreement or of these presents the total amount of the advance or advances that may still be owing to the WAPCOS shall immediately on the happening of such default be repayable by the Contractor to the WAPCOS together with interest thereon at twelve per cent per annum from the date or respective dates of such advance or advances to the date of repayment and with all costs charges, damages and expenses incurred by the WAPCOS in or for the recovery thereof or the enforcement of this security or otherwise by reason of the default of the Contractor and the Contractor hereby covenants and agrees with the WAPCOS to repay and pay the same respectively to him accordingly.

(8) That the Contractor hereby charges all the said materials with the repayment to the WAPCOS of the said sum of Rupees ……and any further sum or sums advanced as aforesaid and all costs charges, damages and expenses payable under these presents PROVIDED ALWAYS and it is hereby agreed and declared that notwithstanding anything in the said agreement and without prejudice to the powers contained therein if and whenever the covenant for payment and repayment herein before contained shall become enforceable and the money owing shall not be paid in accordance therewith the WAPCOS may at any time thereafter adopt all or any of the following courses as he may deem best :-

(a) Size and utilize the said materials or any part thereof in the completion of the said works on behalf of the Contractor in accordance with the provisions in that behalf contained in the said agreement debiting the Contractor with the actual cost of effecting such completion and the amount due in respect of advances under these presents and crediting the Contractor with the value of work done as if he had carried it out in accordance with the said agreement and at the rates thereby provided. If the balance is against the Contractor he is to pay same to the WAPCOS on demand.

b) Remove and sell by public auction the seized materials or any part thereof and out of the moneys arising from the sale retain all the sums aforesaid repayable or payable to the WAPCOS under these presents and pay over the surplus (if any) to the Contractor.

(c) Deduct all or any part of the moneys owing out of the security deposit or any sum due to the Contractor under the said agreement.

(9) That except in the event of such default on the part of the Contractor as aforesaid interest on the said advance shall not be payable.

(10) That in the event of any conflict between the provisions of these presents and the said agreement the provisions of these presents shall prevail and in the event of any dispute or difference arising over the construction or effect of these presents the settlement of which has not been herein before expressly provided for the same shall be finally resolved as per provisions of clause 25 of the contract.

In witness whereof the said Contractor and WAPCOS by the order and under the direction of the WAPCOS have hereunto set their respective hands the day and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	**For and on behalf of the WAPCOS**
NAME _____	**NAME**_____
Designation _____	**Designation**_____
in the presence of witness:	**in the presence of Witness**
1_____	1_____
2 _____	2 _____

ANNEXURE-V

(To be submitted on non-judicial stamp paper of Rs. 100)

FORMAT FOR BANK GUARANTEE OF EMD

To,
The WAPCOS Limited,
76-C, Sector 18, Institutional Area
Gurugram, Haryana-122015.

WHEREAS, M/s …….. having their Registered/Head Office at …….. (hereinafter called "the Bidder") has submitted his Bid dated …… for the …… [hereinafter called "the Bid"] to M/s WAPCOS Limited (hereinafter called the Employer)
KNOW ALL PEOPLE by these presents that we …… (name of the Bank) having our head office at …… (hereinafter called "the Bank") are bound unto Employer in the sum of …… for which payment well and truly to be made to the Employer, the Bank binds itself, its successors and assigns by these presents.

SEALED with the Common Seal of the said Bank this …… day of ……month…… year.

THE CONDITIONS of this obligation are:
(1) If after Bid opening, the bidder withdraws his bid during the period of Bid validity specified;

OR

(2) If the bidder having been notified of the acceptance of his bid by …… during the period of Bid Validity:

We undertake to pay to the …… up to the above amount upon receipt of his first written demand, without the Employer having to substantiate his demand, provided that in his demand the bidder will note that the amount claimed by him is due to him owing to the occurrence of one or any of the above mentioned two conditions and specify the occurred condition or conditions.
This Guarantee will remain in force up to and including the date …… after the deadline for submission of Bids as is stated in the instructions to bidders or as it may be extended by the …… notice of which extension(s) to the Bank is hereby waived and notice to the bidder would constitute sufficient notice to the Bank. Any demand in respect of this guarantee should reach the Bank not later than the above date.
Notwithstanding anything contained herein

i) Liability under this guarantee shall not exceed ……
ii) This bank guarantee shall be valid upto …… and;
iii) Our liability to make payment shall arise and we are liable to pay the guaranteed amount or any part thereof under this guarantee only and only if you serve upon us a written claim or demand in terms of the guarantee on or before …… (indicate a period twelve months after the date of issue of Bank Guarantee).

Dated this _____ day of _____ at……...
Authorized Signatory of …… Bank

Signature	**Signature**
Name……..	**Name……..**
Signature Code/ S.S no. ……	**Signature Code/ S.S no. ……**

ANNEXURE-VI

(To be submitted on Contractor's original Letter Head)

FORMAT FOR SEEKING EXTENSION OF TIME

1. Name of Contractor:
2. Name of work:
3. Agreement No. and Date:
4. Date of commencement of work as per Agreement:
5. Period and Stipulated date of completion as per Agreement:
6. Period for which extension of time already given:

Extension	Period	Reasons Stated earlier for seeking EoT
(a) 1st extension		
(b) 2nd extension		
(c) 3rd extension		
(d) 4th extension		
(e) 5th extension		

9) Reasons for present extension

10) Period for which extension is applied for

It is understood that we will not claim any additional cost due to above extension of time and also understand that WAPCOS have rights to act in accordance with provisions in relevant clauses of Contract Agreement.

Dated……..

Contractor's Signature and Stamp

Annexure – VII

(On Rs. 100 non- Judicial Stamp Paper duly attested by Notary / Magistrate and will be signed by the person who sign the Original Agreement)

FORMAT FOR GUARANTE BONDS

To Be Executed by Contractor for Structural Stability, Removal of Defects after completion of work

This Supplementary Agreement made this ____ day of _____ 20___ between (Name of Contractor firm & address) _____ (hereinafter called the CONTRACTOR / GUARANTOR of the one part) and the WAPCOS LIMITED, 5th floor, Kailash Building, 26, K. G. Marg, New Delhi (hereinafter called WAPCOS of the other part) for the Work **<Name of Work>** in respect of Contract Agreement (hereinafter called the "Original Agreement" signed between ……(Name of Contractor firm) and WAPCOS on…….. dated ……..), whereby the contractor interalia, under look to render the work in the said contract recited structurally stable workmanship and use of sound materials.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said work will remain structurally stable and guarantee against faulty workmanship, manufacturing defects of materials etc.

NOW THE GUARANTOR hereby guarantee that work executed by him will remain structurally stable, for the minimum life of ten years, to be reckoned from the date of start of Defect Liability Period or Maintenance Period which ever is later, prescribed in the Contract.

The decision of the WAPCOS with regard to nature and cause of defects shall be final. During the period of guarantee the Guarantor shall make good all defects to the satisfaction of the WAPCOS calling upon him to rectify the defects, failing which the work shall be got done by the WAPCOS by some other agencies at the Guarantor's cost and risk. The decision of the WAPCOS as to the cost payable by the Guarantor shall be final and binding.

That if the Guarantor fails to make good all the defects, commits breach thereunder then the guarantor will indemnify the Principal and his successor against all loss, damage cost expense or otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this Supplementary Agreement. As to the amount of loss and / or damage and / or cost incurred by the WAPCOS the decision of the WAPCOS will be final and binding.

IN WITHNES WHEREOF those presents have been executed by the GUARANTOR ……..(Name and Designation who sign the Original Contract Agreement) on behalf of .....(Name of Contractor Firm) and WAPCOS on the day, month and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor

NAME _____
Designation
in the presence of witness:
1_____

2 _____

For and on behalf of the WAPCOS

NAME _____
Designation
in the presence of Witness
1_____

2 _____

Annexure – VIII

(On Rs. 100 non- Judicial Stamp Paper duly attested by Notary / Magistrate and will be signed by the person who sign the Original Agreement))

FORMAT FOR GUARANTE BONDS
To Be Executed by Contractor for Water Proofing after Completion of Work

This Supplementary Agreement made this ____ day of _____ 20___ between (Name of Contractor firm & address) _____ (hereinafter called the CONTRACTOR / GUARANTOR of the one part) and the WAPCOS LIMITED, 5th floor, Kailash Building, 26, K. G. Marg, New Delhi (hereinafter called WAPCOS of the other part) for the Work **<Name of Work>** in respect of Contract Agreement (hereinafter called the "Original Agreement" signed between ……(Name of Contractor firm) and WAPCOS on…….. dated ……..), whereby the contractor interalia, under look to render the buildings and structures in the contract recited completely water and leak-proof for Toilets, Shower , Under Ground Tank, Roof, Over Head Tank, Basement and any other allied areas of building.

AND WHEREAS THE GUARANTOR agreed to give a guarantee to the effect that the said structures will remain water and leak-proof for **ten years** from the date after the Defect Liability Period or Maintenance Period which ever is later, prescribed in the contract. NOW THE GUARANTOR hereby guarantees that water proofing treatment given by him will render the structures completely leak proof and the minimum life of such water proofing treatment shall be **ten years** to be reckoned from the date after the Defect Liability Period / Maintenance Period which ever is later, prescribed in the contract.

Provided that the Guarantor will not be responsible for the leakage caused by earthquake or structural defects or misuse of roof or alteration and for such purpose:

a. Misuse of roof shall mean any operation which will damage proofing treatment, like chopping of firewood and things of the same nature which might cause damage to the roof.
b. Alteration shall mean construction of an additional storey or a part of the roof or construction adjoining to existing roof whereby proofing treatment is removed in parts.
c. The decision of the Principal Employer with regard to cause of leakage/seepage shall be final.

During this period of guarantee the Guarantor shall make good all defects and in case of any defect being found, render the building water proof to the satisfaction of the Principal Employer at his cost and shall commence the work for the rectification within seven days from the date of issue of the notice from the Principal Employer calling upon him to rectify the defects failing which the work shall be done by the Principal Employer by some other agency at the GUARANTOR's risk and cost. The decision of the Principal Employer as to the cost payable by the Guarantor shall be final and binding. That if Guarantor fails to make good all defects or commits breach there under then the Guarantor will indemnify the principal and his successors against all loss, damage, cost expense otherwise which may be incurred by him by reason of any default on the part of the GUARANTOR in performance and observance of this Supplementary Agreement. As to the amount of loss and/or damage and/or cost incurred by the Principal Employer the decision of the owner will be final and binding on the parties.

IN WITHNES WHEREOF those presents have been executed by the GUARANTOR ……..(Name and Designation who sign the Contract) on behalf of .....(Name of Contractor Firm) and Principal Employer on the day, month and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	**For and on behalf of the Principal Employer/Employer**
NAME _____ Designation **in the presence of witness:** 1_____ 2 _____	NAME _____ Designation **in the presence of Witness** 1_____ 2 _____

ANNEXURE VIII (a)

FORM OF BANK GUARANTEE BOND FOR WATER PROOFING WORK

1. In considerable of the ……..(Name of Principal Employer) (hereinafter called "The Owner") having agreed to exempt..... (Hereinafter called the said contractor(s)) from the demand, under the terms and conditions of the Agreement No..... dated.....Made between ..... and ..... For the work of..... (hereinafter called "The said Agreement") security deposit for the due fulfillment by the said contractor(s) of the terms & conditions contained in the said Agreements for the work of Anti water proofing work on production of an irrevocable Bank Guarantee for Rs. 10 Lakhs for ten years we ..... (Indicate the name of the bank) (Hereinafter referred to as "the Bank) hereby undertake to pay to the Owner an amount not exceeding Rs. ……(Rupees ……only) on demand by the Owner

2. We..... (indicate the name of the bank) do hereby undertake to pay the amounts due and payable under this Guarantee without any demure, merely on a demand from Principal Employer stating that the amount claimed is required to meet the recoveries due or likely to be due from the said contractor(s). Any such demand made on the Bank shall be conclusive as regards the amount due and payable by the bank under the Guarantee. However, our liability under this guarantee shall be restricted to an amount not exceeding Rs. ……(Rupees ……only).

3. We..... (indicate the name of the bank) further undertake to pay to Principal Employer any money so demanded notwithstanding any dispute or disputes raised by the contractor(s) in any suit or proceeding pending before any court or Tribunal relating thereto, our liability under this present being absolute and unequivocal.
   The payment so made by as under this bond shall be a valid discharge of our liability for payment there under and the contractor(s) shall have no claim against us for making such payment.

4. We..... (indicate the name of the Bank) further agree that the guarantee hereinafter contained shall remain in full force and effect during the period that would be taken for the performance of the said agreement and that it shall continue to be enforceable till all the dues of Principal Employer under or by virtue of the said agreement have been fully paid and its claims satisfied or discharged or till Principal Employer certified that the terms and condition of the said agreement have been fully and properly carried out by the said contractor(s) and accordingly discharges this guarantee.

5. We…….. (indicate name of the bank) further agree with Principal Employer that Principal Employer shall have the fullest liberty without our consent and without effecting in any manner our obligations hereunder to vary any of the terms and conditions of the said agreement or to extend time of performance by the said contractor(s) from time to time or to postpone for any time or from time to time any of the powers exercisable by Principal Employer against the said contractor(s) and to for bear or enforce any of the terms and conditions relating to the said agreement and we shall not be relieved from our liability by reason of any such variation, or extension being granted to the said contractors(s) or for any bearance, act of commission of the part of Principal Employer or any indulgence by Principal Employer to the said contractor(s) or by any such matter of thing whatsoever which under the law relating to sureties would, but for this provision, have effect of so relieving us.

6. This guarantee will not be discharged due to the change in the constitution of Bank or the contractor(s).

7. We…… (indicate the name of the Bank) lastly undertake not to revoke this guarantee except with the previous consent of Principal Employer in writing

8. This guarantee shall be valid upto ..... unless extended on demand by Principal Employer. Notwithstanding anything mentioned above, our liability against this guarantee is restricted to Rs. ……(Rupees ……only) and unless a claim in writing is lodged with us within six months of the date of expiry or the extended date of expiry of this guarantee all our liabilities under this guarantee shall stand discharged

Dated this _____ day of _____ at……...

Authorized Signatory of …… Bank

Signature **Signature**

Name…….. **Name……..**

Signature Code/ S.S no. …… **Signature Code/ S.S no. ……**

Annexure – IX

(On Rs. 100 non- Judicial Stamp Paper duly attested by Notary / Magistrate)

FORMAT FOR GUARANTE BONDS FOR ANTI-TERMITE TREATMENT
To Be Executed by Contractor for Anti Termite Treatment after Completion of Work

This Agreement made on this ____ day of _____ 20___ between_____ (Name of Contractor firm & address) _____ (hereinafter called the CONTRACTOR / GUARANTOR of the one part) and the _____(hereinafter called Principal Employer/Employer of the other part) for Anti Termite Treatment Works for **<Name of Work>**

WHEREAS This Agreement is Supplementary, to a Contract (hereinafter called the Contract) Contract no._____ dated _____and made between the _____ (Name of Contractor) and WAPCOS LIMITED, 5th floor, Kailash Building, 26, K. G. Marg, New Delhi, whereby the contractor, inter alia, undertook to render the wooden work in the said contract recited completely Termite proof.

THE GUARANTOR hereby guarantee that the anti-termite treatment given by him will render the wooden works completely Termite proof and the minimum life of such Anti-Termite treatment shall be five years to be reckoned from the from the date after the Defect Liability Period or Maintenance Period which ever is later, prescribed in the contract.

During the period of guarantee the Guarantor shall make good all defects and in case of any defects being found render the wooden works termite proof to the satisfaction of the Principal Employer at his cost and shall commence the work for such rectification within seven days from the date of issue of notice from the Principal Employer calling upon him to rectify the defects, failing which the work shall be got done by the Principal Employer through some other Agency at the Guarantor's cost and risk. The decision of the Principal Employer as to the cost payable by the Guarantor shall be final and binding.

That if the guarantor fails to execute the Anti-termite works, or commits breach thereunder then the guarantor will indemnify the Principal and his successor against all loss, damage, cost of expenses or otherwise which may be incurred by him by reason of any of any default on the part of the GUARANTOR in performance and observance of this Supplementary Agreement. As to the amount of loss and / or cost incurred by the Principal Employer on the decision of the Principal Employer will be final and binding.

IN WITHNES WHEREOF those presents have been executed by the GUARANTOR ……..(Name and Designation who sign the Contract) on behalf of .....(Name of Contractor Firm) and Principal Employer on the day, month and year first above written.

SIGNED, SEALED AND DELIVERED

For and on behalf of the Contractor	**For and on behalf of the Principal Employer/Employer**
NAME _____ Designation	NAME _____ Designation
in the presence of witness:	**in the presence of Witness**
1_____	1_____
2 _____	2 _____

ANNEXURE – X

SAFETY CODES

1. Suitable scaffolds should be provided for workmen for all works that cannot safely be done from the ground, or from solid construction except such short period work as can be done safely from ladders. When a ladder is used, an extra mazdoor shall be engaged for holding the ladder and if the ladder is used for carrying materials as well suitable footholds and hand-hold shall be provided on the ladder and the ladder shall be given an inclination not steeper than ¼ to 1(¼ horizontal and 1 vertical).

2. Scaffolding of staging more than 3.6 m (12ft.) above the ground or floor, swung or suspended from an overhead support or erected with stationary support shall have a guard rail properly attached or bolted, braced and otherwise secured at least 90 cm. (3ft.) high above the floor or platform of such scaffolding or staging and extending along the entire length of the outside and ends thereof with only such opening as may be necessary for the delivery of materials. Such scaffolding or staging shall be so fastened as to prevent it from swaying from the building or structure.

3. Working platforms, gangways and stairways should be so constructed that they should not sag unduly or unequally, and if the height of the platform or the gangway or the stairway is more than 3.6 m (12ft.) above ground level or floor level, they should be closely boarded, should have adequate width and should be suitably fastened as described in (2) above.

4. Every opening in the floor of a building or in a working platform shall be provided with suitable means to prevent the fall of person or materials by providing suitable fencing or railing whose minimum height shall be 90 cm. (3ft.).

5. Safe means of access shall be provided to all working platforms and other working places. Every ladder shall be securely fixed. No portable single ladder shall be over 9m. (30ft.) in length while the width between side rails in rung ladder shall in no case be less than 29 cm. (11½") for ladder upto and including 3 m. (10 ft.) in length. For longer ladders, this width should be increased at least ¼" for each additional 30 cm. (1 foot) of length. Uniform step spacing of not more than 30 cm shall be kept. Adequate precautions shall be taken to prevent danger from electrical equipment. No materials on any of the sites or work shall be so stacked or placed as to cause danger or inconvenience to any person or the public. The contractor shall provide all necessary fencing and lights to protect the public from accident and shall be bound to bear the expenses of defence of every suit, action or other proceedings at law that may be brought by any person for injury sustained owing to neglect of the above precautions and to pay any damages and cost which may be awarded in any such suit; action or proceedings to any such person or which may, with the consent of the contractor, be paid to compensate any claim by any such person

6. (a) Excavation and Trenching - All trenches 1.2 m. (4ft.) or more in depth, shall at all times be supplied with at least one ladder for each 30 m. (100ft.) in length or fraction thereof, Ladder shall extend from bottom of the trench to at least 90 cm. (3ft.) above the surface of the ground. The side of the trenches which are 1.5 m. (5ft.) or more in depth shall be stepped back to give suitable slope or securely held by timber bracing, so as to avoid the danger of sides collapsing. The excavated materials shall not be placed within 1.5 m. (5ft.) of the edges of the trench or half of the depth of the trench whichever is more. Cutting shall be done from top to bottom. Under no circumstances, undermining or undercutting shall be done.

   (b) Safety Measures for digging bore holes:-

i. If the bore well is successful, it should be safely capped to avoid caving and collapse of the bore well. The failed and the abandoned ones should be completely refilled to avoid caving and collapse;
ii. During drilling, Sign boards should be erected near the site with the address of the drilling contractor and the Engineer-in-charge of the work;
iii. Suitable fencing should be erected around the well during the drilling and after the installation of the rig on the point of drilling, flags shall be put 50m all round the point of drilling to avoid entry of people;
iv. After drilling the borewell, a cement platform (0.50m x 0.50m x 1.20m) 0.60m above ground level and 0.60m below ground level should be constructed around the well casing;
v. After the completion of the borewell, the contractor should cap the bore well properly by welding steel plate, cover the bore well with the drilled wet soil and fix thorny shrubs over the soil. This should be done even while reparing the pump;
vi. After the borewell is drilled the entire site should be brought to the ground level.

7. Demolition - Before any demolition work is commenced and also during the progress of the work,
   (i) All roads and open areas adjacent to the work site shall either be closed or suitably protected.
   (ii) No electric cable or apparatus which is liable to be a source of danger or a cable or apparatus used by the operator shall remain electrically charged.
   (iii) All practical steps shall be taken to prevent danger to persons employed from risk of fire or explosion or flooding. No floor, roof or other part of the building shall be so overloaded with debris or materials as to render it unsafe.

8. All necessary personal safety equipment as considered adequate by the Engineer-in-Charge should be kept available for the use of the person employed on the site and maintained in a condition suitable for immediate use, and the contractor should take adequate steps to ensure proper use of equipment by those concerned. The following safety equipment shall invariably be provided.
   (i) Workers employed on mixing asphaltic materials, cement and lime mortars shall be provided with protective footwear and protective goggles.
   (ii) Those engaged in white washing and mixing or stacking of cement bags or any material which is injurious to the eyes, shall be provided with protective goggles.
   (iii) Those engaged in welding works shall be provided with welder's protective eyeshields.
   (iv) Stone breaker shall be provided with protective goggles and protective clothing and seated at sufficiently safe intervals.
   (v) When workers are employed in sewers and manholes, which are in active use, the contractors shall ensure that the manhole covers are opened and ventilated atleast for an hour before the workers are allowed to get into the manholes, and the manholes so opened shall be cordoned off with suitable railing and provided with warning signals or boards to prevent accident to the public. In addition, the contractor shall ensure that the following safety measure are adhered to :-
      (a) Entry for workers into the line shall not be allowed except under supervision of the JE or any other higher officer.
      (b) At least 5 to 6 manholes upstream and downstream should be kept open for at least 2 to 3 hours before any man is allowed to enter into the manhole for working inside.
      (c) Before entry, presence of Toxic gases should be tested by inserting wet lead acetate paper which changes colour in the presence of such gases and gives indication of their presence.
      (d) Presence of Oxygen should be verified by lowering a detector lamp into the manhole. In case, no Oxygen is found inside the sewer line, workers should be sent only with Oxygen kit.
      (e) Safety belt with rope should be provided to the workers. While working inside the

manholes, such rope should be handled by two men standing outside to enable him to be pulled out during emergency.

(f) The area should be barricaded or cordoned of by suitable means to avoid mishaps of any kind. Proper warning signs should be displayed for the safety of the public whenever cleaning works are undertaken during night or day.

(g) No smoking or open flames shall be allowed near the blocked manhole being cleaned.

(h) The malba obtained on account of cleaning of blocked manholes and sewer lines should be immediately removed to avoid accidents on account of slippery nature of the malba.

(i) Workers should not be allowed to work inside the manhole continuously. He should be given rest intermittently. The Engineer-in-Charge may decide the time up to which a worker may be allowed to work continuously inside the manhole.

(j) Gas masks with Oxygen Cylinder should be kept at site for use in emergency.

(k) Air-blowers should be used for flow of fresh air through the manholes. Whenever called for, portable air blowers are recommended for ventilating the manholes. The Motors for these shall be vapour proof and of totally enclosed type. Non sparking gas engines also could be used but they should be placed at least 2 metres away from the opening and on the leeward side protected from wind so that they will not be a source of friction on any inflammable gas that might be present.

(l) The workers engaged for cleaning the manholes/sewers should be properly trained before allowing to work in the manhole.

(m) The workers shall be provided with Gumboots or non sparking shoes bump helmets and gloves non sparking tools safety lights and gas masks and portable air blowers (when necessary). They must be supplied with barrier cream for anointing the limbs before working inside the sewer lines.

(n) Workmen descending a manhole shall try each ladder stop or rung carefully before putting his full weight on it to guard against insecure fastening due to corrosion of the rung fixed to manhole well.

(o) If a man has received a physical injury, he should be brought out of the sewer immediately and adequate medical aid should be provided to him.

(p) The extent to which these precautions are to be taken depend on individual situation but the decision of the Engineer-in-Charge regarding the steps to be taken in this regard in an individual case will be final.

The Contractor shall not employ men and women below the age of 18 years on the work of painting with products containing lead in any form. Wherever men above the age of 18 are employed on the work of lead painting, the following precaution should be taken:-

(a) No paint containing lead or lead products shall be used except in the form of paste or readymade paint.

(b) Suitable face masks should be supplied for use by the workers when paint is applied in the form of spray or a surface having lead paint is dry rubbed and scrapped.

(c) Overalls shall be supplied by the contractors to the workmen and adequate facilities shall be provided to enable the working painters to wash during and on the cessation of work.

9. The Contractor shall not employ women and men below the age of 18 on the work of painting with product containing lead in any form, wherever men above the age of 18 are employed on the work of lead painting, the following principles must be observed for such use :

(i) White lead, sulphate of lead or product containing these pigment, shall not be used in painting operation except in the form of pastes or paint ready for use.

(ii) Measures shall be taken, wherever required in order to prevent danger arising from the application of a paint in the form of spray.

(iii) Measures shall be taken, wherever practicable, to prevent danger arising out of from dust caused by dry rubbing down and scraping.

(iv) Adequate facilities shall be provided to enable working painters to wash during and on cessation of work.

(v) Overall shall be worn by working painters during the whole of working period.

(vi) Suitable arrangement shall be made to prevent clothing put off during working hours being spoiled by painting materials.

(vii) Cases of lead poisoning and suspected lead poisoning shall be notified and shall be subsequently verified by medical man.

(viii) WAPCOS may require, when necessary medical examination of workers.

(ix) Instructions with regard to special hygienic precautions to be taken in the painting trade shall be distributed to working painters.

10. When the work is done near any place where there is risk of drowning, all necessary equipments should be provided and kept ready for use and all necessary steps taken for prompt rescue of any person in danger and adequate provision, should be made for prompt first aid treatment of all injuries likely to be obtained during the course of the work.

11. Use of hoisting machines and tackle including their attachments, anchorage and supports shall conform to the following standards or conditions :-

(i) (a) These shall be of good mechanical construction, sound materials and adequate strength and free from patent defects and shall be kept repaired and in good working order.

(b) Every rope used in hoisting or lowering materials or as a means of suspension shall be of durable quality and adequate strength, and free from patent defects.

(ii) Every crane driver or hoisting appliance operator, shall be properly qualified and no person under the age of 21 years should be in charge of any hoisting machine including any scaffolding winch or give signals to operator.

(iii) In case of every hoisting machine and of every chain ring hook, shackle swivel and pulley block used in hoisting or as means of suspension, the safe working load shall be ascertained by adequate means. Every hoisting machine and all gear referred to above shall be plainly marked with the safe working load. In case of a hoisting machine having a variable safe working load each safe working load and the condition under which it is applicable shall be clearly indicated. No part of any machine or any gear referred to above in this paragraph shall be loaded beyond the safe working load except for the purpose of testing.

(iv) In case of departmental machines, the safe working load shall be notified by the Electrical Engineer-in-Charge. As regards contractor's machines the contractors shall notify the safe working load of the machine to the Engineer-in-Charge whenever he brings any machinery to site of work and get it verified by the Electrical Engineer concerned.

12. Motors, gearing, transmission, electric wiring and other dangerous parts of hoisting appliances should be provided with efficient safeguards. Hoisting appliances should be provided with such means as will reduce to the minimum the risk of accidental descent of the load. Adequate precautions should be taken to reduce to the minimum the risk of any part of a suspended load becoming accidentally displaced. When workers are employed on electrical installations which are already energized, insulating mats, wearing apparel, such as gloves, sleeves and boots as may be necessary should be provided. The worker should not wear any rings, watches and carry keys or other materials which are good conductors of electricity.

13. All scaffolds, ladders and other safety devices mentioned or described herein shall be maintained in safe condition and no scaffold, ladder or equipment shall be altered or removed while it is in use. Adequate washing facilities should be provided at or near places of work.

14. These safety provisions should be brought to the notice of all concerned by display on a notice board at a prominent place at work spot. The person responsible for compliance of the safety code shall be named therein by the contractor.

15. To ensure effective enforcement of the rules and regulations relating to safety precautions the arrangements made by the contractor shall be open to inspection by the Labour Officer or Engineer-in-Charge of the department or their representatives.

16. Notwithstanding the above clauses from (1) to (15), there is nothing in these to exempt the contractor from the operations of any other Act or Rule in force in the Republic of India.

ANNEXURE – XI

MODEL RULES FOR THE PROTECTION OF HEALTH AND SANITARY ARRANGEMENTS

FOR WORKERS EMPLOYED BY CONTRACTORS

1. APPLICATION

These rules shall apply to all buildings and construction works in which twenty or more workers are ordinarily employed or are proposed to be employed in any day during the period during which the contract work is in progress.

2. DEFINITION

Work place means a place where twenty or more workers are ordinarily employed in connection with construction work on any day during the period during which the contract work is in progress.

3. FIRST-AID FACILITIES

(i) At every work place, there shall be provided and maintained, so as to be easily accessible during working hours, first-aid boxes at the rate of not less than one box for 150 contract labour or part thereof ordinarily employed.

(ii) The first-aid box shall be distinctly marked with a red cross on white back ground and shall contain the following equipment:-

(a) For work places in which the number of contract labour employed does not exceed 50- Each first-aid box shall contain the following equipments :-

1) 6 small sterilised dressings.
2) 3 medium size sterilised dressings.
3) 3 large size sterilised dressings.
4) 3 large sterilised burn dressings.
5) 1 (30 ml.) bottle containing a two per cent alcoholic solution of iodine.
6) 1 (30 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label.
7) 1 snakebite lancet.
8) 1 (30 gms.) bottle of potassium permanganate crystals.
9) 1 pair scissors.
10) 1 copy of the first-aid leaflet issued by the Director General, Factory Advice Service and Labour Institutes, Government of India.
11) 1 bottle containing 100 tablets (each of 5 gms.) of aspirin.
12) Ointment for burns.
13) A bottle of suitable surgical antiseptic solution

(b) For work places in which the number of contract labour exceed 50. Each first-aid box shall contain the following equipments.

1) 12 small sterilised dressings.
2) 6 medium size sterilised dressings.
3) 6 large size sterilised dressings.
4) 6 large size sterilised burn dressings.
5) 6 (15 gms.) packets sterilised cotton wool.
6) 6.1 (60 ml.) bottle containing a two per cent alcoholic solution iodine.
7) 1 (60 ml.) bottle containing salvolatile having the dose and mode of administration indicated on the label

8) 1 roll of adhesive plaster.
9) 1 snake bite lancet.
10) 1 (30 gms.) bottle of potassium permanganate crystals.
11) 1 pair scissors.
12) 1 copy of the first-aid leaflet issued by the Director General Factory Advice Service and Labour Institutes / Government of India.
13) A bottle containing 100 tablets (each of 5 gms.) of aspirin.
14) Ointment for burns.
15) A bottle of suitable surgical antiseptic solution.

(iii) Adequate arrangements shall be made for immediate recoupment of the equipment when necessary

(iv) Nothing except the prescribed contents shall be kept in the First-aid box.

(v) The first-aid box shall be kept in charge of a responsible person who shall always be readily available during the working hours of the work place.

(vi) A person in charge of the First-aid box shall be a person trained in First-aid treatment in the work places where the number of contract labour employed is 150 or more.

(vii) In work places where the number of contract labour employed is 500 or more and hospital facilities are not available within easy distance from the works. First-aid posts shall be established and run by a trained compounder. The compounder shall be on duty and shall be available at all hours when the workers are at work.

(viii) Where work places are situated in places which are not towns or cities, a suitable motor transport shall be kept readily available to carry injured person or person suddenly taken ill to the nearest hospital.

4. DRINKING WATER

(i) In every work place, there shall be provided and maintained at suitable places, easily accessible to labour, a sufficient supply of cold water fit for drinking.

(ii) Where drinking water is obtained from an Intermittent public water supply, each work place shall be provided with storage where such drinking water shall be stored.

(iii) Every water supply or storage shall be at a distance of not less than 50 feet from any latrine drain or other source of pollution. Where water has to be drawn from an existing well which is within such proximity of latrine, drain or any other source of pollution, the well shall be properly chlorinated before water is drawn from it for drinking. All such wells shall be entirely closed in and be provided with a trap door which shall be dust and waterproof.

(iv) A reliable pump shall be fitted to each covered well, the trap door shall be kept locked and opened only for cleaning or inspection which shall be done at least once a month.

5. WASHING FACILITIES

(i) In every work place adequate and suitable facilities for washing shall be provided and maintained for the use of contract labour employed therein.

(ii) Separate and adequate cleaning facilities shall be provided for the use of male and female workers.

(iii) Such facilities shall be conveniently accessible and shall be kept in clean and hygienic condition.

6. LATRINES AND URINALS

(ii) Latrines shall be provided in every work place on the following scale namely :-

(a) Where female are employed, there shall be at least one latrine for every 25 females.
(b) Where males are employed, there shall be at least one latrine for every 25 males.

Provided that, where the number of males or females exceeds 100, it shall be sufficient if there is one latrine for 25 males or females as the case may be upto the first 100, and one for every 50 thereafter.

(iii) Every latrine shall be under cover and so partitioned off as to secure privacy, and shall have a proper door and fastenings.

(iv) Construction of latrines: The inside walls shall be constructed of masonry or some suitable heat-resisting nonabsorbent materials and shall be cement washed inside and outside at least once a year, Latrines shall not be of a standard lower than borehole system.

(v) (a) Where workers of both sexes are employed, there shall be displayed outside each block of latrine and urinal, a notice in the language understood by the majority of the workers "For Men only" or "For Women Only" as the case may be.

(b) The notice shall also bear the figure of a man or of a woman, as the case may be.

(vi) There shall be at least one urinal for male workers upto 50 and one for female workers upto fifty employed at a time, provided that where the number of male or female workmen, as the case may be exceeds 500, it shall be sufficient if there is one urinal for every 50 males or females upto the first 500 and one for every 100 or part thereafter.

(vii) (a) The latrines and urinals shall be adequately lighted and shall be maintained in a clean and sanitary condition at all times.

(b) Latrines and urinals other than those connected with a flush sewage system shall comply with the requirements of the Public Health Authorities.

(viii) Water shall be provided by means of tap or otherwise so as to be conveniently accessible in or near the latrines and urinals.

(ix) Disposal of excreta: - Unless otherwise arranged for by the local sanitary authority, arrangements for proper disposal of excreta by incineration at the work place shall be made by means of a suitable incinerator. Alternately excreta may be disposed of by putting a layer of night soil at the bottom of a pucca tank prepared for the purpose and covering it with a 15 cm. layer of waste or refuse and then covering it with a layer of earth for a fortnight (when it will turn to manure).

(x) The contractor shall at his own expense, carry out all instructions issued to him by the Engineer-in-Charge to effect proper disposal of night soil and other conservancy work in respect of the contractor's workmen or employees on the site. The contractor shall be responsible for payment of any charges which may be levied by Municipal or Cantonment Authority for execution of such on his behalf.

7. PROVISION OF SHELTER DURING REST

At every place there shall be provided, free of cost, four suitable sheds, two for meals and the other two for rest separately for the use of men and women labour. The height of each shelter shall not be less than 3 metres (10 ft.) from the floor level to the lowest part of the roof. These shall be kept clean and the space provided shall be on the basis of 0.6 sqm (6 sft) per head.

Provided that the Engineer-in-Charge may permit subject to his satisfaction, a portion of the building under construction or other alternative accommodation to be used for the purpose.

8. CRECHES

(i) At every work place, at which 20 or more women worker are ordinarily employed, there shall be provided two rooms of reasonable dimensions for the use of their children under the age of six years. One room shall be used as a play room for the children and the other as their bedroom. The rooms shall be constructed with specifications as per clause 19H (ii) a,b & c.

(ii) The rooms shall be provided with suitable and sufficient openings for light and ventilation. There shall be adequate provision of sweepers to keep the places clean.

(iii) The contractor shall supply adequate number of toys and games in the play room and sufficient number of cots and beddings in the bed room.

(iv) The contractor shall provide one ayaa to look after the children in the creche when the number of women workers does not exceed 50 and two when the number of women workers exceed 50.

(v) The use of the rooms earmarked as creches shall be restricted to children, their attendants and mothers of the children.

9. CANTEENS

a. In every work place where the work regarding the employment of contract labour is likely to continue for six months and where in contract labour numbering one hundred or more are ordinarily employed, an adequate canteen shall be provided by the contractor for the use of such contract labour.

b. The canteen shall be maintained by the contractor in an efficient manner.

c. The canteen shall consist of at least a dining hall, kitchen, storeroom, pantry and washing places separately for workers and utensils.

d. The canteen shall be sufficiently lighted at all times when any person has access to it.

e. The floor shall be made of smooth and impervious materials and inside walls shall be limewashed or colour washed at least once in each year.
Provided that the inside walls of the kitchen shall be lime-washed every four months.

f. The premises of the canteen shall be maintained in a clean and sanitary condition.

g. Waste water shall be carried away in suitable covered drains and shall not be allowed to accumulate so as to cause a nuisance.

h. Suitable arrangements shall be made for the collection and disposal of garbage.

i. The dining hall shall accommodate at a time 30 per cent of the contract labour working at a time.

j. The floor area of the dining hall, excluding the area occupied by the service counter and any furniture except tables and chairs shall not be less than one square metre (10 sft) per diner to be accommodated as prescribed in sub-Rule 9.

k. (a) A portion of the dining hall and service counter shall be partitioned off and reserved for women workers in proportion to their number.
(b) Washing places for women shall be separate and screened to secure privacy.

l. Sufficient tables stools, chair or benches shall be available for the number of diners to be accommodated as prescribed in sub-Rule 9.

m. (a) 1. There shall be provided and maintained sufficient utensils crockery, furniture and any other equipments necessary for the efficient running of the canteen.
2. The furniture utensils and other equipment shall be maintained in a clean and hygienic condition.
(b) 1. Suitable clean clothes for the employees serving in the canteen shall be provided and maintained.
2. A service counter, if provided, shall have top of smooth and impervious material.
3. Suitable facilities including an adequate supply of hot water shall be provided for the cleaning of utensils and equipments.

n. The food stuffs and other items to be served in the canteen shall be in conformity with the normal habits of the contract labour.

o. The charges for food stuffs, beverages and any other items served in the canteen shall be based on ‘No profit, No loss’ and shall be conspicuously displayed in the canteen.

p. In arriving at the price of foodstuffs, and other article served in the canteen, the following items shall not be taken into consideration as expenditure namely:-
(a) The rent of land and building.
(b) The depreciation and maintenance charges for the building and equipment provided for the canteen.
(c) The cost of purchase, repairs and replacement of equipment including furniture, crockery, cutlery and utensils.

(d) The water charges and other charges incurred for lighting and ventilation

(e) The interest and amounts spent on the provision and maintenance of equipment provided for the canteen.

q. The accounts pertaining to the canteen shall be audited once every 12 months by registered accountants and auditors.

10. ANTI-MALARIAL PRECAUTIONS

The contractor shall at his own expense, conform to all anti-malarial instructions given to him by the Engineer-in-Charge including the filling up of any borrow pits which may have been dug by him.

11. The above rules shall be incorporated in the contracts and in notices inviting tenders and shall form an integral part of the contracts.

12. AMENDMENTS

Government may, from time to time, add to or amend these rules and issue directions - it may consider necessary for the purpose of removing any difficulty which may arise in the administration thereof.

ANNEXURE-XII

Contractor's Labour Regulations

1. **GENERAL**

These Labour regulations shall be followed by the Contractor.

2. **DEFINITIONS**

(i) Workman means any person employed by contractor directly or indirectly through a subcontractor with or without the knowledge of the WAPCOS to do any skilled, semiskilled or unskilled manual, supervisory, technical or clerical work for hire or reward, whether the terms of employment are expressed or implied but does not include any person :-

(a) Who is employed mainly in a managerial or administrative capacity : or

(b) Who, being employed in a supervisory capacity draws wages exceeding five hundred rupees per mensem or exercises either by the nature of the duties attached to the office or by reason of powers vested in him, functions mainly of managerial nature: or

(c) Who is an out worker, that is to say, person to whom any article or materials are given out by or on behalf of the Employer/ Principal Employers to be made up cleaned, washed, altered, ornamental finished, repaired adopted or otherwise processed for sale for the purpose of the trade or business of the Employer/ Principal Employers and the process is to be carried out either in the home of the out worker or in some other premises, not being premises under the control and management of the principal employer.

(i) No person below the age of 14 years shall be employed to act as a workman.

(ii) Fair Wages means wages whether for time or piece work fixed and notified under the provisions of the Minimum Wages Act from time to time.

(iii) Contractors shall include every person who undertakes to produce a given result other than a mere supply of goods or articles of manufacture through contract labour or who supplies contract labour for any work and includes a subcontractor.

(iv) Wages shall have the same meaning as defined in the Payment of Wages Act.

3. (i) Normally working hours of an adult employee should not exceed 9 hours a day. The working day shall be so arranged that inclusive of interval for rest, if any, it shall not spread over more than 12 hours on any day.

(ii) When an adult worker is made to work for more than 9 hours on any day or for more than 48 hours in any week, he shall be paid over time for the extra hours put in by him at double the ordinary rate of wages.

(iii) Every worker shall be given a weekly holiday normally on a Sunday, in accordance with the provisions of the Minimum Wages (Central) Rules 1960 as amended from time to time irrespective of whether such worker is governed by the Minimum Wages Act or not.

(iv) Where the minimum wages prescribed by the Government under the Minimum Wages Act are not inclusive of the wages for the weekly day of rest, the worker shall be entitled to rest day wages at the rate applicable to the next preceding day,

(iv) provided he has worked under the same contractor for a continuous period of not less than 6 days.

(v) Where a contractor is permitted by the Engineer-in-Charge to allow a worker to work on a normal weekly holiday, he shall grant a substituted holiday to him for the whole day on one of the five days immediately before or after the normal weekly holiday and pay wages to such worker for the work performed on the normal weekly holiday at overtime rate.

4. **DISPLAY OF NOTICE REGARDING WAGES ETC.**

The contractor shall before he commences his work on contract, display and correctly maintain and continue to display and correctly maintain in a clear and legible condition in conspicuous places on the work, notices in English and in the local Indian languages spoken by the majority of the workers giving the minimum rates of wages fixed under Minimum Wages Act, the actual wages being paid, the hours of work for which such wage are earned, wages periods, dates of payments of wages and other relevant information as per Appendix 'III'.

5. **PAYMENT OF WAGES**

(i) The contractor shall fix wage periods in respect of which wages shall be payable.

(ii) No wage period shall exceed one month.

(iii) The wages of every person employed as contract labour in an establishment or by a contractor where less than one thousand such persons are employed shall be paid before the expiry of seventh day and in other cases before the expiry of tenth day after the last day of the wage period in respect of which the wages are payable.

(iv) Where the employment of any worker is terminated by or on behalf of the contractor the wages earned by him shall be paid before the expiry of the second working day from the date on which his employment is terminated.

(v) All payment of wages shall be made on a working day at the work premises and during the working time and on a date notified in advance and in case the work is completed before the expiry of the wage period, final payment shall be made within 48 hours of the last working day.

(vi) Wages due to every worker shall be paid to him direct by contractor through Bank or ECS or online transfer to his bank account.

(vii) All wages shall be paid through Bank or ECS or online transfer.

(viii) Wages shall be paid without any deductions of any kind except those specified by the Central Government by general or special order in this behalf or permissible under the Payment of Wages Act 1956.

(ix) A notice showing the wages period and the place and time of disbursement of wages shall be displayed at the place of work and a copy sent by the contractor to the Engineer-in-Charge under acknowledgment.

(x) It shall be the duty of the contractor to ensure the disbursement of wages through bank account of labour.

(xi) The contractor shall obtain from the Junior Engineer or any other authorised representative of the Engineer- in-Charge as the case may be, a certificate under his signature at the end of the entries in the "Register of Wages" or the "Wage-cum-Muster Roll" as the case may be in the following form:-

6. **FINES AND DEDUCTIONS WHICH MAY BE MADE FROM WAGES**

i) The wages of a worker shall be paid to him without any deduction of any kind except the following:-

a. Fines

b. Deductions for absence from duty i.e. from the place or the places where by the terms of his employment he is required to work. The amount of deduction shall be in proportion to the period for which he was absent.

c. Deduction for damage to or loss of goods expressly entrusted to the employed person for custody or for loss of money or any other deduction which he is required to account, where such damage or loss is directly attributable to his neglect or default.
d. Deduction for recovery of advances or for adjustment of overpayment of wages, advances granted shall be entered in a register.
e. Any other deduction which the Central Government may from time to time allow.

ii) No fines should be imposed on any worker save in respect of such acts and omissions on his part as have been approved of by the Chief Labour Commissioner.
Note :- An approved list of Acts and Omissions for which fines can be imposed is enclosed at Appendix-X

iii) No fine shall be imposed on a worker and no deduction for damage or loss shall be made from his wages until the worker has been given an opportunity of showing cause against such fines or deductions.

iv) The total amount of fine which may be imposed in any one wage period on a worker shall not exceed an amount equal to three paise in a rupee of the total wages, payable to him in respect of that wage period.

v) No fine imposed on any worker shall be recovered from him by instalment, or after the expiry of sixty days from the date on which it was imposed.

vi) Every fine shall be deemed to have been imposed on the day of the act or omission in respect of which it was imposed.

7. **LABOUR RECORDS**

i) The contractor shall maintain a Register of persons employed on work on contract in Form XIII of the CL (R&A) Central Rules 1971 (Appendix IV)

ii) The contractor shall maintain a Muster Roll register in respect of all workmen employed by him on the work under Contract in Form XVI of the CL (R&A) Rules 1971 (Appendix V).

iii) The contractor shall maintain a Wage Register in respect of all workmen employed by him on the work under contract in Form XVII of the CL (R&A) Rules 1971 (Appendix VI).

iv) Register of accident - The contractor shall maintain a register of accidents in such form as may be convenient at the work place but the same shall include the following particulars:
a. Full particulars of the labourers who met with accident.
b. Rate of Wages.
c. Sex
d. Age
e. Nature of accident and cause of accident.
f. Time and date of accident.
g. Date and time when admitted in Hospital,
h. Date of discharge from the Hospital.
i. Period of treatment and result of treatment.
j. Percentage of loss of earning capacity and disability as assessed by Medical Officer.
k. Claim required to be paid under Workmen's Compensation Act.
l. Date of payment of compensation.
m. Amount paid with details of the person to whom the same was paid.
n. Authority by whom the compensation was assessed.
o. Remarks

v) The contractor shall maintain a Register of Fines in the Form XII of the CL (R&A) Rules 1971 (Appendix-XI) The contractor shall display in a good condition and in a conspicuous place of work the approved list of acts and omissions for which fines can be imposed (Appendix-X)

vi) The contractor shall maintain a Register of deductions for damage or loss in Form XX of the CL (R&A) Rules 1971 (Appendix-XII)

vii) The contractor shall maintain a Register of Advances in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIII)

viii) The contractor shall maintain a Register of Overtime in Form XXIII of the CL (R&A) Rules 1971 (Appendix-XIV)

8. **ATTENDANCE CARD-CUM-WAGE SLIP**

i) The contractor shall issue an Attendance card-cum-wage slip to each workman employed by him in the specimen form at (Appendix-VII)

ii) The card shall be valid for each wage period.

iii) The contractor shall mark the attendance of each workman on the card twice each day, once at the commencement of the day and again after the rest interval, before he actually starts work.

iv) The card shall remain in possession of the worker during the wage period under reference.

v) The contractor shall complete the wage slip portion on the reverse of the card at least a day prior to the disbursement of wages in respect of the wage period under reference.

vi) The contractor shall obtain the signature or thumb impression of the worker on the wage slip at the time of disbursement of wages and retain the card with himself.

9. **EMPLOYMENT CARD**

The contractor shall issue an Employment Card in Form XIV of the CL (R&A) Central Rules 1971 to each worker within three days of the employment of the worker (Appendix-VIII).

10. **SERVICE CERTIFICATE**

On termination of employment for any reason whatsoever the contractor shall issue to the workman whose services have been terminated, a Service certificate in Form XV of the CL (R&A) Central Rules 1971 (Appendix-IX)

11. **PRESERVATION OF LABOUR RECORDS**

All records required to be maintained under Regulations Nos. 6 & 7 shall be preserved in original for a period of three years from the date of last entries made in them and shall be made available for inspection by the Engineer-in-Charge or Labour Officer or any other officers authorised by the Ministry of Urban Development in this behalf.

12. **POWER OF LABOUR OFFICER TO MAKE INVESTIGATIONS OR ENQUIRY**

The Labour Officer or any person authorised by Central Government on their behalf shall have power to make enquires with a view to ascertaining and enforcing due and proper observance of Fair Wage Clauses and the Provisions of these Regulations. He shall investigate into any complaint regarding the default made by the contractor or subcontractor in regard to such provision.

13. **REPORT OF LABOUR OFFICER**

The Labour Officer or other persons authorised as aforesaid shall submit a report of result of his investigation or enquiry to the Engineer-in-charge concerned indicating the extent, if any, to which the default has been committed with a note that necessary deductions from the contractor's bill be made and the wages and other dues be paid to the labourers concerned. In case an appeal is made by the contractor under Clause 13 of these regulations, actual payment to labourers will be made by the Engineer-in-charge after the Competent Authority of WAPCOS has given his decision on such appeal.

(i) The Engineer-in-charge shall arrange payments to the labour concerned within 45 days from the receipt of the report form the Labour Officer as the case may be.

14. **APPEAL AGAINST THE DECISION OF LABOUR OFFICER**

Any person aggrieved by the decision and recommendations of the Labour Officer or other person so authorised may appeal against such decision to the Engineer-in-charge concerned within 30 days from the date of decision, forwarding simultaneously a copy of his appeal to the Engineer-in-charge concerned but subject to such appeal, the decision of the officer shall be final and binding upon the contractor.

15. **PROHIBITION REGARDING REPRESENTATION THROUGH LAWYER**

(i) A workman shall be entitled to be represented in any investigation or enquiry under these regulations by:-

a. An officer of a registered trade union of which he is a member.
b. An officer of a federation of trade unions to which the trade union referred to in clause (a) is affiliated.
c. Where the employer is not a member of any registered trade union, by an officer of a registered trade union, connected with the industry in which the worker is employed or by any other workman employed in the industry in which the worker is employed.

(ii) An employer shall be entitled to be represented in any investigation or enquiry under these regulations by :-

a. An officer of an association of employers of which he is a member.
b. An officer of a federation of associations of employers to which association referred to in clause (a) is affiliated.
c. Where the employers is not a member of any association of employers, by an officer of association of employer connected with the industry in which the employer is engaged or by any other employer, engaged in the industry in which the employer is engaged.

(iii) No party shall be entitled to be represented by a legal practitioner in any investigation or enquiry under these regulations.

16. **INSPECTION OF BOOKS AND SLIPS**

The contractor shall allow inspection of all the prescribed labour records to any of his workers or to his agent at a convenient time and place after due notice is received or to the Labour Officer or any other person, authorised by the Central Government on his behalf.

17. **SUBMISSIONS OF RETURNS**

The contractor shall submit periodical returns as may be specified from time to time.

18. **AMENDMENTS**

The Central Government may from time to time add to or amend the regulations and on any question as to the application/Interpretation or effect of those regulations the decision of the Engineer-in-charge concerned shall be final.

ANNEXURE – XIII

NO CLAIM CERTIFICATE

Address to :
The Engineer- in-Charge
WAPCOS Ltd.,

Subject : ……

Ref: 1. Work Order no.:-
2. Contract Agreement no.:-

Sir,

We have submitted ----------nos. of bills including final bill total gross amounting for the subject project of Rs. ----------/- (Rupees ---------- only).

However, following payment are due with Employer:

1. Balance Net amount (if any) of Rs. ----------/- against RA Bill No.----------
2. Balance GST (if any) of Rs. ----------/- against RA Bill No.----------
3. Performance Guarantee no. ----------dated ---------- amounting to Rs.----------/- issued by --------Bank which will be released by Employer as per tender conditions.
4. Security Deposit amounting to Rs.----------/- which will be released by Employer as per tender conditions

We declare unequivocally that the above payments are full and final amount for execution of subjected works against referred Contract Agreement with WAPCOS. We will not raise any further claim and have no dispute of any description whatsoever, regarding the amounts worked out as payable to us and that we shall continue to be bound by the terms and conditions of the Contract Agreement, as regards Performance of the Contract.

Yours faithfully,

Date:

(Signature, name and designation of the Authorized signatory)

Place:

Name and seal of bidder

WAPCOS LIMITED

A Government of India Undertaking - Ministry of Jal Shakti
76-C, Institutional Area, Sector-18, Gurugram, Haryana - 122015
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Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works At Sector-19 Dwarka, Delhi

Document Reference:	WAP/C&C/DelhiLaw/2026/01
Issue Date:	July 30th, 2026
Issued by:	Centre for Commercial & Construction, WAPCOS Limited

Volume-II

Employer's Requirements, Scope of Work, Finishing Schedule, Design Basis Report, and Topographical & Geotechnical Investigation Report

Part A

EMPLOYER'S REQUIREMENT AND SCOPE OF WORK

Employer's Requirement & Scope of works

Description of Works

The project involves Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works at Sector-19 Dwarka, Delhi.

The estimated cost of the project has been prepared on the basis of CPWD Plinth Area Rates-2025, Delhi Schedule of Rates 2023 (Civil), Delhi Schedule of Rates-2025 (E&M), DSR for Horticulture/Landscaping Works and market rates, as applicable.

The execution shall be done based on the approved working & structural drawings. CPWD Specifications, relevant IS codes, National Building Code 2016, ECBC 2017 and other standard specifications shall be followed in general except otherwise mentioned in bid document.

Samples of the materials of approved make or otherwise shall be got approved from the Engineer-in-Charge before use in the work. The buildings are to be planned and designed as a GRIHA RATING 4 for buildings / IGBC Platinum Rating.

Based on the requirement of the client / PMC, the architectural design, specifications and drawings have been prepared and are enclosed with this tender document. The structural drawings have also been prepared and are also enclosed for reference. However, the EPC contractor may suggest the improvements in the design in line with the client's requirement and site conditions, if any. Based on the suggestions, the client / PMC may or may not agree for the modifications in the design.

Similarly, the structural drawings along with the Design Basis Report are also being provided with this tender document. The structure has been designed as RCC framed structure. The contractor may suggest any other construction methodology /technology. The proposal shall be studied and the client / PMC may agree for the change in the construction methodology /technology. In such a case, the contractor shall be responsible for preparation of structural design, drawings, along with the details of all services etc. The structural drawings will have to be vetted from IIT Delhi or any other IIT at the cost of the contractor. No additional cost shall be payable for this activity.

The final approving authority in this regard shall be the client / PMC and they may or may not agree to the suggestions. The decision in this regard shall be binding on the contractor. The contractor shall do this exercise without any additional cost.

The structural drawings have been prepared based on the geotechnical investigation already conducted, which is also enclosed with the tender documents. However, the EPC contractor shall carry out his own geotechnical investigation for their verification and satisfaction. The EPC contractor shall be fully responsible for any geological findings throughout the duration of the project. No extra claim / variation shall be considered for any design modification because of subsoil / subsurface /geological strata/ geotechnical data.

Even if the contractor does not opt for change / modifications in the architectural / structural design philosophy, the contractor shall be responsible for design review and its correctness in all respect as per relevant IS codes, NBC 2016 and other applicable guidelines and laws. The contractor shall be fully responsible for making the project fully functional and structurally sound to the satisfaction of the client. Being an EPC contract, the contractor shall be review and finalize all the aspect of the project before and during construction and till the successful handing over of the project including Defect liability period of two years.

The cost quoted by the contractor shall be considered as including all the item / activities / points / aspects necessary and essential for successful completion in all respect and satisfaction of the project to the client.

The details including areas / quantities of the infrastructure, MEP and other services mentioned in the tender documents should be considered as indicative, based on the present designs. The final quantities shall be governed by requirement and statutory approvals. The contractor needs to make their own assessment and quote their prices considering these possible changes. There will be no variation / claims allowed in this respect.

The brief of Infrastructure to be developed as mentioned this Section and as follows:

Sr. No.	Description	Scope of Work
1.	Construction of Type VI Residence G+12 Plinth Area: 11150 Sq.mt.	All Civil works in Sub-Structure and Super-Structure, Finishing as per Schedule, MEP (Plumbing, Fire Fighting, Electrical, EPABX, Fire alarm & PA system etc.), Lifts, fixed wooden furniture in kitchen/ Dress/ Shoe-rack/ Cupboards (excluding any loose furniture) etc. as per Drawings, Specifications and Design Basis Reports mentioned in Tender Document complete in all respect, along with any other work required to be executed/conducted for project to be made functional and complete in all respects for its successful handing over to the owner/client.
2.	Construction of Type V Residence G+12 Plinth Area: - 11850 Sq.mt.	All Civil works in Sub-Structure and Super-Structure, Finishing as per Schedule, MEP (Plumbing, Fire Fighting, Electrical, EPABX, Fire alarm & PA system etc.), Lifts, fixed wooden furniture in modular kitchen/ Dress/ Shoe-rack/ Cupboards (excluding any loose furniture) etc. as per Drawings, Specifications and Design Basis Reports mentioned in Tender Document complete in all respect, along with any other work required to be executed/conducted for project to be made functional and complete in all respects for its successful handing over to the owner/client.
3.	Construction of Common Basement	All Civil works in Sub-Structure and Super-Structure, Finishing as per Schedule, MEP (Mechanical Ventilation, Plumbing, Fire

Sr. No.	Description	Scope of Work
	(2 level basement) 11200 sq.mt.	Fighting, Fire alarm & PA system, Electrical etc.), Lifts, fixed Fit out locker rooms, service rooms, toilets, public utilities, parking signs, markings, signage, boom barriers etc., as per Drawings, Specifications and Design Basis Reports mentioned in TENDER Document complete in all respect, along with any other work required to be executed/conducted for project to be made functional and complete in all respects for its successful handing over to the owner/client.
4.	Construction of All External Infrastructure Services	**External Infrastructure and other ancillary works as per requirements / designs / statutory guidelines / approvals to be executed mentioned as following:** a) Roads works, inclusive of cutting and filling as per required levels, for a minimum area of 2300 sq.mt. (Tentative as per the present design) as per Design Basis Reports mentioned in Tender Document complete in all respects. However, if the area increases as per actual site requirement, no extra payment shall be admissible for the additional area executed. b) Sewerage Works c) Storm Water Drain works d) Sewage Treatment Plant of 70 KLD or more (as per final design and GRIHA norms) e) Modular / Conventional Rain water Harvesting, Rain Water Tank (as per the environment report / GRIHA Norms) f) Water Treatment & supply infrastructure including Water Recycling, Water supply system of different dia. of CPVC as per actual requirement g) PUMP room with all facilities h) Street Lightings with solar provisions, i) Retaining walls, Landscaping around the buildings, j) Fire-fighting system, k) Swimming Pool along with all associated works l) Boundary wall with Gate Complex and Guard Rooms etc., m) Tot lot area with equipment n) Sports facilities o) Electrical substation & equipment p) HT & cabling work with laying in trenches or Hume pipe
5.	Construction of Central Under Ground Tank (UGT), UGT - 02 nos.	Construction of 2 Nos. of **Under Ground Tanks** (Fire + Raw + Domestic + Irrigation + Flushing Water Tanks), with minimum total capacity 151 KL with pump rooms with pumping system including Civil, Electrical, Plumbing pumps, Firefighting Pumps, Hydrants, Pipelines etc. as per Drawings, Specifications and Design Basis Reports mentioned in Tender

Sr. No.	Description	Scope of Work
		Document complete in all respects.

Brief Scope of Work

1.1 Description of Works:

The project involves Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works at Sector-19 Dwarka, Delhi, to be developed within Residential campus to provide modern, secure, and comfortable housing for judicial officers. The brief of Infrastructure to be developed as mentioned in this document. However, the broad scope for completion of the facility for intended use but not limited to, is mentioned underneath -

- The general character and the scope of work is Engineering, Procurement and Construction of the Project as per requirement of Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi to be carried out under this contract. The brief is illustrated through Drawings, Design Information, Master Development Plan, Specifications, DBR, Finishing Schedules, etc.
- The EPC Contractor shall appoint a Design Consultant/Architect for Coordinating the Design Development Process.
- The EPC Contractor shall carry out and complete the said work within the stipulated timelines under this contract in every respect in conformity with the contract documents and in accordance with the direction of & to the satisfaction of the competent Authority.
- In case of any deviation happens in respect of design, drawing, specification, procedure, methodology, timelines etc. from the approved one & without the respective approval of Competent Authority then in that case onus lies with EPC Contractor.
- Brief scope of work is underneath:

1.2 General Scope of Work

Engineering, Procurement and Construction of the project as stipulated in the tender documents including execution and defect liability for a period of 2 years.

1.3 Scope of Work

EPC contractor will have to prepare a scheme, designs, and footprint layout on an area identified. Design will include but not limited to designing, detailing, approval and developing of building services, broadly covering:

- Architectural GFC drawings including approval from PMC / Client
- R.C.C. structural design including vetting of the drawings from IIT Delhi or any other IIT, if required. Bidder shall perform the structural design based on the architectural layout mentioned list of drawing section of tender document. Bidder shall propose the structural system in line with performance and loading parameter mentioned in the structural DBR.
- Formulating schemes / designs for internal and external services including Civil works, Interior Design, Mechanical works, Electrical works etc. (Internal Electrification, ELV work as per scope, Sub Station, DG Set, LT & HT Cabling and Networks, Lifts and Traffic analysis, street lighting etc.),
- Water Supply and Plumbing works,
- Pump Room with all facilities
- Storm Water Drainage System
- Data and Tele-Communication Service & Design,

- STP of 70 KLD capacity (minimum or as per actual requirement as per GRIHA norms / statutory approvals)
- Rainwater harvesting and Rain Water Tanks.
- Other development works, etc.
- Prepare Good for construction drawings.
- Necessary schemes for making a barrier free campus
- Details of finishes for respective buildings and its area are provided in the schedule of finishes and drawings attached with the tender. However, for additional detailing, it would be guided by the requirement of the client/owner and as per the direction of Engineer-in charge.

The EPC contractor shall provide services broadly described above. However, it should be clearly understood that the description of services is only indicative, and the EPC contractor shall be required to perform any other services which may be required whether or not expressly mentioned hereinafter for the project.

1.4 Detailed Architectural, Civil Scope of Services:

1.4.1 Preliminary Site Investigations & Surveys

- The Soil investigation to assess soil bearing capacity and composition, if required. Geotechnical Investigation Report carried out by WAPCOS is enclosed.
- Carry out topographical surveys to establish site contours and levels. Survey carried out by WAPCOS is enclosed.
- Perform water testing to determine groundwater quality and availability.
- Conduct a survey of existing services and buried utility lines to map out existing infrastructure.
- Carry out shifting of existing Major services and utility lines, wherever necessary, to accommodate the project.

1.4.2 Site Preparation & Temporary Facilities

- Execute demolition of existing buildings/infrastructure, if any.
- Manage removal and disposal of debris from the project site in compliance with environmental regulations.
- Set up labor camps with sanitation and basic amenities.
- Construct material sheds for safe storage of construction materials.
- Provide site offices with infrastructure as defined in GCC & SCC.
- Ensure provision of site safety equipment for all construction activities.
- Barricading, covering as per environmental guidelines and warning markers all along the project site complete in all respect.
- Obtain and maintain insurance coverage for site operations and workforce.

1.4.3 Site Layout & Compliance

- Setting out buildings precisely as per location defined in the master plan.
- Maintain open spaces between buildings as per zoning and planning regulations.

- Electrical NOC from service provider.
- Environmental Clearances and NOC from Pollution Control Board (if required).

1.4.4 Design & Engineering Coordination

- Preparation of structural detailed design and working drawings, obtaining approval from the Engineer in charge.
- Vetting of the structural drawings from IIT Delhi or any of the IITs to ensure structural stability as per 50-year building life standards.
- Preparation of MEPF detailed design and working drawings, securing approval from the WAPCOS.
- Preparation of site infrastructure working drawings, ensuring compliance with project requirements.
- Preparation of landscape working drawings with approval from the Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi Integration of all detailed engineering without compromising the design intent specified in the DBR.

1.4.5 Liasoning and assistance for statutory approvals

- Assisting PMC / Client with day-to-day liaison and documentation works in order to obtain all statutory approvals at interim and completion stages.
- Liasoning and obtaining all pre-construction and post-construction approvals / statutory clearances / Certificates.

1.4.6 Construction & Execution

- Supply, fabrication, construction, installation, and commissioning of all required elements.
- Ensure compliance with Super ECBC norms to achieve minimum IGBC Platinum / Griha 4 Star rating.
- Excavation and backfilling (earthworks) as per structural and geotechnical requirements.
- Execution of piling and foundation works including testing and load-bearing verification.
- Construction of retaining walls with proper waterproofing and structural integrity.
- Implement pest control measures as per building health and hygiene requirements.
- Construct underground tanks, pump rooms, bore-wells, and recharge pits as per design.
- Commissioning of underground electrical and mechanical services.
- Construction of RCC slabs, beams, and columns in line with architectural drawings and IS codes.
- Provide plinth protection to prevent water ingress and maintain structural durability.

1.4.7 Hardscaping & External Works

- Install concrete pavers/driveway tiles in stilt areas for durability and aesthetics.
- Ensure proper termination and turning of services for ease of maintenance.
- Construct vehicular and pedestrian ramps with anti-skid treatment.

- Provide safety railings or parapet walls for all ramps and walkways.
- Construct external steps at building entries with anti-skid treatment.
- Provide tile drops and thresholds where required.
- Construction of swimming pool with sides and top covering.
- Provide Sports facilities and Tot Lot area.

1.4.8 Building Services & MEPF Works

- Execute all electrical, plumbing, firefighting, and HVAC/mechanical ventilation works.
- Carry out civil works for drainage and sewerage, including manholes and inspection chambers.
- Civil works for HVAC/Mechanical Ventilation, electrical, and firefighting systems including ducting, trenches, and platforms.
- Construct and commission all overhead structures at roof level per architectural drawings.

1.4.9 Architectural Elements, Façade Treatments & Fenestrations

- Provide canopies, balconies, and façade elements.
- Retain all cantilevered elements as per design.
- Use shuttering for exposed concrete finishes as per the design brief.
- Apply protective coatings for exposed concrete surfaces.
- Provide exterior texture paint finish with waterproofing.
- Construct cornices, bund walls, planter beds, curved floor plates, and concrete grooves.
- Install loose planters on all flowerbeds as per landscape DBR and technical specifications
- SS railings with Glass for balconies as per tender drawings & also provide shop drawings for approval.
- Construct window and door jambs as per architectural finishes schedule/ RDS.
- Install windows and doors as per schedule and technical specifications.
- Install all slit windows/glazing (unitized/semi unitized)
- Provide GRC jali for terraces, shafts, and podiums as per tender drawings and exterior finishes schedule.
- Provide stone coping for parapet walls.
- Coping detail for elevation feature above roof level as
- Install facade lighting as per approved lighting scheme.

1.4.10 Staircases & Circulation Spaces

- Construct all RCC staircases as per architectural drawings.
- Provide pressurization shafts for staircases and lobbies, where required.
- Install single length stone for risers and treads with chamfered nosing.
- Provide staircase skirting and dado
- Provide staircase lighting
- Install staircase windows as per window schedule.
- Provide MS staircase railings for fire staircase as per approved designs.
- Provide SS staircase railings for main staircase as per approved designs.

1.4.11 Service Areas & Utility Spaces

- Construct and finish service areas and shafts.
- Install shaft doors and windows for access.
- Provide service slabs/platforms in shafts for maintenance purposes.
- Water proofing of service slabs
- Rung ladder for water tanks, manholes, all underground services, wherever necessary

1.4.12 Waterproofing & Drainage

- Apply waterproofing to toilets, balconies, kitchens, terraces, refuge areas, podiums, part basements, water tanks (underground as well as overhead), underground pump rooms, water bodies
- Provide drain channels and floor drains across all wet areas.
- Ensure proper slopes for seamless water discharge.
- Sump channels for all underground water tanks, pump rooms, water bodies

1.4.13 Vertical Transportation

- Supply and install passenger and service elevators.
- Provide smoke windows for lift shafts
- Provide lift machine rooms, where required
- Provide Machine room less elevators, where required
- Internal finish of lift shafts
- Steel fabricated ladder for access from terrace to overhead tank for servicing and maintenance

1.4.14 Roof Structures & Special Features

- Provide MS gutters for rainwater drainage.
- Construct elevation features in RCC/steel above terrace level.
- All other fabrication works, as required
- Lightening arrestor on all buildings at highest point of every structure, included in total permissible building height

1.4.15 Fire Safety & MOEF Compliance

- Provide fire doors as per NBC and DFS (DELHI) requirements.
- Implement all MOEF compliance measures.
- Implement all DFS (DELHI) NOC compliance measures.

1.4.16 Interior Finishes

- Construction of partitions using Fly Ash Bricks, gypsum board, glass, metal, or wood, as per approval
- Ensuring floor flatness, correcting uneven surfaces, and preparing walls for finishes.
- Execute internal flooring and skirting for all flooring Types: Vitrified tiles, ceramic tiles, marble, granite, engineered wood, sports flooring, laminate flooring.
- All toilets to have wall dado up to full wall height.
- All toilets to have anti-skid flooring as per RDS

- All toilets to have metal ceiling.
- All sanitary fitting and fixtures as per RDS.
- All internal walls to be plastered with gypsum plaster, except internal surface of toilet walls
- Execute wall cladding, dado and wall finishes for all types: Emulsion paint, textured paint, enamel, lime wash, oil-bound distemper, wallpaper, paneling (wood, MDF, PVC), veneer, wall cladding (stone, tile, glass, metal, fabric, ACP)
- Execute all ceiling types: Gypsum false ceiling, metal ceiling, mineral fiber ceiling, etc.
- Lighting Integration in ceiling design: Cove lighting, recessed lights, chandeliers, pendant lights, and special effects lighting.
- Polishing of wooden surfaces, metal surfaces, PU/Melamine finish
- all toilets to be sunken for waterproofing and drainage if shown in architectural drawings
- All plumbing works, concealed as well as exposed as per design
- Kitchen slab platform in stone, overhead modular storage above platform, vitrified tile flooring, wall dado up to beam bottom, gypsum plastered walls with paint.
- All accessories: Mirrors, soap dispensers, towel racks, tissue dispensers, room fresheners, modular shoe rack
- Nosing and chamfered fascia
- Stone basin counters
- True ceiling with damp proof paint finish
- All Indoor Lighting: Decorative lighting, task lighting, ambient lighting, emergency lighting.
- All internal electrical works: wiring & switchboard, Planning of circuits, DB panel installation, cable routing, Power Points & Data Points

1.4.17 Parking & Signages:

- Provide minimum number of parking as per Traffic NOC requirement, mentioned in the drawings and as per statutory approvals.
- Execute Trimix flooring in driveway & parking bays along with waterproofing.
- Fixed parking marks in reflected paint finish

1.4.18 Fixed Fit-Out Furniture's:

- **Modular Kitchen**

Cabinet Carcass: 18 mm HDHMR board, laminate finished, minifix and wooden dowel joinery, 0.8 mm PVC edge banding.
Shutters: 18 mm HDHMR with minimum 1.0 mm laminate as per approved make, 2 mm PVC edge beading.
Hardware: Soft-close as per approved make
Accessories: Tandem drawers, bottle pull-out, cutlery tray, pantry units, baskets, waste bins etc.
Countertop: 18 mm pre polished (edge moulded with minimum 100mm facia) granite with SS sink with drain board and hob cut-outs complete.

Base Cabinets:

Factory Made Modular Kitchen of approved ready to assemble type, self-standing for

Apartment as per approved drawings. Detailed shop drawing considering actual site dimensions with provision for following items: Consisting 7 units are of each depth 580mm, height 720mm. Brand must have all the prevalent quality & safety related certifications like ISO:9001, ISO:14001, ISO:45001, IIOS Certification along with Appliances: Chimney and Hobb of Approved Make

A. 900mm wide Cooking Kit with 3 tandem indaux drawers and 1 cutlery tray.
B. 900mm Wide sink unit with 2 nos 375mm wide hinged door
C. 900mm L corner unit with a L shaped shelf
D. 1 nos grain trolley 600mm wide and tandem drawer
E. 1 nos indaux bottle pull out with 2 tandem drawers
F. 100 mm PVC legs with skirting.
G. 850 mm shutter opening unit with 1 shelf
H. 750mm shutter opening unit with 1 shelf
Top Unit (Wall cabinet): Consisting 7 units are of each of depth 355mm, height 600mm and comprises the following items as shown in the drawing.
A) 2 Nos. of 700mm wide plain shelf unit each with 2 Nos 350mm wide shutter with removable shelf
B) 1 Nos. of 950mm wide plain shelf unit with 2Nos 475mm wide shutter with removable shelf.
C) 1 Nos. of 900mm wide GTPT with 2nos 450mm wide shutter.
D) 800mm L corner unit with a L shaped shelf
E) 250mm wide open box with fixed shelf
F) 900mm chimney cover with 2 shutters 450mm each
Accessories & Hardware :
A - 6 Nos Indaux Tandem Drawers
B - PVC Cutlery
C - BPO
D - 900mm GTPT
E - Legs and skirting

- **Modular Wardrobe**

18 mm HDHMR carcass and shutters, laminate finish, minifix and dowel joinery, 0.8 mm PVC edge beading to carcass and 2 mm to shutters.
Soft-close hardware as per approved make, includes hanging space, drawers, locker, shelves, loft and dressing mirror all complete as per approved drawings.

Cup Board of Overall Size: Width – 2030/2250/1800 (As per requirement), Depth - 600, mm Height - 2400 mm.

Material: Body panels are made of 18 mm thick MDF Board with all the exposed edges are edge banded with 0.8 mm thick PVC edge banding. Side panel are made of 18 mm thick MDF board with all the exposed edges are edge banded with 0.8 mm thick PVC edge banding. Drawer components are made of 18 mm thick MDF board. All the exposed edges are edge banded with 0.8 mm thick PVC edge banding. Three Hanging Rods, 1 drawer and 10 shelves are provided per room. Body back and drawer bottom are made of 8 mm thick MDF board. Hardware: The high quality hardware used like Hinges, minifix, wooden dowels

as per approved makes. Lock used for main door is 3 way lock and lock used for drawer is cam lock

Brand must have all the prevalent quality & safety related certifications like ISO:9001, ISO:14001, ISO:45001, IIOS Certification.

- **Shoe Rack**

Pre-laminated particle board carcass and shutters with PVC edge beading.
Minifix and dowel joinery.
Soft-close hardware as per approved make.

- **Bathroom Vanity**

18 mm HDHMR vanity cabinet with minimum 1.0 mm laminate finish.
Granite vanity counter with sink cut-out.
Soft-close hardware as per approved make.
Smart Mirror with LED light and moisture-resistant backing. Size of mirror as per approved drawing.

NOTE:
All works includes design, shop drawings, manufacture, transport, installation, accessories, hardware, edge beading, cut-outs, sealing and complete commissioning.

1.4.19 Signage Works

- **GENERAL REQUIREMENTS**

Scope of Work

The scope of work covers the complete design engineering, fabrication, procurement, supply, strict testing, and neat installation of external illuminated and non-illuminated architectural signages, internal photo luminescent safety tags, area tags, and ceiling-hung indicators for the Judicial Officers Residence at Sector-19, Dwarka, Delhi. All works shall execute via specialized CNC routings, multi-micron anodization processes, and flawless concealed fixation assemblies.

Compliance Standards and Reference Codes

Except where otherwise modified by these custom specifications, all construction raw components and assemblies shall unconditionally comply with the latest editions of following standards:

CPWD Specifications
IS 733
BS 1474 (1987
National Building Code (NBC
IP 67 Standard

Design, Shop Drawings and Mock-up Approvals

Prior to mass manufacturing, the Contractor shall submit detailed shop-drawings detailing the typography layout sheets, precise bilingual text metrics (Hindi and English), installation engineering details, structural anchor points, and wiring paths for approvals. Physical mock-

up elements of key modular profiles and acrylic elements must be submitted to the Engineer-in-Charge for review.

- **COMPONENT MATERIAL SPECIFICATIONS**

Aluminum Extrusion Profiles

All structural framework profiles, boundary parameters, and core casing units shall be extruded using high-grade Grade 6063 architectural aluminum alloy. All exterior facing aluminum items shall be chemical anodized to a film thickness between 18 to 20 microns. Standard frame units require a minimum wall thickness of 2 mm to avoid deflection.

Aluminum Composite Panels (ACP)

External Signages: Total depth of 4 mm comprising a non-toxic mineral-filled or dense polyethylene compound inner core tightly bonded between twin sheets of exterior-grade aluminum foil skin layers, each with a strict minimum depth of 0.5 mm.
Internal Signages: Overall depth of 2 mm to 3 mm as structurally defined for background composite plates.

High-Impact Acrylic Elements & Translucent Vinyl Sheets

Signage facias must be premium high-impact, UV-resistant, cast translucent acrylic sheets with depths ranging from 3.5 mm to 4.5 mm. Graphic overlay text elements shall use premium plotter-cut cast translucent vinyl with a minimum thickness of 90 microns and a 5-year replacement warranty against color fading or peeling.

Core Electrical Infrastructure and Backlighting Components

LED Backlighting: Solid-state linear architectural modules with integrated optic arrays manufactured exclusively by OSRAM or equivalent approved grade.
Power Drivers: Heavy-duty outdoor electronic power conversion drivers certified to IP 67 waterproof standards, manufactured by OSRAM.
Internal Wiring: All structural internal power routing shall use premium multi-strand FR-LSH (Flame Retardant Low Smoke Halogen) copper conductor cords.

- **DETAILED ITEM-WISE SPECIFICATIONS**

Main Gate Signages (Bilingual Graphics & Logo Identity)

Fascia characters must be premium 3.5 mm thick translucent cast acrylic layered with premium vinyl. The return boundaries (sides) shall be processed using continuous CNC precision channel-bending machinery out of 1 mm thick Grade 6063 structural extrusion profiles with total internal depths of 125 mm to 130 mm. The rear closure panel must utilize 4 mm thick structural ACP (0.5 mm foil skins). Internal lighting requires high-density OSRAM LED units paired with isolated drivers. Weatherproofing gaskets must be integrated around the internal profile channel edge.

Surface-Mounted Entry / Exit Casing Panels

Enclosures shall be processed from 80 mm wide specialized aluminum extrusion profiles of Grade 6063 engineered to achieve completely smooth exterior faces with zero visible screws. The front panel must feature a 4.5 mm thick translucent white acrylic plate layered with a 90-micron plotter-cut graphics vinyl. The frame profile must include a mechanical

hinge or localized locking catch allowing internal cleaning access without dismounting the primary casing.

Ground-Anchored Lit Directional Totem Frameworks

Internal core structure shall be structural steel frames built from 100x50x4 mm Rectangular Hollow Sections (RHS) combined with 50x50x2 mm Square Hollow Sections (SHS). The steel frame must be sandblasted, applied with zinc-chromate primer, and finished with 2 coats of enamel paint. Outer panels must be 4 mm thick ACP claddings with 0.5 mm thick aluminum foils, featuring CNC routings for text lines. Letter lines must be backed with 9.5 mm solid acrylic sheets (5 mm inside, 4.5 mm extending past the ACP panel face) covered with 90-micron vinyl film. The 260 mm wide side returns shall include clear polycarbonate diffusers for side-lit linear illumination. Lighting elements must be OSRAM LEDs and IP67 drivers.

Non-Illuminated Post-Mounted Traffic Control Indicators

Support shafts require structural 100x100 mm MS poles rising 1800 mm high from a 250x250x10 mm thick welded steel base plate, factory powder-coated to a minimum depth of 50 microns. Panel 1 units shall measure 400x110x1200 mm with internal 50x50x2 mm MS sub-frames, enclosed with 4 mm thick ACP. Panel 2 components shall consist of 600x600 mm circular/square configurations of 4 mm thick ACP. All graphics must use premium 3M or Avery Prismatic Retro-reflective sheetings with custom UV-stable color overlay matrices.

Photo luminescent Internal Life Safety & Evacuation Decals

Base elements must be 2 mm thick solid acrylic or high-density ACP plates crafted with corner radii between 8 to 12 mm. Background panels must include a high-intensity photo luminescent film giving a sustained ambient afterglow duration of 4 hours minimum (NBC standard-compliant). Graphics must be directly processed via high-speed UV-curable industrial flatbed printing presses, secured via rear-mounted 3M VHB double-sided tapes or SS fasteners.

Interior Flush and Boxed Area Tags (Area identification)

Modular systems shall utilize a base 3 mm thick ACP box unit combined with specialized architectural 6063 alloy profiles to hold the ACP edges. The edge profile shall measure 18x38 mm and extend 5 mm forward and 3 mm outward beyond the frame boundary to create a recessed front facade. The main face requires a 3 mm thick acrylic sheet fixed staggered over the ACP sheet, with text characters precisely cut via CNC router out of 2 mm thick solid acrylic plates and chemically welded to the front face. Mounting must use heavy-duty rear-mounted hidden clips.

Double-Sided Basement Ceiling-Suspended Infrastructure

Frameworks shall be built from 13+13 mm dual-face ultra-slim edge architectural modular aluminum extrusion profiles. The internal core must be sheeted with approved 4 mm thick double-sided ACP panel units. Reflective directional arrows and texts must be digitally cut from premium Avery or 3M Type 4 retro-reflective vinyl sheetings. Suspensions must use 2 mm stainless steel high-tensile aircraft wire cords or SS link chains anchored with heavy-duty metal wedge anchors.

Entry Area Identification Signs for Ramps (Single Sided)

- **Construction:** Single-sided variation using a 13 mm to 14 mm thick ultra-slim edge modular aluminum extruded profile housing.
- **Face Substrate:** Approved grade ACP lined with precision digital-cut **Type IV Retroreflective Vinyl (3M / Avery Dennison)** for enhanced visibility at vehicular entry gradients.

1.4.20 Miscellaneous

- Mechanical Exhaust for toilets, kitchens, basements, any other areas without natural ventilation as per HVAC design and DBR, (also to be aligned with fire NOC).
- Wayfinding, security & fire signages
- Grinding of concrete wherever necessary as per QC requirements

1.4.21 BIM & Documentation (As Built Drawings Level Requirement)

- Preparation of detailed drawings and integration into BIM models LOD 350 (Construction documentation)
- Preparation and submission of shop drawings approval within the BIM framework. LOD 400 (Fabrication & assembly).

1.5 Detailed Electrical Scope of Services:

1. General

A. The Contractor shall undertake the design, engineering, supply, installation, testing, and commissioning of the complete internal and external electrification works in Engineering, Procurement, and Construction (EPC) mode. This includes low voltage and extra-low voltage installations, along with any additional works necessary for the efficient functioning of the project. All electrical, LV, and ELV works shall be designed and executed in accordance with the latest codes of practice for electrical installations and must comply with the latest Indian Electricity Rules/Act, relevant Indian Standards (IS) codes/rules, Latest CPWD specifications, CEA, NEC 2024, NBC 2016 and latest, IEC, IEEE, NFPA 70, IEC 62305 Part 1-2-3 Super ECBC building requirements 2017 amendment up to 2020 guidelines and latest as well as the specific requirements of Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi.

B. The ratings and capacities of the equipment listed below are the minimum standards to be provided. However, if necessary, during detailed design, the capacity or rating of the equipment may be upgraded by the design consultant.

C. If any item necessary to make the building/scheme habitable and functional is not explicitly mentioned in the scope of services, it shall be considered included within the scope of this tender.

2. Scope of Works Electrical, Low Voltage, Extra Low Voltage Works

The Electrical, LV, ELV and allied services required for the project, the following components with IGBC Platinum / Griha 4 Star Super ECBC building compliance components:

- Provision of Minimum 2 No. 1600 KVA ONAN Transformer, (complying IS 2026 & Losses as per GRIHA applicable), with capacitor panel 650 KVAR APFC panel with 14% detuning rectors in accordance of applicable IEC standards.
- Provision of Minimum 250KVA Silent type DG Set as per Latest CPCB norms along with AMF panel.
- Provision of LT Panel with adequate breakers for transformer, Solar PV System & DG set with Bus coupler and interlocking provisions along with required outgoings for all buildings with LT & HT cables & terminations for connection of building all other substation equipment along with all safety equipment's (Extinguisher, Checker Plate Fire Buckets, Rubber Mat, Chart etc.) is in scope of work of contractor
- FS (Fire Survival) LT cables as per NBC for Fire Fighting Panel, Fire Lift shaft cabling.
- Internal Electrical Installations as per CPWD 2023 specification's guidelines and DBR.
- All LT Panel having incomer breaker above and equal to 800 amps must be complying TTA (IES 61439).
- Earthing provisions for substation equipment's and Panels, Building equipment and panels must comply as per IS: 3043 (Latest).Resistance of system not be greater than 1 ohm.
- All civil works like foundation, trenches and fencing will be in scope of work of contractor.
- Voltage grade of transformer, VCB etc 33 or 11 KV subject to sanction and guaranteed by SEB.
- IP 54 Sandwich type Bus bar trunking external Earth, tap off Boxes, End feed units' necessary tee bend elbows for All residential with floor panels Smart Meters compatible with data Communication enabled ports.
- All Common Area Panel and EV charging panels also have Smart Meters compatible with data Communication enabled ports.
- Distribution Boards PPI TPN, VTPN, SPN, FLEXY DB, MCB, MCCB
- External Electrical Installations.
- Road, Compound, and Landscape Lightings.
- Solar PV Generation on grid load to LT panels. Feeder Provision shall be made accordingly
- Lightning Protection for All buildings as per IEC 62305 Structure Earthing as recommended as per NBC 2016.
- Solar Hybrid LED Street Lighting Poles IGBC Super ECBC building compliance
- Indoor & Outdoor LED Lighting Fixtures IGBC Super ECBC building compliance.
- Architectural & Decorative Lighting fixtures
- Building Wise UPS for ELV & LV & Inverter for Emergency Lighting System & Exist signages
- Internal and External Electrical Distribution Work
- All internal electrical provisions for Residential buildings (Type-V, Type-VI) shall be provided as per "Scale of Amenities for Electrical Installation in General Pool Residential Accommodation" contained in CPWD PAR-2025 document.
- Passive & Active LAN Networking and Wi-Fi enabled System for Campus and Various Buildings (Information Communications and Technology).

- Fire Alarm System all Fire alarm Panels Network based connected to Central control command center, as per NBC 2016 latest & Provisional Fire NOC.
- Passive Security system (at Gate Complex Such as Boom Barrier).
- MRL (Machine Room Less) Lifts.
- Electric Vehicle (EV) Charging with Charger as per MOEF requirements for 4-wheeler & 2-wheeler as per requirements.
- Emergency Exit Signages (including photo-luminescent/battery backup as per NBC 2016).
- Surge protection devices shall be provided as needed and in accordance with applicable standards. If any item required to make the building/scheme habitable and functional is not specifically mentioned in the scope of services, it shall be deemed included within the scope of this tender, and no additional payment will be made for such items.
- Suitable-sized shafts, cutouts, niches, and openings shall be provided. All floors must be sealed with fire sealant products to facilitate the installation of rising mains, pipelines, cable trays, ducts, etc., across the floor slabs of both buildings for various service areas. All provided shafts, cutouts, niches, and openings in the floor slabs shall be suitably closed after the installation of service lines, adhering to fire safety norms as per NBC 2016. Doors shall be considered part of the civil work and provided for all shafts on all floors, in accordance with fire safety norms as per NBC 2016.
- Wires

  The design manufacture, testing and supply of single core FRLS PVC insulated 1.1 KV grade stranded twisted wires under this specifications shall compile with latest edition of following standards.

  IS : 3961 Current rating for cables.
  IS : 5831 HRPVC/PVC insulation and sheath of electric cables.
  IS : 694 HRPVC/PVC insulated cables for working voltage upto and including 1100 volts.
  IEC : 754(i) FRLS PVC/HFFR insulated cable.

Copper/Aluminum stranded twisted conductor HRPVC / FRLS PVC / PVC / XLPE insulated wires shall be used in conduit as per item of work. Aluminum for power cables and copper for control cables shall be used.

The wires shall be color coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in meters at every one meter shall be provided on the outer sheath of cable.

Cable laying must compile IS: 7098(I) Specification for cross linked polyethylene insulated HRPVC/PVC sheathed cable for working voltage up to 1.1 KV.

Cable laying and termination must compile CPWD external electrical specification.

(a) HT cable laying as per CPWD specification. The cross linked polyethylene (XLPE) cable shall be aluminum conductor PVC outer sheath steel strip armored over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1985 and (Part-II) 1973. The screening shall be done on individual

cover. The armoring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

(b) Voltage drop for cable must compile ECBC norms.

- **Additionally, IoT-based microcontroller devices are** required in the electrical installations of the building as stipulated in Circular No. शासन परिपत्रक क्र. मु विि न - 2021/प्र. क्र.114/ ऊर्◌ाा-5. All electrical installations and wirings must be conducted by a government-approved licensed electrician in compliance with the prevailing Electricity Act and Rules. A certificate confirming this must be obtained from the licensed electrician before applying for compliance remarks from the relevant department.

IoT-Based Devices for Electrical Installation of the Building:

a) IoT-based microcontroller devices shall be incorporated in the electrical installations as per the requirements specified in Circular No. शासन परिपत्रक क्र. मु विि न - 2021/प्र. क्र.114/ ऊर्◌ाा-5.

b) The IoT-based microcontroller devices shall be tested and verified by an NABL-accredited testing agency/laboratory in accordance with IS: 732-2019, the recognized code for practice for electrical wiring installation.

c) The complete installation of IoT-based microcontroller devices shall be checked and certified by the Chief Electrical Inspector of the Government of Delhi, and a certificate to that effect shall be issued upon compliance.

d) The data and alerts generated by the IoT-based microcontroller devices shall be monitored by the building management system, necessitating immediate corrective actions by the owner or occupier.

e) The data generated by the IoT-based microcontroller devices shall be made available to the fire brigade department as required to aid in investigating the cause of any fire incidents.

Electrical Power Requirement

The electrical load requirement has been calculated based on the covered area of the Residential buildings, in accordance with NBC 2016.

- Lifts
- Pump Rooms, (PHE Pumps & Fire Fighting cluster wise)
- External Solar Hybrid Street & Landscape Lighting
- Sewage Treatment Plant (STP)
- Water Treatment Plant (WTP)

  The total connected load is assumed to be 1444.76 KW. With an overall diversity factor of 80%, the average peak load demand for the Dwarka Residential campus is calculated as 1386.97 kW.
- **Total Load in kVA (@ 0.9 Power Factor):** 1541.08 KVA
- **Power Transformer Capacity:** Minimum 2 No. 1600 KVA transformer ONAN type (complying IS 2026 & IS 1180 Level 2 losses), with capacitor panel 650 KVAR & 3200 Ampere ACB at LT side) in accordance of applicable IEC standards.
- **Distribution:** Scope of work starts from provided 11 kV tapping point by SEB near to the boundary includes providing laying of HT cable till substation and substation equipment's as following.

Receiving Stations:

i. Provision of 11 KV VCB cubical panel consist of 2 Nos Incomer, 1 No. Bus coupler, and adequate number of outgoing with spare provision.

ii. Provision of Minimum 2 No. 1600 KVA outdoor type transformer ONAN type (complying IS 2026 & IS 1180 Level 2 losses), with capacitor panel 650 KVAR & 3200 Ampere ACB at LT side) in accordance of applicable IEC standards.

iii. Provision of Minimum 250KVA Silent type DG Set as per Latest CPCB norms along with AMF panel.

iv. Provision of LT Panel with adequate breakers for transformer, Solar PV System & DG set with Bus coupler and interlocking provisions along with required outgoings for all buildings with LT & HT cables & terminations for connection of building all other substation equipment along with all safety equipment's (Extinguisher, Checker Plate Fire Buckets ,Rubber Mat, Chart etc.) is in scope of work of contractor.

v. All LT Panel having incomer breaker above and equal to 800 amps must be complying TTA (IES 61439).

vi. Earthing provisions for substation equipment's and Panels, building equipment and panels must comply as per IS:3043 (Latest). Resistance of system not be greater than 1 ohm.

vii. All civil works like foundation, trenches and fencing will be in scope of work of contractor.

viii. Voltage grade of transformer, VCB etc. 33 or 11 KV subject to sanction and guaranteed by SEB.

Additional features include:

- Gas Suppression System: This system will be installed in emergency panels, lift panels, and fire-fighting panels per NBC-2016 guidelines.
- Surge Protection Devices: These will be provided as needed and in accordance with current standards.

Internal El & External Electrical Works

This section covers the complete internal and external electrical works, including:

- All copper wiring in PVC HMS conduit FRLS concealed in slab and MS conduit on surface as per CPWD specifications.
- LED energy-efficient luminaires for Indoor & outdoor Landscape lightings shall compliance with Super ECBC Buildings methods
- Modular switches and sockets for Residentials.
- Distribution Boards (DBs), Miniature Circuit Breakers (MCBs), Molded Case Circuit Breakers (MCCBs), and Residual Current Circuit Breakers (RCCBs)
- Sandwich rising mains with aluminum conductor, end feed units, and tap-off boxes
- Distribution of normal power, UPS power, and low-side power
- Structural earthing and lightning protection systems in accordance with NBC-2016 and IS-IEC 62305
- Telephone, TV & ELV wiring in PVC HMS conduit FRLSH
- Street lighting, compound lighting, and landscape lighting distributions shall be as per Architecture and Landscape requirements of Master plan.

- Electrical signage (including photo luminescent/battery backup as per NBC 2016) and display systems.

Surge protection devices shall be installed as required and in compliance with standards.

Any item necessary to make the building or scheme habitable and functional, not specifically mentioned in the scope of services, is considered included within the scope of this tender.

3.1 Fire alarm and Public Address system

The work shall consist of Automatic Intelligent Addressable Fire Alarm system and Voice Evacuation cum Public Address System. The system shall be as per CPWD specifications, NBC 2016, and Local bylaws and as per clearance issued by Delhi Fire Services.

The system shall be UL/NFPA approved for all components. All 3rd party integration shall be provided by the contractor.

1. Cabling and Infrastructure

- Detailed specifications for all cabling required (e.g., Ethernet, power, coaxial).
- Equipment racks and mounting for server hardware.
- Guidance on installation, including cable management and safety standards.

2. Integration with Other Systems

- Interfacing with existing fire alarm systems, CCTV and other ELV systems.

3. Testing and Commissioning

- Protocols for testing the system functionality and performance.
- User acceptance testing with stakeholders.
- Training sessions for facility staff and end-users.

4. Compliance and Standards

- Adherence to local regulations and standards for fire safety and security.
- Industry best practices for access control systems.

3.2 Lifts

The scope of work includes the operation of lifts as per architectural plans, with all necessary control equipment and accessories for the required number of landings/openings and capacity, in accordance with NBC 2016 and its amendments.

Lift Design and Standards:

- All lift installations shall adhere to the architectural and NBC 2016 standards, or OEM specifications where they exceed these standards.
- Lift well, pit depth, enclosure, headroom, car size, and entrance dimensions must conform to NBC 2016 or be in line with OEM recommendations.
- All lifts shall be Machine Room Less (MRL), regenerative type elevators with center opening doors.

Performance and Safety:

- Handling capacity, lift speed, door-to-door time, and passenger waiting time must meet NBC 2016 standards.
- Installation must comply with NBC-2016 fire and life safety guidelines.
- The factor of safety for any lift part must not be less than five, with higher safety factors applied as per accepted standards.
- The lift system and components must meet fire protection requirements.

Electrical and Structural Considerations:

- Electrical work includes interconnections from 4P/TP+N switches and loop earthing from the earth bar in the machine room/top landing.
- All lift materials, fittings, and appliances must conform to Indian standard specifications.
- Provide adequate lighting in lift shafts and landings.
- Install a hoisting beam or hook above the lift well and a trap door.
- Architrave work at lift entrances is required.
- Temporary barricades with caution boards must be installed at each landing to prevent accidents during work execution.
- Electric supply to each lift shall be from a dedicated lift panel.
- There should be a separate exclusive earth pit for each group of lifts or connection to an equipotential system.

Advanced Features:

- Destination control features for office building passenger elevators.
- LED displays for passenger information.
- Lift cars should have an emergency telephone or alarm.
- The lift system must include an automatic rescue device (ARD).
- Lifts should be equipped with both seismic mode and seismic standby mode.
- CCTV shall be provided each lift.
- Fire Lifts specifications shall be provided as per Standards CPWD & PWD

3.3 LAN SYSTEM

The scope of work shall include Planning, Design Engineering, confirmation, supply, installation, testing & commissioning of complete of CCTV and IP telephone System. The scope Included with Active & Passive components, Including necessary, Switches Layer 2, Layer3, Servers hardware redundant servers Fire wall Protections up to outside services provider room.

Scope of works

The outlets are as described in the Internal EI subhead. The scope of work also includes the provision of both Active & Passive Components with Automated Intelligence Management passive system requirements as per design basis & Technical specifications.

The complete system shall be on a 10G backbone.

The core switch shall be N working + 1 Stand-by NBD support.

The complete system must be supplied, installed, tested and commissioned in complete manner to have a fully functional system, as required.

Every floor shall have suitable no. of floor-standing/ wall-mounted racks with suitable no. of switch in each wing where the CAT-6A cabling from the respective floor data points shall terminate.

The design system considered and ensured that the maximum length from the switch to the data point including the patch cords etc. does not exceed 80m. There will be 20% redundancy on each switch.

Each floor rack shall be connected to the Server Room Main racks through backbone Optical Fibre cable and links. Each rack shall have dual linkage from the different server racks.

CCTV network rack and its entire LAN system shall consider separately Layer Switch.

3.4 Lightning Protection System

Design Basis
The scope of work includes planning, design engineering, confirmation, supply, installation, testing, and commissioning of a complete Lightning Protection System (LPS) scheme.

General Requirements Lightning protection for office buildings shall be implemented in accordance with IS/IEC 62305-3 (latest amendments), CPWD specifications, and NBC 2016 norms. The primary and most effective measure for protecting structures against physical damage is a lightning protection system (LPS). An external LPS consists of the following components:

Air-Termination System: Intercepts lightning flashes to the structure.

Down-Conductor System: Safely conducts the lightning current towards the ground.

Earthing System: Disperses the lightning current into the earth.

Accordingly, a standard lightning protection system will be provided in all buildings per NBC 2016 standards, using single-prone finials and horizontal and downcomer earthing strips of suitable size, terminating in earth pits.

General Standards All aspects of the Lightning Protection System shall conform to IS/IEC 62305-2. The Lightning Protection Level (LPL) can be determined through a risk analysis as outlined in IS/IEC 62305-2.

Components of External LPS The external LPS will consist of the following components:
1. Air terminal (designed according to the rolling sphere method, mesh method, protective angle method, or a combination thereof).
2. Down conductor (made of copper).
3. Earthing system (chemical maintenance-free earthing stations).

Air Termination System In accordance with IS/IEC 62305, all down conductors must be connected to vertical earth pits, which are interconnected with a ring earth system.

Down Conductor System to minimize the likelihood of damage to electronic and electrical equipment, down conductors shall be arranged at equal distances, ensuring multiple parallel current paths exist from the point of strike to earth. The lengths of these current paths should be minimized. The distance between down conductors will be determined based on the Class of LPL/LPS.

3.5 EV Charger

This scope covers the design confirmation, supply, installation, testing, and commissioning of a complete Electric Vehicle (EV) Charger system for the project.

1. **EV Charger Installation:**
   Minimum EV charger provision to be provided as: (12 Nos 24 Kw DC, 17 Nos 7 kw DC, 16 Nos 7 Kw AC or additional as per green building requirement.)
   - The LT panel for the EV charger will be installed in the Stilt corresponding podium area of each block-Cluster & Open area Parking.
   - Each basement/podium will be equipped with 63 Amp Double Pole (DP) and 63 Amp Four Pole (FP) MCCBs Waterproof IP 65 housed in suitable enclosures, featuring a prepaid system.
   - Level 2 Charging: Higher capacity chargers (e.g., 11 kW to 22 kW) that require dedicated electrical installations and provide faster charging.
   - Adhering to BEE's recommendations and standards for energy efficiency in EV charging systems, including energy consumption analysis and lifecycle assessment.
   - Park bay AC Charge Point (for 3W and 4W - M1 Category)

Power Level 2	Charging Device / Protocol	EV - EVSE Communication	Charge Point Plug / Socket	Vehicle Inlet / Connector
Normal Power ~11kW / 22 kW	IS-17017-1	IS-15118 [PLC]	IS-17017-2-2	IS-17017-2-2

2. **Wiring and Distribution:**
   - Wiring will be executed using 3-core copper cables installed on cable trays.
   - EV charger outlets will be strategically distributed throughout the basement and podium areas.

3. **Compliance and Standards:**
   - EV charger outlets will adhere to BIS standards or as directed by the Engineer-in-Charge.
   - The EV chargers will include features for payment based on energy consumption through a mobile app prepaid system.

4. **Design Requirements:**

- The bidder is responsible for providing 10 normal charging point stations and 02 fast charging point stations.

3.6 GREEN BUILDING DESIGN

The EPC contractor shall adhere to highest standards of environment and energy sustainability as stipulated in respective clause, an Environmental Brief and as approved by Wapcos. Holistic integration of the environmental sustainability brief in design, materials, construction, services, processes, and maintenance concerns should be strictly addressed in planning and design to achieve a Green Campus equivalent to **IGBC PLATINUM / GRIHA 4 STAR RATING**. All stage-wise approvals from the concerned authorities be coordinated and obtained by the EPC Contractor. Nothing extra shall be paid on this account. Since this is an optional requirement of the Institute, this should not be read as Statutory / Government requirement.

3.7 The EPC Contractor's Roles and Responsibilities will include:

The EPC contractor will be carrying out topographical survey and soil investigation survey and the survey of all existing services and other constraints existing in and around the site. Thereafter, the report will be utilized for working out of the overall scheme. The EPC Contractor will study and interpret the soil investigation reports and input data for structural and foundation design for individual buildings/ structures/ equipment's etc. as per relevant IS codes. The Soil investigation & determination of safe bearing capacity would also be forming the part of the scope of the EPC Contractor which they have to carry out on their cost & shall be included in the quote.

3.8 DETAILED WORKING DRAWINGS

i. Prepare detailed working drawings. The detailed working drawings shall include detailed site plan, detailed drawings for each buildings including floor plans, elevations, door & window schedules, finishing schedules, fitting schedules, color schemes, flooring patterns, reflected ceiling plans, ironmongery, joinery, installation details, wall profiles, Staircases, ramp and lift details, details of important building parts /areas, landscape & horticulture details etc. The details are to be in line with the standards, specifications & schedule of finishes mentioned in the TENDER & as required by WAPCOS needs.

ii. Drawings shall be adequately detailed and shall contain enough information to enable construction, The drawing shall include in accordance with the details provided in the TENDER:

a. **Layout Plan showing:**

- All proposed buildings, play fields, green area, Sewage Treatment Plant, Sump, Rainwater Harvesting, Electrical Sub-Station, Pump Room etc. in accordance with
- Blow up of road junction / parking area and other such area as required.
- Coordinated External services.

b. **Detailed Drawings of:**

- Floor plans, fully coordinated with all services/disciplines.

- Elevations
- Sections
- Wall profiles
- Doors & Window details
- Stairs/Ramps/Lifts details
- Details of building parts, areas, critical special treatments.
- Toilet details.
- Flooring pattern and details
- Dado details
- Roof flow, draining including rainwater harvesting system underground tank.
- Detailed designed and drawing of all types of furniture, all lab equipment, all workshop machineries, all kitchen equipment, modular wardrobe, Dressing, etc.
- Detailed drawing of artwork.
- Any other detailed require by the Authority Engineer/ Wapcos.

c. **Any other details required for completion of the buildings/services.** – The layout drawings, detailed drawings for utility buildings and ancillary buildings like Electrical Substations, Central UGT, Pump rooms, STP/ ETP, water tank, etc., shall be forming the scope of EPC Contractor.

d. **ELECTRICAL ENGINEERING SERVICES**

The electrical system shall be in accordance with IGBC Platinum / Griha 4 Star RATING. They should be in accordance with the detail schematics, specifications given in the TENDER.

e. **Internal and External Electrification**

- Drawing of internal electrification network of building with adequate sizing of cables, wires, switchgears, distribution boards, panels, electrical fittings, fixtures etc. based on the design given in the TENDER.
- Earthing protection system to be in accordance with latest IS standards.
- Lifts and escalators shall be barrier free campus including relevant norms and provisions for Persons with Disabilities and should be Stretcher lift.
- Calculation and Simulation required conforming to IGBC Platinum / Griha 4 Star RATING for complete electrical lightning system for the best illumination level (foot candles), uniformity, layout, and aesthetic considerations such as color rendition shall be taken into account.
- Measures for energy conservation –day light harvesting, occupancy sensor etc.
- All the staff quarters and faculty housing shall have the provision of communicable electrical billing system.

f. **External Electrification- other works**

- Streetlights and landscape lightning to be provided in accordance with IGBC Platinum / Griha 4 Star RATING as per drawings & details provided in the TENDER.
- Suitable Automatic Power Factor correction system to be provided.

g. **Telephone, Intercom & Communication System**

- Telephone layout and telephone equipment including conduit and accessories layout for the telephone system and any protective devices battery back-up required.
- Before start of work in the EPABX/EPBX room. Prepare conduit layout of cables and terminals inclusive of a fibre optic or other special data transmission cables for system required.
- Intercom layout and intercom equipment including conduit and accessories layout for the intercom system and any protective devices required.
- Topology of networking, LAN (Structured Cabling), cables, conduits, raceways, sockets, layout drawings floor wise.
- Get the approval from authority engineer/Wapcos detailed drawings of the suppliers and manufacturers.
- Latest IP based telephony system

h. **Cable TV/Dish Antenna System.**

- Prepare working drawings indicating the locations of TV points, Central panel/racks of dish antenna as per the details provided in the TENDER.
- Get approval of the Authority Engineer/Wapcos the suppliers'/ manufacturers drawings/ documents.

i. **Lightning Protection and Earthing System**

- Lighting protection system shall be an advanced integrated lighting protection system as specified in the TENDER.
- Prepare plans showing internal/external earth grid, earth electrodes and lightning protection with size of conductors and details of each electrical and lightning arrestors along with details of earthing pits.
- Earth system shall be as per relevant Indian Standards and Indian Electricity rules. And its latest guidelines.

j. **External Lighting**

- Assess the external lighting requirement for parking, pathway road, buildings as required for human access etc.
- Prepare plans indicating the road lighting with circuit details, typical pole detail with type of fixture, cabling, earthing etc.
- Prepare and get approved from the Authority Engineer/Wapcos detailed drawings of the suppliers and manufacturers.

k. **UPS back-ups**

Minimum rating of UPS to be provided as 3 Nos10 kVA UPS.

- Prepare the plan indicating the locations of UPS rooms in the buildings, UPS room layout, Floor wise UPS power distribution drawings, Single line diagram/Power flow diagram.
- Get Approved from the Authority Engineer/Wapcos detailed drawings of the suppliers/ manufacturers.

l. **Roof Top Solar PV System:-**

- Roof Top Solar PV System with minimum Capacity 100 kWPe with following item specification.

m. **Fire alarm system**.

- Prepare working drawings (Floor wise) indicating the zones, location of the fire alarm sensors, Response Indicator, Manual call points, Hooters, their conduits and wiring and location/details of FDA control panels, evacuation plans. As per NBC 2016.

n. **Lifts and Escalators**

- Prepare detail layout for the necessary machine areas as [per specified capacity and type of lifts/escalators to be provided.
- Lifts and escalators installation as per the Statutory/local regulations.
- Lift and escalators shall be in apt with person with disability and old age person to make the campus barrier free.
- Lift quantity and type (Passenger / Bed Lift) , travelling height , speed , stop / open as per the approved architectural drawing and as per approval of traffic analysis for Lifts of all building

o. **Water Pumps**

- Specify the type of pumps for water supply & dewatering purpose as per the requirements.
- Prepare and get approved from Authority Engineer/WAPCOS the suppliers'/ manufacturers drawings/ documents.

p. **Fire Fighting & Fire Suppression System**

- Prepare working drawings for internal and external fire protection and suppression system including hydrant, sprinkler system, CO2 flooding system, pressurization system, fire extinguisher system, Underground Tanks, fire pump rooms etc. in line with the statutory requirements and the details provided in the TENDER.
- Get approved from the Authority Engineer/ WAPCOS the detailed drawings and data sheet of suppliers/ manufacturer

q. **Plumbing and Integrated Water Management System**

- Prepare drawing of plumbing system for internal and external. It shall include comprehensive design concepts and installation guidelines for energy conservation and water harvesting & shall be in accordance with the specification schematics given TENDER.
- Integrated and sustainable water management focusing on least anthropogenic water discharge from human activities should be pursued.
- The use of water conservation fixtures, landscaping, rainwater harvesting, aquifer recharging, and waste-water recycling need to be given due consideration.
- Involve use of efficient building and plumbing services components and fixtures tailor-made to meet sustainability objectives and creating sufficient awareness among the users of building facility and its services, during the occupancy stage.

- Ensure potable quality of water for drinking and washing as per the prescribed standards and to ensure that treated wastewater is meeting the desired standards for reuse or disposal.
- Minimize the consumption of mains supply potable water and minimize the volumes of urban storm water run-off.

r. **PUBLIC HEALTH ENGINEERING**

- All the design and drawings should be well coordinated with Architecture and other services drawings.
- All designs shall be as per the latest Indian Standards, Local byelaws, and statutory norms/regulation.
- Design of Public Health & Engineering services taking into account various topographical, meteorological, Hydrological etc. reports, identify the source and quality of water, conduct survey of existing water supply system, Sewerage system, Drainage system, Fire-fighting system, other site development works etc. for planning of services. These existing systems are to be augmented with proposed (Required) system.
- The services shall include following major components as discussed in detail:
  - i) Water Supply System
  - ii) Internal Sanitary Installations
  - iii) Sewerage System
  - iv) Drainage System

i) **Water Supply System**

- Prepare detail working drawings of internal and external water supply system including Underground tank, Overhead tank, Water treatment plant, pumping stations, rising mains, distribution system and internal plumbing, recycling of treated wastewater etc.
- Prepare and get approved from Authority Engineer/IIM Mumbai detailed shop drawings and data sheets of suppliers/ manufacturers.

ii) **Internal Sanitary Installations**

- Prepare working drawings of internal sanitary installations.
- Prepare working drawings of handicapped friendly toilets and sanitary installations.
- Prepare and get approved from Authority Engineer/IIM Mumbai detailed shop drawings and data sheets of supplies / manufacturers.

iii) **Sewerage System and Sewage Treatment Plant**

- Prepare working drawings for internal and external soil/waste disposal systems including sewage treatment plant and treated water usages, etc as per the details in TENDER.
- Prepare and get approved from Authority Engineer/IIM Mumbai detailed shop drawings and data sheets of suppliers/ manufacturers.

iv) **Drainage**

- Work out and prepare working drawings for storm water drainage including roof

drainage, service area drainage and surface drainage.

- Prepare working drawings for rainwater harvesting system.
- Get approved from the authority Engineer/WAPCOS detailed shop drawings and data sheets of suppliers/ manufacturers.
- Also prepare a scheme how best the rainwater from roof can be made use of (rainwater harvesting)
- The EPC contractor shall propose a scheme for handling, disposal, reuse and recycling of Construction and Demolition (C&D) Waste as generated at site as per advisories issued from time to time.

- The EPC contractor shall also prepare scheme for purchase/disposal of all products such as bricks, paver blocks, coarse and fine aggregate etc. generated during treatment and recycling of C&D waste. The overall objectives of C&D waste management are to: -
  1. Maximize recovery of recyclable C&D material(s).
  2. Maximize reuse of recovered material in construction activity.
  3. Eliminate waste quantity that requires landfill disposal.
  4. Increase life of sanitary landfill site(s) and
  5. Reduce in total costs of C&D waste management.

s. **SITE DEVELOPMENT WORKS**

- Prepare working drawings (longitudinal & cross section) for roads/ footpaths/ parking areas etc.
- Prepare working drawings of irrigation system for horticulture Landscape & Hardscape.

CONSTRUCTION STAGE:

i. The works shall include construction for the project with all necessary Materials, labor, plant & equipment, scaffolding / platform for satisfactory construction, completion of the works covered in the scope of the works to the intent and meaning of the drawings, Master Development plan, Technical Specifications, DBR, and orders approved by the Authority Engineer/ IIM Mumbai.

ii. The scope of works shall include, whether specifically mentioned or not in the various clauses of approved Technical Specifications, DBR, lifting and shifting at all leads and lifts, all apparatus, plant, equipment, tools, fuel, water, hoists, ladders, temporary structures required during construction, timbering, transport, temporary stores, workshop, staff, labor, watch & ward of the works, Quality Lab, adequate lighting etc. as required for the scope of Works at all locations, all heights etc. complete to the satisfaction of Authority Engineer/ IIM Mumbai.

iii. It shall also include adherence to norms for safety of workers, first-aid equipment, suitable accommodation for the staff and workmen with adequate sanitary arrangements, the effecting and maintenance of all required

insurances, the payment of all wages, salaries, fees, royalties & duties if any applicable for the EPC Contractor's Scope of works or other charges arising out of the erection of works and the regular clearance of rubbish, reinstatement and clearing-up of the site as may be required on completion of works (safety of the public and protection of the works including adjoining property pertaining to the EPC Contractor's scope of work. This also includes all activities not specifically mentioned herein or noted on the Drawings / Documents as being furnished or installed, but which are necessary and customary to be performed under this contract.

iv. To provide documents, as-built drawings and arrange with the various local authorities for the necessary testing, inspection, submission, third party testing and approval requirements to be carried out up to and including the approval stage and to assist in obtaining clearance until Occupation Certificate approval.

v. The specifications and drawings issued along with TENDER document/Letter of Award and/ an essential and integral part of these Works. The scope of work in this contract shall also include the provision of suitably qualified professionals, engineers, management team, skilled and unskilled manpower, equipment (plant and machinery), materials, etc. to complete the entire scope of Project within contractual period based on specifications, drawings & details.

vi. The work shall be carried out under the Supervision and as per directives of the Authority Engineer/WAPCOS.

vii. Working time in a day at site shall be from 6:00 AM to 9:00 PM with a special condition to allow the execution time beyond the working period in case of exigency as may be subject to approval by the competent authority of WAPCOS. Since the site under this development lies withing the existing campus, the EPC Contractor, upon permission of working beyond the specified hours, shall ensure that construction activities causing high intensity and disturbing noise/ sounds shall be avoided.

viii. The scope of work including but not limited to following: -

- Plot development including site clearing, cutting of trees and re-planting the same as per norms of Environmental clearance obtained by the Authority.
- Demolition of existing structures and necessary excavation.
- To interface and coordinate with other contractors (If Any) engaged by the Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi for any trade time to time.
- To provide all tools, scaffoldings (MS), transport equipment, hoist, lifts, tower cranes, ladder, or any other type of equipment required for system delivery, installation, testing, certification, and acceptance.

- To prepare the design on the design intent & DBR, liaisoning for approvals of all related NOCs required to execute the work.
- Testing of materials and finished works as called for in technical specifications and elsewhere in contract for all civil, sanitary, and other specialist civil works and any other works and third-party testing.
- To prepare shop drawings, Good for Construction Drawings, and detailed schedule to monitor procurement, material delivery, installation, execution, start up and certification.
- Quality assurance and control for the installation and certification
- Executing samples, mockups for Authority Engineer/ Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi approvals. EPC Contractor to execute the work as per approved drawings, samples, and mockups by Authority Engineer/ Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi etc. complete.
- To provide documents, As-built drawings and arrange with the various local authorities for the necessary testing, inspection, submission, and approval requirements to be carried out up to and including the approval stage. EPC Contractor to provide the submittal in the hard copies as mentioned in the Special Conditions of Contract.
- Procurement of materials as per material specifications defined under Technical Specification of Contract.
- The scope of work includes completion to the extent that the area/ building unit is ready for use.
- The layout drawings include landscaping layout designs including both hard & soft landscaping. The required arboriculture should be developed especially the green lawn by the time of handing over/ closure of the project. The cost of developing these should also be accounted for in the overall quote by the bidder, as these are forming the part of scope.
- Handing over of the project shall be taken for the whole development as per agreed scope of work, without any phasing.

4.1 Liaisoning & Approvals (Obtaining approvals, certifications, clearances, NOC's, permissions, etc.):

a) All necessary mandatory approvals, from local/state/central government authority for obtaining necessary certifications, permissions, clearances, statutory approvals/ NOC's during, pre and During construction need to be obtained. The contractor needs to assist and help in making of required drawings / documents for approvals and the expenditure towards appointing required consultants for certification shall be under the EPC Contractors purview. The EPC Contractor scope shall also include the cost of modifications if any as may be suggested by any approving statutory / Government authorities.

b) Time required for such approvals is part of the Contract Period.

c) **Below is the list of statuary approvals required to be obtained/ assisted by the contractor but not limited to-**

1) Assistance / Liasoning / Obtaining the Approvals Pre Construction

- Building Plan Sanction / Building Permit issued by DDA
- Layout Plan / Local Area Plan approval from DDA
- NOC from Airports Authority of India (AAI) - Height Clearance
- Approval / NOC from Delhi Urban Art Commission (DUAC)
- NOC from Delhi Fire Services
- Environmental Clearance (EC) from DPCC / MoEF&CC
- NOC from Delhi Jal Board (DJB) - Water & Sewerage
- NOC from BSES / Electricity Supply Authority
- NOC from Delhi Metro Rail Corporation (DMRC)
- NOC from Traffic Police, Delhi
- NOC from Archaeological Survey of India (ASI), if applicable
- Obtaining Demarcation of trees for Cutting and obtaining NOC
- Any other statutory approvals, NOCs required

2) Approvals During & Post Construction

- Approval of water requirement (separate for construction and post construction usage)
- Approval of power supply requirement (separate for construction use and post construction usage)
- Labour license for all contractors / sub-contractors
- Completion certificate from sewerage projects
- Completion certificate from MCD/DDA.
- Final DFS NOC for OC
- NOC for OC from EE (T&C)
- Pollution control board NOC
- Delhi pollution control board NOC for dg set/ STP/ OWC
- NOC from electrical inspector-govt. of Delhi
- Completion certificate from contractor / consultant
- Consent to operate (final environmental approval)
- GRIHA-4 star certification

3) EPC Contractor's Scope of Policy & Registration and Permits/ Certifications

- WC Policy (Workmen's Compensation Policy)
- CAR Policy (Contractor All Risk Policy)
- CLRA Registration (Contract Labour Regulation & Abolition Act 1970)
- BOCW (Building & Other Construction Workers Act 1996)
- ESIC & PF registration
- Excavation/ Mining Approval if applicable
- NOC for Traffic & Coordination (In case of any amendment due to MEP & Structural design)
- NOC for CFO (In case of any amendment due to MEP & Structural design)
- Site Office Approval (if required)
- Permission for Excavation/ Royalty Payment

- Half yearly submission of Reports to MoEF & CPCB
- ECBC compliance
- Final Structural Stability Certificate

4.2 Other Miscellaneous

- EPC Contractor to take due care of structure considering the project location in close vicinity of existing structure and specific atmospheric conditions. EPC Contractor to explore the option of special paints having the anti-carbonation properties or suitable treatment to protect structure for weather conditions at project location. Necessary anti corrosive treatment to be considered for steel reinforcement and steel structure during construction.

- All buildings to be designed as per latest IS codes/ NBC Norms considering the design compliance with earthquake resistant structure at project location.

- Master development includes necessary rainwater harvesting, lakes, ponds, and water bodies as per requirement of Environmental clearance to store the water during the rainy season.

- All necessary plot development (cut and fill) to be considered as per the contour and survey. All necessary surveys required for the plot development are part of the scope.

- The scope also includes design and construction of ancillary buildings like Substations pump rooms etc. All ancillary buildings like UGT, WTP, STP, Substations, Pump house, etc. should be RCC framed structures or as approved by client / architect.

4.3 Guarantee/ Warranty and Performance Certificates (as required)

- The EPC Contractor’s shall submit guarantee/warranty and performance certificates following packages but not limited to–
  - Transformers
  - Lifts
  - Power Substations
  - DG
  - Fire Fighting Systems including Pumps and Panels.
  - STP
  - UGT including pumps and ancillary works
  - Roof top Solar System
  - External and Internal Electrical Lightings
  - Sanitary Installations and Fittings & Fixtures
  - LAN, UPS, CCTV System, Telephone, WIFI etc.
  - Electrical Vehicle Charger
  - Swimming Pool and ancillary works
  - Sports facilities and equipment’s
  - Boom Barrier, Signage etc.
  - Rain Water Harvesting System and ancillary works

- Waterproofing, False Ceilings, Aluminum/WPC/UPVC Doors & Windows, Anti-termite, Fixed Fit out Furniture, Modular Kitchen etc.

Table 4: New Development

	Building Name	Typology	No. of Blocks	No. of Floors	Building Footprint	Total Plinth Area
1	Type VI Housing	Residential	1	13	898	11150
2	Type V Housing	Residential	1	13	916.54	11850
3	Basements	Residential	1	2	5556	11,200
3	ESS	Non-Residential	1	1	200	200
4	Pump Room	No-Residential	1	1	250	250
TOTAL Plinth Area (in sqm)						34650

Individual Building Wise Areas

Floor Level	Type V Plinth (SqM)	Type VI Plinth (SqM)	COMMON BASEMENT	Utilities (SqM)	Total Plinth Area (SqM)
Basement 1	-	-	5600.00	-	
Basement 2	-	-	5600.00	-	
Ground Floor	917	898		450.00	
1st Floor	898	615		-	
2nd Floor	898	862		-	
3rd Floor	898	862		-	
4th Floor	898	862		-	
5th Floor	898	862		-	
6th Floor	898	862		-	
7th Floor	898	862		-	
8th Floor	898	862		-	
9th Floor	898	862		-	
10th Floor	898	862		-	
11th Floor	898	862		-	
12th Floor	898	862		-	
MISC	157	155		-	
TOTAL	**11850**	**11150**	**11200**	**450.00**	**34650**

Part B

FINISHING SCHEDULE

1.0 Amenities for Residential Units

- Shafts for services line sanitary services, electrical and communication services as well as ventilation shafts for toilets etc. are not to be included in these Plinth Area Norms. No Utility balcony be located on the main facade of the building in all categories of houses. Special care must be taken in the design so that overall aesthetic is not compromised.
- Windows to be designed with the provision of window type AC's and splits AC's in all rooms in all the category of houses except Kitchen, Toilets, Utility areas etc. The proper drainage system is to be provided for dripping water of AC's units.
- Location of all the electrical points shall be done as per the furniture layout proposed and approved.
- All buildings shall be checked for thermal comfort as NBC 2016 by simulation and all measures shall be taken to keep the building /s thermally comfortable for human being as per given parameters in NBC 2016.
- Railings shall Glass Railing with 8.89mm thick Laminated toughened glass (4mm+0.89mm Sentry Glass+4mm) and Stainless Steel (Grade304) for balconies, SS Railing for staircase (Grade 304) and MS railing for fire staircase as per the design approved.
- Dual piping system & use of water from STP.
- External finishes shall be used as per the climatic conditions, Architectural design & availability of local materials.
- Provision for barrier free access as per the building byelaws, PWD Act 2016 (with latest amendments) & CPWD manual shall be provided.
- Adequate facility of toilets shall be provided in basements / gate complex for supporting staff/ maids and visitors.
- Products made from recycled C& D waste material shall be used for non-structural work such as Boundary wall masonry, Cement Concrete Blocks in filler/partition walls, Kerb stones, Pavers, Footpath Tiles/slabs, open parking; drain/manhole covers, precast service ducts, graded Aggregate of size 10mm-5mm and up to 150 mm for sub base of internal roads & paths etc. with the prior approval of Engineer-in-charge.
- Adequate waterproofing shall be done of Terraces of upper most basement to house green lawn and plantation on it.

2.0 Minimum Scale of Amenities - Civil

S.No.	Item	Type-V & VI
1	**Kitchen Cabinets**	
	i) Cooking Platform	Yes
	ii) Stainless Steel AISI 304 (18/8) Kitchen sink as per IS 13983 with drain board	Yes

S.No.	Item	Type-V & VI
	iii) 18mm HDHMR (High Density High Moisture Resistant) board carcass, finished internally with premium anti-scratch laminate. Assembled utilizing high-precision minifix and structural wooden dowel joinery with 0.8mm factory-bonded PVC edge banding over all exposed edges.	Yes
	iv) 18mm thick HDHMR shutters finished externally with minimum 1.0mm premium decorative laminate from approved makes and 2.0mm impact-resistant PVC edge beading. Outfitted completely with commercial-grade premium soft-close hinges, soft-close tandem drawers, bottle pull-outs, cutlery trays, and branded wire baskets.	Yes
2	**Wardrobes**	
	Floor-to-ceiling built-in wardrobe structures (minimum 650mm depth; section widths between 3 to 4 feet max). Carcass and shutters fabricated from 18mm HDHMR boards with internal/external laminate finishes, minifix/ dowel joinery, 0.8mm PVC edge banding on carcass lines, and 2.0mm edge beading on shutters. Features high-quality soft-close hinges, internal soft-close drawers (min 2 per unit), integrated digital locker, hanging rods, adjustable layout shelving, and a full-length integrated dressing mirror.	One in each bed room up to ceiling height
3	Curtain rods with required accessories of SS grade 316	In all windows doors in all rooms except kitchen, Toilets
4	Set of Pegs SS grade 316	In all toilets
5	18mm thick projected window Sill lining window jambs & soffit.	All round stone (Green or equivalent) marble
6	**WC with seats in toilets**	
	i) European-type floor mounted/wall-hung WC with seat, lid and low-level flushing PVC cistern, water jet/health faucet.	All toilets except one
	ii) Orissa pan WC seat with low level flushing PVC cistern.	In one toilet
7	Wash Basin with CP Brass mixture type for hot & cold water with single lever, quarter turns.	In each toilet

S.No.	Item	Type-V & VI
8	Tap (Kitchen, toilet) CP Brass bib cock provided with quarter turns.	2 in Kitchen 1 in each toilet,
9	Shower with CP Brass mixture type tap for hot & cold water with single lever, quarter turns.	1 in each toilet
10	Tower rail of SS grade 304	1 in each toilet
11	Mirror with frame of PVC or superior material & Glass shelf supported on SS brackets.	600mmX450mm with each wash basin
12	Toilet paper holder of SS grade 304 with European WC.	Yes
13	Soap rack/Niche as per architectural Design and Specifications	1 in each toilet
14	Drain trap	Cockroach proof drain trap shall be provided wherever required.
15	Plumbing for water purifier and Geyser.	Yes

2.1 Schedule of Finishes Residential Units:

2.1.1 For Type – V & VI

S.No.	Description	Type – V & VI
1	Foundation	As per structural requirements
2	**Super Structure**	
	For Multi-Storied Residential Blocks Structure	Structural system for the building is proposed as RCC Special moment resisting frames (RC SMRFs). Refer Structural DBR.
3	Masonry	Fly Ash Bricks/ AAC Blocks with polymer modified adhesive mortar and RCC horizontal and vertical bands and in Wet area Fly ash Brick to be used
4	**Door & Window Frames, Shutters and Hardware Fittings**	
	Main Entrance Door Frame	2nd class teak wood

S.No.	Description	Type – V & VI
	& Shutter	
	Door Frames	2nd class teak wood section as per drawing.
	Window Frames	All frame sections of external windows must be three track UPVC frame UPVC extruded frame sections with wall thickness min. 2.0mm
	Internal & External shutters	All shutters shall be 30 mm thick factory made flush door shutters with both side 1mm Laminate
	Toilets -shutters	30 mm thick exterior grade flush door shutter
	Kitchen doors	30 mm thick 2nd class teak wood shutter having 12mm thick pre-laminated particle board panel at the bottom part and stainless-steel wire mesh at upper part
	Window Shutter	Three track UPVC frame with double shutter two with glazed panel & other with wire mesh (of SS grade 316) shutter. (Toughened Glass panel for windows opening directly outside as shown in the drawings attached)
	Fittings for Doors	Sliding door bolts of suitable size, two tower bolts (250x10mm) and handles (125mm). All of SS grade 316
	Fittings for Windows	As per requirement and material used
5	**Flooring**	
(i)	All rooms / kitchen	Vitrified Polished / Satin matt (as desired) tile flooring 800mm x 800mm laid with adhesive, with spacers (groove filled with epoxy grout), without spacers in Kitchen.
(ii)	Toilets	Anti-skid ceramic – rectified tiles minimum 600mm x 600mm laid with adhesive, without spacers.
(iii)	Balconies	Anti-skid ceramic – rectified tiles minimum 600mm x 600mm laid with adhesive without spacers.
	Kitchen Counter	Pre-polished granite (black)
	Staircases - Main	Granite stone fixed with Adhesive

S.No.	Description	Type – V & VI
	Skirting in rooms and other areas	Skirting / Dado / Wall Cladding shall be matching with the floor with adhesive, as given below i) 100mm high skirting matching the floor material in rooms ii) Minimum 1500 mm Dado in corridors / walkways iii) Full height wall cladding with granite stone in lift lobby as per architectural drawing
6	**Finishes**	
	External Facade	As per Architectural drawing attached with this document.
	External Walls	(i) External surface shall be made smooth with coarse putty before painting work. (ii) Textured Finish
	Internal Walls & Ceiling	(i) Walls treated with white cement-based Polymer Modified Coarse Putty (ii) For AAC Block Partition: Light-weight gypsum plaster
	Living Room	Low VOC 1st Quality Acrylic distemper
	All Bedrooms	Low VOC 1st Quality Acrylic distemper
	Kitchen	Low VOC 1st Quality Acrylic distemper Glazed /digital / coloured ceramic tiles of size not less than 300mm x 450mm from floor to full height, with decorative bands at certain intervals
	Toilets	Glazed /digital / coloured ceramic tiles of size not less than 300mm x 450mm from floor to full height, with decorative bands at certain intervals
	Store / Dress	Low VOC 1st Quality Acrylic distemper
	Balcony / External Finishes	Texture finish
	Ceiling	Low VOC 1st Quality Acrylic distemper
	Toilets	METAL False Ceiling
7	**Parking Podium**	
(i)	External Walls	Texture Finish

S.No.	Description	Type – V & VI
(ii)	Internal Walls & Ceiling	Cement Paint.
8	**Basement**	
(i)	Flooring	Minimum 100mm thick VDF as per design. Plants room, Garbage room, compost plant area flooring/ skirting shall be kota and wall Finishing shall be ceramic glazed tiling full height (Drainage channel – with removable covers as well sumps with automatic pumps to be provided)
(ii)	Internal walls and ceiling	Cement Paint.
(iii)	Water tank	Floor & wall shall be treated with ceramic glazed tile.
9	**Water Proofing**	
(i)	External envelope of Basement	For raft horizontal and vertical area 1.5 mm composite thick fully bonded weldable HDPE membrane and 2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane for retaining walls as per the specification of manufacturer and given in this document.
(ii)	Roofs of Tower	1.5mm thick 2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane as per the specification of manufacturer and given in this document.
(iii)	Roofs of Podium/Basement Deck	2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane Waterproofing as per the specification of manufacturer and given in this document. Screed minimum 50mm thick laid to slope – Greening & Hardscaping including drainage system as per landscaping drawings.
(iv)	Sunken floors of toilets & kitchen	Liquid acrylic polymer modified cementitious coating with bore packing and screeding.
(v)	Water tanks and all other water retaining structures	Liquid acrylic polymer modified cementitious coating with Food grade epoxy coating and Crystalline treatment of walls as per the specification of manufacturer and given in this document including food grade coating of it inside.

S.No.	Description	Type – V & VI
10	Shutters for exposed service shafts	Aluminum shutters (with glass panel for fire shafts and louvered aluminum panels for other shafts)
11	(i) Balcony railings	Glass Railing with Stainless Steel (Grade304)
	(ii) Stairs railings	Factory made railing of Stainless Steel Grade 304

3.0 Scale of Amenities (Electrical)

S.No.	Description	Type-V	Type VI
1	Power Points (15 amp 6 pins)	3 in drawing room 3 in Dining Room 2 in each Bedroom 2 in Kitchen 1 in Utility Area	3 in drawing room 3 in dining room 2 in each bedroom 2 in kitchen 1 in utility area
2	Plug Points (5 amp)	2 in each room 1 in kitchen 1 in store 1 in main balcony	2 in each room 1 in kitchen 1 in store 1 in each balcony
3	Bracket Lights (with normal fittings excluding lamp/bulb)	1 in store 1 in each toilet 1 in utility	1 in store 1 in each toilet 1 in utility
4	Mirror Light	With wash-basins mirror	With wash-basins mirror
5	Ceiling Fans	2 in drawing room 1 in dining room 1 in each bedroom 1 in each balcony	2 in drawing room 1 in dining room 1 in family lounge 1 in each bedroom 1 in

S.No.	Description	Type-V	Type VI
			each balcony
6	Call Bell Points	3	3 (One with image display system)
7	Exhaust Fans	1 each in kitchen & toilets	1 each in kitchen & toilets
8	AC Points (with MCB connected socket outlet with wiring)	1 in each room except kitchen & toilets	1 in each room except kitchen & toilets
9	Geyser Point (with MCB connected socket outlet with wiring)	1 in kitchen 1 in each toilet	1 in kitchen 1 in each toilet
10	MCBDB, Double door type (single phase)	1 at appropriate place	1 at appropriate place
11	Cable TV Point	1 in drawing room 1 in each bedroom	1 in drawing room 1 in dining room 1 in each bedroom
12	Telephone point as per the approval of competent authority	1 in drawing room 1 in each bedroom	1 in drawing room 1 in dining room 1 in each bedroom
13	20 watts LED tube light fitting	1 in drawing room 1 in dining room 1 in each bedroom 1 in kitchen	1 in drawing room 1 in dining room 1 in each bedroom 1 in kitchen
14	Modular Switches	Yes	Yes
15	Common areas of basement / stilt / residential towers Nos. of LED	Nos. of LED light fixture complete with tubes / lamps and their ratings shall be as per requirement to achieved	

S.No.	Description	Type-V	Type VI
	light fixture complete with tubes / lamps and their ratings shall be as per requirement to achieved desired illumination level and lay out as approved by Engineer-in-Charge.	desired illumination level and lay out as approved by Engineer-in-Charge.	

4.0 Development Works

S.No.	Heads	Description
1	**Water Supply**	
(i)	Sluice Valve	D.I sluice valve (with cap) complete with bolts & nuts, rubber insertion etc
(ii)	Chambers for:-	a) Sluice Valve b) Fire Hydrant CC Blocks of recycled C& D waste material
(iii)	Thrust Blocks	M-20 grade
(iv)	Disinfection	Disinfection to be done using bleaching powder @ 0.5gm/liter of water and cleaned with fresh water with minimum 3 times operation as per DJB Conditions.
(v)	UGT / Pump House for water supply & Fire fighting.	RCC UGT of required capacity as per DBR with boosting arrangement including necessary installation for supply of water.
2	**Sewerage**	
(i)	Pipe	SW Pipes upto first manhole with fittings and diameter as per design. NP2 pipe for rest of the network of desired dia.
3	**Storm Water**	
(i)	Pipe	NP2 pipe of required diameter including testing of joints as per approved procedures, NP3 pipe of required diameter shall be used at road crossings.
(ii)	Manholes	Manholes of required dia. As per depth with brick wall (with Sewer Bricks/CD-100 bricks) in cement mortar 1:4 (1 cement: 4 coarse sand) with foundation concrete M10 with stone aggregate inside cement plaster 1:4 (1 cement:4 coarse sand) with floating coat of neat cement, outside

S.No.	Heads	Description
		cement plaster 1:4 (1 cement: 4 coarse sand) with SFRC. In sub-soil or adverse soil conditions, manholes & enhancing pipes shall be as per approved credible structural design to avoid sinking and settlement of lines / manholes
(iii)	Foot Rest	Orange colour safety foot rest of minimum 6mm thick plastic encapsulated complete as per IS: 10910
(iv)	Drop connection	For drop more than 0.610m drop connection as per CPWD Specifications to be provided
4	**S.W. Drain**	
(i)	Base & Walls	The base & walls of drain shall be of RCC in M-25 grade (Minimum)
	Perforated Covers	Cover of design mix M-25 or SFRC shall be provided to cover all the drains
5	**Campus Roads, Open Parking & Paths**	
(i)	Kerb Stone	High grade concrete precast block. M-35 Grade made of recycled C&D waste material
(ii)	Inter-locking pavers	Heavy duty pavers, shape & pattern in cement colour (red, green, grey, yellow etc.) M-60 grade made of recycled C&D waste material)
(iii)	Road	Internal road to be of VDF high grade concrete over 300mm WMM / GSB in 2 layers compacted sub grade / earth as per design.
(iv)	Road painting	75mm wide thermoplastic reflective road marking paint for indicating parking spaces.
(v)	Pedestrian foot path	Concrete pavers M-35 grade
6	**Boundary Wall**	
	Boundary Wall with gates	Boundary wall as per drawing attached
7	**Signages & Graphics**	
	Signages & Graphics	Necessary identification, directional and statutory signages including road signage as per drawing attached.

05. DETAILED SPECIFICATIONS OF RESIDENCE BUILDING TYPE VI

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
1	DRAWING ROOM	800X800 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL GYPSUM FALSE CEILING
2	DINING HALL	800X800 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL GYPSUM FALSE CEILING
4	BEDROOM 01	800X800 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
5	BEDROOM 02	800X800 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
6	BEDROOM 03	800X800 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
7	MASTER BEDROOM	ENGINEERED	100 MM. HIGH	6 MM. THK. POP PUNNING PAINTED	GYPSUM FALSE

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
		WOODEN FLOORING (15 mm)	SKIRTING MATCHING WITH FLOOR MATERIAL	WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	CEILING
8	KITCHEN	800X800 MM VITRIFIED TILES	SAME AS FLOORING	CERAMIC TILES 900 MM. HT.ABOVE COUNTER AND ACRYLIC EMULSION PAINT ABOVE	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC ACRYLIC EMULSION PAINT.
9	BALCONY/ UTILITY BALCONY	ANTI SKID CERAMIC TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	CLADDING ON WALLS	EXTERNAL WEATHERPROOF PAINT
10	TOILETS	ANTI SKID CERAMIC TILE	N.A.	CERAMIC GLAZED TILE FULL HEIGHT	PLAIN METAL FALSE CEILING
11	SERVANT ROOM	600X600 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER
12	SERVANT TOILET	ANTI SKID CERAMIC TILE	N.A.	OIL BOUND DISTEMPER OVER CERAMIC GLAZED TILE UPTO 2100 MM.	PLAIN METAL FALSE CEILING
COMMOM AREAS					
13	FIRE STAIRCASE LIFT LOBBY	KOTA STONE	LIFT ENTRY DOOR WALL FULL HEIGHT FULL BODY GRANITE, REST WALL 1500 MM , AND ACRYLIC EMULSION PAINT ABOVE DADO		ACRYLIC EMULSION PAINT
14	STAIRCASE	POLISHED GRANITE	100 MM. HIGH SKIRTING MATCHING	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
			WITH FLOOR MATERIAL		
15	FHC/ LV SHAFT / ELECTRICAL SHAFT	KOTA STONE	100 MM. HIGH SKIRTING MATCHING WITH THE FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
16	HALL	GRANITE	100 MM. HIGH SKIRTING MATCHING WITH THE FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
17	GYM	RUBBER STONE	100 MM. HIGH SKIRTING MATCHING WITH THE FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT.SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
18	SPORT CENTER	RUBBER STONE	100 MM. HIGH SKIRTING MATCHING WITH THE FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
19	PANTRY	800X800 MM VITRIFIED TILES	SAME AS FLOORING	CERAMIC TILES 900 MM. HT.ABOVE COUNTER AND ACRYLIC EMULSION PAINT ABOVE	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC ACRYLIC EMULSION PAINT.
20	CORRIDOR	GRANITE	SAME AS	WHITE WASH	600X600 GI

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
			FLOORING		POWDER COATED METAL WITH GYPSUM BORDER FALSE CEILING
21	STORE ROOM	KOTA STONE	100 MM. HIGH SKIRTING MATCHING WITH THE FLOOR MATERIAL	WHITE WASH	SAME AS WALL
NOTE / REMARKS					
1	**EXTERNAL FINISHING**	GRC PANELS, GLAZING, ALUMINIUM LOUVERS, , GRC JALI(FOR SHAFTS), ACP, GRC CLADDING, TEXTURED PAINTING (NON PIGMENTED CRUSHED GRANITE CHIPS & CERAMIC TEXTURED FINISH) ETC.			
2	**ENTRANCE RAMP**	ANTI ACID GRANITE FLOORING (TWO SHADES GRANITE AS PER DESIGN APPROVED BY EIC)			
3	**TOILET DOORS**	DOOR FRAME--GI FRAME WITH HARDWOOD INSERT THROUGH THE SECTION. DOOR SHUTTER - 35 MM. THK. FLUSH DOOR SHUTTER & 1 MM. THK. LAMINATES ON ONE SIDE AND 1 MM THICK ALUMINIUM SHEET FROM THE SIDES WITH THE PROVISION OF LOUVERS.			
4	**MUMTY DOORS**	M.S. DOOR			
5	**MACHINE ROOM DOORS**	M.S. DOOR			
6	**ALL OTHER DOORS**	DOOR FRAME-WOODEN FRAMESWORK DOOR SHUTTER- 35 MM. THK. FLUSH DOOR SHUTTER WITH VISION PANEL & 1 MM. THK. LAMINATES ON BOTH SIDES. SLIDING UPVC DOORS			
7	**STAIRCASE AND LIFT LOBBY, AHU, ELECTRICAL ROOM, LV ROOM ETC**	METAL FIRE DOOR WITH VISION PANEL			
8	**CERAMIC TILES**	600 MM X 300MM CERAMIC TILE IN WALL IN TOILETS.600 MM X 600MM IN FLOORS IN TOILETS			
9	**SPACER**	Tile Spacer of 3mm spacers made of PVC as per manufacturers			

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
		specifications with size of 30 x 30 x 3mm shall be provided.(in floor & wall both)			
10	**VITRIFIED TILE**	600 MM X 300MM CERAMIC TILE IN ALL TOILETS. 800MM X 800MM VITRIFIED TILE IN ALL OTHER AREAS. ALL THE FLOOR AND DADO TILES FIXED WITH 3MM JOINT FILLED WITH EPOXY GRAUT.			
11	**WINDOW**	HEAVY SECTION UPVC CASEMENT WINDOW WITH FLYPROOF MESH & GRILL. GLASS - TOUGHENED GLASS			
12	**COUNTER TOP**	ALL THE KITCHEN COUNTER TOP, TOILET COUNTER TOP, LAB SINK COUNTER TOP SHOULD BE OF GRANITE.			
13	**FHC**	ALL THE FIRE HYDRANT SHAFTS SHOULD BE OF VITRIFIED TILES FLOORING AND FIXED WITH FACTORY FABRICATED POWDER COATED MS DOOR.			
14	**STAIRCASE TREAD**	NOSING & ANTI SKID GROOVES ON TREAD.			
15	**KITCHEN**	FACTORY MADE MODULAR KITCHEN AS PER FIXED FIT-OUT FURNITURE'S HAVING SS SINK WITH DOUBLE BOWL & DOUBLE DRAIN BOARD, COOKING PLATFORM & ELECTRICAL CHIMNEY OF REPUTED BRAND. 19 MM. THK. PRE POLISJHED GRANITE SLAB WITH PRE MOULDED NOSING. A HOLE FOR GAS PIPE IN KITCHEN PLATFORM SHALL BE PROVIDED. PROVISION FOR ELECTRIC CHIMNEY			
16	**LIFT LOBBY**	15 MM THICK FULL BODY VITRIFIED TILE (SIZE- 800MM X 2400 MM) ITEM SL. NO. 11.49 A/ DSR 2021- VOL-1 (for flooring and dado)			
17	**SKIRTING**	MINIMUM 150 MM			
Following Points has also to be considered in Finishing Work:					
1	**SHOE RACK**	MODULAR			
2	**UTILITY BALCONY**	WOODEN SHADE TILE (ANTI SKID)			
3	**AC DRAINS**	TO BE CONCEALED			
4	**SWITCHES**	AT LEAST 3 POINTS			
5	**WC**	WALL MOUNTED WESTERN FIXTURES ONLY			
6	**WASH BASIN AND BATHROOMS**	D2 WAY DIVERTER (HOT AND COLD)			
7	**TAP FIXTURES**	SOFT CLOSURE			
8	**KITCHEN**	MODULAR			
9	**TOILETS**	GLASS PARTITION b/w WET AND DRY AREAS			
10	**SHOWER**	HAND SHOWER ALSO			
11	**GEYSER**	TO BE FIXED AT THE BALCONIES (IN KITCHEN ALSO)			
12	**KITCHEN**	DOUBLE SINK UNIT WITH ADJUSTABLE TAP			
13	**BALCONY/**	TAP PROVISION IN ALL BALCONIES			

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
	UTILITY BALCONY				
14	**STORE ROOM**	SWITCH POINTS			
15	**ENTRANCE DOORS**	WITH PEEPHOLE PROVISON			
16	**RAILING**	BALCONY RAILING 4FT HEIGHT (SS WITH GLASS)			
17	**BATHROOMS**	MIRROR AND STORAGE IN TOILETES			
18	**LIGHTINGS**	COLORFUL LEDS (2 COLORS)			
19	**FANS**	BLDC CEILING FANS 5 STAR RATED IN ALL BEDROOMS (1 EACH) DRAWING ROOM / LOBBY (2 EACH), KITCHEN (1 EACH)			
20	**SWIMMING POOL**	COVERED WITH PROPER VENTILATION			
21	**CHILDRE AREA**	PROPER KIDS EQUIPMENTS LIKE SWINGS, SLIDES , SANDBOXES, ETC.			
22	**LANDSCAPE**	RCC BENCHES AND TABLES WITH GRANITE TOP ON TABLES			
23	**GROUND FLOOR**	CORRIDOR WITH TILE DADO			
24	**BASEMENT**	STORE ROOM/CHANGING ROOM			
25	**BASEMENT**	ELECTRICAL POINT PROVISION FOR EVS			
26	**EXTERNAL**	CC ROADS			
27	**EXTERNAL**	SECURITY ROOMS WITH TOILETS			
28	**DOOR HARDWARE**	GUNMETAL FINISH			

06. DETAILED SPECIFICATIONS OF RESIDENCE BUILDING TYPE V

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
1	DRAWING ROOM	800X800 MM VITRIFIED TILES	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
2	DINING	800X800 MM VITRIFIED TILES	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
4	BEDROOM 01	800X800 MM VITRIFIED TILES	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
5	BEDROOM 02	800X800 MM VITRIFIED TILES	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	SAME AS WALL
6	MASTER BEDROOM	ENGINEERED	100 MM. HIGH	6 MM. THK. POP PUNNING	SAME AS WALL

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
		WOODEN FLOORING (15 mm)	SKIRTING MATCHING WITH FLOOR MATERIAL	PAINTED WITH LOW VOC PLASTIC EMULSION PAINT. SYNTHETIC ENAMEL PAINT ON ALL WOOD & STEEL WORKS	
7	KITCHEN	800X800 MM VITRIFIED TILES	SAME AS FLOORING	CERAMIC TILES 900 MM. HT.ABOVE COUNTER AND ACRYLIC EMULSION PAINT ABOVE	6 MM. THK. POP PUNNING PAINTED WITH LOW VOC ACRYLIC EMULSION PAINT.
8	BALCONY/ UTILITY BALCONY	ANTI SKID CERAMIC TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	CLADDING ON WALLS	EXTERNAL WEATHERPROOF PAINT
9	TOILETS	ANTI SKID CERAMIC TILE	N.A.	CERAMIC GLAZED TILE FULL HEIGHT	PLAIN METAL FALSE CEILING
10	SERVANT ROOM	600X600 VITRIFIED TILE	100 MM. HIGH SKIRTING MATCHING WITH FLOOR MATERIAL	OIL BOUND DISTEMPER	OIL BOUND DISTEMPER
11	SERVANT TOILET	ANTI SKID CERAMIC TILE	N.A.	OIL BOUND DISTEMPER OVER CERAMIC GLAZED TILE UPTO 2100 MM.	PLAIN METAL FALSE CEILING
COMMOM AREAS					
13	FIRE STAIRCASE LIFT LOBBY	KOTA STONE	LIFT ENTRY DOOR WALL FULL HEIGHT FULL BODY GRANITE , REST WALL 1500 MM , AND ACRYLIC EMULSION PAINT ABOVE DADO		ACRYLIC EMULSION PAINT
14	STAIRCASE	POLISHED GRANITE	DADO-VITRIFIED TILES UPTO 1200MM HT AND EMULSION PAINT ABOVE UPTO		OIL BOUND DISTEMPER

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
			CEILING		
15	FHC/ LV SHAFT / ELECTRICAL SHAFT	KOTA STONE	101 MM. HIGH SKIRTING MATCHING WITH THE FLOOR MATERIAL	WHITE WASH	N.A.
20	CORRIDOR	GRANITE	SAME AS FLOORING	WHITE WASH	600X600 GI POWDER COATED METAL WITH GYPSUM BORDER FALSE CEILING
NOTE / REMARKS					
1	**EXTERNAL FINISHING**	GRC PANELS, GLAZING, ALUMINIUM LOUVERS, , GRC JALI, ACP, GRC CLADDING, TEXTURED PAINTING (NON PIGMENTED CRUSHED GRANITE CHIPS & CERAMIC TEXTURED FINISH) ETC			
2	**ENTRANCE RAMP**	ANTI ACID GRANITE FLOORING (TWO SHADES GRANITE AS PER DESIGN APPROVED BY EIC)			
3	**TOILET DOORS**	DOOR FRAME--GI FRAME WITH HARDWOOD INSERT THROUGH THE SECTION. DOOR SHUTTER - 35 MM. THK. FLUSH DOOR SHUTTER & 1 MM. THK. LAMINATES ON ONE SIDE AND 1 MM THICK ALUMINIUM SHEET FROM THE SIDES WITH THE PROVISION OF LOUVERS.			
4	**MUMTY DOORS**	M.S. DOOR			
5	**MACHINE ROOM DOORS**	M.S. DOOR			
6	**ALL OTHER DOORS**	DOOR FRAME-WOODEN FRAME WORK DOOR SHUTTER- 35 MM. THK. FLUSH DOOR SHUTTER WITH VISION PANEL (IF REQUIRED) & 1 MM. THK. LAMINATES ON BOTH SIDES. UPVC SLIDING DOORS			
7	**STAIRCASE AND LIFT LOBBY, AHU, ELECTRICAL ROOM, LV ROOM ETC**	METAL FIRE DOOR WITH VISION PANEL			
8	**CERAMIC**	600 MM X 300MM CERAMIC TILE IN WALL IN TOILETS.600 MM			

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
	TILES	X 600MM IN FLOORS IN TOILETS			
9	**SPACER**	Tile Spacer of 3mm spacers made of PVC as per manufacturers specifications with size of 30 x 30 x 3mm shall be provided.(in floor & wall both)			
10	**VITRIFIED TILE**	600 MM X 300MM CERAMIC TILE IN ALL TOILETS. 800MM X 800MM VITRIFIED TILE IN ALL OTHER AREAS. ALL THE FLOOR AND DADO TILES FIXED WITH 3MM JOINT FILLED WITH EPOXY GRAUT.			
11	**WINDOW**	HEAVY SECTION UPVC CASEMENT WINDOW WITH FLYPROOF MESH & GRILL. GLASS - TOUGHENED GLASS			
12	**COUNTER TOP**	ALL THE KITCHEN COUNTER TOP, TOILET COUNTER TOP, LAB SINK COUNTER TOP SHOULD BE OF GRANITE.			
13	**FHC**	ALL THE FIRE HYDRANT SHAFTS SHOULD BE OF VITRIFIED TILES FLOORING AND FIXED WITH FACTORY FABRICATED POWDER COATED MS DOOR.			
14	**STAIRCASE TREAD**	NOSING & ANTI SKID GROOVES ON TREAD.			
15	**KITCHEN**	FACTORY MADE MODULAR KITCHEN AS PER FIXED FIT-OUT FURNITURE'S THK PRE HAVING SS SINK WITH DOUBLE BOWL & DOUBLE DRAIN BOARD, COOKING PLATFORM & ELECTRICAL CHIMNEY OF REPUTED BRAND. 19 MM. THK. PRE POLISJHED GRANITE SLAB WITH PRE MOULDED NOSING. A HOLE FOR GAS PIPE IN KITCHEN PLATFORM SHALL BE PROVIDED. PROVISION FOR ELECTRIC CHIMNEY			
16	**LIFT LOBBY**	15 MM THICK FULL BODY VITRIFIED TILE (SIZE- 800MM X 2400 MM) ITEM SL. NO. 11.49 A/ DSR 2021- VOL-1 (for flooring and dado)			
17	**SKIRTING**	MINIMUM 150 MM			
Following Points has also to be considered in Finishing Work:					
1	**SHOE RACK**	MODULAR			
2	**UTILITY BALCONY**	WOODEN SHADE TILE (ANTI SKID)			
3	**AC DRAINS**	TO BE CONCEALED			
4	**SWITCHES**	AT LEAST 3 POINTS			
5	**WC**	WALL MOUNTED WESTERN FIXTURES ONLY			
6	**WASH BASIN AND BATHROOMS**	D2 WAY DIVERTER (HOT AND COLD)			
7	**TAP FIXTURES**	SOFT CLOSURE			
8	**KITCHEN**	MODULAR			
9	**TOILETS**	GLASS PARTITION b/w WET AND DRY AREAS			
10	**SHOWER**	HAND SHOWER ALSO			
11	**GEYSER**	TO BE FIXED AT THE BALCONIES (IN KITCHEN ALSO)			

FINISHING SCHEDULE OF RESIDENTIAL QUARTERS					
S. No.	**ROOM /SPACE**	**FLOOR**	**SKIRTING**	**WALL**	**CEILING / SOFFIT**
12	**KITCHEN**	DOUBLE SINK UNIT WITH ADJUSTABLE TAP			
13	**BALCONY/ UTILITY BALCONY**	TAP PROVISION IN ALL BALCONIES			
14	**STORE ROOM**	SWITCH POINTS			
15	**ENTRANCE DOORS**	WITH PEEPHOLE PROVISON			
16	**RAILING**	BALCONY RAILING 4FT HEIGHT (SS WITH GLASS)			
17	**BATHROOMS**	MIRROR AND STORAGE IN TOILETES			
18	**LIGHTINGS**	COLORFUL LEDS (2 COLORS)			
19	**FANS**	BLDC CEILING FANS 5 STAR RATED IN ALL BEDROOMS (1 EACH) DRAWING ROOM / LOBBY (2 EACH), KITCHEN (1 EACH)			
20	**SWIMMING POOL**	COVERED WITH PROPER VENTILATION			
21	**CHILDRE AREA**	PROPER KIDS EQUIPMENTS LIKE SWINGS, SLIDES , SANDBOXES, ETC.			
22	**LANDSCAPE**	RCC BENCHES AND TABLES WITH GRANITE TOP ON TABLES			
23	**GROUND FLOOR**	CORRIDOR WITH TILE DADO			
24	**BASEMENT**	STORE ROOM/CHANGING ROOM			
25	**BASEMENT**	ELECTRICAL POINT PROVISION FOR EVS			
26	**EXTERNAL**	CC ROADS			
27	**EXTERNAL**	SECURITY ROOMS WITH TOILETS			
28	**DOOR HARDWARE**	GUNMETAL FINISH			

Volume-II

Part C

DESIGN BASIS REPORTS

STRUCTURAL DESIGN BASIS REPORT

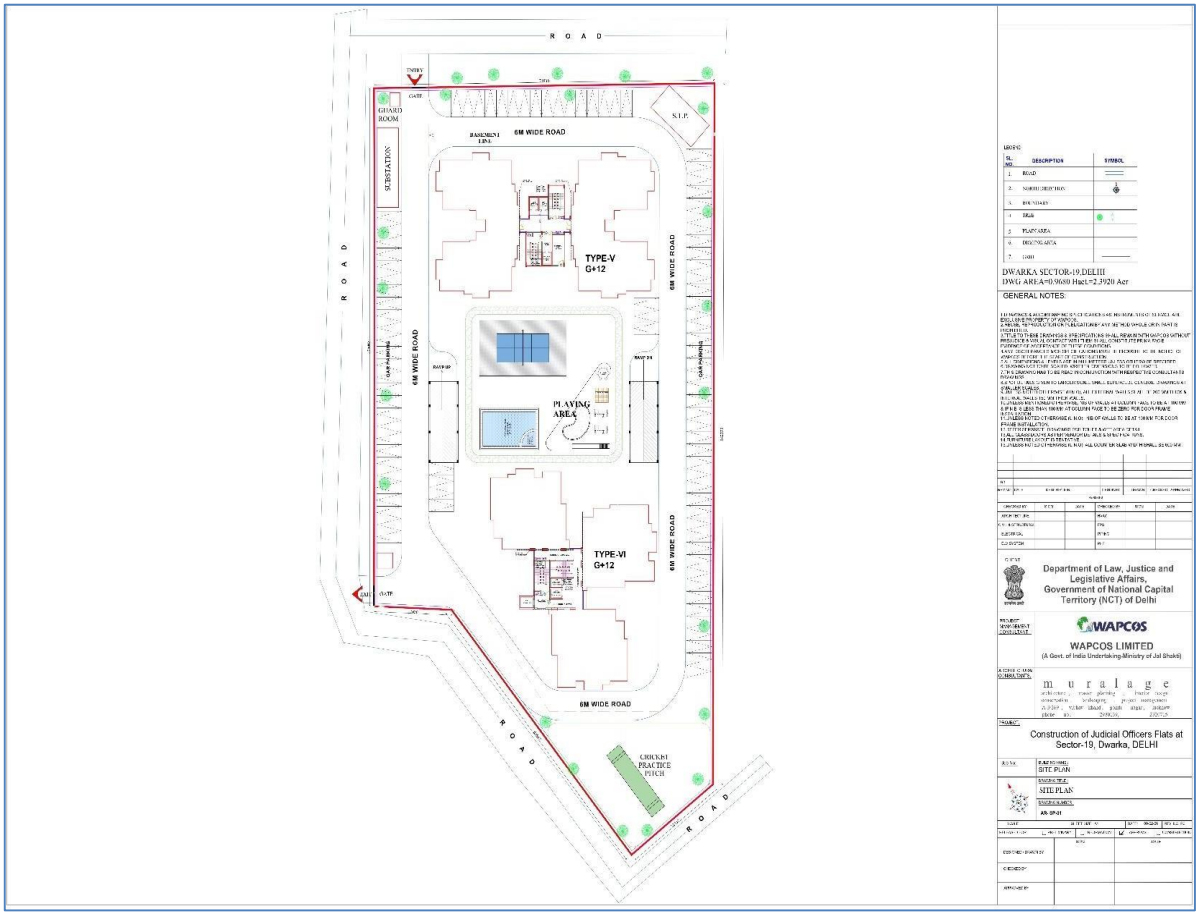
1. Copy of Design Basis Report

This Report describes in brief the structural aspects and design philosophy including selected construction aspects. The report also deals with considerations relating to seismic design of the building in addition to the structural system of the building.

The structural design will be primarily based on the current Indian Codes of practice. While efforts have been made to incorporate all the structural aspects of the project in this report, a revision of the same at the later stages of the project cannot be ruled out which may be necessary due to some aspects not foreseen now.

2. Salient Features of Project

a. Site Location/Floor Plan



b. Proposed Project: The design of the proposed Construction of Double Basement +G+12th Storied Judicial Residential Building in Dwarka at District - Delhi is based on the Architectural drawings.

3. Structural Scheme:

It is intended to develop a structural scheme such that the proposed structure is able to satisfy architectural and service requirements and also meet durability, longevity and aesthetics criteria.

a. Building's Super structure: Structural system for the building is proposed as RCC Special moment resisting frames (RC SMRFs).

b. Buildings Substructure: Raft, Combine & isolated footing shall be provided

for the building.

c. **Liquid Retaining Structures:** Water retaining structures shall be designed as per IS: 456 -2000 and IS: 3370 – 2009 part2. These structures are subjected to cyclic loading (full or empty conditions). As structural concept all water retaining structures shall be designed based on limit state method. The maximum calculated surface width of cracks for direct tension and flexure or restrained temperature and moisture effects shall not exceed 0.2mm with specified cover for water tanks and for STP it shall be less than 0.1mm.

d. **Shuttering System:** Conventional shuttering system has been considered.

4. Applicable Computer Applications

- **ETABS 2022**
- SAFE version 20
- AUTOCAD 2020

5. Important Indian Standards Proposed to be followed

Table2 -Important Indian Standards Proposed to be followed with latest amendments

S.No.	Code	Description
1.	IS:456–2000	Code of Practice for Plain and Reinforced Concrete
2.	IS-875(Part1)-1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures–Unit weights of buildings materials and stored material
3.	IS-875(Part2)-1987	Code of Practice for Design Loads (other than earthquake) for Buildings and structures-Imposed loads
4.	IS-875(Part3)-2015	Code of Practice for Design Loads (other than earthquake) for buildings and structures–Wind loads. (Amended2016) using 47 m/sec as base wind speed.
5.	IS-875(Part5)-1987	Code of Practice for Design Loads (other than earthquake) for buildings and structures–Special loads and load combinations
6.	IS:1786–2008	Specification for High Strength Deformed Bars and Wires for Concrete Reinforcement
7.	IS:432(Part2)-1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement–Hard Drawn Steel Wire
8.	IS:13920-2016	Ductile detailing of reinforced concrete structures subjected to Seismic forces–Code of practice
9.	IS:2062–2011	Steel for General Structural Purposes. Specification
10.	IS:1161–1998	Specification for Steel tubes for Structural Purposes
11.	IS:4923-1997	Specification for Hollow steel section for structural use
12.	IS:800–2007	Code of Practice for General Construction in Steel
13.	IS:1893-2016	Criteria for Earth quake resistant design of structures
14.	IS:269–1989	Specification for Ordinary, rapid hardening and low heat

S.No.	Code	Description
		Portland cement
15.	IS:455-1989	Specification for Port land blast furnace slag cement
16.	IS:1489-1991	Specification for Port land Pozzolana Cement
17.	IS:383-1970	Specification for coarse and fine aggregates from natural sources for concrete
18.	IS:516-1959	Method of test for strength of concrete
19.	IS:432-1982	Specification for Mild Steel and Medium Tensile Steel Bars and Hard Drawn Steel Wire for Concrete Reinforcement
20.	IS:4990-1993	Specification for plywood for concrete shuttering works
21.	IS:2645-1975	Specification for integral cement water proofing compounds
22.	IS:2950 (Part1)-1981	Code of Practice for Design & Construction of Raft Foundations
23.	IS:1904-1986 Reaffirmed2006	Code of Practice for Design and Construction of Foundations in Soil
24.	IS:1905	Code of practice for structural use of unreinforced masonry
25.	IS:3370(Part2)-2009	Code of Practice for Concrete structures for storage of liquids
26.	IS:4326-2013	Earth quake Resistant Design and Construction of Buildings
27.	SP16	Hand book for Structural Engineers
28.	NBC2016	National Building Code of India2016
29.	SP34	Handbook on Concrete Reinforcement & Detailing
30.	IS:16700-2016*	Criteria of structural safety of tall concrete building
31.	IS:3370(Part 2): 2009	Concrete Structure For storage of liquids (part 2) Reinforced concrete structures.

Note: The above list is suggestive and not exhaustive. Apart from these basic codes, any other related codes shall also be followed wherever required.

6. Design Basis and Considerations

a. General

The proposed structure of the project is designed in accordance with the Indian Code IS: 456-2000, with latest amendments, which is considered mandatory for reinforced concrete structures in the country. Designed structure has physical interface with almost all the disciplines like Geotechnical, MEP Services and Land scape etc.

The design life of all general buildings and structures is taken as 50 years and important buildings such as hospitals is taken as 100 years as per IS-875(Part3): 2015 recommendations satisfying the criteria of environmental conditions. This requirement is applicable only for concrete works and not applicable to replaceable finishing materials,

water proofing membrane and thermal insulations (if any). Hence periodic maintenance /refurbishment is required for all replaceable material for longer life.

b. **Material**

i. **Cement:** The cement used shall be PPC confirming to 1489 (Part I) - 1991 (Latest revision) (with minimum fly ash content of 25 %), for all works except where specifically mentioned in the Drawings, Bill of Quantities, and/or directed by the Project Manager. Ordinary Portland cement conforming to IS 8112 - 1989 (Latest revision) of grade 43/ IS 12269 - 2013 (Latest revision) with permissible percentage of fly ash replacement can also be allowed.

ii. **Reinforcement**: High yield strength deformed bars with **Fe=550D N/mm2** confirming to IS: 1786–2008 with a 14.5% minimum elongation shall be used in the project. Reinforcement bars of 6,8,10,12,16,20,25,28,32 mm shall be used. No lapping allowed in columns and walls, when diameter of bars is 20 mm or higher; mechanical couplers as per IS: 16172 should be used to extend bars. For lapping of bars relevant clauses of IS: 13920 shall apply.

iii. **Structural Steel:** Structural Steel Conforming to IS 2062 shall be used with yield strength of 250 MPa for thickness less than 20mm. Hollow steel section can be used with yield strength of 250MPa.

iv. **Concrete**: Minimum grade of concrete shall be M40 for moderate condition as per IS 456-2000, Table-5 and as per clause5.2 of IS13920:2016 other than tall structures (Height more than 50m).

v. Hence, Grade of Concrete for various structural elements considered is as follows:

- Foundations : M40
- R.C.C. Retaining Walls : M40
- Beam & Slabs : M40
- Columns : M40
- Water Tank, UG Tank : M40
- STP : M40

All concrete mix shall be designed by competent agency and same shall be approved by Structural Consultants prior to execution

Column beam junction casting: Columns shall have same grade as the beams. Site shall take care to concrete the column beam junction with the column grade only.

c. **Exposure Condition:** Proposed Building is located in Delhi India. General environment to which concrete will be exposed during its working life as per classification given in Table 3 of clause 8.2.2.1 of IS: 456 shall be **Moderate Exposure Conditions**. Concrete in contact with soil shall be considered to be moderate exposure and other wise concrete is considered as mild exposure.

d. **Fire Resistance:** Fire resistance is the time in hours that a material or assembly of materials will with stand the passage off lame and transmission of heat when exposed to fire. Type of construction and Minimum Dimensions of Reinforced Concrete Members for Fire Resistance for specified period shall be as per NBC 2016, Table-2 – Page-20 – Part-4 and clause 21 of IS: 456: 2000.Since FAR is less than 2 as per Architect, hence Type-2 construction shall be followed. Fire resistance shall be 4.0 hours for columns, Shear walls, Transfer Girders and foundations, for beams shall be 3.0 hours' fire resistance and for slabs fire resistance shall be 2.0 hours.

Minimum dimension shall be as per clause 21of IS: 456:2000

- Beam : 250mm,
- Slab : 125mm
- Column : 450mm (Fully exposed)
- Column : 350mm (50% exposed)
- Column : 240 mm (One face exposed)
- Walls : 250 mm

e. **Nominal Cover to Reinforcement:** The appropriate concrete cover to reinforcement including links is governed by the following main considerations:

i. Durability of Concrete
ii. Corrosion Protection of the Reinforcement
iii. Bar Size
iv. Nominal maximum aggregate size

Nominal cover to meet durability requirement and prevent corrosion of reinforcement depending on exposure condition and fire resistance for specified period based on construction type shall be as per the clause 26.4 of IS: 456-2000 and NBC-2016.

Table3-NominalCover

Structural Element	Nominal Cover to all reinforcement (as PerIS456:2000)		Nominal Cover Provided for Prescribed Fire Rating & Exposure
	For Durability	For Fire Resistance as noted above	
Beams (Mild)	25mm	40mm for simply supported 30mm for continuous	40mm for simply supported 30mm for continuous
Slab (Mild)	20mm	25mm for simply supported 20mm for continuous	25mm for simply supported 20mm for continuous
Stitch Slabs-Top (Mild)	20mm	NA	20mm
Stitch Slabs-Bottom (Moderate)	30mm	NA	30mm
Columns	40mm	40mm	40mm

Footings	50mm	50mm (as per clause26.4.2.2)	50mm
Raft Slabs	50mm	75mm	75mm
Retaining Walls&Shear wall	25mm		30mm
Under Ground & Over Head Water Tank Wall–Inner Side (Severe)	45mm		45mm
Under Ground & Over Head Water Tank Wall-Outer Side	30mm		30mm

7. Stiffness Modifiers

For structural analysis and design at ultimate loads, following are the values of stiffness modifiers that has to be used as per clauses 6.4.3.1 in IS-1893:2016.

Moment of Inertia: -

a) Columns = 70% of gross
b) Beams = 35% of gross

8. Design Loads

The following basic loads shall be considered in analysis and design of structure and its elements:

a) Dead Loads: Dead load shall mean the total weight of /or foundations, and all materials permanently attached there to or supported thereby. The dead loads for the RCC members are considered on the basis of the density of RCC as 25 KN/cum. The density of brick wall (Red Bricks) in place is taken as 20 KN/cum.

The allowance for the floor finish is considered as 50 mm for whole structure from basement floor to below terrace floor level. Floor finish at terrace level to be considered as 120 mm thick. The toilets are considered with 300 mm sunk as per architect requirement and light weight material at density of max. 2400 kg/cum is taken for filling.

Load of 0.5 KN/sqm. Shall be considered for false-ceiling and services. The Load taken for railing is 6kN/m and the load for parapet is 6kN/m.

The self-weight of structure is automatically calculated by the analysis software depending upon the cross-sectional area and density of each member as follows:

Density of R.C.C Members	25.0KN/m^3
Density of P.C.C Members	24.0KN/m^3
Density of Structural Steel	78.5KN/m^3
Density of Brick Masonry Walls (230/115 mm Thick)	20.0KN/m^3
Density of AAC Wall (200/100 mm Thick)	8.5KN/m^3
Density of solid concrete Block	22.0KN/m^2
Dry density of Soil	18.0KN/m^3
Density of Saturated Soil	20.0K/m^3
Density of Water	10.0KN/m^3

Density of Floor finish	24.0KN/m^3
Density of Plaster	20.0KN/m^3
Density of Lightweight Filling	8.0KN/m^3
Density of Screed	24KN/m^3
Density of Glass	27.2KN/m^3

b) Imposed Loads: Following live loads have been considered in analysis: For Type-5& 6

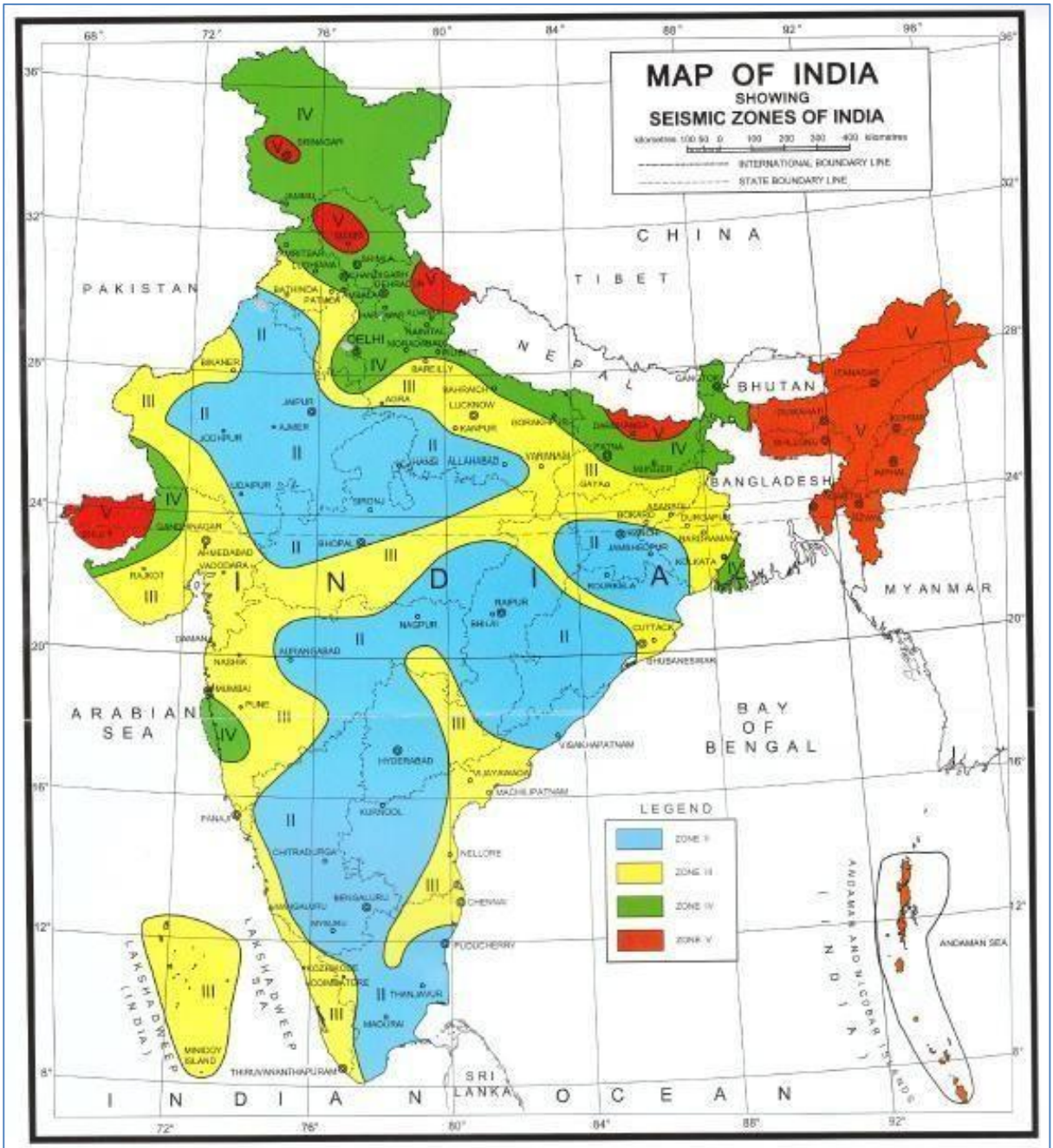
Occupancy Type	Load kN/sqm
Staircase, Lobby, Corridor	3
Rooms	2
Store+others	3
Toilet	3
Terrace(Accessible)	1.5
Terrace(Not-Accessible)	0.75

The slabs are designed for the above-specified loads. In cases specified areas are to be designed for higher loading, the same shall be informed.

Type of Load	Minimum UDL KN/m^2
Screed and Finishes(50mm)	1.25
Mechanical & Electrical Services Ceiling	0.5
Demount-able partitions	1.0
Brick/Block work partitions	As per actual

The imposed and super imposed loads shall be considered as perIS:875(Part2)–1987, depending upon the finishes and occupancy classifications. The Equipment Load on the roof of the building shall be as per Vendor’s data. Water tank loads shall be as per MEP Consultants requirement.

b. Seismic Loads as per IS 1893:2016EARTH QUAKE MAP OF INDIA



Based upon Survey of India Political map printed in 2002.

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The territorial waters of India extend into the sea to a distance of twelve nautical miles measured from the appropriate baseline.

The interstate boundaries between Arunachal Pradesh, Assam and Meghalaya shown on this map are as interpreted from the North-Eastern Areas (Reorganisation) Act, 1971, but have yet to be verified.

The state boundaries between Uttarakhand & Uttar Pradesh, Bihar & Jharkhand, and Chhattisgarh & Madhya Pradesh have not been verified by the Governments concerned.

The administrative headquarters of Chandigarh, Haryana and Punjab are at Chandigarh.

The external boundaries and coastlines of India agree with the Record/Master Copy certified by Survey of India.

The responsibility for the correctness of internal details rests with the publisher.

NOTE – Towns falling at the boundary of zones demarcation line between two zones shall be considered in higher zone.

FIG. 11 SEISMIC ZONES OF INDIA

S. No	Load		Reference
1)	Earthquake load:		
a)	Zone	4	IS-1893-2016
b)	Importance factor	As per Table1 given above	*1.2 (Residential)*
		SMRF	
c)	Type of structure		
		5	
d)	Response Reduction Factor Method of application	(Type-II) 0.075h^.75 due ot acc blocks used.	According to clause 7.6.2 of IS-1893 (PART-1) 2016
e)	Soil type		
f)	Time period to be used*	h=Height of building, in m (From Ground Floor to Terrace)	

Time Period shall be used as per Clause 7.6.2 (b) of IS 1893 (Part_1): 2016 as given below:

To be check for minimum earth quake load as per bare frame

b) Buildings with RC structural walls:

$$T_a = \frac{0.075h^{0.75}}{\sqrt{A_w}} \geq \frac{0.09h}{\sqrt{d}}$$

where A_w is total effective area (m^2) of walls in the first storey of the building given by:

$$A_w = \sum_{i=1}^{N_w} \left[A_{wi} \left\{ 0.2 + \left(\frac{L_{wi}}{h} \right)^2 \right\} \right]$$

where

h = height of building as defined in **7.6.2**(a), in m;

A_{wi} = effective cross-sectional area of wall i in first storey of building, in m^2;

L_{wi} = length of structural wall i in first storey in the considered direction of lateral forces, in m;

d = base dimension of the building at the plinth level along the considered direction of earthquake shaking, in m; and

N_w = number of walls in the considered direction of earthquake shaking.

Figure 4 Time Period Formula

For Seismic forces, Response spectrum analysis shall be done with slab at each floor idealized as rigid diaphragm as per clause 7.6.4 IS 1893:2016 so that all frames sway equally under lateral loads and with masses lumped at the joints with 5% damping. The slab panels shall be designed for Dead, live and lateral loads as per IS 456-2000. Seismic weights shall be calculated as per 7.4.1 of IS-1893:2016 with the appropriate amount of imposed load as per the table 10 (Up to 3 KN/m^2 - 25% and above 3 KN/m^2 - 50%). Terrace lives need not to be considered for seismic weight calculation as per clause 7.3.2 IS-1893:2016. Several mode shapes are given in analysis in such a way that mass participation factor in both directions is achieved up to 90%. The combination of result for various modes is adopted using Complete Quadratic Combination (CQC). The design base shear (VB) shall be compared with a base shear (VBT) calculated using a fundamental period, Ta. In case VB is less than VBT, all the response quantities are multiplied by scale factor.

9. Analysis and Design

The buildings shall be analyzed as 3-D structures idealized with shear walls/columns as vertical members and Beam and slab as horizontal members in “ETABS” computer program. Above mentioned Analysis/Design software has been thoroughly tested, validated and recognized internationally by several organizations and is well suited for the analysis of building system.

Beams and columns in the structure will be modelled as line members. The Shear walls as well as flat slab shall be modelled as “thin shell” elements. Geometrical dimensions, member properties and member-node connectivity including eccentricities will be modelled in the analysis problem. Variation in material grades, if present, will also be considered. Structural Analysis and Design will be carried out for all possible load combinations of both vertical (dead and live loads) as well as horizontal loads (earthquake/wind loads).

The computer analysis will evaluate individual internal forces, reactions at foundation level and deflection pattern of the entire structure and in the individual members. This data will then be used to verify the adequacy of the member sizes adopted and after further iteration to arrive at the most optimized design of the structural members. Some re-runs of the analysis programs might be required for arriving at the optimum3-Dimensional structural frame that satisfy the strength and stability criteria in all respects.

c) Load Combinations

All structural designs are carried out by Limit State method of design. For this purpose, the Load factor for various load combinations indicated in IS 875(Part5):1987 and IS 456:2000 are as follows:

The appropriate part of imposed load as specified in IS: 1893–2016 is used only for evaluating earthquake effects. For design of columns and foundations combinations per IS 1904 shall apply in which Live Load Reduction shall be done as per procedure give in Appendix A of IS 875 Part2.

In addition, following load combinations are considered for calculating the forces at serviceability limit state.

i. Service Load Combination

[For Checking of Deflection & Crack Width]:
DL+ LL
DL + SPECX DL – SPECX DL + SPECY DL-SPECY
DL + LL + SPECX DL + LL + SPECX DL + LL - SPECY DL + LL -SPECY DL + LL + WLX
DL + LL -WLX DL + LL + WLY
DL + LL - WLY

ii. Load combination (For Design)

a) Ref.No.	Analysis No.	Load Combination
1		1.5 (DL) +1.5 (LL)
2		1.2 (DL) +1.2 (LL) +1.2 (EQX1)
3		1.2 (DL) +1.2 (LL) +1.2 (EQX2)
4		1.2 (DL) +1.2 (LL) +1.2 (EQX3)
5		1.2 (DL) +1.2 (LL) +1.2 (RSXMax)
6		1.2 (DL) +1.2 (LL) -1.2 (EQX1)
7		1.2 (DL) +1.2 (LL) -1.2 (EQX2)
8		1.2 (DL) +1.2 (LL) -1.2 (EQX3)
9		1.2 (DL) +1.2 (LL) -1.2 (RSXMax)
10		1.2 (DL) +1.2 (LL) +1.2 (EQY1)
11		1.2 (DL) +1.2 (LL) +1.2 (EQY2)
12		1.2 (DL) +1.2 (LL) +1.2 (EQY3)
13		1.2 (DL) +1.2 (LL) +1.2 (RSYMax)
14		1.2 (DL) +1.2 (LL) -1.2 (EQY1)
15		1.2 (DL) +1.2 (LL) -1.2 (EQY2)
16		1.2 (DL) +1.2 (LL) -1.2 (EQY3)
17		1.2 (DL) +1.2 (LL) -1.2 (RSYMax)
18		1.2 (DL) +1.2 (LL) +1.2 (WLX)
19		1.2 (DL) +1.2 (LL) -1.2 (WLX)
20		1.2 (DL) +1.2 (LL) +1.2 (WLY)
21		1.2 (DL) +1.2 (LL) -1.2 (WLY)
22		1.5 (DL) +1.5 (EQX1)
23		1.5 (DL) +1.5 (EQX2)
24		1.5 (DL) +1.5 (EQX3)
25		1.5 (DL) +1.5 (RSXMax)
26		1.5 (DL) -1.5 (EQX1)
27		1.5 (DL) -1.5 (EQX2)
28		1.5 (DL) -1.5 (EQX3)
29		1.5 (DL) -1.5 (RSXMax)
30		1.5 (DL) +1.5 (EQY1)

a) Ref.No.	Analysis No.	Load Combination
31		1.5 (DL) +1.5 (EQY2)
32		1.5 (DL) +1.5 (EQY3)
33		1.5 (DL) +1.5 (RSYMax)
34		1.5 (DL) -1.5 (EQY1)
35		1.5 (DL) -1.5 (EQY2)
36		1.5 (DL) -1.5 (EQY3)
37		1.5 (DL) -1.5 (RSYMax)
38		1.5 (DL) +1.5 (WLX)
39		1.5 (DL) -1.5 (WLX)
40		1.5 (DL) +1.5 (WLY)
41		1.5 (DL) -1.5 (WLY)
42		0.9 (DL) +1.5 (EQX1)
43		0.9 (DL) +1.5 (EQX2)
44		0.9 (DL) +1.5 (EQX3)
45		0.9 (DL) +1.5 (RSXMax)
46		0.9 (DL) -1.5 (EQX1)
47		0.9 (DL) -1.5 (EQX2)
48		0.9 (DL) -1.5 (EQX3)
49		0.9 (DL) -1.5 (RSXMax)
50		0.9 (DL) +1.5 (EQY1)
51		0.9 (DL) +1.5 (EQY2)
52		0.9 (DL) +1.5 (EQY3)
53		0.9 (DL) +1.5 (RSYMax)
54		0.9 (DL) -1.5 (EQY1)
55		0.9 (DL) -1.5 (EQY2)
56		0.9 (DL) -1.5 (EQY3)
57		0.9 (DL) -1.5 (RSYMax)
58		0.9 (DL) +1.5 (WLX)
59		0.9 (DL) -1.5 (WLX)
60		0.9 (DL) +1.5 (WLY)
61		0.9 (DL) -1.5 (WLY)

SPECX	=	Dynamic seismic load in X-direction
SPECY	=	Dynamic seismic load in Y-direction
DL	=	Dead Load
LL	=	Live Load
TL	=	Temperature Load

The appropriate part of imposed load as specified in IS: 1893 (Part-1): 2016 is used only for

evaluating earthquake effects. Load combination as per IS 1904 shall apply in which live load reduction shall be done as per procedure give in Appendix A of IS 875 Part 2 for the design of column sand foundations.

10. Foundation Recommendation

Please refer the submitted Geo-Technical Report (21.5& 12.28 Ton/sqm SBC has been considered 9m & 3.0m From ground -lvl (for the design of foundation at 3m from Basement-lvl

11. Minimum Cement Content as IS 456:2000

Table 5 Minimum Cement Content, Maximum Water-Cement Ratio and Minimum Grade of Concrete for Different Exposures with Normal Weight Aggregates of 20 mm Nominal Maximum Size

(Clauses 6.1.2, 8.2.4.1 and 9.1.2)

Sl No.	Exposure	Plain Concrete			Reinforced Concrete		
		Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete	Minimum Cement Content kg/m³	Maximum Free Water-Cement Ratio	Minimum Grade of Concrete
1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
i)	Mild	220	0.60	–	300	0.55	M 20
iii)	Moderate	240	0.60	M 15	300	0.50	M 25
iii)	Severe	250	0.50	M 20	320	0.45	M 30
iv)	Very severe	260	0.45	M 20	340	0.45	M 35
v)	Extreme	280	0.40	M 25	360	0.40	M 40

NOTES

1 Cement content prescribed in this table is irrespective of the grades of cement and it is inclusive of additions mentioned in **5.2**. The additions such as fly ash or ground granulated blast furnace slag may be taken into account in the concrete composition with respect to the cement content and water-cement ratio if the suitability is established and as long as the maximum amounts taken into account do not exceed the limit of pozzolona and slag specified in IS 1489 (Part 1) and IS 455 respectively.

2 Minimum grade for plain concrete under mild exposure condition is not specified.

Table 6 Adjustments to Minimum Cement Contents for Aggregates Other Than 20 mm Nominal Maximum Size

(Clause 8.2.4.1)

Sl No.	Nominal Maximum Aggregate Size mm	Adjustments to Minimum Cement Contents in Table 5 kg/m³
(1)	(2)	(3)
i)	10	+40
ii)	20	0
iii)	40	–30

Minimum Reinforcement as IS 456:2000

26.5 Requirements of Reinforcement for Structural Members

26.5.1 *Beams*

26.5.1.1 *Tension reinforcement*

a) *Minimum reinforcement*—The minimum area of tension reinforcement shall be not less than that given by the following:

$$\frac{A_s}{bd} = \frac{0.85}{f_y}$$

where

A_s = minimum area of tension reinforcement,

b = breadth of beam or the breadth of the web of T-beam,

d = effective depth, and

f_y = characteristic strength of reinforcement in N/mm².

b) *Maximum reinforcement*—The maximum area of tension reinforcement shall not exceed 0.04 bD.

26.5.1.6 *Minimum shear reinforcement*

Minimum shear reinforcement in the form of stirrups shall be provided such that:

$$\frac{A_{sv}}{bs_v} \geq \frac{0.4}{0.87 f_y}$$

where

A_{sv} = total cross-sectional area of stirrup legs effective in shear,

s_v = stirrup spacing along the length of the member,

b = breadth of the beam or breadth of the web of flanged beam, and

f_y = characteristic strength of the stirrup reinforcement in N/mm² which shall not be taken greater than 415 N/mm².

26.5.2 *Slabs*

26.5.2.1 *Minimum reinforcement*

The mild steel reinforcement in either direction in slabs shall not be less than 0.15 percent of the total cross-sectional area. However, this value can be reduced to 0.12 percent when high strength deformed bars or welded wire fabric are used.

26.5.3 *Columns*

26.5.3.1 *Longitudinal reinforcement*

a) The cross-sectional area of longitudinal reinforcement, shall be not less than 0.8 percent nor more than 6 percent of the gross cross-sectional area of the column.

ELECTRICAL AND LV WORKS DESIGN BASIS REPORT

ELECTRICAL AND LV WORKS

1. GENERAL

The EPC Contractor shall carry out Design, Supply, Installation, Testing & Commissioning of complete Internal & External Electrification works including Low Voltage (LV) and other works (as per scope of work) as required for smooth functioning of the **CONSTRUCTION OF JUDICIAL OFFICERS FLATS AT SECTOR-19, DWARKA, DELHI**. All Electrical & LV works shall be executed as per latest codes of practice for Electrical installations and meeting the requirements of Indian Electricity Rules/Act, applicable I.S. Codes/Rules and relevant IS/IEC/NEC/NBC /State PWD specifications and schedules including compliance of state electrical licenses.

The rating and capacity of equipment indicated herein below are minimum to be provided. However, during detailed designing, if required and found necessary, the capacity/rating of the equipment may be upgraded by the EPC Contractor.

2. SCOPE OF WORK:

a) **Internal Electrical Work: - All internal electrical provisions for Residential buildings (Type-Type-VI) shall be provided as per "Scale of Amenities for Electrical Installation in General Pool Residential Accommodation" contained in CPWD PAR-2023 document.**
b) Provision for point and circuit wiring as per CPWD specifications.
c) Provision for circuit / sub-main wiring with MS/PVC conduit as per NBC-2016. Sub main wiring MS for surface conducting & PVC can be used for concealed conducting.
d) Provision for DB's (SPN, vertical TPN & horizontal TPN) with MCCB's and MCB's: 12 way, SPN Double door, 6, 8, 12 way TPN Double door DB Provided.
e) Provisions of Floor panels, sub panels, main panels as required for power distribution
f) Provision for Cable tray of different sizes. -150mm, 300, 450mm, 600mm, 750mm, 900mm provided.
g) Provision of TV sockets along with wiring (RG-6) till by shaft with provision of Junction Boxes (with operable cover) is in scope.
h) Provision for lightening protection as per IS:2309(Latest)
i) Provision of Conventional Lighting Protection of all building to be complied as per IS2309 (1989).
j) All LT cable laying as per CPWD specification.

- **Wires**

The design manufacture, testing and supply of single core FRLS PVC insulated 1.1 KV grade stranded twisted wires under this specifications shall compile with latest edition of following standards.

IS : 3961 Current rating for cables.
IS : 5831 HRPVC/PVC insulation and sheath of electric cables.
IS : 694 HRPVC/PVC insulated cables for working voltage upto and including 1100 Volts.
IEC : 754(i) FRLS PVC/HFFR insulated cable.

Copper/Aluminum stranded twisted conductor HRPVC / FRLS PVC / PVC / XLPE insulated wires shall be used in conduit as per item of work. Aluminum for Power Cables and Copper for control cables shall be used.

The wires shall be color coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in meters at every one meter shall be provided on the outer sheath of cable.

Cable laying must compile IS: 7098(I) Specification for cross linked polyethylene insulated HRPVC/PVC sheathed cable for working voltage up to 1.1 KV.

Cable laying and termination must compile CPWD external electrical specification.

a) HT cable laying as per CPWD specification. The cross linked polyethylene (XLPE) cable shall be aluminum conductor PVC outer sheath steel strip armored over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1985 and (Part-II) 1973. The screening shall be done on individual cover. The armoring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.
b) Voltage drop for cable must compile ECBC norms.
c) Provision for Internal and External Light Fixtures (with Aluminum housing ,lumen output higher than 120 lumen /watt, CRI>80,THD<10%) as per lux level calculations complying National lighting code and Fans installation as per IS along with CPWD specifications with following description:-

LED Recessed/surface Down lighter (Round/ square/ Rectangular) SMD type of following body material with PMMA and prismatic diffuser and construction as per IS : 10322 with driver as per the requirement with Driver efficiency >85%, Operating voltage AC 140-270 Volt, frequency 50/60 hz, Operating temp range -5 0C to 40 0C centigrade, internal surge protection of 2.5 KV with Short & Open circuit protection ,THD < 10%, P. F.≥0.95, IP20, CRI >80, UGR (Unified Glare Rating) <19, Flicker free (flicker should be below 5%), life time (LED, Driver & electrical circuitry), life time of minimum 50000 Burning Hours with 70% of initial Lumen maintained till life ends, CCT 3000°K / 4000°K / 5700°K /6500°K (As per ANSI Bin), SDCM(Standard Deviation Color Matching) <3, Maximum power consumption should not more than the specified rating and Fixture shall be of relevant BIS standard. Manufactures Word Mark/ Name Engraved/ Embossing/ Screen printing on housing Complete in all respect i/c external connections with 1.5 sq mm FRLS/HFFR, PVC insulated copper conductor single core cable and earthing etc. as required with Minimum 5 year OEM warranty. System lumen efficacy ≥120 <135 lm/Watt output. LM79 & LM80 Test report and all testing required for LED fixtures as per BIS shall be submitted. Shape size and CCT shall be as approved by Engineer-in Charge as per requirement. (Thermal management: heat sink of aluminum housing such that LED junction temperature shall not rise above 90°C). Powder coated die cast /Extruded aluminum Body including trim.

- - 7 watt
- 12 -15 watt
- 18 watt

LED Batten light (System lumen efficacy ≥120 85%, Operating voltage AC 140- 270 Volt, frequency 50/60 hz, Operating temp range -5 0C to 40 0C, internal surge protection of 2.5 KV with Short & Open circuit protection ,THD < 10% , P. F.≥0.95, IP20, CRI >80, Flicker free (flicker should be below 5 %), life time (LED , Driver & electrical circuitry), of minimum 50000 Burning Hours with 70% of initial Lumen maintained till life ends, CCT 3000°K / 4000°K / 5700°K /6500°K (As per ANSI Bin), SDCM(Standard Deviation Color Matching) <3, Maximum power consumption should not more than the specified rating and Fixture shall be of relevant BIS standard. Manufactures Word Mark/ Name Engraved/ Embossing/ Screen printing on housing, complete in all respect i/c external connections with 1.5 sq.mm FRLS/HFFR, PVC insulated copper conductor single core cable and earthing etc. as required with Minimum 5 year OEM warranty. System lumen efficacy ≥120 <135 lm/Watt output .LM79 & LM80 Test report and all testing required for LED fixtures as per BIS shall be submitted. Shape size and CCT shall be as approved by Engineer-in-Charge as per requirement. (Thermal management: heat sink of aluminum housing such that LED junction temperature shall not rise above 90°C).Powder coated die cast /Extruded aluminum Body (Thickness > 1.20 mm) 18- 22 Watt

Panel light 2x2 ft., of following body material and construction as per IS : 10322 with driver as per the requirement with Driver efficiency >85%, Operating voltage AC 140-270 Volt, frequency 50/60 hz, Operating temp range -5 0C to 40 0C, internal surge protection of 2.5 KV with Short & Open circuit protection ,THD < 10% , P. F.≥0.95, IP20, CRI >80, UGR (Unified Glare Rating) <19, Flicker free, (flicker should be below 5 %), life time (LED, Driver & electrical circuitry), of minimum 50000 Burning Hours with , 70% of initial Lumen maintained till life ends, CCT 3000°K / 4000°K / 5700°K /6500°K (As per ANSI Bin), SDCM(Standard Deviation Color Matching) <3, Maximum power consumption should not more than the specified rating and Fixture shall be of relevant BIS standard. Manufactures Word Mark/ Name Engraved/ Embossing/ Screen printing on housing. Complete in all respect i/c external connections with 1.5 sq mm FRLS/HFFR, PVC insulated copper conductor single core cable and earthing etc. as required with Minimum 5 year OEM warranty. System lumen efficacy ≥120 <135 lm/Watt output .LM79 & LM80 Test report and all testing required for LED fixtures as per BIS shall be submitted. Shape size and CCT shall be as approved by Engineer-in-Charge as per requirement. (Thermal management: heat sink of aluminum housing such that LED junction temperature shall not rise above 90°C).

Powder coated die cast/Extruded aluminum Body (Thickness > 1.20 mm)

36 watt

Water tight oblong **10 Watt LED bulkhead luminaire** with driver set confirming to IP 65 and above Protection complete in all respect including connection with 1.5 sqmm FRLS PVC insulated copper conductor

Mirror Wall Light oblong 10 Watt LED luminaire with driver set confirming to IP 65 and above Protection. Complete in all respect including connection with 1.5 sqmm FRLS PVC insulated copper conductor

illuminated exit sign with 1 x 6 watt LED lamp including providing maintenance free batteries & charger capable of working for 2 hr duration mounted on ceiling/wall complete with the approved EXIT self-adhesive labels as per site requirement as required including connection with 1.5 sqmm FRLS PVC insulated copper conductor 18"-24" LED chandelier with adjustable height, chain mount with matching canopy suitable for dimming of **(40-60 watt)**

Ceiling fan with Brush Less Direct Current (BLDC) Motor, class of insulation: B, 3 nos. metal(Aluminum alloy) blades, 30 cm long down rod, 2 nos. canopies, shackle kit, safety rope, copper winding, steel/Al body Power Factor not less than 0.9, Service Value (CM/M/W) minimum as below, 350 RPM (tolerance as per IS : 374-2019), THD (Total Harmonic Distortion) less than 10%, suitable for operation with regulator for speed control and all remaining accessories including safety pin, nut bolts, washers, temperature rise=75 0C (max.), insulation resistance more than 2 mega ohm, suitable for 230 V, 50 Hz, single phase AC supply, Ceiling Fan compliant to IS 374:2019 fan i/c external connections with 1.5 sq.mm FRLS/HFFR, PVC insulated copper conductor single core cable and earthing etc. as required.
1200mm, service value ≥ 6.0 CM/Min/Watt, air delivery 210 CM/Min (Minimum)
Supplying, of following size **exhaust fan** complete with gravity louver and connection with 3 core flexible wire as required.

380mm 900 RPM

(B) Fire Alarm & detection system:- Fire alarm , detection and PA system along with all required provisions for all buildings as per NBC-2016 & Local fire bye laws. Provision of integration of all fire alarm system must be provided with microprocessor based intelligent addressable main fire alarm panel and system.

(C) 1 Nos Substation equipment sets.

Description of substation -1 equipment (for buildings)

i. Provision of Minimum 2 No. 1600 KVA Compact Substation (SF6 /VCB incomer with RMU at HT side, 1600 KVA transformer ONAN type (complying IS 2026 & IS 1180 Level 2 losses), with capacitor panel 650 KVAR & 3200 Ampere ACB at LT side) in accordance of applicable IEC standards.
ii. Provision of Minimum 250KVA Silent type DG Set as per Latest CPCB norms along with AMF panel.
iii. Provision of LT Panel with adequate breakers for transformer, Solar PV System & DG set with Bus coupler and interlocking provisions along with required outgoings for all buildings with LT & HT cables & terminations for connection of building all other substation equipment along with all safety equipment's (Extinguisher, Checker Plate Fire Buckets, Rubber Mat, Chart etc.) is in scope of work of contractor.
iv. All LT Panel having incomer breaker above and equal to 800 amps must be complying TTA (IES 61439).
v. Earthing provisions for substation equipment's and Panels, Building equipment and panels must comply as per IS: 3043(Latest).Resistance of system not be greater than 1 ohm.

vi. All civil works like foundation, trenches and fencing will be in scope of work of contractor.

vii. Voltage grade of transformer, VCB etc 33 or 11 KV subject to sanction and guaranteed by SEB.

Roof Top Solar PV System: - Roof Top Solar PV System with minimum Capacity 100 kWPe with following item specification.

On-grid Solar Photovoltaic Power Plant conforming to various applicable standards BIS, IEC, MNRE guidelines, the Central Electricity Authority Regulations and CPWD Specifications as amended up to date, consisting of Mono/Poly Crystalline silicon solar cells module, net metering facility, necessary control, protections, earthing, cabling, mounting structure, junction boxes, power conditioning units, Real time online web interfaced Data Monitoring System, Distribution panels, grid connecting arrangement, conduits, pipes, cable trays and other accessories etc. as required.

a) High Energy Efficiency Solar Photovoltaic Module of capacity 330 Wp or above, manufactured in India, conforming to IS 14286/IEC 61215, IS/IEC 61730- Part-1, IS/IEC 61730-Part-2. Solar Photovoltaic Module conversion efficiency shall not be less than 23% at STC with temperature coefficient of Pmax better than -0.30% per 0C. PV modules used in solar power plants/ systems must be warranted for their output peak watt capacity, which should not be less than 90% at the end of 10 years and 80% at the end of 25 years. Solar Modules shall be designed to operate in relative humidity upto 100% with temperature between -10 0C and +85 0C. Further, each PV module used in any solar power project must have Radio frequency identification tag with information such as name of manufacturer, month and year of manufacturing, country of origin (separately for Solar cell and module), I-V curve, Unique Serial No and Model No of the module, Wattage, Im, Vm and FF, name of test lab issuing IEC certificate.

b) Power Conditioning Unit (PCU) of 350-800 V DC Input voltage range and 415 V AC, three phase, 4 wire, 50Hz +/- 2.5 Hz, output voltage suitable to generate AC with a variation of 10% at nominal voltage. Power with efficiency not less than 97%, total harmonic distortion less than 3% and suitable for ambient temperature from 0 to 50 0C, Minimum IP-65 for outdoor and Minimum IP 21 for indoor, Built-in meter and data logger, MPPT, switching devices

c) IGBT/MOSFETs and controller Microprocessor /DSP. PCU/inverter shall be capable of complete automatic operation including wake-up, synchronization & shutdown. The PCU shall be able to withstand unbalanced load conforming to IEC standard with shutdown/standby mode. It must be provided with grid islanding along with manual disconnect pole isolation switch besides automatic disconnection. Minimum protections: Mains Under / Over Voltage, Over current, Over/Under grid frequency, Over temperature, Surge voltage induced at output due to external source, Short-circuit, Lightening, Anti Islanding (for grid synch. Mode) and other protections as per applicable standards. LCD/LED display of minimum parameters: DC input voltage, DC current, AC Voltage and current (all 3 phases, in case of 3 phase), Instantaneous & cumulative AC output power, Daily DC energy produced and other parameters applicable standard. Communication interface RS 485 / RS 232.

d) Module mounting structure: The roof top solar plant generation units shall be installed by using supporting Aluminum/Galvanized MS structure (mass of zinc coating shall be as per IS4759) having minimum head room clearance of 2.4 meter above the terrace level / ground level. The mounting structure would be designed to sustain wind load and seismic parameter of the site of installation. All the structure shall be design as per applicable BIS code and the material shall also confirm the applicable BIS Code. Structural material shall be corrosion resistant and electrolytically compatible with the materials used in the module frame, its fasteners, and nuts and bolts. The suitable arrangements for maintenance and cleaning shall be provided.

d) Real time online web interfaced Data Monitoring System complete with accessories for various parameters such as Solar Irradiance, temperature, AC Output Voltage and current, Output Power, Power factor, DC Input Voltage and Current, Time Active, Time disabled, Time Idle, Power produced and other parameters as per standard practices.

e) Array junction box & Main junction box with IP 65 protection and termination arrangement for incoming and outgoing cable along with glands, lugs and other accessories etc. as required. Each junction box shall be made of GRP/FRP/Powder Coated Aluminum /cast aluminum alloy with full dust, water & vermin proof arrangement with High quality Suitable capacity

f) **Metal:** Oxide Varistors (MOVs) (semiconductor diode with resistant applied voltage)/ surge arrestors and suitable Reverse Blocking Diodes, isolation switches isolate the DC input to Inverter, copper bus bar etc.

g) Lightning, surge voltage protection, earthing protection and grid islanding.
h) **Cables:** Connections & Interconnections by required size IR/UV protected XLPE insulated copper conductor 1.1 kV grade armored power and control cables(ISI Marked) along with supplying & fixing of necessary channel/conduit, GI cable trays, supports, lugs, thimble and other accessories etc. as required.

i) DC Distribution Board And AC Distribution Panel Board: IP65, free standing, metal cladded, having copper bus bar, having required protection and control gears, connection-interconnection, etc. as required.

IP Telephone Network System:-

- Provision of Telephone Network Including providing all Telephone outlets ,telephone wiring with conduiting Krone boxes, Tag blocks with IP EPBAX complete in all respect complying **Scale of Amenities for Electrical Installation in General Pool Residential Accommodation" contained in CPWD PAR-2023 document.**
- Item description and specification as following.

CCTV Surveillance.-

- Provision to cover all entry exits of buildings, all staircase and lifts entry exits and covering all corridors, entry of premises and all roads and parking area.
- Type of camera-
- Dome Camera- to be provided at internal of building.

- Bullet Camera- to be provided outdoor place, areas without ceiling, main entry of buildings.
- PTZ- outdoor, with Pole mounting, to cover roads and entrance and exit of premises.
- NVR.
- For Item description detail and specification as following-

4MP IP IR Dome Camera having following specifications and features etc.:-

1) Signal System: PAL/NTSC, Signal to Noise Ratio: > 50 dB, Camera should display Camera title, Date & Time in live & recorded video.
2) Image Sensor: 1/2.8" or better progressive Scan CMOS to get color image even at night condition(Minimum Illumination: 0.006 Lux@ F1.4, AGC ON, 0 lux with IR or better) True Day & Night High Performance Mechanical IR cut filter with auto switch, Integrated IR Source (Auto, Manual)- Inbuilt IR LED's with effective distance up to 50 meter or better and 30 meter for color view in night, Imaging: 1/3s to 1/30000s electronic shutter support, Auto Gain Control , White Balance- Auto, Back Light Compensation, Multi zone Privacy Masking, HLC, Digital Watermarking.
3) Compression (Minimum): Video: - H.265 or better, Audio: - G.711U/A, G.711Mu, G.726, AAC, G.723.
4) Wide Dynamic Range: - WDR (120dB or more).
5) Digital Noise Reduction: - DNR (3D) On/Off.
6) Video Streaming & Frame Rates: - Triple streaming, configurable Main stream: 4MP (2560×1440)25/30fps, Sub streams minimum: 720P@25/30 fps.
7) Image Setting: Rotate Mode, saturation, brightness, contrast, and sharpness adjustable through client software or web browser, Edge Analytics: Tripwire, Intrusion, and Motion Detection.
8) Cyber Security: AES 256-bit Encryption, Configuration encryption, trusted execution, Digest, security logs, account lockout, video encryption, IP/MAC filtering, HTTPS, trusted upgrade.
9) Onboard Storage: Camera should support built-in Micro SD/ SDHC/ SDXC Card slot upto 512 GB. It should be supplied with minimum 128GB memory Card.
10) Recording Management: Format SD, overwrite, storage management, video to NAS device
11) Alarm Trigger: Motion/tampering detection; network disconnection detection; IP conflict detection; memory card state detection; memory space detection
12) Network Protocol: SFTP, IPv6, IPv4, DNS,RTCP, NTP, RTP, HTTP, HTTPS, SNMP TCP/IP, PPPoE, NFS, UDP, ICMP, SSL, DHCP, SMTP, RTSPS, unicast.
13) System Capability: ONVIF, Camera shall support open source VMS.
14) Ethernet: 1 RJ 45 10/100 Ethernet port.
15) Audio: It should support 1 x Built-In Mic and 1/1 Alarm In/ Out for External Mic. and Speakers as per site requirement.
16) Power Input: The camera should support simultaneous dual power input—12 VDC (via power adapter) and PoE (802.3af) - to ensure continuous operation in the event of a failure in one power source.
17) Power Requirement: 12VDC/24 VDC/PoE (802.3af)/ePoE.
18) Housing/ Enclosure: - IP67 weather proof, IK10, Metallic body.
19) Operating Condition: - Ambient Temperature: - (-) 05°C to 50°C, humidity 95% (max) (non-condensing)
20) IR life: 40000 hours or higher.

21) Video Bit rate: 32 KBPS - 8 MBPS or better.
22) Standards: BIS with ER, STQC Certified, CE, FCC and RoHS

4MP @ 25/30fps@1440P (2560 x 1440) Dome Camera with 2.8/ 3.6/ 6/8/12 mm fixed lens (as per site requirement).

4MP IP IR Outdoor Bullet Camera having following specifications and features etc. :-

1) Signal System: PAL/NTSC, Signal to Noise Ratio: > 50 dB, Camera should display Camera title, Date & Time in live & recorded video
2) Image Sensor: 1/2.8" or better progressive Scan CMOS get color image even at night condition(Minimum Illumination: 0.006 Lux@ F1.4, AGC ON, 0 lux with IR or better) True Day & Night High Performance Mechanical IR cut filter with auto switch, Integrated IR Source (Auto, Manual)- Inbuilt IR LED's with effective distance up to 50 meter or better and 30 meter for color view in night, Imaging: 1/3s to 1/30000s electronic shutter support, Auto Gain Control , White Balance- Auto, Back Light Compensation, Multi zone Privacy Masking, HLC, Digital Watermarking.
3) Compression (Minimum): Video: - H.265 or better, Audio:- G.711U/A, G.711Mu, G.726, AAC, G.723.
4) Wide Dynamic Range: - WDR (120dB or more). Digital Noise Reduction: - DNR (3D) On/Off.
5) Video Streaming & Frame Rates: - Triple streaming, configurable Main stream: 4MP
6) (2560×1440)25/30fps Sub streams minimum: 720P@25/30 fps.
7) Image Setting: Rotate Mode, saturation, brightness, contrast, and sharpness adjustable through client software or web browser, Edge Analytics: Tripwire, Intrusion, and Motion Detection
8) Cyber Security: AES 256-bit Encryption, Configuration encryption, trusted execution, Digest, security logs, account lockout, video encryption, IP/MAC filtering, HTTPS, trusted upgrade
9) Onboard Storage: Camera should support built-in Micro SD/ SDHC/ SDXC Card slot up to 512 GB. It should be supplied with minimum 128GB memory Card. 10) Recording Management: Format SD, overwrite, storage management, video to NAS device.
10) Alarm Trigger: Motion/tampering detection; network disconnection detection; IP conflict detection; memory card state detection; memory space detection.
11) Network Protocol: SFTP, IPv6, IPv4, DNS,RTCP, NTP, RTP, HTTP, HTTPS, SNMP TCP/IP, PPPoE, NFS, UDP, ICMP, SSL, DHCP, SMTP, RTSPS, unicast.
12) System Capability: ONVIF, Camera shall support open source VMS
13) Ethernet: 1 RJ 45 10/100 Ethernet port.
14) Audio: It should support 1 x Built-In Mic and 1/1 Alarm In/ Out for External Mic. and Speakers as per site requirement.
15) Power Input: The camera should support simultaneous dual power input—12 VDC (via power adapter) and PoE (802.3af)—to ensure continuous operation in the event of a failure in one power source.
16) Power Requirement: 12VDC/24 VDC/PoE (802.3af)/ePoE.
17) Housing/ Enclosure: - IP67 weather proof, IK10, Metallic body.
18) Operating Condition: - Ambient Temperature: - (-) 05°C to 50°C, humidity 95% (max) (non-condensing).

19) IR life: 40000 hours or higher.
20) Video Bit rate: 32 KBPS - 8 MBPS or better
21) Standards: BIS with ER, STQC Certified, CE, FCC and RoHS

4MP @ 25/30fps@1440P (2560 x 1440) Outdoor Bullet Camera with 2.8/ 3.6/6/8/12 mm fixed lens (as per site requirement)

PTZ (Pan, Tilt and Zoom) IP IR Camera having following specifications and features etc :-

PTZ (Pan, Tilt and Zoom) IP IR Camera having following specifications and features etc :-

1) IP IR PTZ Camera: Motorized PAN TILT ZOOM with IR
2) Image Sensor: 1/2.8" or better progressive Scan CMOS.
3) Signal System: PAL/NTSC.
4) Minimum Illumination: 0.008 Lux@ F1.6, AGC ON,0 lux with IR, or better
5) Imaging: 1/1s to 1/30000s, Auto Gain Control, White Balance- Auto, Back Light Compensation, Image Rotation, Multi zone Privacy Masking (Up to 24 Area), HLC, Defog, Region Of Interest and EIS features
6) On Screen Display: Camera should display Camera title, Date & Time in live & recorded video both
7) Signal to Noise Ratio: > 50 dB.
8) Event Notification: Through Relays, E-Mails or FTP
9) Day & Night: True Day & Night High Performance Mechanical IR cut filter with auto switch, IR Source Inbuilt IR LED's with effective distance. The camera should have IR LED’s and cover distance up to 300 meter or above
10) Auto Tracking: The camera should be equipped with Deep-learning-based auto tracking function using simultaneously all of the panning, tilting and zooming should be available. When a motion is detected in a registered monitoring area, the camera should track the motion (object) and capture it.
11) Pre/Post Event Buffering: The camera should support at least of 5 seconds of pre & post event buffering
12) Presets: 300 Presets.
13) Video Compression (Minimum): H.265 or better, H.264, Audio: - G.711U/A, G.711Mu, G.726, AAC, G.723.
14) Wide Dynamic Range: WDR (120dB or more), HLC & BLC.
15) Digital Noise Reduction: DNR (2D+3D) On/Off.
16) Image Setting: Rotate Mode, ROI, EIS, Defog, saturation, brightness, contrast, sharpness adjustable through client software or web browser.
17) Profile Management: User configuration import, export.
18) Cyber Security: Configuration encryption, AES 256-bit Encryption, Digest, account lockout, video encryption, IP/MAC filtering, trusted boot, trusted upgrade, trusted execution.
19) Onboard Storage: Camera should support built in Micro SD/SDHC/SDXC Card slot up to 512 GB. It should be supplied with minimum 128GB Memory.
20) Recording Management: Format SD, overwrite, storage management, video to NAS device, remote archive access via FTP login.

21) Edge based Video Analytics & Alarm Trigger: Motion/tampering detection; network disconnection detection; IP conflict detection; memory card state detection; memory space detection, Tripwire, Intrusion, Object Abandon/ Missing, SMD, Face Detection.
22) Network Protocol: SFTP, IPv6, IPv4, DNS, NTP, HTTP, HTTPS, SNMP, TCP/IP, PPPoE, NFS, ICMP, DHCP, SMTP, RTSPS.
23) System Capability: ONVIF Profile S, G & T. CCTV Camera OEM should be fulltime member of ONVIF and quoted models should be listed on ONVIF official website (All the certifications & Credentials should be valid on the date of technical evaluation)
24) VMS: Camera shall support open source VMS
25) Connectivity: 1x LAN RJ-45 (10/100Base-T).
26) Audio Support: Audio Interface: The camera should have 1/1 Audio In/Out to connect External Mic and Speaker Audio Compression: PCM, G.711U/A, G.711MU, G.726, MPEG2-Layer2, G.722.1.
27) Alarm In/Out: Alarm In/out- 7/2 Ch In/Out
28) Power Input: The camera should support simultaneous dual power input—DC/ AC (via power adapter) and PoE (802.3af)—to ensure continuous operation in the event of a failure in one power source.
29) Power Requirement: 24 VDC, 2.5 A (± 25%), PoE+ (802.3at).
30) Enclosure & Weather Proof Standard: IP67 weather proof and IK10, TVS 8000V lightning proof, surge protection, voltage transient protection.
31) Operating Condition: - Ambient Temperature: - (-) 05°C to 50°C, humidity 95% (max) (non-condensing).
32) IR life: 40000 hours or higher.
33) Video Bit rate: 32 KBPS - 8 MBPS or better.
34) Standards: BIS with ER, STQC Certified, CE, FCC and RoHS
35) 2 MP IP IR motorized PTZ @ 25/30fps or better camera, Triple streaming , configurable on resolution Main stream: 1080p@25/30 fps Sub streams :1080p@25/30 fps & D1@25/30 fps or better, varifocal lens 4.3-137 mm or better with Automatic & manual Focus Adjustment provisions, 32x Optical zoom and 12x Digital zoom with angle of view 57˚–2.4˚ , PAN Travel: Pan: 0° ~ 360° endless, Manual Pan: 260° /s, Preset : 300° /s, Tilt, Travel: Tilt: -20° ~ 90°, auto flip 180°, Manual Tilt: 120° /s, Preset : 200°/s

Network Video Recorder (NVR) with camera licenses to record for all channels having specifications and features etc as mentioned below:

1) Network Video Recorder Embedded/ Installed OS (Linux) along with Camera Licenses to record per NVR and to provide a live view, storage and simultaneously Multi-channel playback of all IP camera or more and must be ONVIF with minimum support of 384 Mbps incoming Bandwidth
2) NVR should support video compressions: H.265 or better, H.264, MJPEG.
3) Must support 1 channel RCA Input, 2 channel RCA Output for Two-way Talk with G.711U/A, G.711u, PCM, G726 audio compressions.
4) Intelligent auto power on when power resumes after power outage. Storage: It should support minimum 8 SATA Slots with 20TB capacity/ Slot and RAID support of RAID 0/1/5/6/10.
5) Connectivity Interface: 2 Nos. x 10/100/1000 Mbps Ethernet Ports, 1x RS485, 1x RS232, 1x eSATA Port.

6) Backup Interface : Its should have 4 Nosx USB port (2x USB3.0, 2xUSB2.0)
7) Video Output Ports: 2x HDMI and 2 VGA
8) Alarm Ports: It should have 16/8 Ch In/ Out ports to connect various type of external sensors and output devices like hooter/ Siren etc.
9) Email & SMS Alert options: Option for SMS/ Email Alerts to minimum 5 designated mobile number for power failure, HDD failure, vandalism, tempering, network disconnection and panic.
10) Web & Mobile Application: Web, Mobile app (For iPhone, iPad, Android Phone) for alerts and viewing.
11) Protocols: HTTP, HTTPS, TCP/IP, IPv4/IPv6, UDP, DHCP, DNS, SMTP, UPnP, IP Filter, PPPoE,FTP, DDNS, Alarm Server, IP Search, Multicast, Auto Registration, ONVIF (Profile T, Profile S, Profile G), CGI, SDK and OEM Cloud for remote monitoring without any public IP need.
12) Standards: CE, FCC, RoHS, BIS Certified.
13) Power Supply: Should support AC100-240V, 50/60Hz Power supply.
14) Operating Condition : -5°C to 50°C, humidity 90% (max) (non-condensing)
15) The VMS application shall support all the features & functionalities of the offered cameras.
16) VMS should consist Licenses for all channels to record Cameras with General, motion detection, intelligent, alarm and POS recording modes. VMS should be provided with Camera Licenses, with no dependency of VMS licenses by binding with the MAC address of the cameras to achieve the functionality.
17) The NVR OEM shall be responsible for providing a mobile application compatible with both Android and iOS devices, enabling remote monitoring and playback of cameras/NVR footage.
18) The OEM must provide its own DDNS server hosted in India, eliminating the need for a public IP address for remote monitoring over the Internet.
19) Must support Continuous, Alarm, Motion, Instant, and Panic Recording Mode.
20) It should support Resolution: 32MP; 24MP; 16MP; 12MP; 8MP; 5MP; 4MP; 1080p; 720p; D1; CIF; QCIF.
21) When alarm recording is enabled and an event occurs, you can click the alarm icon on monitoring page to view the alert details. The snapshot function is supported on monitoring and playback page.
22) The Network Video Recorder (NVR) shall be configured to send email whenever a system message is created or an alarm event occurs. The email server shall be a valid SMTP server. Each recipient email address shall be configured to receive any combination of critical, warning, or informational messages or alarm notifications. When an alarm occurs, the email message includes the NVR name, time of alarm and a list of camera that is configured to record upon alarm.
23) It should have Web and GUI interface.
24) Built-In Artificial Intelligence: NVR should have built-in AI :- 2 Channel face detection and recognition, - Minimum

4 Channel perimeter protection, - Minimum 8 Channel Smart Motion Detection.

25) Face Recognition Database Capacity: It should support total Blacklist and Whitelist capacity of Minimum 20,000 Faces or more with Face Detection speed of 12 face

images/sec and facility to add Name, gender, birthday, address, credential type, credential No., countries & regions and state to each face image.

26) Face & Human Attributes Search: Search Pictures/ Video by Gender, age group, glasses, expressions, face mask, beard, Top color, top type, hat, bag, age, gender and umbrella.

27) ANPR Capability: It should support ANPR Camera with License plate, plate color, vehicle body, vehicle model, vehicle logo, calling, seatbelt, vehicle registration location etc vehicle attributes.

28) Alarm Notifications based on: Motion detection, video tampering, video loss, scene changing, PIR alarm, Camera external alarm, Face detection, face recognition, perimeter protection (intrusion and tripwire), ANPR, people counting, stereo analysis, crowd distribution, heat map, Disk Full, Storage Error, IP Conflict and abnormal behavior of fan, cybersecurity exception.

29) Alarm Notification should be linked with Recording, snapshots, Camera external alarm output, buzzer, logs, presets and email.

30) General AI Based Search: Search Pictures by channel, time, and event type, target classification (Fall Detection, People Approach Detection, and People No. Exception Detection, People Staying Detection, Violence Detection.

31) Smart playback function: Should support smart search for the selected area in the video and smart playback to improve the playback efficiency.

32) VCA (Video Content Analytic): Should support multiple video contented analytics based on camera analytics.

33) Analytics by NVR: Perimeter protection and face recognition.

64 Channel Network Video Recorder (NVR) having display split :- Main screen: 1/4/8/9/16/25/36/64, 2nd screen: 1/4/8/9/16 Serveillance grade Hard Disk with up to 256MB/s Transfer Rate, 256 MB Cache, 7200 RPM Disk Speed, 3.5 inch form factor, SATA Interface, BSMI, ICES-003/NNB-003, CE, FCC, KC, Maghreb, RCM, UKCA, VCCI, CB-Scheme, TUV, UL Certifications. **4TB (Terabytes)** LED display (LED monitor) industrial grade with 3840x2160 resolution or better, USB playback, Bluetooth and Miracast connectivity, 4X HDMI 2.0, DP 1.2, HDR 10/10+, brightness: 500-nits or better, Video wall mode should be available, contrast ratio: 1200:1, OPS slot, viewing angle (H/V): 170°/ 170°, response time less than 12ms, Display control shall be on monitor screen and programmable with remote (remote shall be supplied with system), Key Board, Optical Mouse, etc. as required.

55 inch or larger LSZH Cat 6A-10G speed unshielded twisted pair computer cable with 23 AWG solid copper conductors in existing concealed/surface conduits/Raceways complete 305 Mtr. Roll as per specification etc. all complete.

Layer 2 POE+ 24 Port switch 10/100/1000 1G support and 4 SFP Port 10G uplink requirement for CCTV, Wi-fi as per the given Specification etc. all complete.

Integrated Services Digital Network (ISDN) Compatible Voice Over Internet Telephone(VoIP) ready 19" Rack mountable EPABX presently equipped with 04 ISDN PRI Trunk Lines (200 Channel), 16 IP Extension, 16 Digital Extension, 150 Analogue Extension, Expandable up to 500 Ports / Channels and other as per the given Specification etc. all complete.

Multi-mode Fiber Optic Cable having corrugated steel armoring, laser optimize 50/125 µm with HDPE jacket, LSZH (Low smoke Zero Halogen), Tight-buffered or loose tube, maximum attenuation: < 3.5 dB/km at 850 nm, < 1.5 dB/km at 1300 nm, bandwidth > 2000 MHz-km at 850 nm, > 500 MHz-km at 1300 nm compliance and certifications: ISO/IEC 11801 Ed. 2.2, ANSI/TIA-568- C.3, ITU-T G.651.1 RoHS compliant. Multi-Mode Fiber shall be Central-loose tube filled with Thixotropic jelly, duly following Standards: ISO 11801, IEC 60793- 1/60794-1-2, ITU-T-REC G.652D and Telcordia GR- 20-core, High quality Electro Chromium Coated Corrugated Steel tape (ECCS) and HDPE- Sheath, Operating ambient Temperature should be – 5 0C to +50 0C and Storage Temperature should be – 5 0C to +50 0C, Maximum Attenuation ± 3.5 dB/km at Operational Wavelength 850 nm and ± 1.5 dB / km at Operational Wavelength 1300 nm . Type of fiber should be 50/125 / G.652D & Refractive Index should be 1.483/1.478, the value for Mode-filed, Cladding Diameter 50 ± 2.5 µm and 125 ± 1µm correspondingly i/c splicing & marking etc complete as required.

6 Core Multi Mode Optical Fiber Cable

LSZH Cat 6A-10G speed unshielded twisted pair computer cable with 23 AWG solid copper conductors in existing concealed/surface conduits/Raceways complete 305 Mtr. Roll as per specification etc. all complete.

UPS:- Minimum rating of UPS to be provided as 3 Nos10 kVA UPS with following specification:

Online UPS- Input Supply: Three Phase, Output supply: Three Phase. Supplying, installation, Testing & Commissioning of following capacity at full load (Unity Power Factor) at operating temperature 0 to 40 0C, Relative humidity 0 to 95%, Online double conversion true sine wave Uninterrupted hot swapable (allow for the replacement or addition of battery modules without shutting down the entire system) modular Power Supply (UPS) system with N+1 modules (N denotes total number of modules required for rated capacity). The UPS shall include a Rectifier, inverter, battery bank suitable for 30 minutes back up (Battery VAH capacity shall not be less than 1600 VAH per KVA of UPS rating per Hour backup time) on full load (Battery shall be VRLA, SMF in ABS Container) and Static Bypass switch along with provision for manual bypass, suitable isolation transformer for additional protection against neutral faults etc. UPS shall have inbuilt phase sequence correction. The UPS systems offered are to be of the latest technology with Digital Control Microprocessor based for reliable operation using Insulated Gate Bipolar Transistor (IGBT)'s both for the rectifier & inverter (3 Level) with PWM (Pulse Width Modulation). The quality of design, manufacturing and inspection process should confirm to the relevant Inter-national standards such as IEC/EN/VDE. The operating efficiency of the UPS systems shall be >96% while operating on battery mode and delivering quality power to the 100% non-linear loads. Current total harmonic effect (ITHD) on the input grid shall be < 5% at 50 %load. (The required LC (inductor (L) and a capacitor (C)) filters shall be included in UPS cost), extreme power factor kit to be included to limit the input power factor (PF) to 0.99 and output power factor shall be unity (i.e. kw rating of the UPS shall be kva rating x 1), however UPS shall be suitable to take load at 0.7 lagging to 0.7 leading power factor loads. UPS shall be suitable for incoming supply AC: 3Phase 400V +/-20%, 50 Hz +/-5 Hz, AC Output voltage: 3Phase 415 Volt, 50 Hz +/- 0.2Hz, Overload capacity of 120% for 10 mins, Sine wave output. Non condensing, noise level less than 60db at 1 meter distance, protections: Input

Under voltage over voltage, abnormal out voltage, battery over charging, output over current, short circuit protection, battery deep discharge protection, 10KV surge. UPS must comply with low voltage electromagnetic compatibility (EMC) achieved as per EN 6204, EN6204 Part I and Part 2, it shall be a Voltage and Frequency Independent (VFI)-type UPS. . Communication RS232/RS485/SNMP port open protocol for BMS integration, all hardware & software for iOT Communication as per approved by Engineering in charge. Required battery racks and interconnecting copper conductor cables of suitable size and connectors and all required accessories are inclusive of the cost). This system must provide a means for logging and alarming of all monitored points plus email notification. Forced air-cooling with integral inbuilt fans with redundancy (if one fan fail UPS should be able to handle at least 80% of the load, Noise Level 65 DB at 1 meter distance. The system shall be in compliance IEC 62040 - 1, 2 & 3, IS: 16242 and CPWD Specification. Display Panel (minimum) (In-build 5 inch or more LC Display / LED) to display: a) Input: Voltage, current, Frequency. b) Bypass: Voltage, Frequency. c) Output: Voltage, frequency, Current. d) Battery: Voltage, Capacity. e) Load: KVA, KW, Percentage. f) Temperature: STS, Inverter, PFC. g) Event Logging & Statistical Data (On LCD/LED): UPS should capture and display up to 3000 events like: Over temperature / DC Bus Fail / Fan Fail / Fuse Fail / Overload / Short-circuit / Device Fail / Inverter Fail / Rectifier Fail / Bypass Fail, etc. h) Statistical Data: No. of power failures / Transfers to Bypass / Total Running time, etc. i) Mains Mode of Operation /Battery Mode of Operation / Bypass feeding the load / UPS Fault /Battery charging and discharging, overload, battery voltage and battery capacity. j) Audible Alarms : Mains Failure, Battery Low Alarm, UPS Overload, Fault, Shutdown, Input Over, Under Voltage, Output Over, Under Voltage, Battery Over, Under Voltage, Over Load and short circuit, Over Temperature. The UPS should have QR code which should contain drawing, test report OEM manual, Geo- Tag of manufacturing location etc.

S.No.	Location	Total CONNECTED Load (in KW)	Diversity Factor/Qty.	DEMAND Load (in KW)	
					DG BACKUP
1	TYPE-V	1003.47	0.8	802.77	58.76
2	TYPE-VI	716.50	0.8	573.20	83.36
3	SUB-STATION	9.11	0.8	7.29	7.29
	OTHER LOAD				
4	WTP	25.00	0.60	15.00	15.00
5	STP	75.00	0.30	22.50	22.50
6	Fire	100.00	0.20	20.00	20.00
7	Street Lighting	10.00	0.40	4.00	4.00
	TOTAL	1939.08		1444.76	203.61
	-				

S.No.	Location	Total CONNECTED Load (in KW)	Diversity Factor/Qty.	DEMAND Load (in KW)	
	TRANSFORMER SIZE CALCULATION				
	Total Demand Load			**1444.76**	KW
	PROVISION OF FUTURE LOAD@ 20%			**288.95**	
	Taking Overall Diversity @ 0.8			**1386.97**	
	In KVA @0.9			**1541.08**	KVA
	Suggested Transformer Size 2 Nos 1600 KVA (1 Working and 1 Standby)				
	DG SIZE CALCULATION				
	Total Demand Load			**203.61**	KW
	Taking Overall Diversity @ 0.66			134.38	KW
	DG Loading Factor @.85			158.10	KW
	DGRating @ .8 PF			**197.62**	KVA
	Suggested DG Size 1 Nos 250 KVA				

LIFTS

1. GENERAL

The EPC Contractor shall carry out Design, Supply, Installation and Testing & Commissioning of Lift Works. Passenger cum Bed lifts and Passenger Lifts shall be provided for various buildings in the complex. The installation shall be carried out as per statutory rules & regulations stipulated by Central/ State/ Local Bodies and IS Codes that govern the installations of the lift. The voltage and frequency of the supply shall subject to variation permissible under Indian Electricity Act and Rules.

IP-based CCTV camera (1 No.) shall be provided in all Lift Cars of all buildings for surveillance/monitoring of lift control panel. The CCTV cameras, installed in the lifts, shall be connected/ integrated with the CCTV system with suitable cabling, hardware items etc. as required. Suitable warning mentioning “You are under CCTV surveillance” shall be posted inside the lift car. These cameras may be located at ceiling level and at any location which cannot be easily accessed, noticed or tampered with. The cable used for connecting in car camera to monitoring system, shall be of trailing grade. Ordinary co-axial or twisted pair wires shall not be lashed or tied along with trailing cables. Specialized trailing cables shall be used in lift applications. Wireless CCTV cameras complete with transmitter/ receiver & all accessories as required, may also be provided alternatively.

Passenger cum Bed lifts and Passenger Lifts for shall be provided as per details given below:

Supplying, Installation, Testing & Commissioning of following capacity passenger Machine room less (MRL) lift with regenerative drive as per CPWD General Specification for Electrical Works (Part-III Lift & Escalator) 2003, BIS Codes, NBC 2016 as amended up to date having provision for barrier free access as per Harmonized Guidelines & Standards for Universal Accessibility in India - 2021 of MoHUA, serving different floors in the lift shaft as per detailed specifications enclosed and as under including all other equipment and accessories complete as required:-

i. Speed-1 MPS
ii. Floors-5 (G+4)
iii. Travel -17 Meters (approx.)
iv. Stops & opening- 5 stops and 5 openings
v. Controller: A.C. variable voltage & variable frequency
vi. Automatic rescue device (ARD) complete with dry maintenance free batteries as required
vii. Operation: Microprocessor based single automatic push button/simplex selective collective/duplex collective selective with/without attendant
viii. Power-415 Volts+10%, 3 phase, 50 Hz, 4 wires system
ix. Car Enclosure: Stainless steel scratch proof (Moon Rock/Honeycomb/ Hairline Finish) on all sides and stainless steel decorative ceiling with fans (indirect throw) and LED fitting.
x. The car flooring should be smooth and antiskid as approved by engineer-in-charge.
xi. Type of doors
xii. Car: Power operated, center opening horizontal sliding stainless steel scratch proof (Moon Rock/Honeycomb/ Hairline Finish)
xiii. Landing doors: stainless steel scratch proof.
xiv. A hand rail not less that 600mm long at 900mm above floor level to be fixed adjacent to control panel in the lift car.
xv. Voice announcement system in the car to announce the position of the elevator in the hoist way as the car passes or stops at floor served by the elevator.
xvi. Closed loop Control System, protection against power fluctuation, self-diagnostic control, Landing doors 2 hours Fire rated, Overload detection and protection, Over speed Governor, Dot Matrix LED D & P Indicators In Car & Landings, BMS Compatibility, tamper proof infrared curtain covering almost the entire height of the lift car door, Alarm horn, Anti Nuisance Operation, CCTV camera system with 4 MP IP camera, suitable NVR and HDD for 30 days storage backup , Firemen switch, 2/3 way intercom, Emergency Stop Switch with battery backup for fan and light fitting for 1 hour, pit ladder.
xvii. The lift doors shall have a vision panel to enable persons with hearing impairment to signal for help or assistance in the event of an emergency.
xviii. An appropriate technological support be provided (Through emergency messaging |services or alarms etc.) to respond to the emergency requirements of person with hearing impairment or deafness.
xix. In case of failure of ARD or other electronic devices, a provision of manual rescue be provided

Lift Details				
Sr.	**Buildings' Name**	**13 Passenger cum Bed Lift (1 Meter/Sec)**	**16 Passenger Lift (1.5 Meter/ Sec)**	**No. of Floors**
1	TYPE-V	3		No of floor and travel height as per Arch. Plans
2	TYPE-VI	2	1	
Total		5	1	
Grand Total		**06**		

Note:

1. Lift Well, Car Size, Lift Pit Depth, Overhead, and Clear Entrance Width & Height dimensions shall conform to NBC 2016 / IS Code or OEM Standards/ recommendations. All lifts shall be Gearless Type with Machine room.
2. Provision for Brail letters in call buttons inside and outside of Lift for physically disabled persons.
3. All Lifts in College Building shall have Two Panel Telescopic Doors (2P TSPD) with door opening width of 1200 mm clear.
4. All lifts in Bachelor Doctor Hostel, Guest House and Residential Buildings (Type – III, IV & V) shall have Centre Opening Power Operated Doors (COPD) with door opening width of 900 mm clear.
5. Anti-skid granite or Stainless Steel 304 chequered plate flooring of suitable thickness shall be provided in all the lifts.
6. Car enclosure & doors shall be made out of SS 304 sheet of required thickness.
7. All lift shall have necessary provisions & door opening as required for physically challenged person.
8. Power supply to each elevator shall be connected with dual source. One elevator from each bank of elevators shall be key operated to be used as fireman's lift as per code.
9. Lift Car operating Panel shall be equipped with Braille buttons. Automatic rescue device and emergency lighting shall be provided in each elevator supported by independent rechargeable batteries.
10. All Lifts shall be integrated with BMS System for normal operation status & operation in case of fire. Lift shall be compatible with Modbus /BacNet communication protocol or as per OEM requirement.
11. Lifts shall be provided complete in all respect as per technical specifications and directions of the Engineer-in-Charge.

ELECTRICAL VEHICAL CHARGER: - Supply Installation testing Commissioning of following rating chargers with outdoor IP65 Canopy with following specifications

Parkbay DC Charger (Mode-3) Power Level 2: Normal Power ~24KW and above, 3 phase 415VAC(-40% to +20%), Frequency:50 Hz +/-5%, output supply: DC 12/24 Volt, Operational temperature range : -25 to 55 0C (outdoor), -5 to 55 0C (Indoor), RH up to 95%, Charging Device as per Device/protocol: IS-17017-23, EV-EVSE Communication as per IS-17017-24, ISO- 15118, Infrastructure Socket as per IS-17017-2-2/3, Vehicle Connector as per IS-

17017-2-3 Vehicle Inlet/ Connector As per EV manufacturer, suitable for 4 wheelers. Indoor use: at least IP42; Outdoor use: at least IP54. Mechanical Strength: protection of the external enclosure against mechanical impact shall be IK08 according to IEC 62262. O/L, S/C protection. Insulation Resistance > 1 M Ω. Cable Length: 7.5 m. RCD having a rated residual operating current not exceeding 30 mA; Separate RCD for multiple outputs. Tele communication port of the EV supply equipment according to IS 13252 (Part 1): 2010.OCPP (Open charge point protocol) 1.6J upgradable to ocpp 2.0. Device should follow 17017 series of IS codes in general and the installation of the system shall comply with relevant IS Codes.

Light EV DC Charger (Mode 4) Power Level 1: Up to 7 kW, Input power supply: 1phase 230 +10% Volt/3phase 415 Volt, Frequency: 50 Hz +/-5%, output supply: 12/24 Volt DC.

Operational temperature range : -25 to 55 0C (outdoor), -5 to 55 0C (Indoor), RH up to 95%, Charging Device as per IS-17017-25, EV-EVSE Communication:IS-17017-25, one Charge Point Plug/ Socket as per IS-60309 and IS-17017-2, Vehicle Inlet/ Connector As per EV manufacturer, suitable for 2 Wheelers and 4 wheelers. Indoor use: at least IP42; Outdoor use: at least IP54. Mechanical Strength: protection of the external enclosure against mechanical impact shall be IK08 according to IEC 62262.O/L,S/C protection. Insulation Resistance > 1 M Ω. Cable Length: 7.5 m. RCD having a rated residual operating current not exceeding 30 mA; Separate RCD for multiple outputs. Telecommunication port of the EV supply equipment according to IS 13252 (Part 1): 2010. OCPP (Open charge point protocol) 1.6J upgradable to ocpp 2.0. Device should follow 17017 series of IS codes in general and the installation of the system shall comply with relevant IS Codes.

Light EV AC Charger (Mode-3) Power : 7 kW, Input power supply: 1phase 230 +10% Volt, output supply: 230 Volt AC, Frequency:50 Hz +/-3%, Operational temperature range : -25 to 55 0C (outdoor), -5 to 55 0C (Indoor)., RH up to 95%, Charging Device as per IS-17017-22-1 EV-EVSE Communication: as per relevant IS Codes, Bluetooth Low Energy, one Charge Point Plug/ Socket as per IS-60309 and IS-17017-2, Vehicle Inlet/ Connector As per EV manufacturer, suitable for 2 Wheelers and 4 wheelers. Indoor use: at least IP42; Outdoor use: at least IP54. Mechanical Strength: protection of the external enclosure against mechanical impact shall be IK08 according to IEC 62262.O/L,S/C protection. Insulation Resistance > 1 M Ω. Cable Length: 7.5 m. RCD having a rated residual operating current not exceeding 30 mA; Separate RCD for multiple outputs. Telecommunication port of the EV supply equipment according to IS 13252 (Part 1): 2010. OCPP (Open charge point protocol) 1.6J upgradable to ocpp 2.0. Device should follow 17017 series of IS codes in general and the installation of the system shall comply with relevant IS Codes.

BOOM BARRIER: - Automatic boom barrier shall be consisting of following specifications.

Boom Barrier Front Design: Round Barrier, Color: Silver/Grey Color, PARKI Electromechanical Drive, Mechanism 6meters boom arm Illuminated, Boom Arm (Red/Green) ,Opening Speed: 3.5 Sec Reverse on Obstable Detection, intelligent control mechanism, Automatic Fault Detection Arrow , Led Indication on barrier body (Red/Green) ,Duty Cycle 100 %, IP Rating : IP 55, RS 485 Communication complete in all respect.
FIRE SUPPRESSION SYSTEM:- CLEAN GAS FIRE SUPPRESSION SYSTEMS : 34/80/120/140/180 ltr completely CCOE approved high pressure seamless BIS 7285

approved Cylinders having 34/80/120/140/180 ltr capacity, UL/FM approved based Novec 1230 clean agent stored pressurized system with PESO approved valve assembly . The system also to be fitted with digital pressure gauge to monitor pressure and temperature with safety burst disc safety cap, elbow and other accessories, mounting bracket, container straps, NRV , Pressure operated control head which shall allow for pressure actuation of gas mounted, manually operated actuator to actuate the gas flooding process with the help of a lever, flexible rubber hose with wire bralded enforcement to route the gas from the storage cylinder to the discharge piping, to be connected to the discharge outlet of gas cylinder valve & to be terminated at the system piping or discharge manifold, Flexible actuation hose complete as required. Designated to provide proper flow rate & distribution Novec 1230 gas to flood the hazard area as per latest NFPA 2001.

The system shall sustain upto 65oC operating temperature. Filling facility shall be in India and shall be UL approved. The complete gas suppression system shall be UL/FM approved. As system is UL/FM approved, the software for calculation used to be UL/FM approved. The documentary evidence to pe provided for all approval during the time of bidding.

34/80 ltr complete PESO approved high pressure seamless BIS 7285 approved Cylinders with contact pressure gauge and Peso approved valve, respective size mounting bracket

Novec 1230 manufactured by 3M, with Zero Ozone Depletion Potential and Very Low Global Warming Potential of 1 with 20 Years Blue Sky Warrantee against any regulatory Bans and Restrictions. UL Listed & FM approved.

Master Cylinder Kit complete comprises of Electric Control Head operated electrically from the detection and control system with a manual actuator and Wire Braided Flexible Rubber Hose with Elbow and connectors complete assembly to Connect Novec 1230 Cylinder Assembly Discharge outlet with Discharge Pipe or Discharge Manifold. On any displacement of solenoid valve, master cylinder kit shall be able to notify the fault by audio/visual mean. UL Listed / FM approved.

Warning Signs and Plates for Inside Room and Outside Room application.

Discharge Nozzles to Discharge Novec 1230 Gas in the Hazard Area as hydraulic calculation and flow rate required in 180 Deg/360 Deg Discharge Pattern. UL Listed / FM approved.

Discharge pressure switch with actuation hose and fittings to connect - standard (UL/FM)

Discharge Pipe with Support and Fittings, CS Seamless to ASTM A-106 Schedule 40.

Fire Alarm System with respect to Room size

Automatic Gas Extinguishing Panel. 2 No’s of programmable Initiating Device Circuit and 1 No’s of Releasing Agent circuit, with the independent correlation of any no of initiating devices circuit. History event log shall be at least of 256 events. UL Listed / FM approved/IS 2189.

Conventional Multicriteria Detector with base.

Manual Release Switch & Abort Switch. The Dual action Manual release switch to provide the signal of fire manually to Gas release panel. Abort Switch. The Dual action Abort switch to provide the signal of fire manually to Gas release panel for abort.

Audio Visual Alarm for pre alarm in case of single zone detection & discharge alarm in case of second zone detection.

Response Indicator.

Supplying, laying, testing and commissioning of following sizes of Low Smoke Zero Halogen Silicon Insulated Fire Survival Cable with Drain Wire Armoring, solid copper conductor cable approved by LPCB as per BSEN 50200:2015 PH 120 (Fire, Mech Shock & Water 120 Minutes @ 830 deg Celsius, Fire & Mech Shock every 5 Min for 2 Hours- Both test conducted on same sample) and BS-6387 CWZ The cable shall sustain 950 deg. C. The cable shall be BS EN 60332-1-2:2004 for Bunched Flame Retardancy (installed as a single or bunched cable self-extinguishes leaving the upper cable sheath unaffected showing the cable does not propagate fire). Cable shall be guaranteed for 10 years from the date of manufacture marked on the cable 2C X 1.5sqmm.

Installation of a System, Complete job

FIRE SUPPRESSION IN PANEL: UL Certified Extinguishing agent filled in PESO Approved Filling Station: 5 Kg FK-5-1-12 Clean agent filled in PESO approved stored pressure type seamless steel cylinder as per IS 7285 with DLP Valve Assembly, Safety Burst Disc at 28 Bar and Mounting Bracket with all necessary fittings & supports Stored Pressure type fitted with Pressure gauge, UV Resistance, Operating Pressure 15 bar, Hydraulic Pressure Tested to 250 bar, Burst Pressure at 350 bar, Red Powder coated.

UL Certified Extinguishing agent filled in PESO Approved Filling Station: 10 Kg FK-5-1-12 Clean agent filled in PESO approved stored pressure type seamless steel cylinder as per IS 7285 with DLP Valve Assembly, Safety Burst Disc at 28 Bar and Mounting Bracket with all necessary fittings & supports Stored Pressure type fitted with Pressure gauge, UV Resistance, Operating Pressure 15 bar, Hydraulic Pressure Tested to 250 bar, Burst Pressure at 350 bar, Red Powder coated.

UL Certified Linear pneumatic Heat Detection Tube for automatic fire detection & suppression system made by special modified polyamide (PA), color red RAL300, burst temperature 1000C to 1400C, inner diameter 4mm, outer diameter 6mm. Pressurized with dry nitrogen at 15 bar pressure with all necessary fittings & supports.

Master Control Unit with audio visual alarm Control Panel, 12 Volt battery, 2 NO/NC potential free relay contact for Main Fire Alarm/BMS/SCADA Integration. Gas discharge led indicator, battery led indicator, system status Led indicator, AC power ON Led indicator with all necessary fittings & supports.

PLUMBING DESIGN BASIS REPORT

Design Basis Report- Plumbing

(Water Supply and Sanitary Installation)

General:

The Plumbing DPR, read in conjunction with the Detailed Plumbing Specification, and all other contract documents forming part of the turnkey contract, has been duly implemented. In case of variances, the stringent provisions indicated in the DPR were adopted in compliance with the directions of the Engineer-in-Charge.

The scope covering Design, Engineering, Supply, Installation, Testing, and Commissioning for Plumbing (Water Supply and Sanitary Installation System) has been executed in full conformity with the latest CPWD Specifications.

The estimation of water supply and sewerage demand was carried out strictly as per NBC, Local Bye-laws, and statutory norms. The different components of the plumbing services, as listed in the DPR, have been completed and commissioned successfully.

Accordingly, the plumbing works stand completed in line with the approved DPR and are now submitted for record and acceptance.-

Internal Plumbing Works

i. Sanitary fixtures & C.P brass fittings
ii. Soil, waste & rain water piping system
iii. Internal domestic and flushing water supply system
iv. Hot water supply system
v. Disposal of soil, waste & rain water pipe to 1st manhole

External Water Supply System

- Raw water supply to the campus has been arranged from the Tube Wells/Bore Wells. Irrigation and flushing water demand is being met from the STP treated water.
- Tube Wells/Bore Wells have been provided as per the DPR to meet raw water requirements of all buildings and facilities.
- The raw water so received has been treated to make it fit for human consumption and buildings requirements.
- A complete water supply distribution network system has been laid across the buildings.
- UG Water Storage Tanks (Fire Water Tanks, Raw Water Tanks, Domestic Water Tanks, Irrigation and Flushing Tanks) have been constructed and commissioned as per relevant norms.
- Distribution systems for Sewer, STP Treated Water have been installed and made functional as per requirements.

Sewerage System

- Sewerage network has been provided from each and every building up to the Sewage Treatment Plant (STP).
- Sewer generated from the buildings is being fed into the Sewage Treatment Plant.

- Recycled water from the STP is being utilized for flushing and irrigation purposes in compliance with DPR.

Storm Water Drainage System

- Proper collection and conveyance system for storm water around all proposed buildings has been executed with suitable disposal arrangements.
- Roof rainwater is collected in masonry chambers, which are interconnected to rainwater harvesting pits for effective disposal and groundwater recharge.
- Open surface rainwater is collected in drain channels and further connected to rainwater harvesting pits, ensuring safe disposal and compliance with DPR provisions.

Garden Hydrant System

- External garden hydrant system has been installed to supply water for horticulture purposes, ensuring adequate irrigation of all landscaping and green areas around the buildings.
- The system has been tested, commissioned, and is fully operational as per the provisions of the DPR.

Pumps & Water Treatment Equipment

- Water supply pumps for residential towers, EWS units, and other associated facilities, as well as flushing water supply systems, have been provided and commissioned.

Basic Objectives

- All sanitary engineering services and specifications have been executed in line with the DPR objectives.
- High standards of materials and workmanship have been ensured.
- Plumbing systems are leak-proof and reliable, designed to provide dependable performance.
- The overall system has been planned and executed to minimize energy requirements.
- All works have been carried out with due care to create minimum nuisance and disturbance to the environment.

List of Codes and Manuals

- The following codes and manuals were strictly followed during design and execution of the Sanitary Plumbing and Fire Fighting Systems, in compliance with DPR:
  i. National Building Code 2016
  ii. Hand Book on Water Supply & Drainage (with Special Emphasis on Plumbing), Bureau of Indian Standards SP-35
  iii. Manual on Water Supply & Treatment (Ministry of Urban Development)
  iv. Manual on Sewerage & Sewage Treatment (Ministry of Urban Development)
  v. CPWD Specifications
  vi. National Building Code 2016 (Part-IV — Fire Protection)

Proposed Water Management System

- The Reduce, Re-use, Re-cycle Model has been successfully adopted for meeting water requirements.

- Measures implemented include:
  - ❖ Disciplined use of water across the campus.
  - ❖ Installation of water-saving toilet fixtures, faucets, and flow regulators.
  - ❖ Adoption of water-efficient landscaping techniques, including selection of appropriate grass and plants, and provision of efficient irrigation systems.

Water Supply System

- Water requirements have been estimated and provided as per the latest acceptable standards.
- References were taken from the National Building Code of India, Public Health Manuals, Ministry of Environment & Forest Guidelines, and CPWD Specifications.
- Inputs from other service consultants were also integrated into the planning and implementation process.
- The system has been fully completed, tested, and commissioned, meeting all DPR provisions.

Design for Water Supply / Waste Water Distribution System

- A continuous water supply system at adequate pressure has been designed and executed as per DPR.
- Main water supply lines from underground tanks and overhead tanks up to the buildings have been laid using Ductile Iron (DI) Class K-9 pipes conforming to IS 8329 (for dia. above 80 mm) and cPVC SDR 11 pipes conforming to IS 15778 (for dia. 80 mm & below).
- All operational valves and fittings have been provided using DI Specials Class K-12 conforming to IS 9523. These are installed in brick/fly ash masonry chambers as per specifications.
- Water supply piping from buildings to overhead tanks, terrace ring mains, and down-take lines in shafts up to floor entry have been provided with cPVC SDR 11 pipes as per IS 15778.
- Concealed piping inside floors and up to end-user points is also executed with cPVC pipes of required grade/class conforming to IS 15778.
- Flushing water pipelines from STP to overhead tanks, shafts, and concealed areas have been provided with DI / cPVC SDR 11 pipes, in line with specifications.
- Storm water / Rain water pipes inside buildings up to first manhole are of UPVC SWR Type-B pipes (6 kg/sq.cm pressure rating), while external storm water networks beyond first manhole are laid in Reinforced Concrete NP3 pipes conforming to IS 458:2003.
- Irrigation water supply has been executed with cPVC SDR 13.5 pipes conforming to IS 15778.
- Soil and waste water pipes from buildings to first manhole are hub-less centrifugally cast (Span) iron pipes epoxy coated (inside and outside) as per IS 15905, and from first manhole to STP, the network is provided with Reinforced Concrete NP3 pipes conforming to IS 458:2003.
- All pipelines have been laid underground up to building shafts, and in shafts they are supported with standard clamps up to overhead tanks, fully conforming to specifications.

Water Metering

- A comprehensive water metering system has been provided as per DPR.
- Sub-metering has been installed to monitor and control consumption across the following applications:
  - ❖ Municipal / Bore Well water supply
  - ❖ Bore water consumption
  - ❖ Treated waste water consumption
  - ❖ Water consumption for landscape / irrigation requirements
  - ❖ Water consumption for flushing systems
  - ❖ Water consumption for air-conditioning cooling tower make-up

Sanitary Works

All sanitary fixtures, C.P. brass fittings and accessories shall be of first quality, approved make, heavy-duty commercial grade, free from manufacturing defects and conforming strictly to the latest relevant Indian Standards (IS Codes).

All plumbing fixtures provided in the Servant Quarters shall be of standard quality, suitable for basic utility usage. In contrast, fixtures installed in the Judge's Residence shall be of superior quality, premium make, and aesthetically appropriate, ensuring enhanced durability, performance, and finish in line with the status and functional requirements of the residence

- All materials shall be:
- ISI marked wherever applicable
- Supplied with manufacturer test certificates
- Subject to approval of Engineer-in-Charge prior to installation

European Water Closets (WCs):

- European type, floor mounted/wall hung as per drawings.
- Dual flush system (4/2 litres) with concealed cistern.
- Conforming to IS: 2556 (Latest Revision).
- Cistern shall be fully insulated to prevent condensation.
- Flush mechanism shall be heavy-duty, suitable for high footfall (hospital/public use).
- Seat cover shall be soft-close, antibacterial, heavy-duty thermoset plastic.

Indian Water Closets (WCs):

- Indian WC (Orissa Pattern) shall be of first quality white vitreous china.
- Conforming to IS: 2556 (Part 3) – Latest Revision.
- Integral footrests with anti-slip surface.
- Trap size: Minimum 100 mm P-trap/S-trap as per layout.
- Water seal depth: Minimum 50 mm.
- Flushing: Dual flush concealed cistern (4/2 litres) or 10 litre exposed cistern as per BOQ.
- Cistern shall conform to IS: 2556.
- Heavy duty PVC/CP flush pipe (32 mm)

Wash Basin

- Wall-hung / Over-counter / Under-counter type as per DPR & drawings.
- Made of high-grade vitreous china with uniform glazing and smooth finish.

- Conforming to IS: 2256 (Part 7): 1995 (Latest Revision).
- Equipped based brass faucets (chrome plated).
- Taps shall be IP65 protected and suitable for hospital use.

Lavatory Basin

- Wall-hung / Over-counter / Under-counter type as per DPR & drawings.
- Made of high-grade vitreous china with uniform glazing and smooth finish.
- Conforming to IS: 2256 (Part 7): 1995 (Latest Revision).
- Equipped based brass faucets (chrome plated).
- Taps shall be IP65 protected and suitable for hospital use.

Urinals:

- Wall-hung vitreous china urinals.
- Conforming to IS: 2556 (Latest Revision).
- Infra-red sensor operated flush valve (battery type).
- Heavy-duty concealed flush valve with anti-splash design.
- Suitable for continuous public usage.

Accessories:

- Soap dispensers, toilet paper holders, grab bars, hand dryers etc.
- Material: Minimum 304 grade stainless steel (mirror/satin finish).
- Thickness not less than 1.0 mm (where applicable).
- Rust-proof, tamper-proof and suitable for hospital use.

Chrome Fittings:

- All fittings shall conform to IS: 781-1984 (Latest Revision).
- Material: Forged brass body (minimum 59% copper content).
- Chrome plating thickness: Minimum 10 micron nickel + 0.3 micron chromium.
- Heavy-duty cartridge (minimum 5 lakh cycle tested).
- Suitable for high pressure and hospital application.

Urinal Partitions:

- Urinal partitions shall be made of 12 mm thick compact laminate (HPL) board, water-proof, termite-proof and anti-bacterial.
- Density: Minimum 1400 kg/m³.
- Edges machine polished and rounded.
- Height: 900 mm to 1200 mm (as per drawing).
- Fixing with SS 304 grade brackets and fasteners.
- All hardware shall be rust-proof and concealed where possible.
- Colour to be approved by Engineer-in-Charge

Plumbing fixtures have been installed with **maximum threshold flow rates** as per DPR:

Plumbing item	Flow rate
Water closets	Dual flush 4/2, where 4 litres for solid and 2 litres for liquid

	waste
Urinals	1.5 litre/flush or less
Kitchen faucet	3.8 litres/minute or less
Lavatory faucet	3 litres/minute
Showers All taps	6 litres/minute 3 litres/minute

Note- Fixtures have been tested at standard reporting pressure of **3 bar** (0.42 N/mm²). Dual flush WCs and reduced flush urinals have been adopted to ensure water conservation.

Water supply Pipe System
As per NBC considering water capacity for half day on terrace overhead tank and one-and-a-half-day capacity for underground water tank

System capacity has been designed as per NBC provisions with 33.33% day storage on terrace overhead tank and 66.67% day storage in underground tank.

- **Domestic Water Supply:**
  - Bore well water is first stored in the Firefighting UG Tank, with overflow connected to the domestic Water Tank.
  - Domestic overhead tank is supplied through hydro-pneumatic system from treated water tank.
- **Flushing Water Supply:**
  - Treated water from STP is stored in underground flushing water tank. Flushing overhead tank is supplied through hydro-pneumatic system.
  - Connections are provided only to urinals and WC cisterns.

- **Internal Building Supply:** Water is distributed under gravity from overhead tanks.
- **Water Supply Piping in Ducts:** Each toilet duct equipped with:
  Cold water supply pipe
  - Hot water supply pipe
  - Hot water return pipe
  - Flushing water supply pipe

- **Water Management System**
  - Water Storage: Provision of 1 day's storage of the total domestic water requirement to ensure uninterrupted supply across all buildings.
  - Recycled Water: Treated wastewater from the STP is reused for irrigation purposes, in compliance with DPR and environmental guidelines.
  - Rainwater Harvesting: Roof runoff and surface water flows are directed to harvesting pits to promote groundwater recharge.
  - Water Conservation: Implementation of low-flow fixtures, meeting or exceeding Green Building standards, to minimize water consumption.

- **Water Supply Distribution:**

- Domestic Water Supply: Water to the Overhead Tanks (OHT) is provided through hydro-pneumatic pumping, ensuring adequate pressure and continuous supply.
- Gravity Distribution: From the OHT onwards, water is supplied to all internal systems via a gravity-fed distribution network.
- Domestic Water Supply: Supplied through a gravity system for all required points.
- Irrigation Water Supply Distributed using transfer pumps to ensure efficient delivery to landscaped areas.

❖ **Hot Water System:**

- Solar Water Heating: Adequate capacity solar water heating systems have been installed for all buildings.
- Coverage: At least 20% of the total hot water demand is met through the Solar Water Heating System, in compliance with MoEF guidelines

❖ **Soil & Waste Pipe System**

- Design Basis: Two-pipe system designed as per IS Code of Practice for Soil & Waste.
- Soil Pipes: Carry discharge from WCs, urinals, etc., and connect directly to the first manhole outside the building.
- Waste Pipes: Carry discharge from basins, kitchen sinks, etc., connecting to gully traps outside the buildings, which further connect to external manholes.
- Internal sanitary disposal is provided through core-cut RCC slabs with suspended piping, complying with structural requirements.

❖ **Pipe Specifications:**

- 40 mm PVC Pipes: Used for wash basin and urinal connections to floor traps.
- 40 mm CP Bottle Traps: Provided for wash basin and urinal connections.
- Soil, Waste & Vent Pipes: Hubless centrifugally cast (SPAN) iron pipes, epoxy coated inside and outside as per IS 15905, are used throughout the system.
- Pipe Joints: All connections are made using SS 304 grade couplings with EPDM rubber gaskets, ensuring leak-proof performance and compliance with specifications

❖ **Design Parameters:**

- Vent Termination: All vertical stacks terminate as vent pipes at terrace level.
- Ground Connection: Vertical stacks terminate at ground floor level and connect to external sewer lines.
- Pipe Sizing & Slope: Pipe diameter and slope have been designed according to load requirements.
- Maintenance Provisions: Cleanout doors and plugs have been provided at required locations for easy rodding and maintenance.
- Installation: Vertical stacks are installed in shafts (external or internal) as per the architectural toilet planning

Basement Drainage System

This report outlines the design basis for the Basement Drainage System provided for the buildings. The system is designed to effectively collect and discharge seepage, wastewater, and storm water from the basement areas and Sewage pits to maintain a dry and hygienic environment. 2 no. Basement Drainage Sumps, Each sump is equipped with twin submersible pumps (1 working + 1 standby) for automatic drainage to the external sewer or storm network

- Storm Water & Firefighting Drainage:
- 300 mm wide drain channel with MS grating.
- 1500×1500×1500 mm sump with 2 pumps (1W+1S).

Sewerage System

6.1. Design Parameters

a)	Velocity		
Minimum velocity at peak		=	0.75 m/sec
Maximum velocity at peak		=	2.4 m/sec
b)	Peak Factor	=	3 times the average flow
c)	Interception factor	=	0.80
d)	Manning Constant	=	0.011 (for pipes)
e)	Design Equation	=	Manning Equation.

6.1.1. **Flow conditions in pipe**

Pipes up to 250 mm dia	=	50% full running.
Pipes from 400-900 mm dia	=	67% full running.

Minimum Depth for Sewers

- Branch Sewers: Minimum depth of 1.5 m (maximum as required).
- Lateral, Main & Trunk Sewers: Depth ranges from 1.5 m up to 6.5 m, depending on the required gradient and site conditions, as per DPR provisions and IS/CPHEEO standards.

Type of Distribution

- Sewer flow is conveyed **entirely by gravity** up to the final disposal point.
- The **external sewer network** is connected to the **centralized Sewage Treatment Plant (STP)**.

Manholes

- Construction: Manholes have been constructed in brick masonry as per CPWD Standard Specifications.
- Cover Slabs: RCC cover slabs with DI manhole covers has been provided, designed for anticipated load.
- Waterproofing: Internal surfaces have been plastered with waterproof cement mortar to ensure water tightness.
- Benching & Channels: Finished smooth to maintain self-cleansing velocity of flow.
- Maintenance Access: Step irons have been provided in manholes deeper than 1.0 m for safe maintenance access.

Rectangular manhole

- For depths less than 0.9mtr depth - 900 mm × 800 mm.
- For depths from 0.9 m and up to 2.5m -1200 mm × 900 mm.

Circular manhole

- For depths above 1.65 m and up to 2.30 m - 1200 mm diameter.
- For depths above 2.30 m and up to 9.00 m - 1500 mm diameter

Spacing of Manholes

- Placement & Junctions: Manholes have been provided at all junctions, changes in direction, changes in pipe diameter, and as per connection requirements from each unit.
- Spacing: Maximum distance between manholes on the main sewer line is 30 meters, depending on pipe diameter and local site conditions.

Manhole Covers

- Medium Duty: S.F.R.C. covers for manholes on service roads, gully traps, and chambers not located on main roads, pedestrian ways, side berms, or lawn areas.
- Heavy Duty: S.F.R.C. covers for manholes, service chambers, and gully traps located on main roads and service roads.
- Specifications: Shape and dimensions of all manhole covers conform to IS 12592.

Rain Water Drainage System

Planning of Storm Water Drainage

- Terrace Rainwater: Internal rainwater has been Collected in clay brick masonry chambers and conveyed through the using NP3 pipes (as per IS 458:2003) to rainwater harvesting pits.
- Open Surface Rainwater: the external rainwater has been Collected in RCC drain channels (aligned with natural drainage per hydrological survey) and conveyed through to rainwater harvesting pits.
- Network: The storm water system has been designed as per site requirements and primarily consists of catch basins and NP3 pipe network.
- Pipe Sizing:
- 110 mm dia UPVC RWP
- 160 mm dia UPVC RWP

Design Parameters

- Roof Drainage Design: Rainfall intensity of 40 mm/hr has been considered (NBC guidelines). Minimum pipe diameter for terrace RWP: 110 mm & 160 mm
- Manhole to Manhole Pipe: NP3 pipes have been used.
- Construction Standards: All manhole sizes, chambers, and pipes have been constructed as per CPWD specifications.
- Campus Storm Water System: RCC pipes, RCC drains with precast perforated covers, clay brick masonry chambers, and manholes have been utilized and Designed for the developed area
- Flow Velocity:
- Minimum velocity at peak = 0.75 m/sec

- Maximum velocity at peak = 2.4 m/sec

Rain Water Harvesting:

- **Roof Runoff Collection:** Rainwater intensity and flow have been considered in the design & UPVC SWR Type-B downpipes sized to handle the roof of each building is drained efficiently through adequately spaced rainwater outlets (khurras) and heavy-duty gauge
- **Pipe Routing:** Rainwater pipes have been located along the periphery of the building, routed with necessary slope, and dropped vertically to ground level (GL).
- **Ground-Level Conveyance:** The collected rainwater has been conveyed to the main storm water drainage at ground level through pipes of suitable diameter, integrated with catch basins at appropriate locations.
- **Pipe Standards**: Rainwater pipes and network conform to NP3 pipes as per IS 458:2003
- Roof & Surface Runoff: Roof runoff and surface water flows have been directed into the proposed rainwater harvesting pits for collection and utilization.
- **Groundwater Recharge**: Rainwater has been collected & recharged into the ground through percolation pits located alongside drains, ensuring replenishment of the groundwater table.
- **External Drain Integration:** Rainwater collected from the external drainage system has been effectively routed to rainwater harvesting and recharge structures.
- Supply and installation of a 100% recycled polypropylene modular tank system (non-plate and non-hyperboloid design) engineered for underground applications. The system shall be based on mat raft foundation with a column base structure and unidirectional assembly of modular units. Each module measures 600 mm × 600 mm × 250 mm and offers an effective water holding capacity of 85 litres, with a void ratio of 94.5% for maximum runoff storage. The design allows tool-free stacking up to 6 meters, making it ideal for deep cavity installations. Made from high-quality recycled PPCP, the structure is resistant to chemicals and high temperatures and offers a minimum service life of 20 years. It is designed to withstand vehicular loads up to SLW 60 (HGV class) with appropriate backfilling and features a double-lock connection mechanism for enhanced stability. The vertical column structure is engineered to distribute loads evenly, with column spacing not exceeding 75–80 mm and a minimum column density of 75–80 columns per square meter. Systems using more than four components per module shall not be permitted.

Rainwater harvesting system to capture at least ‘one-day rainfall*’ runoff volume from roof and non-roof areas has been provided. The rain water harvesting system to capture rain water harvesting or storage system. The calculation is mentioned below.

Irrigation system for lawns and gardens

Gardens and lawns have been irrigated through a combination of Garden Hydrant System and Sprinkler Irrigation System. The garden hydrant system has been provided as per the external irrigation plan, covering the defined scope of work. The sprinkler irrigation system has been installed in the lawns and green areas surrounding the buildings.

Garden Hydrant System, Network System

- A separate and independent garden hydrant system has been proposed to supply water for horticultural operations across all landscaped areas.
- The distribution network for garden mains is designed with CPVC SDR-11 pressure pipes, connected to a dedicated pumping set drawing treated water from the STP outlet.
- All piping for the garden hydrant system shall be of CPVC SDR-11 pressure class, conforming to relevant specifications.
- Garden hydrant outlets of 25 mm diameter shall be provided at intervals of approximately 20–25 meters.
- The garden hydrant pumping system has been planned such that the network is sized to operate a maximum of six outlets simultaneously.

Population & Design Basis

Population estimation and system design have been carried out as per **NBC 2016 (Part 9 – Plumbing Services)**. All water demand, sewage generation, and treatment system capacities have been finalized accordingly.

Engineering Systems Executed

- High-quality materials and workmanship ensured at all stages of construction.
- Leak-proof plumbing system implemented with durable, corrosion-resistant fittings.
- All engineering systems installed are reliable, energy-efficient, and environment-friendly.
- Safety and operational standards strictly maintained in accordance with IS and CPWD guidelines.

Treatment & Heating Systems

- Sewerage Treatment Plant (STP) – Installed, tested, and commissioned.
- Hot Water Systems – Building-wise Air-to-Water Heat Pumps installed on terrace; BEE 3-star rated geysers provided in balance blocks.
- Solar Hot Water Systems – Installed with electrical backup to meet a minimum of 20% of total hot water demand, complying with GRIHA norms.

Water Distribution Network

- All Domestic /STP/ interconnecting pipelines laid underground at appropriate depths with proper bedding, encasement, and protection as per CPWD Specifications.
- Valves, chambers, and thrust blocks provided as per approved drawings.

Safety & Operational Provisions

- Pump room /STP rooms equipped with:
- Elastomeric mats (as per IS standards) for electrical panels.
- Fire extinguishers and fire buckets placed at designated points.
- Safety gloves, PPE kits, and warning charts installed.
- Framed schematic diagrams (SLD) and safety signage displayed on walls.

Testing & Commissioning

- All systems have been tested, flushed, disinfected, and commissioned.
- Test reports and as-built drawings submitted for departmental record.

Water Demand Projection & Water Supply System Scope: Water estimation, storage, and distribution have been considered only for the buildings/developments under the current scope of work and not for future expansions.

Water Storage Underground & Overhead Tanks:

- Underground water tanks have been provided for a minimum 66.67% domestic requirement.
- Overhead tanks (OHT) at terrace level have been provided for 33.33% capacity.
- Firefighting tanks have been designed as per NBC Code and DBR specifications.
- Internal surfaces of all tanks have been finished with APP-modified bitumen membrane waterproofing.

Tank Capacities:

- Underground Soft Water and Irrigation Water Tanks have been provided as per NBC 2016 norms.
- Domestic water has been stored in Domestic Tanks and distributed to OHTs via dedicated hydro-pneumatic pumps.

Water Transfer & Distribution Domestic Water:

- One set (1W + 1S) of hydro-pneumatic pumps has been provided per building with minimum one standby. Water has been distributed from OHTs by gravity.

Flushing Water:

- Dedicated pumps have been provided to transfer flushing water from UG tanks to respective OHTs.

Hydro-pneumatic pumps

- One hydro-pneumatic pump set (2 Working + 1 Standby) for Domestic Water Supply.
- One hydro-pneumatic pump set (2 Working + 1 Standby) for Flushing Water Supply.
- Water shall be pumped from UG tank to OHT.
- Internal distribution shall be by gravity from OHT.
- Hydro-pneumatic system shall maintain uniform pressure in distribution lines.

Pump Specification

- Type: Multistage centrifugal pump.
- Capacity: As per peak hour demand calculation.
- Head: Based on static head + friction loss + residual pressure requirement.
- Motor: IE3 efficiency, IP55, 415V, 3 Phase.
- Impeller: SS 304.
- Mechanical seal: Heavy duty.

Pressure Criteria (Camps Use)

- Minimum residual pressure at farthest tap: 1.0 bar.
- Flushing line pressure: 0.8–1.0 bar.
- Maximum velocity in pipe: 1.5–2.0 m/s.

Control & Protection

- Automatic duty/standby alternation.
- Dry run protection.
- Overload & short circuit protection.
- Level controller in UG tank & OHT.

Pump Sizing & Operation:

- Pumps have been sized to ensure ~8 hours of operation to fill OHTs, considering building height, pipe friction, bends, and site conditions.
- One standby pump has been provided for each type.

OHT Capacity:

- Minimum 500 L capacity per OHT has been provided; PVC OHTs have been installed up to 2000 L as directed.

Water Meters, Valves & Controls

- Digital water meters have been installed for domestic, flushing, irrigation, and Cooling Tower make-up water, complying with IGBC Platinum requirements.
- Motorized valves and level sensors/controllers have been provided for automatic tank filling. Systems have been integrated with BMS for overflow prevention.

Motorized Valve system for OHT (Over Head Tank) with **top & bottom level indication** - this is a buildings plumbing automation setup.

- Low level (Bottom sensor) → valve opens → tank fills
- High level (Top sensor) → valve closes → overflow stops
- Optional: indicator panel shows tank status

Valve

- **Type:** Motorized Ball Valve / Butterfly Valve
- **Size:** 15 mm to 100 mm (depends on pipe size)
- **Body Material:** Brass / SS304 / Cast Iron
- **Actuator Voltage:**
- 230V AC (most common)
- 24V DC (safe control systems)
- **Power Consumption:** 5W – 25W
- **Operation:**
- ON/OFF (2-point control)
- **Opening/Closing Time:** 5–15 seconds
- **Pressure Rating:**
- Up to 10 bar (typical domestic/industrial)
- **IP Rating:** IP65 (recommended for outdoor tanks)

Pressure Reducing Valve (PRV) for OHT System

A **Pressure Reducing Valve (PRV)** is a self-operating control valve used to **reduce high inlet water pressure to a constant, safe outlet pressure**, ensuring protection of pipelines, fittings, and storage systems like Over Head Tanks (OHT).

- Type: Direct acting
- Size: 15–50 mm
- Inlet Pressure: Up to 10–16 bar
- Outlet Pressure: 1–6 bar (adjustable)
- Material: Brass / CI / SS
- Temperature: Up to 80°C

Pump Room & Piping

- Pumps/motors have been mounted on suitable foundations with anti-vibration arrangements.
- Pipes have been fixed on supports with pedestals as required.
- Flow rates have been selected to meet building requirements and site conditions

DEMAND CALCULATION CHART

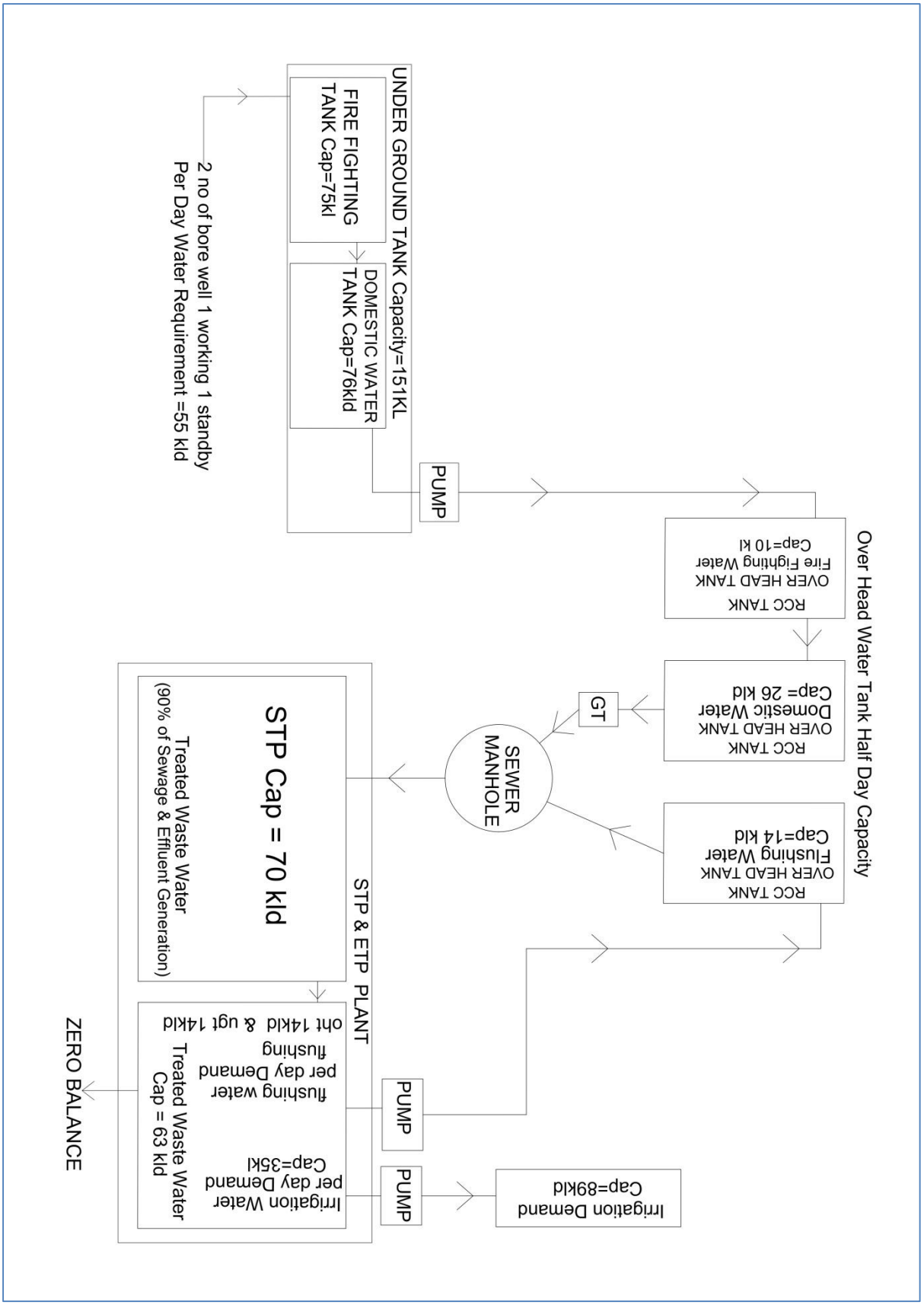
JUDICIAL OFFICERS FLATS-WAPCOS-DWARKA-NEW DELHI					
SUBJECT: WATER TANK CAPACITIES & SPACE REQUIREMENTS					
1	TOTAL WATER REQUIREMENT	KLD	Unit	LITER	Area requirement in sqm
i	OHT Domestic Water Demand	26	m^3/ (0.5 day)	26000	15.29
ii	UGT Domestic Water Demand	76	m^3/ (1.5 day)	76000	21.71
iii	OHT Flushing Water Demand	14	m^3/ (0.5 day)	14000	8.24
iv	UGT Flushing Water Demand	14	m^3/ (0.5 day)	14000	4.00
v	OHT Fire Fighting Water Demand	10	$_m3$	10000	5.88
vi	UGT Fire Fighting Water Demand	75	$_m3$	75000	21.43
	Per Day Water Requirements	**51**	**m^3/ (day)**	**51000**	
	Round Off Per Day Water Requirements	**55**	**m^3/ (day)**	**55000**	
	1 No. of Bore well per day water capacity Proposed 2 no. of bore well (1 no. of working & 1 standby)	**55**	**m^3/ (day)**	**55000.0**	
2	(Sewage Treatment Plant) S.T.P. (Capacity & sizes)	KLD	Unit	15	
i	Total Water Requirements	80	m^3/day	43	
ii	Total Sewage Generation @ 85% of Water Requirements	68.0	m^3/day	68000	
iv	S.T.P. Capacity required	70	m^3/day	70000	
v	**Proposed Capacity of STP**	**70**	m^3/day	8	
vi	Treated Waste Water (90% of Sewage Generation)	63	m^3/day	8	
vii	**Area required (Approx.)**	**47**	m^2		
4	**STP Treated Water Management**				
	Total STP Treated Water	**63**	**m^3/day**		
c	Total Flushing Water Demand	**28**	**m^3/day**		
c	Total Hoticulture Water Demand 6 ltr per sqm (nbc)	**35**	**m^3/day**		
5	**Under Ground Tank**				
a	Fire Fighting Capacity	75	**m^3**		
b	Domestic	76	**m^3/day**		
	Total Under Ground Water Tank Capacity	**151**	**m^3**	60.4	

JUDICIAL OFFICERS FLATS-WAPCOS-DWARKA-NEW DELHI

WATER DEMAND CALCULATIONS

S. No.	Unit Name	No. of Users per Unit	Domestic potable Water Consumption per Person per day	Flushing Water Consumption per Person per day	Domestic Potable water demand per day	Flushing water demand per day	Remark
		34.0		(LPCD)	LPD	LPD	
1	TYPE-VI(G+12)						
	No of Persons	238	90	45	21420	10710	
	Visitors 5%	12	5	10	60	119	
							NBC 2016 PART -9
	Sub-Total				21480	10829	
	TOTAL WATER DEMAND PER DAY (including hot water & drinking water)				21,480	10,829	
				ROUNDUP	21	11	
	DESCRIPTION	LTR		KLD	Area requirement in sqm		
	DOMESTIC WATER CAPACITY						
	Proposed Capacity of Over head Domestic Potable tank (50% of Requirements (For Gravity based System	10739.8		11.0	6.47		NBC 2016 PART -9
2	Proposed Capacity of Under Ground Domestic Potable tank (150% of Requirements (For hydro pneumatic pump based System	32219.3		33.0	9.43		NBC 2016 PART -9
	FLUSHING WATER CAPACITY						
	Proposed Capacity of Over head Flushing tank (50% of Requirements (For Gravity based System	5414.5		6.0	3.53		
	Proposed Capacity of Under Ground Flushing tank (50% of Requirements (For hydro pneumatic pump based System	5414.5		6.0	1.71		
	FIRE FIGHTING WATER CAPACITY						
	Proposed Capacity of Over head Fire Fighting tank as per NBC part 4 2016	5000		5.0	2.94		NBC 2016 PART -4
3	Proposed Capacity of Under Ground Fire Fighting tank as per NBC part 4 2016	0		0	0.00		NBC 2016 PART -4
	SOLAR WATER HEATER & RO PLANT						
	Proposed Capacity of Hot water 25 ltr. Per person	5950		6.0	12		NBC 2016 PART -9
	Proposed Capacity of Drinking water 5 ltr per person						Public health engineering book

JUDICIAL OFFICERS FLATS-WAPCOS-DWARKA-NEW DELHI							
WATER DEMAND CALCULATIONS							
S. No.	Unit Name	No. of Users per Unit	Domestic potable Water Consumption per Person per day	Flushing Water Consumption per Person per day	Domestic Potable water demand per day	Flushing water demand per day	Remark
		52.0		(LPCD)	LPD	LPD	
1	TYPE-V(G+12)						
	No of Persons	312	90	45	28080	14040	
	Visitors 5%	16	5	10	78	156	
							NBC 2016 PART -9
	Sub-Total				28158	14196	
	TOTAL WATER DEMAND PER DAY (including hot water & drinking water)				28,158	14,196	
				ROUNDUP	28	14	
	DESCRIPTION	LTR		KLD	Area requirement in sqm		
	DOMESTIC WATER CAPACITY						
	Proposed Capacity of Over head Domestic Potable tank (50% of Requirements (For Gravity based System	14079.0		15.0	8.82		NBC 2016 PART -9
2	Proposed Capacity of Under Ground Domestic Potable tank (150% of Requirements (For hydro pneumatic pump based System	42237.0		43.0	12.29		NBC 2016 PART -9
	FLUSHING WATER CAPACITY						
	Proposed Capacity of Over head Flushing tank (50% of Requirements (For Gravity based System	7098.0		8.0	4.71		
	Proposed Capacity of Under Ground Flushing tank (50% of Requirements (For hydro pneumatic pump based System	7098.0		8.0	2.29		
	FIRE FIGHTING WATER CAPACITY						
	Proposed Capacity of Over head Fire Fighting tank as per NBC part 4 2016	5000		5.0	2.94		NBC 2016 PART -4
3	Proposed Capacity of Under Ground Fire Fighting tank as per NBC part 4 2016	0		0	0.00		NBC 2016 PART -4
	SOLAR WATER HEATER & RO PLANT						
	Proposed Capacity of Hot water 25 ltr. Per person	7800		8.0	16		NBC 2016 PART -9
	Proposed Capacity of Drinking water 5 ltr per person						Public health engineering book


UNDER GROUND TANK Capacity=151KL
FIRE FIGHTING TANK Cap=75kl
DOMESTIC WATER TANK Cap=76kld
2 no of bore well 1 working 1 standby
Per Day Water Requirement =55 kld
PUMP
Over Head Water Tank Half Day Capacity
RCC TANK
OVER HEAD TANK
Fire Fighting Water
Cap=10 kl
RCC TANK
OVER HEAD TANK
Domestic Water
Cap= 26 kld
RCC TANK
OVER HEAD TANK
Flushing Water
Cap=14 kld
GT
SEWER MANHOLE
STP & ETP PLANT
STP Cap = 70 kld
Treated Waste Water
(90% of Sewage & Effluent Generation)
Irrigation Water
per day Demand
Cap=35kl
flushing water
per day Demand
flushing
Treated Waste Water
Cap = 63 kld
PUMP
PUMP
Irrigation Demand
Cap=89kld
ZERO BALANCE

Hot Water System including Solar Hot Water System

General

The EPC Contractor has carried out the Design, Engineering, Supply, Installation, Testing, and Commissioning for the Hot Water System, including the Solar Hot Water System. The entire hot water requirement of the campus has been met through Heat Pumps, Energy Efficient Electric Geysers (minimum BEE 3-star rated), and the Solar Hot Water System. The Solar System has been provided in compliance with GRIHA Norm requirements.

Heat Pump & Electric Geysers

- Water has been supplied to Heat Pumps and Electric Geysers after preheating through the Solar Hot Water System.
- Heat Pumps have been provided for all buildings' load and have been installed at the terraces.
- Hot water has been supplied to all areas of the buildings, including showers, kitchen/pantry sinks, and wash basins, based on individual building requirements to meet total hot water demand.
- Electric Geysers have been provided for residential units.

Solar Hot Water Heating System

- Solar Hot Water Generation Systems with recirculation pumps have been provided for all buildings to meet approximately 40% of the total hot water requirement of each building.
- The system has been selected based on geographical location, cost optimization, functional requirement, and space availability.
- Flat plate type solar hot water systems have been provided, sized according to each building's hot water demand.
- Quantity of Solar Hot Water Collector Panels has been calculated separately for each building.
- Hot Water Recirculation Systems have been provided for all buildings as required.

System Components

The Solar Hot Water System has been provided complete with:

- Solar collector panels and suitable supports
- Mixing tanks as per building requirements
- Absorbers and heat exchangers as per building requirements
- Electrical control panels
- Backup heaters and make-up water tanks
- Recirculation pumps
- Interconnecting pipes with suitable insulation, valves, pressure gauges, and thermometers

All components have been installed as per OEM standards and directions of the Engineer-In-Charge.

Water Supply & Usage

- Solar Hot Water System has been provided for academic, boy's hostel, girls hostel buildings in accordance with directions of E-I-C, meeting ECBC norms.

- Dedicated water supply systems have been provided from the solar hot water tanks to the requisite locations.
- Hot water has been supplied for bathing, washing hands, utensils, clothes, laundry, etc.
- Hot water points have been installed at tap points/shower points in bathrooms, kitchen sinks, wash basins, laboratories' sinks, laundry, and other locations as required for functional purposes.

Sewage Treatment Plant

General

The EPC Contractor has carried out the Design, Engineering, Supply, Installation, Testing, and Commissioning for the Sewage Treatment Plant (STP)

Design, Fabrication, Supply, Installation, Testing, and Commissioning of **70 KLD STP (on MBBR Technology)** have been completed.

- Structural design and construction of RCC treated water storage tanks have been executed.

Scope of EPC Contractor

- Flow Diagram of STP has been prepared.
- Capacity of treated water storage tanks has been provided.
- Master Plan indicating location and coordinates for STP layout at site has been prepared.
- Sewer line network up to STP from various buildings/facilities under construction has been laid.
- Pumping of STP treated water for flushing, irrigation, and HVAC make-up water has been implemented.

All drain lines for sewage and effluent waste have been supplied and laid from various buildings/blocks to the STP. Treated water has been pumped and distributed to required locations for flushing, irrigation, and cooling towers for HVAC systems.

All balance works (civil, electrical, plumbing, etc.) pertaining to STP have been completed.

Sewage Source & Treatment

The source of sewage has been identified as soil and wastewater from toilets, kitchens, , etc., of the, Residential Blocks, All equipment has been designed to fit within allowable space and height at site. Treated wastewater has been used for flushing, cooling tower make-up, and landscape irrigation to the maximum extent possible.

- RCC tanks for STP have been provided.
- Common Plant Room for STP has been constructed.
- STP have been designed for 16–20 hours of operation.
- Wastewater estimation, treatment, and distribution have been carried out only for buildings/developments under the current scope.

STP Plant Room

- Sufficient maintenance space has been provided inside the STP room for accessibility of pumps, panels, etc. during repair and maintenance activities.
- The STP room has been ventilated with adequate ACPH as per NBC 2016 code.
- Suitable sumps with submersible pumps and level indicators have been provided, with proper slopes to prevent stagnancy and channel water to the nearest drainage sump.
- STP tank sizes have been provided as per functional requirements, OEM standards, and directions of the Engineer-In-Charge.
- Safety equipment/items, including elastomeric mats, fire buckets, extinguishers, gloves, safety charts, framed schematics/SLD, etc., have been installed.
- SCADA system for STP & has been installed.

Sewage Treatment Plant (MBBR Technology)

- 70 KLD MBBR-based STP has been installed to meet specified outlet water parameters.
- The plant has been provided with pumps (non-clogging monoblock type), blowers, bar screen chambers, grease traps, equalization tanks, reaction tanks, centrifuge/filter press, sludge holding tanks, multi-grade filters, activated carbon filters, pressurized sand filters, clear water tanks, MBR hollow fiber membranes, anoxic tank, aeration tank, level sensors, instruments, interconnecting piping (PVC, MS, SS, GI as applicable), valves, tube settler, chlorine dosing, pressure gauges, control panels, and electrical wiring.
- Tanks have been constructed as partial under/over-ground, using RCC or fabricated metal as per requirement.
- STP plant room has been ventilated suitably.
- One standby pump has been provided for each type.

MBBR processes have provided a substantially clarified and disinfected effluent suitable for discharge to sensitive bodies or for reuse in urban irrigation, utilities, or toilet flushing.

- STP panels of required size and number of feeders have been installed during the first phase, with provision for necessary spares for future use

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Desired Quality after Treatment

a. Desired Effluent Quality (After Treatment):

Sl. No	Parameter	Unit	Treated water
1	pH	-	6.5 - 8.5
2	Suspended solids	Mg/l	< 100
3	BOD	Mg/l	< 150
4	COD	Mg/l	< 300
5	Oil & Grease	Mg/l	<5

b. Desired Sewage Quality (After Treatment):

Sl. No	Parameter	Unit	Treated water
1	pH	-	6.5 - 8.5
2	Suspended solids	Mg/l	<5
3	BOD	Mg/l	< 5

4	COD	Mg/l	<10
5	Oil & Grease	Mg/l	Nil

Treated discharge effluent/sewage water has been made to meet all relevant norms, including BIS standards and IGBC Platinum compliances.

FOR STP			
Sl. No.	**Pump**	**Pump Position**	**Application**
1	Submersible Raw Sewage Pump	Between Raw Sewage Tank and Anoxic tanks. Then over flow to aeration tank, then over flow to MBR Tank	To transfer raw sewage to MBR Tank
2	Recirculation Pump	Between Tube Settler Tank and Sludge Holding Tank	To transfer sludge generated in Tube Settler Tank to Sludge Holding Tank and MBR Tank. The purpose of sending it to MBR Tank is to dilute the concentration of sewage in the MBR Tank which will increase the overall efficiency of the Plant.
3	Filter Feed Pump	Between Clear Water Tank and Multi-Grade Filter	To transfer Clear Water from Clear Water Tank to Multi-Grade Filter
4	Flushing Water Pump	Between Treated Water tank to Overhead Tank	To supply treated flushing water to Overhead tank filling of Buildings
5	Bypass Sewage Transfer Pump	Connected to Equalization Tank	To transfer sewage to the last manhole connection to municipal external drain.
6	Soft Water Transfer Pump	Soft water treated tanks to Cooling Tower make up tanks for DG Sets & HVAC	To Pump Soft water treated tanks to Cooling Tower make up tanks for DG Sets & HVAC
Sump Pumps to be provided for plant room drainage			

Disposal points for excess sewage in the event of an STP overflow/failure have been identified, and details such as the location of existing manholes, invert levels, pipe diameters, and materials have been verified with local bodies. The necessary sewage and wastewater piping has been provided to discharge into the designated manholes of the local bodies

FIRE FIGHTING - DESIGN BASIS REPORT

Design Basis Report- Fire Fighting
(Fire Fighting System)

General:

The firefighting DPR given below shall be read in conjunction with the detailed firefighting Specification, List of Make & overall other contract documents forming part of the turnkey contract. In case of any variance, firefighting requirements given here in DPR or stringent among those shall supersede any other requirements mentioned in any other parts of turnkey contract document & the instructions / directions of engineer-in-charge will be binding on the contractor.

The EPC Contractor shall carry out Design, Engineering, Supply, Installation, and Testing & Commissioning for Fire Fighting System. The work shall in general conform to the Latest CPWD Specifications. The water supply and sewerage demand shall be estimated, based on the population as required by, NBC, Local bye Laws norms. The different components related to services are listed as below: -

Fire Fighting system shall comprise of Wet Riser /Hydrant (Internal & External), Sprinkler system, Gas flooding system for panels, Computer Rooms & other sensitive areas, Fire Extinguishers, Fire Signage's near Fireman's lift, Fire Exits, Fire Brigade Inlet/Draw Out Connections etc. proposed for various Buildings. Suitable size shafts, cutouts, Niche, openings etc. shall be provided to facilitate installation of Pipelines etc. in all floor slabs of various buildings for various service areas, as required.

All shafts, cutouts, Niche, openings etc. provided on floor slabs and walls etc shall be suitably closed after laying of services lines as per fire safety norms as per NBC 2016 with 2 hour rated fire sealant material. All vertical & horizontal openings, cutouts, shafts etc in all buildings shall be closed with fire sealant materials procured from OEM as per approved make list. Fire containment installation shall be done by the OEM Accredited Fire Specialty Contractor or by certified installers gone through OEM training and in accordance with OEM guidelines and UL system test certificates or approved EJ document. Fire Specialty Contractor needs to submit work completion certificate along with installation report for periodic inspection & maintenance purpose. Doors shall be provided for all shafts at all floors as per fire safety norms as per NBC 2016.

The ratings and capacities of various equipment are based on NBC 2016 Part - IV and subject to revision during detailed engineering stage. The firefighting system is proposed on basis of type of occupancy as per NBC 2016 Part -IV and building Height. The system proposed are water based and gas based. Water based Fire suppression system is having piping network inside and outside the building with internal and external Hydrants, First Aid Hose reel at regular intervals according to various type of occupancy. The distribution system is finally connected to ring main system for firefighting.

Sprinkler system with water distribution pipes sprinkler heads above and below false ceiling is designed to actuate automatically to extinguish the fire by discharge of water when room temperature crosses 68˚ C in case of fire.

The following standards, bye-law, manual has been followed in designing the firefighting system:-

a. Relevant IS codes published by Bureau of Indian Standards.
b. National Building Code 2016, Part IV - Fire and Life Safety.
c. Pumps, Valves and Accessories shall be UL listed and FM approved.
d. CPWD General Specifications for Electrical Works-part V (Wet Riser & Sprinkler System-2006).
e. NFPA/UL/FM certifications & TAC for guidance.
f. Water Requirements:
g. Water services for Hydrants and sprinkler system shall be stored in underground / overhead tanks.

Underground Static Fire Tanks: Underground reservoir shall be provided of 75 KL capacity as per latest NBC-16 Table No. 7 / Bye laws.

Overhead storage fire tank: -
Overhead fire water tanks on the terrace will be provided for down comer system and as supplementary fire storage as per NBC requirement/ Bye laws.

The effective capacity of reservoir, as per Table 7 of NBC 2016 Part – 4, is given below: -

Sl. No.	Underground/ Overhead Tanks	Capacity of Fire Reservoirs
1.	Under Ground Static Water Storage Tank	75000 Ltrs
2.	Terrace OH Tank	Capacity as per NBC 2016 - Part IV -Table -7

System Description: - The Fire Fighting System shall consist of Diesel Fire Pumps, Electrical Driven Fire Hydrant pump, ,Jockey Pumps, Fire hydrant (Internal & External), Air Cushion Tank with air release valves for all risers, Down comer system with /without terrace pumps, Pressure vessel, associated instruments, cabling, piping (internal & external), valves, Fire Brigade inlet connections, draw out connections for each wet riser, fire signage's, extinguishers, Gas based fire suppression system, Fire detectors, Discharge Nozzles, control panel etc. has to be provided as per NBC 2016 requirements. Jockey pumps shall maintain pressure in all water lines for Hydrants & Sprinklers fully charged under pressure for full Automatic operation in case of fire. In case of slow pressure loss, jockey pump will start and at about 1 kg/cm2 pressure loss in the system, jockey pump will not start and main pump will start automatically.

Shafts/Cut Outs & Room Provisions: Minimum size of shafts to be provided to accommodate sprinkler/wet riser/down comer /drain pipes etc. will be 1200 X 2100 MM (approx.) and to be provided at suitable locations as per relevant codes & standards. At places where this size is not feasible, shaft size as per site conditions meeting functional requirement may be accepted as per directions of E-I-C.

Fire Control Room shall be provided In Ground Floor of Hospital Building which shall be easily accessible & shall accommodate all fire alarm system panel/public address system panel etc.

Glazing &Windows: Glass façade/ windows shall be in accordance with the following:

- All gaps between floor-slabs and façade assembly shall be sealed at all levels by approved fire resistant sealant material of equal fire rating as that of floor slab to prevent fire and smoke propagation from one floor to another.
- Openable glass panels in façade glazing & windows shall be provided on each floor and shall be spaced not more than 10 m apart measured along the external wall from center-to-center of the access openings. Such openings shall be operable at a height between 1.2 m and 1.5 m from the floor, and shall be in the form of openable panels (fire access panels) of size not less than 1 000 mm × 1 000 mm opening outwards. The wordings, 'FIRE OPENABLE PANEL - OPEN IN CASE OF FIRE, DO NOT OBSTRUCT' of at least 25 mm letter height shall be marked on the internal side. Such panels shall be suitably distributed on each floor based on occupant concentration. These shall not be limited to cubicle areas and shall be also located in common areas/corridors to facilitate access by the building occupants and fire personnel for smoke exhaust in times of distress.

Egress components: -

- Egress components to be considered are the no. of exits to which access is provided, capacity of exit access, travel distance to an exit, directional exit etc.
- The width of corridors, aisles/ramps required for exit access shall be sufficient to ensure smooth flow of occupants to exit. Exits shall be so located that the travel distance on the floor shall not exceed distance as mentioned in NBC 2016.
- No exit doorway shall be less than 1000 mm in width except in assembly buildings where door width shall not be less than 2000 mm in width. All exit doorways shall not be less than 2000 mm in height.
- The requirements of nos. of staircases shall supplement the requirements of different occupancies as per NBC 2016 norms.

Pressurization, Compartmentation, Fire Door & Fire Sealing:

- Pressurization of enclosed Staircase/Lift Lobby/Lift well provisions to be considered as per NBC 2016 requirements.
- Mechanical ventilation system for basement shall be designed to permit min. 12 ACPH or as per relevant codes in case of fire or distress call.
- All floors shall be compartmented / zoned with area of each compartment conforming to NBC 2016 provisions depending upon usage & area/building type.
- Smoke exhaust fans in mechanical ventilation system shall be fire rated &shall withstand 250 degree Celsius for 120 minutes.
- As per NBC 2016, For vertical fire sealing the Staircase and Lift lobby door shall be 120min. fire rated, Electrical and HVAC shaft doors shall be 120 min. fire rated and all Plumbing shafts shall have 30 min. fire rated doors and for horizontal fire sealing there will be two compartments in each block segregated with 120 min. fire rated doors .
- Openings in walls or floors which are necessary to be provided to allow passage of all building services like cables, electrical wirings, telephone cables, plumbing pipes etc, shall be protected by enclosure in the form of duct / shafts having a fire resistance not less than 120 min. The inspection door for electrical shafts / ducts shall be not less than 120 min fire rated.

- Every vertical opening between the floors of a building shall be suitably enclosed or protected. Reasonable safety to the occupants while using the means of egress by preventing spread of fire, smoke or fumes through vertical openings from floor to floor to allow occupants to complete their use of means of egress.

Access to Fire Tenders:-

- For access to fire tenders, a clear motor-able approach of at least 6 meters shall be kept for movement of fire tenders all around the building. The width of the main entrance to the complex shall not be less than 5.5 meters.

Location & size of Fire Pump House:-

- The fire pump house shall be located adjacent to Partial Under/Over ground fire tanks. The slab of UGT shall be designed structurally to take the load of fire rescue tender (if coming in the drive way area).
- The base of the water tank shall be kept at a level 450 mm to 600 mm (or as desired as per codes) above the level of base of fire pump room so that pumps operate under positive suction conditions & the entire water capacity is above the body of the fire pumps as per best fire engineering practice.
- Fire Pump House shall be separated by fire walls all around & doors shall be protected by fire doors (120 mins rated).
- The size of Fire pump house & distance between pumps, pumps & walls, panel & wall etc. shall be as per latest IS codes/NBC 2016.
- Sufficient maintenance space shall be provided inside the fire plant room for accessibility of various pumps, panels etc. during repair & maintenance activities.
- Fire Plant Room shall be suitably ventilated considering adequate ACPH as per NBC 2016 code.
- Suitable size Sumps with sufficient sized submersible pumps & level indicators to be considered in plant room for drainage. Also, proper slope to be provided in Fire Pump room so that there is no stagnancy of water during any leakage & it is properly channelized to nearest drainage sump.
- Firefighting pipes from Fire Pump Room to various buildings shall be laid underground at suitable depth as per CPWD specs. Adequate no. of hume pipes having suitable dia. with spare shall be laid across the roads/pathways etc.
- Fire Pump Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire buckets, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.

Pumps & related Equipment/Piping & Related Accessories: -

- Quantity & Type of Fire Pumps (Electric driven Jockey/ Electric driven Terrace Booster/ Electric driven Hydrant/ Electric driven Sprinkler/ Diesel driven Pumps) shall conform to NBC 2016/relevant IS codes.
- All fire pumps shall be with positive suction arrangements.
- Capacity of the Pumps shall be selected as per latest NBC 2016 /NFPA/IS codes & Head as per Building Height & Frictional losses due to bends, pipe lengths etc.
- Horizontally mounted end suction single/multi stage, single/multi outlet energy efficient centrifugal pump, suitable for operation on 415 volts ± 10%, 3 phase, 50 HZ A.C supply, IE-3 Class efficiency motor, complete with flexible coupling (double arch) and coupling

guard as required. Fire pump having C.I. body, bronze/gunmetal impeller and S.S. Shaft with mechanical seal to be considered. Casing shall be designed to withstand 1.5 times the working pressure.

- Diesel driven pump with engine (Min. 4 Cylinders), water cooled radiator based cooling & shall be complete with cooling system, fuel system, fuel tank (to cater for min. 2 hours), inter connecting piping, starting system, governing system, PRV, exhaust system with residential silencer suitable for outdoor installation & silencer piping shall be extended upto 1 m, outside pump house duly insulated with 50 mm thick glass wool/ rock wool & 1 mm thick aluminium cladding. Flexible connection in between exhaust pipe & pump needs to be provided to suppress vibrations.
- All the fire pumps shall cut-in automatically based on the pressure settings in pressure switch, so as to ensure that the entire fire main line, risers etc. are pressurized on a continuous basis.
- The jockey pump shall automatically cut-out based on the pressure settings of pressure switch. However, the remaining fire pumps shall cut off only in the manual mode.
- All Foundation (PCC/RCC) for Equipment including foundation bolts & vibration isolation springs/pads shall be provided.
- Mild steel (Class 'C') pipes confirming to IS: 1239/3589 including all fittings like bends, elbows, tees, anchor fasteners, couplings etc. shall be used in firefighting system.
- Suspenders, Brackets & Floor/Wall supports for suspending / supporting pipes to be provided.
- Pressure gauge needs to be provided at each landing/ floor of the building for wet riser/down comer system.
- Till 50 mm dia. Pipe, screwed joints shall be provided & 65 mm dia. & above, welded joints shall be provided.
- Suction dia. & discharge dia. of pumps shall be as per pump discharge as per OEM standards.
- The entire pipe work (above ground), pump etc. shall be painted with one coat of primer & two or more coat of red colour shade no. 536 of IS:5 (Post Office synthetic enameled red paint) as per directions of Engineer-in-Charge.
- At terrace/Remote level hydrant, minimum 3.5 kg/sq.cm. pressure shall be maintained.
- The pipeline shall be designed with suitable flow velocity & friction factor as per relevant standards.
- All pipes below ground will be protected against soil corrosion by wrapping & coating material as per IS: 10221.
- Pipes of 150 mm dia. & below, will conform to IS: 1239. Pipes of 200 mm dia. & above will conform to IS: 3589.
- Suitable Nos. of Installation Control Valve (ICVs) to be considered conforming to latest IS codes depending upon no. of sprinklers.
- All necessary valves of PN 16 rating (min.) like butterfly/ globe/ gate/ non return/ sluice, Y/Pot Strainers, pressure gauges etc. to be considered as per requirement (controlling flow/ isolating/one-way flow etc.) & meeting the functionality.
- Pressure vessels shall be provided with all the terrace pumps & at plant room also.
- All Pumps shall be provided with flexible bellows (double arch, PN-16 Rating) to dampen vibration/noise at source.
- Vibration Isolators/Anti Vibration Pads needs to be provided for all pumps to absorb vibration at source.

- Orifice Plate shall be considered to reduce pressure on individual hydrant to maintain operating pressure of 3.5 kg/sq.cm.
- Air vessel/Pressure vessel of suitable size need to be provided in fire plant room & near terrace pump. To compensate for slight losses of pressure in the system and to provide an air cushion for counteracting pressure surges / water hammer in the pipe work air vessel conforming to IS: 3844 shall be furnished in the pump room near pump. The air vessel shall normally be half full with water and remaining filled with air which shall be under compression when the system is in normal operation.
- Air cushion tanks with air release valves needs to be provided for all risers of sprinkler/hydrant. For one no. wet riser in shaft, one air cushion tank at riser/terrace pump may be acceptable as per directions of E-I-C. For hose reel risers, air release valve will be sufficient at the riser top.
- Pump/ Motor placed on Terrace /open area should be weather proof type & required size of canopy also needs to be provided.
- All pipes should be placed at fixed support. Pedestals at suitable distance to be provided as per requirements & directions of E-I-C.

No. of Pumps with capacities proposed in Fire Pump Room:-
Underground Pump Room

Sl. No.	Fire pump Room Equipment as per NBC 2016	Fire Pump Room Equipment to be Provided	Remarks
1.	2280 LPM – 1 no. Electric Driven Pump (For Both Sprinkler & Wet Risers)	2280 LPM – 1 No. Electric Driven Pumps (1 No. Electric Driven Pump for Wet Riser & basement sprinkler System)	As per NBC-2016 norms and considering Stringency of Building Type
3.	2280 LPM – 1 no. Diesel Driven Pump (For Both Sprinkler & Wet Risers)	2280 LPM – 1 No. Diesel Driven Pumps (For Wet Risers & basement sprinkler)	As per NBC-2016 norms
4.	180 LPM- 2 no. Jockey Pump (For Both Sprinkler, Water curtain & Wet Risers)	180 LPM- Jockey Pump for Wet Risers , basement Sprinkler & water curtain sprinkler	As per NBC-2016 norms and considering Stringency of Building Type

Terrace Pump:

Sl. No.	Terrace pumps as per NBC 2016	Terrace pumps Proposed to be Provided wherever applicable	Remarks
1.	Not required	Not required	Not required

Wet Riser & Hydrants System:
External Yard Hydrants

- External yard hydrants shall be of ‘Stand Post’ type conforming to IS: 908 and comprising of stand post for single or double (conforming to NBC 2016) outlet with oblique pattern hydrant valve, Controlled Percolating (CP) Hose ISI marked (IS:8423) 63 mm dia. x 15 m long complete with instantaneous type gunmetal 63 mm dia. ISI marked Male & Female couplings, 63mm dia. Gunmetal branch pipe with gun metal nozzle of 20

mm nominal bore outlet with instantaneous type 63 mm dia. coupling M.S. fire hose weather proof cabinet (750x600x250mm approx. or as per requirement) made out of 16 gauge M.S. sheet capable of accommodating landing valve, hose pipes, branch pipe, nozzle, fittings & accessories. The box shall have a front glass door with lock and key arrangement & shall be painted with one coat of primer & two coat of finished stove enameled post office red colour paint & "External Fire Hydrant" written on front.

- The ring main around the building will be laid min. 1 m below ground level, 2 m away, within 15 m from face of the building.
- The distance between the external hydrant post shall be considered as per hazard classification conforming to relevant IS codes. However, maximum distance shall be 45 m.

Internal Hydrants

- It shall consists of Type -A- single headed or Type B double Headed (as per requirements), Gunmetal ISI marked oblique pattern hydrant landing valve with 80 mm dia. flange inlet and 63 mm dia. instantaneous type female out let, swinging type First Aid hose reel in red colour drum with 36 mtr long and 20 mm dia. heavy duty rubber water hose, 20 mm dia. Globe valve stop cock, terminating with G.M. coupling & nozzle of 5mm outlet with shut off valve, 63mm dia. Gunmetal branch pipe with gun metal nozzle of 20 mm nominal bore outlet with instantaneous type 63 mm dia. coupling, fireman's axe with heavy duty insulated rubber handle, 2 Nos. of 15 m long Non Percolating Hose Pipe, suitable size of MS door made up of 16 gauge MS Sheet capable of accommodating fire hose reel, landing valve, hose pipes, fittings. The door shall have a front glass with lock and key arrangement & shall be painted with one coat of primer & two coat of finished stove enameled post office red colour paint & "Internal Fire Hydrant" written on front.
- Quantity for the same need to conform to NBC 2016/relevant IS codes.
- One no. pressure gauge to be provided in each internal hydrant riser per floor.
- No. of risers/floor in each building shall be governed by the max. Travel distance as specified in NBC 2016.
- Adequate No. of FHC to be provided at Terrace for mitigating fire due to MEP Equipment placed at Terrace.

Fire Brigade Inlet Connections/ Draw Out Connection

- 4 Way Fire Brigade Inlet connection complete with all accessories (sluice valve/NRV etc.) shall be provided for connection to Ring mains, at delivery header in pump house, main hydrant line feeding to each building, Partial Under/Over ground tank.
- 2 Way Fire Brigade Inlet connection complete with all accessories (sluice valve/NRV etc.) shall be provided for connection to down comer system for residential/hostel buildings etc.
- 2 way draw out connections with foot valve for U.G Fire tanks to be considered near fire Pump House.
- All these above shall be in line with relevant IS codes & as per direction of E-I-C.

Basement Sprinkler System: -

- Automatic sprinkler system shall be provided as per requirements of NBC 2016 or relevant IS codes.
- As per hazard classifications, maximum/minimum distance between sprinklers, between sprinkler & walls to be maintained. Coverage area of each sprinkler &Assumed maximum area of operation shall conform to relevant IS codes.
- Side wall/pendant sprinklers to be provided as per requirements, shall be UL & FM certified, complete with rosette plate, glass bulb temperature rating of 68 degrees Celsius (red colour), Quick response/ action type, chrome plated finish & in compliance with NBC 2016 & relevant IS codes.
- Sprinkler shall be selected as per temperature rating which shall be based on usage type. Colour code shall be in conformance to relevant IS codes.
- Flexible pipe for connecting sprinklers (braided type) & UL & FM certified to be considered of various sizes as per site conditions to maintain symmetry & crossing of ducts & other utilities. The supporting system for flexible pipe shall be suitable for different type of false ceilings.

Water Curtain Sprinkler: - For basement car parking, compartmentation can be achieved, with fire barrier or with water curtain nozzle (K-23) or with combination thereof. Automatic deluge system comprising deluge valve, piping, nozzles, etc shall be used to zone the compartment in case of water curtain system. In case of water curtain, existing water storage shall be supplemented by water demand for water curtain nozzles for 60 min considering the largest compartment' s perimeter out of all compartments of car parking in any of the basements. d) The water supply for the water curtain nozzles shall be through independent electric pump of adequate capacity (flow and head) with piping/riser for the water supply to the nozzles. e) The water curtain shall be operated by the actuation of flow switch actuating sprinkler system

Portable Fire Extinguishers: -

- The sufficient qty. of portable/trolley mounted type fire extinguishers (Gas Based stored pressure type CO2 type /Ammonium Phosphate Type/ Mechanical Foam etc.) shall be provided at all levels of all the building, plant room, basement, substation etc. at strategic locations as per requirements, generally to follow NBC-2016 and IS – 2190: 1992 to extinguish fire of class A, B ,C.
- Location of the Fire Extinguishers shall be considered near all the Internal Hydrants, HT Panel Room, LT Panel Room, Lift Machine Room, Fire Pump House, Server Room, UPS Room, Fire Control Room, Security Control Room, Car Parking, STP etc.
- Clean agent fire extinguishers needs to be provided in all Labs, UPS/Batteries Room, BMS Room, Fire Control Room, other LV Rooms & any other critical areas where it is required as per functional requirements & as per directions of E-I-C.
- All Fire Extinguishers shall be Halon Free.
- Sand buckets 1 set (2 Nos.) of 9 liter capacity for each DG Set/Transformer/Diesel Driven Pump shall be provided. It shall also be in line with relevant norms & standards.
- Minimum provision of Fire Extinguishers as per IS 2190 to be provided in addition to provisions stated in DBR.
- Fire accessories viz, Axe, Fire Suit Kit, Gloves, Shoes, Foldable stair, chargeable search light, fire rated rope, evacuation chair shall be available in duplicate.

Gas based Fire Suppression System:-

For Critical Areas:

- Gas Based Fire Suppression system is required in server Rooms/ Data Centers &Laboratories (of critical nature) and any other rooms which are required as per functional requirements. Gas shall be FM 200
- The Total Room Flooding system of fire detection and quenching is proposed in all Low Voltage Equipment rooms where Water sprinklers cannot be used. The Gas cylinder assembly should be UL/FM approved with seamless CCOE approved cylinder and will be connected to discharge nozzles through metal Piping. The master cylinder Kit fitted on Gas cylinder will be operated through separate Fire Detection Panel and will release zero Ozone depletion potential Gas through the nozzles in case of fire.

For Electrical panels:

- Tube based Fire protection system shall be provided in the Electrical Panels installed in substations (HT Panel, Main LT panel, DG Synchronizing Panel, HVAC Panel, Capacitor Pane, Main L.T. Panel –Hospital Block) the detection Tube shall be installed throughout the compartment of panels. Fire suppression gas shall be Novec 1230.
- Cylinder equipped with brass valve, pressure Gauge isolation valve will be fitted on the wall of the panel with suitable brackets and will be connected to the detection tube. In case of fire the tube shall rupture at a point. The rupture Tube shall result in formation of discharge and release of Gas in uniform pattern.

Fire Signage: Various types of signage are proposed in the complex as per NBC 2016 Part -4. Material of signage shall be of acrylic/aluminum of required dimensions. At every floor near Lift landing diagram showing stairways shall be provided mentioning instructions - 'IN CASE OF FIRE USE STAIRS UNLESS INSTRUCTED OTHERWISE'. The signage shall be above call push button in Lift Lobby. Floor signage will be provided in each floor within the staircase & should easily readable. Each corridor of every floor will have directional signage indicating Fire Escape route. These signages shall be LED based with UPS power backup as per requirement & directions of E-I.C so that they will be visible in dark in case of power failure. Signage for assembly point also needs to be provided. Evacuation path signage & Emergency exit signage shall also be provided. Some of the signages shall be hung from ceiling (both ways) to have proper visibility.

Electrical Works related to Fire Fighting System:

- Firefighting panel of suitable size incomer & sufficient nos. of outgoing feeders for all pumps along with spares/spaces to be provided.
- Power cabling of suitable size to be laid from LT panel to firefighting panel. Power cabling of suitable size from firefighting panel to fire pumps to be laid. Control cabling from fire pumps to firefighting panel & firefighting panel to pressure switch to be done.
- Suspenders and/or cable trays for laying cables to be used.
- For sprinkler system, fire annunciation panel needs to be considered.
- Motor shall be TEFC squirrel cage AC induction type. The motor shall be suitable for continuous duty & rating necessary to drive the pump at 150% of its rated discharge with at least 65% rated head. Motor shall be with class F insulation & IE-3 class efficiency. DOL Starter shall be provided for motors of rating upto and including 7.5 HP. Star Delta starter shall be provided for motors of rating above 7.5 HP.

- Adequate no. of NO/NC contacts for interlocks, indicating lamps, remote operation etc. shall be provided on starter/contactor.
- Metallic body of all motors, medium voltage equipment etc. shall be connected by 2 separate & distinct earth conductors to the earth stations of the installations. Looping of such body earth conductors is acceptable from one equipment to another

Indicative Fire Fighting Parameters to be provided for various Buildings:-

Sl. No.	Name of Building	Type of occupancy	No. of Floor	Fire Extinguisher	
				Provisions as per NBC 2016	Deliverable
1	Type-5	Residential	2B+G+12	Required	To be Provided
2	Type-6	Residential	2B+G+12	Required	To be Provided

Note:-

The Tables provided above has been prepared considering Buildings as per present scope of work.

Fire Fighting Norms w.r.t NBC 2016 have been indicated in the column titled “As per NBC 2016”. The requirements indicated in the column “Deliverable” are minimum to be provided by the Contractor.

Notwithstanding anything mentioned in above table above, additional firefighting provisions specifically contained in the local Bye laws and as directed by concerned Fire Inspector Authority, if any, shall have to be additionally provided within scope of works.

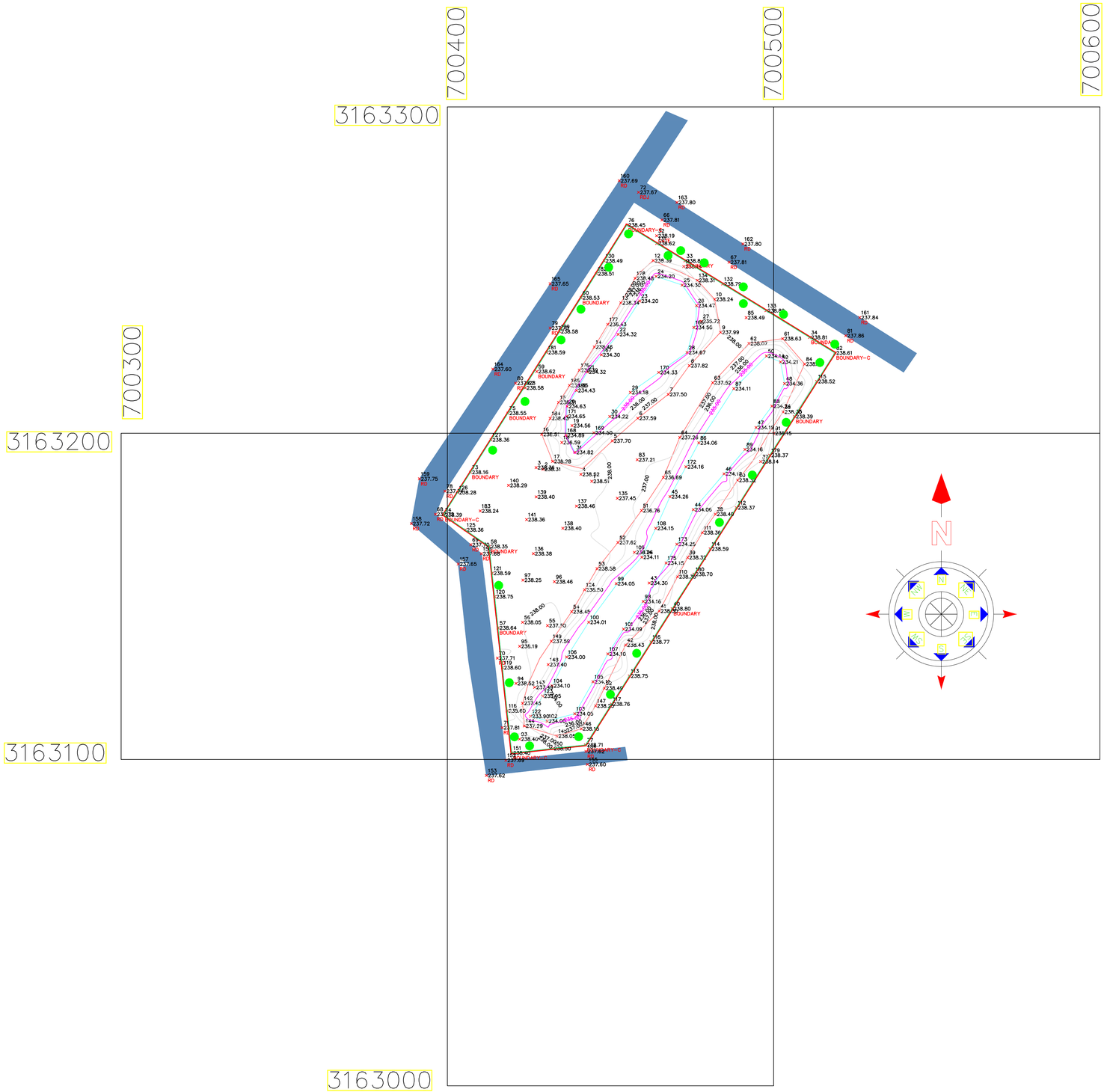
Any building not appearing in the above table shall be dealt with as per NBC 2016 norms & Bye law’s provisions

Volume-II

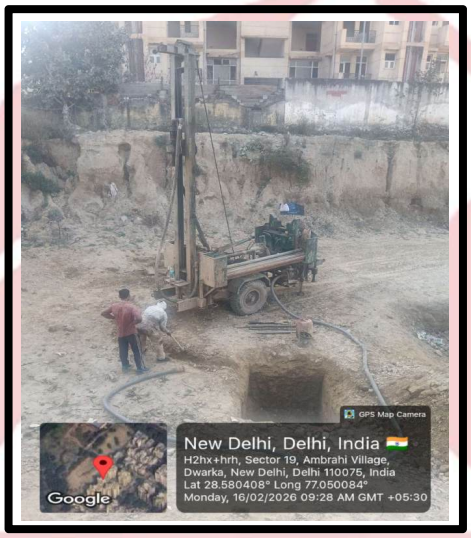
Part D

TOPOGRAPHICAL & GEOTECHNICAL INVESTIGATION REPORT

DWARKA SECTOR-19,DELHI DW



TEST – REPORT ON SUB-SOIL-INVESTIGATION AT THE PROPOSED SITE FOR CONSTRUCTION OF DOUBLE BASEMENT+ G+12TH STORIED JUDICIAL RESIDENTIAL BUILDING IN DWARKA, AT DISTRICT- DELHI.



ABC CONSULTANTS

-: HOUSE FOR :-

Soil / Material Testing, Geological Investigation, Quality Control & Survey of sites

Administrative Office: - C-1074/75, SECTOR – B. MAHANAGAR, LUCKNOW

ACKNOWLEDGEMENT

We are thankful for providing us the opportunity toprepare and submit the soil investigation report andwe appreciate the co□operation & assistance provided by the client. Looking forward to provide, many such reliable & timely services in future.

ABC CONSULTANTS * Engineers, Surveyors * Architects * Lucknow * C-1074/75, Sec-B, Mahanagar

ABC CONSULTANTS
(Soil Investigations and Laboratory Works)

Yours

Authorized Signatory

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5.	General Nature of soil strata	
6.	Water Table	
7.	Interpretation	
8.	Bearing Capacity Calculation	
9.	Conclusion	

1.0 INTRODUCTION :

This report cover the results of field and Laboratory test Conducted at the Proposed Site for Construction of Double Basement +G+12th Storied Judicial Residential Building in Dwarka at District – Delhi. These Investigations have been made to find out the allowable pressure of the soil required for the safe and economical design and execution of engineering works. The work of soil investigation was entrusted to **ABC CONSULTANTS**, **Administrative Office:- C-1074/75, SECTOR – B. MAHANAGAR, LUCKNOW**

It was decided by the concerned to conduct boring at five points up to depth of 30.0 meter each at the point marked by them at the site. Accordingly, the boring was conducted in accordance to I.S:1892–1979. Disturbed & undisturbed soil samples were collected along with conducting the standard penetration test at an interval of 1.5 meter. Or change of strata which ever met earlier starting from boring points to the termination of bore holes.

1.1 UNDISTURBED SOIL SAMPLES:

These samples have been collected by the oven dry sampler. After recovery of soil samples from the bore holes the ends of the tube have been cleaned waxed and marked properly. The depth of undisturbed soil samples have been indicated on the bore log chart as well on the Laboratory test result sheet attached. The soil samples have been collected as per I.S. 1892 – 1979.

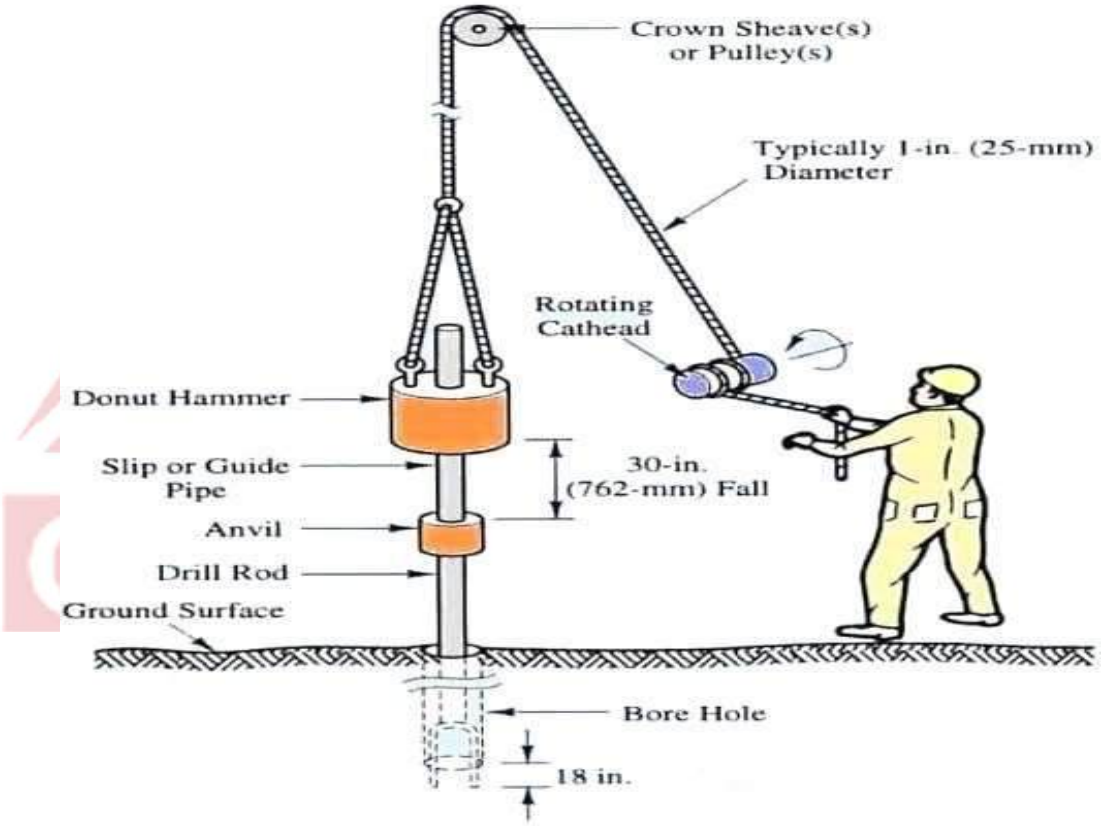
2.1.2 DISTURBED SOIL SAMPLES:

The depth of the disturbed soil samples have been indicated on the bore log chart as well as on the Laboratory test result and were collected in polythene bags & properly leveled.

2.2.1 STANDARD PENETRATION TEST:

The Standard Penetration Test has been conducted in the bore log charts at the intervals of 1.5 meter as per latest IS: 2131-1981 i.e. “Method for standard penetration test for soils”. In this depth Standard split spoon sampler is driven in to the soil are required depth,

with the help of drive weight of 63.5 kg falling freely under gravity through a Vertical height of 75cm. The number of blows for every 15 cms is recorded. The number of below for the first 15 cm. is neglected due to local disturbance and as a seating drive. The number of blows next 30 cm. are recorded as penetration blows 'N' of the soil at the depth. The result of the standard penetration test have been indicated on the laboratory test results sheet as well as on the bore log chart. Disturbed Soil samples obtained from standard split spoon sampler were collected in polythene bags of suitable size. These samples were properly sealed, labelled, recorded and carefully transported to laboratory for testing.



DIAGRAMMATIC OF SPT

2.2.2 CONSISTENCY/RELATIVE DENSITY OF SOIL WITH SPT VALUES AS PER IRC: 75-2015

CORRELATION FOR CLAY/PLASTIC SILT		CORRELATION FOR SAND/NON-PLASTIC SILT	
Consistency	Penetration Value	Relative Density	Penetration Value
Very Soft	0 to 2 Blows	Very loose	0 to 4 Blows
Soft	2 to 4 Blows	Loose	5 to 10 Blows
Medium Stiff	4 to 8 Blows	Medium	11 to 30 Blows
Stiff	8 to 15 Blows	Dense	31 to 50 Blows
Very Stiff	15 to 30 Blows	Very Dense	Above 50
Hard	Above 30		

3.0 LABORATORY WORK

3.1 UNDISTURBED SOIL SAMPLES:

The Undisturbed soils collected from the bore holes have been tested for the following to determine the engineering properties of soil as per requirement.

a) Sieve Analysis (I.S. Code 2720 (Part IV)-2007
b) Atterberg's Limit (Via Liquid and Plastic Limit & Plasticity Index) (I.S. Code 2720 (Part V)-2007
c) Particle size analysis (I.S. Code 2720 (Part IV)-2007
d) Bulk and Dry Density (I.S. Code 2720 (Part XXIX)-2007
e) Natural Moisture Content (I.S. Code 2720 (Part II)-2010
f) Shear Parameters C & Φ (I.S. Code 2720 (Part XII & XIII)-2007
g) Consolidation Test (For determination of Cc values of clayey soil samples) (I.S. Code 2720 (Part XV)-2007
h) Specific Gravity (I.S. Code 2720 (Part III)-2007

3.2 DISTURBED SOIL SAMPLES :

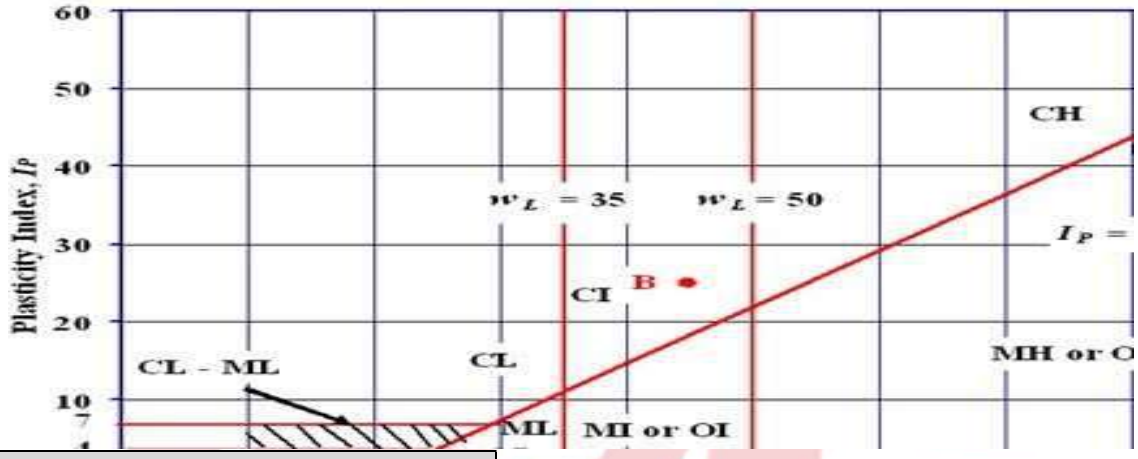
The disturbed soil samples have been tested for the following parameters.

a) Sieve Analysis (I.S. Code 2720 (Part IV)-2007

4.0 SOIL CLASSIFICATION: Soil classification has been done with the help of the soil properties obtained by laboratory test as per I.S. 1498 "Methods of classification and identification of soil for general engineering purposes".

b) Atterberg's Limits (I.S. Code 2720 (Part IV)-2007

The entire Laboratory has been carried out as per relevant I.S. code & has been tabulated.



FOR COHESIVE SOIL	
Plasticity	Liquid Limit
Low Plastic	<35
Medium Plastic	35 to 50
High Plastic	>50

FOR NON-COHESIVE SOIL	
Soil Classification	% Passing on IS Sieve 0.075 mm
ML	>50
SM	13-49
SM-SP	5-12
SP	1-4

ABBREVIATIONS

- CL - SILTY CLAY OF LOW PLASTICITY
- CI - SILTY CLAY OF MEDIUM PLASTICITY
- CH - SILTY CLAY OF HIGH PLASTICITY
- ML - CLAYEY SILT OF LOW PLASTICITY
- CL-ML - CLAYEY SILT OF LOW PLASTICITY
- MI - CLAYEY SILT OF MEDIUM PLASTICITY
- SC - CLAYEY SAND
- GL - GROUND LEVEL
- ML - SANDY SILT
- SM - SILTY SAND
- SM-SP - POORLY GRADED SAND-SILT MIXTURE
- SW/SP - WELL/POORLY GRADED SAND
- GSF - GENERAL SHEAR FAILURE
- LSF- LOCAL SHEAR FAILURE
- ISF - INTERMEDIATE SHEAR FAILURE
- BGL - BELOW GROUND LEVEL

5.0 GENERAL NATURE OF SOIL STRATA:

The general nature of the soil strata met during boring in each of bore holes are indicated on the bore log charts as well as on the laboratory test results sheet. The general nature of entire strata is comprises of 'CL/ML' clayey silt of very low plasticity, 'CI' silty clay of medium plasticity, 'CL silty clay of low plasticity, 'ML sandy silt and 'SC' clayey sand.

5.1 STANDARD PENETRATION TEST:

The 'N' values (or SPT values recorded) during penetration test in the strata in the bore hole No. 1, 2, 3, 4 & 5 found vary from 5 to 57 indicate the consistency of the soil as medium.

6.0 WATER TABLE:

The depth of water table was met at about of 10.0 m depth during boring operation in bore hole at the time of soil exploration in the month of since February 2026. Water is expected 1.00 m rise in post monsoon period. Accordingly, water table is assuming 9.00 m for calculation purpose.

7.0 INTERPRETATION OF THE TEST RESULTS (SHEAR CONSIDERATION):

7.1 The choice of the type of foundation depends upon the safe bearing capacity, design and layout of super structure, relative economics of various alternatives and practical consideration. In case of strip footing the safe bearing capacity / allowable bearing pressure, calculation is governed by IS: 6403-1981, for shear consideration & IS: 1904-1986 & IS: 8009 (Part-I)-1976, for consideration of settlement. Net Safe Bearing capacity from Shear Failure consideration has been computed in accordance with IS: 6403-1981. A factor of safety of 3.0 is selected based on clause 706.3.1.1.1 of IRC 78- 2014 to estimate the net safe bearing capacity from ultimate net bearing capacity. The modified bearing capacity formula are as

below considering the shape of footing, inclination of loading, depth of embedment and effect of water table.

$$Qs = 1/F\ [C.Nc.Sc.dc.ic. + q(Nq-1)\ Sq.dq.iq. + 0.50\ \gamma\ B.\ N\gamma.s\gamma.d\gamma.i\gamma.w']$$

Where:

Qs = Bearing capacity on shear consideration in Kg/cm^2

F = Factor of safety

γ = Unit weight of soil

C = Cohesion in Kg/cm^2

q = effective overburden pressure Kg/cm^2

B = Width of footing

w' = Correction factor for position of water table.

Nc.Nq.Nγ = Non dimensional bearing capacity factors depends upon angle of internal friction ϕ and void ratio e

Sc.Sq.Sγ = Shape factors

dc.dq.dγ = Depth factors

ic.iq.iγ = Inclination factors

7.3 SETTLEMENT CONSOLIDATION: (For Plastic soil)

The settlement in the plastic soil indicating some cohesion is given by the formula:

$$S = \frac{Cc}{} \times H \times \log_{10} \frac{P_o + \Delta P}{}$$

$$\frac{1 + e_o}{P_o}$$

Where:

Cc = Compression Index

H = Thickness of Plastic layer

P_o = Original Pressure at mid depth of Plastic layer

ΔP = Change in Pressure at mid depth of Plastic layer

e_o = Void ratio for pressure P_o

7.4 SETTLEMENT CONSIDERATION: (For non-Plastic soils)

The allowable bearing pressure is also to be so restricted that the anticipated settlement does not except the permissible settlement as specified in IS: 1904-1986, for a particulars type of structure and nature of soil.

7.5 Proposed Design Parameter's for Soil:

7.5.1 For Cohesionless Soils

In cohesion-less soils since it is difficult to collect to collect undisturbed samples, it is preferred to estimate the angle of internal friction from corrected SPT values (Ref: IS: 6403, IRC:78, Euro Code / British Code BS:8004). Particle size distribution among the non-cohesive soils will also affect on angle of internal friction, generally all codes and literatures have provided the curves between corrected SPT(N) value and angle of internal friction for sands (SP type soils) however when fine content increases, the angle of friction reduces. Although it is not necessary to conduct tests on cohesionless soils (Sandy Soils) as phi value may directly be taken from Corrected SPT N value but to check the values as per laboratory tests also the same have been conducted. Direct shear tests may also be conducted on remoulded samples at simulated density; however, the structure of the soil cannot be duplicated.

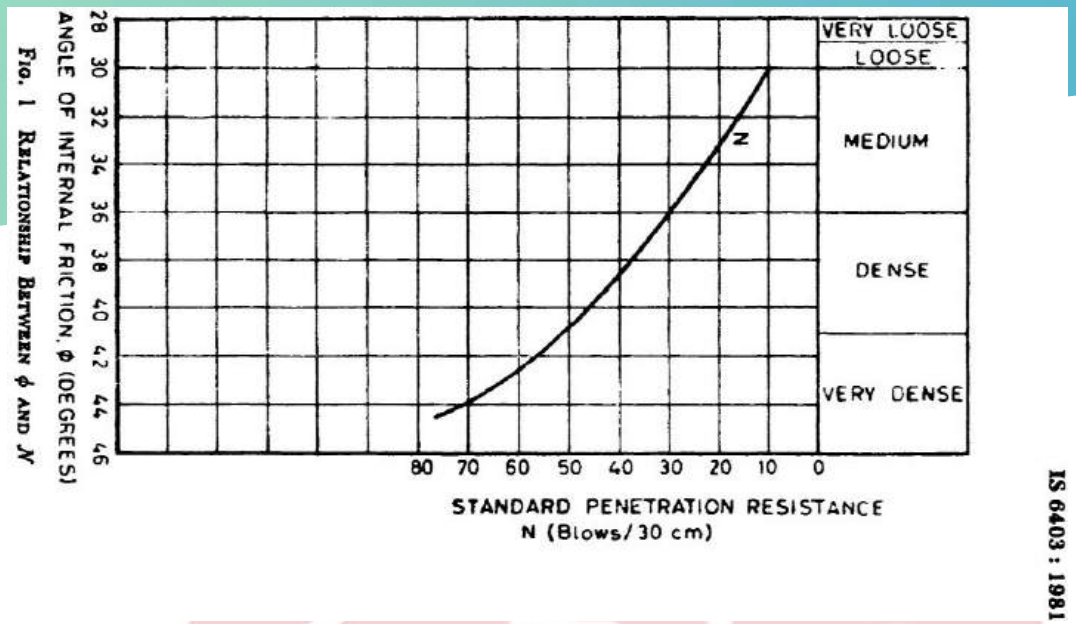


FIG. 1 RELATIONSHIP BETWEEN φ AND N

IS 6403 : 1981

7.5.2 Caltrans Geotechnical Manual:

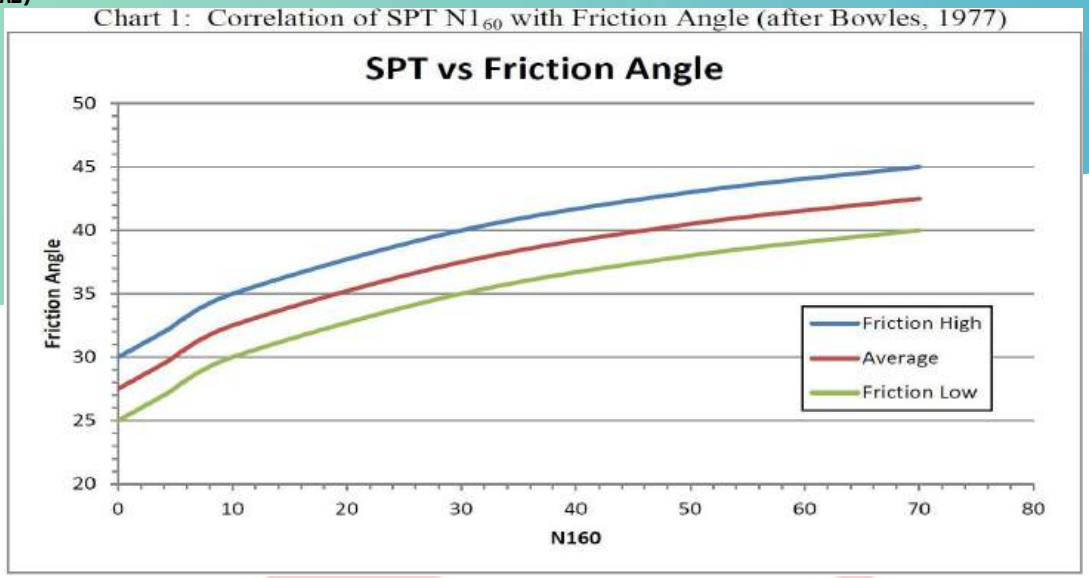
Soil Correlations

This section of the Geotechnical Manual presents the SPT correlations to be used for friction angle (phi angle) and unit weight. The correlations use Standard Penetration Test (N) values corrected for overburden and hammer efficiency (N160). Usage of correlations for geotechnical design is addressed in the various design sections of the Geotechnical Manual. Other correlations, e.g. CPT correlations and shear wave velocity correlations are found elsewhere in the Geotechnical Manual.

Cohesionless Soil: Friction Angle

Correlations of SPT blow counts to cohesionless soil friction angle and unit weight follow Bowles (1977) and are consistent with many of the NHI manuals used by the department. The correlations use Standard Penetration Test (N) values corrected for overburden and hammer efficiency (N160). Use Chart 1 to correlate N160 to the friction (phi) angle.

Chart 1: Correlation of SPT $N1_{60}$ with Friction Angle (after Bowles, 1977)



Choose the friction angle (expressed to the nearest degree) based upon the soil type, particle size(s), and rounding or angularity. Experience should be used to select specific values within the ranges. In general, finer materials or materials with significant (about 30+ %) silt-sized material will fall in the lower portion of the range. Coarser materials with less than 5% fines will fall in the upper portion of the range. The extreme range of phi angles for any N160 is five degrees, so the adjustment factors for particle size and roundness should be only a degree or two. The following bullets provide help in determining which value to select for a given N160 and soil type:

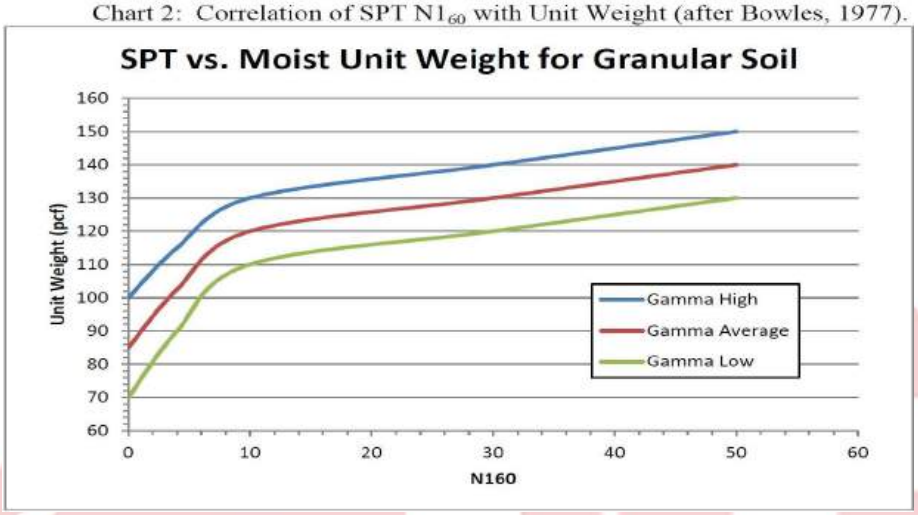
- Use the maximum value for GW
- Use the average for GM and SP
- Use the minimum for SC
- Use the minimum + 0.5 for ML
- Use the average +1 for SW
- Use the average -1 for GC
- Use the Maximum -1 for GP

Values may also be increased with increasing grain size and/or particle angularity and decreased with decreasing grain size and/or increasing roundness. For example, an SP with N160 = 30 could be assigned phi angles of 37, 38 or 39 degrees for fine, medium and coarse grain sizes respectively.

Cohesion less Soil: Unit Weight

Use Chart 2 to correlate N160 to the moist unit weight for cohesion less (Granular) soil.

Chart 2: Correlation of SPT $N1_{60}$ with Unit Weight (after Bowles, 1977).



Choose the unit weight expressed to the nearest five pcf for the soil type based on the following guidelines:

- Use the higher values for well-graded sands and gravels and average values for poorly- graded sands and gravels.
- Use lower values for elastic silt, and clayey or silty sands and gravel.
- Deduct up to 20% for dry soils.

ii. For Cohesive Soil's

For very stiff to hard consistency cohesive/plastic soils where undisturbed samples cannot be collected, correlation for estimating Un-drained cohesion of fine-grained soils based on (N)60 and plasticity index is proposed by M J Tomlinson. "Foundation Design and Construction" seventh edition as below;

$$Cu\ (kN/m2) = f1*(N)60$$

Where,

(N)60 = SPT 'N' value corrected for 100 kPa and 60% of theoretical free fall hammer energy

f1 = factor to be taken from Figure shown below.

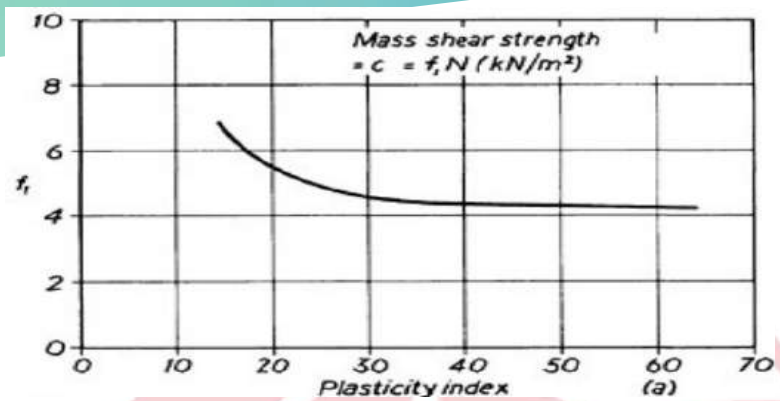


Fig. Relationship between mass shear strength plasticity index and standard penetration test N-values

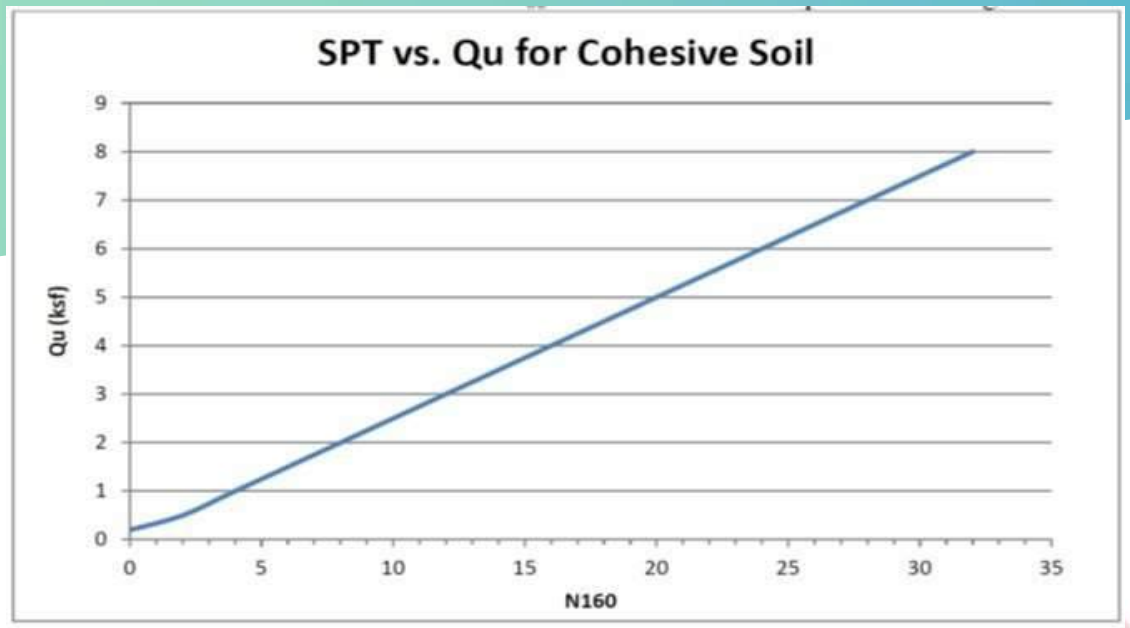
- **Caltrans Geotechnical Manual:**

Cohesive Soil: Unconfined Compressive Strength (Qu) /Undrained Shear Strength (Su)

The standard practice is to determine shear strength of cohesive soils in the field based on measurements with torvane, pocket penetrometer, or vane shear. It is not acceptable to use SPT correlations to determine shear strength or to assign consistency values. For preliminary studies, use Chart 3 to assign shear strength values when only SPT values are available. Usually this is applicable when data are available from old as-built LOTBs where field or laboratory strength tests are not available.

Chart 3: Correlation of SPT N160 to Unconfined Compressive Strength

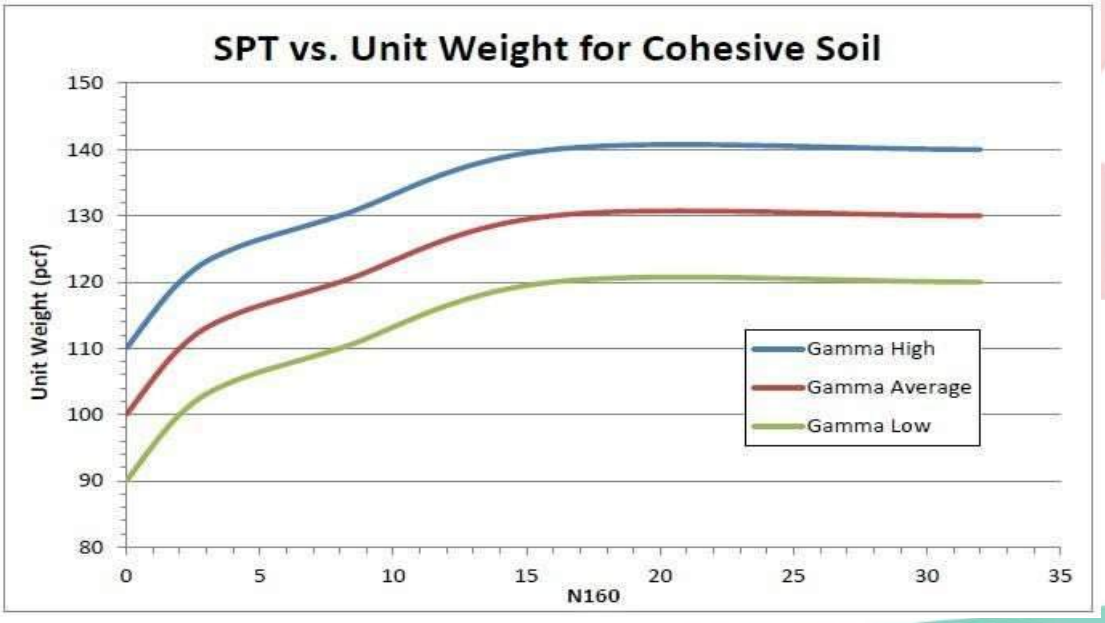
(after Bowles, 1977)



Cohesive Soil: Unit Weight

Use Chart 4 to correlate N160 with the Unit Weight of cohesive soil.

Chart 4: Correlation of SPT N160 with Unit Weight (after Bowles, 1977).



Comparing field pocket penetrometer and/or torvane readings to Chart 4 is a good way of determining whether high or low values should be used. For example, if the pocket penetrometer reading for a clay with N160 = 10 is about 2.5 ksf (the same as the value shown in Chart 3) the unit weight should correspond to the average value. If the pocket penetrometer reading is higher, the unit weight should be increased from the average, and if the pocket penetrometer reading is lower, the unit weight should be decreased from the average.In the absence of SPT data, unit weights can be estimated using Charts 3 and 4 and the strength data (e.g., pocket penetrometer reading). For example, from Chart 3, a pocket penetrometer value of 5 ksf corresponds to an SPT N160 value of 20. Chart 4 shows the average unit weight of a cohesive soil with SPT N160 = 20 is 130 pcf.

8.0 COMPUTATION OF BEARING CAPACITY:

8.1 BEARING CAPACITY FROM SHEAR CRETERIA:

Bearing capacity calculations were carried out Isolated / R.C.C. Raft Foundation at depth 1.20m, 1.50m, 2.00m, 3.00m, 4.50m, 6.00m, 7.50m & 9.00mbelow ground level with size of footing 1.20m, 1.50m, 2.00m (10.00x10.00) m However governing values of bearing capacity was found the calculations for the same are produced below:

8.1.1 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1.	Angle of internal friction ϕ	=	7^0
2.	Cohesion C	=	0.39 Kg/cm^2
3.	Unit weight of soil γ	=	1.80 gm/cc
4.	Submerged density. of soil γ	=	-
5.	Specific Gravity	=	2.72
6.	Dry Density	=	1.62 gm/cc
7.	Void ratio e_o	=	0.68
8.	Condition	=	Medium (Interpolation)

9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	7.230	1.930	0.760
Local Shear failure > = 0.75	6.400	1.533	0.420
Interpolated value for e_0= 0.68	6.691	1.672	0.539

10. Water Table correction Factor w' = 1.0

11. Overburden pressure q at depth 1.20 m = 0.216 Kg/cm^2

12. Type of foundation = Isolated Foundation

13. Depth of foundation df = 1.20 m

14. Width of foundation = 1.20 m

15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.80

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.226 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3054x6.691x1.226x1.30x1.0+0.216x(1.672-1.0)x1.20x1.0+0.5x1.80x 1.20 x 0.5539 x0.80x 1.0x1.0/10.0]

= 1/3 [3.257+ 0.174+ 0.047] Kg/cm^2

= 1.159 Kg/cm^2

8.1.2 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 7^0
2. Cohesion C = 0.39 Kg/cm^2
3. Unit weight of soil γ = 1.80 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.72
6. Dry Density = 1.62 gm/cc
7. Void ratio e_o = 0.68
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	7.230	1.930	0.760
Local Shear failure > = 0.75	6.400	1.533	0.420
Interpolated value for e_0= 0.68	6.691	1.672	0.539

10. Water Table correction Factor w' = 1.0
11. Overburden pressure q at depth 1.50 m = 0.270 Kg/cm^2
12. Type of foundation = Isolated Foundation
13. Depth of foundation df = 1.50 m

14. Width of foundation = 1.50 m

15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.80

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.226 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3054x6.691x1.226x1.30x1.0+0.270x(1.672-1.0)x1.20x1.0+0.5x1.80x 1.50 x 0.539 x0.80x 1.0x1.0/10.0]

= 1/3 [3.257+ 0.218+ 0.058] Kg/cm^2

= 1.177 Kg/cm^2

8.1.3 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 6^0
2. Cohesion C = 0.42 Kg/cm^2
3. Unit weight of soil γ = 1.83 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.69
6. Dry Density = 1.62 gm/cc
7. Void ratio e_o = 0.66
8. Condition = Medium (Interpolation)

9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	6.860	1.750	0.604
Local Shear failure > = 0.75	6.220	1.456	0.360
Interpolated value for e_0= 0.66	6.508	1.588	0.469

10. Water Table correction Factor w' = 1.0

11. Overburden pressure q at depth 2.00 m = 0.366 Kg/cm^2

12. Type of foundation = Isolated Foundation

13. Depth of foundation df = 2.00 m

14. Width of foundation = 2.00 m

15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.80

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.222 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc = 1/3[0.3427 x6.508x1.222x1.30x1.0+0.366x (1.588- 1.0) x1.20x1.0 +0.5 x1.83 x 2.00 x 0.469 x0.80x 1.0x1.0/10.0]

= 1/3 [3.543+ 0.258+ 0.069] Kg/cm^2

= 1.290 Kg/cm^2

8.1.4 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 6^0
2. Cohesion C = 0.42 Kg/cm^2
3. Unit weight of soil γ = 1.83 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.69
6. Dry Density = 1.62 gm/cc
7. Void ratio e_o = 0.66
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	6.860	1.750	0.604
Local Shear failure > = 0.75	6.220	1.456	0.360
Interpolated value for e_0= 0.66	6.508	1.588	0.469

10. Water Table correction Factor w' = 0.85
11. Overburden pressure q at depth 2.00 m = 0.366 Kg/cm^2
12. Type of foundation = R.C.C. raft foundation
13. Depth of foundation df = 2.00 m
14. Width of foundation = (10.0x10.0) m
15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.044 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3427x6.508x1.044.x1.30x1.0+0.366x(1.588-1.0)x1.20x1.0+0.5x1.83x 10.00 x 0.469 x0.60x 1.0x0.85/10.0]

= 1/3 [3.027+ 0.258+ 0.219] Kg/cm^2

= 1.168 Kg/cm^2

8.1.5 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 6^0
2. Cohesion C = 0.42 Kg/cm^2
3. Unit weight of soil γ = 1.83 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.69
6. Dry Density = 1.62 gm/cc
7. Void ratio e_o = 0.66
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	6.860	1.750	0.604
Local Shear failure > = 0.75	6.220	1.456	0.360
Interpolated value for e_0= 0.66	6.508	1.588	0.469

10. Water Table correction Factor w' = 0.80
11. Overburden pressure q at depth 3.00 m = 0.549 Kg/cm^2
12. Type of foundation = R.C.C. raft foundation
13. Depth of foundation df = 3.00 m
14. Width of foundation = (10.0x10.0) m
15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.066 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3427x6.508x1.066.x1.30x1.0+0.549x(1.588-1.0)x1.20x1.0+0.5x1.83x 10.00 x 0.469 x0.60x 1.0x0.80/10.0]

= 1/3 [3.091+ 0.387+ 0.206] Kg/cm^2

= 1.228 Kg/cm^2

8.1.6 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 9^0
2. Cohesion C = 0.36 Kg/cm^2
3. Unit weight of soil γ = 1.85 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.70
6. Dry Density = 1.63 gm/cc
7. Void ratio e_o = 0.66
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	7.980	2.290	1.070
Local Shear failure > = 0.75	6.870	1.750	0.607
Interpolated value for e_0= 0.66	7.370	1.993	0.815

10. Water Table correction Factor w' = 0.75
11. Overburden pressure q at depth 4.50 m = 0.833 Kg/cm^2
12. Type of foundation = R.C.C. raft foundation
13. Depth of foundation df = 4.50 m
14. Width of foundation = (10.0x10.0) m

15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.105 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.2938x7.370x1.105.x1.30x1.0+0.833x(1.993-1.0)x1.20x1.0+0.5x1.85x 10.00 x 0.815 x0.60x 1.0x0.75/10.0]

= 1/3 [3.110+ 0.992+ 0.339] Kg/cm^2

= 1.480 Kg/cm^2

8.1.7 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 7^0
2. Cohesion C = 0.39 Kg/cm^2
3. Unit weight of soil γ = 1.88 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.69
6. Dry Density = 1.64 gm/cc
7. Void ratio e_o = 0.64
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	7.230	1.930	0.760
Local Shear failure > = 0.75	6.400	1.533	0.420
Interpolated value for e_0= 0.64	6.857	1.751	0.607

10. Water Table correction Factor w' = 0.65

11. Overburden pressure q at depth 6.00 m = 1.128 Kg/cm^2

12. Type of foundation = R.C.C. raft foundation

13. Depth of foundation df = 6.00 m

14. Width of foundation = (10.0x10.0) m

15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.135 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3315x6.857x1.135.x1.30x1.0+1.128x(1.751-1.0)x1.20x1.0+0.5x1.88x 10.00 x 0.607 x0.60x 1.0x0.65/10.0]

= 1/3 [3.354+ 1.017+ 0.223] Kg/cm^2

= 1.531 Kg/cm^2

8.1.8 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 9^0
2. Cohesion C = 0.38 Kg/cm^2
3. Unit weight of soil γ = 1.89 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.71
6. Dry Density = 1.64 gm/cc
7. Void ratio e_o = 0.65
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	7.980	2.290	1.070
Local Shear failure > = 0.75	6.870	1.750	0.607
Interpolated value for e_0= 0.65	7.425	2.020	0.838

10. Water Table correction Factor w' = 0.575
11. Overburden pressure q at depth 7.50 m = 1.418 Kg/cm^2
12. Type of foundation = R.C.C. raft foundation
13. Depth of foundation df = 7.50 m
14. Width of foundation = (10.0x10.0) m
15. Shape factors

Sc = 1.30 Sq = 1.20, $S\gamma$ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, $i\gamma$ = 1.0

17. Depth Factors

dc = 1.175 dq & $d\gamma$ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3165x7.425x1.175.x1.30x1.0+1.418x(2.020-1.0)x1.20x1.0+0.5x1.89x 10.00 x 0.838 x0.60x 1.0x0.575/10.0]

= 1/3 [3.590+ 1.735+ 0.273] Kg/cm^2

= 1.866 Kg/cm^2

8.1.9 Bearing capacity Calculation:

Governing soil parameter are from bore hole no. 03

1. Angle of internal friction ϕ = 8^0
2. Cohesion C = 0.43 Kg/cm^2
3. Unit weight of soil γ = 1.93 gm/cc
4. Submerged density. of soil γ = -
5. Specific Gravity = 2.70
6. Dry Density = 1.66 gm/cc
7. Void ratio e_o = 0.63
8. Condition = Medium (Interpolation)
9. Bearing Capacity Factor

Shear Parameters	Nc	Nq	Nr
General Shear failure e_0<=0.55	7.610	2.110	0.912
Local Shear failure > = 0.75	6.620	1.630	0.503
Interpolated value for e_0= 0.63	7.214	1.918	0.748

10. Water Table correction Factor w' = 0.50

11. Overburden pressure q at depth 9.00 m = 1.737 Kg/cm^2

12. Type of foundation = R.C.C. raft foundation

13. Depth of foundation df = 9.00 m

14. Width of foundation = (10.0x10.0) m

15. Shape factors

Sc = 1.30 Sq = 1.20, Sγ = 0.60

16. Inclination factors

ic = 1.0, iq = 1.0, iγ = 1.0

17. Depth Factors

dc = 1.207 dq & dγ = 1.0

18. Factor of safety f = 3.0

Bearing Capacity: -

Qc=1/3[0.3724x7.214x1.207.x1.30x1.0+1.737x(1.918-1.0)x1.20x1.0+0.5x1.93x 10.00 x 0.748 x0.60x 1.0x0.50/10.0]

= 1/3 [4.215+ 1.913+ 0.217] Kg/cm^2

= 2.115 Kg/cm^2

8.2.0 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 1.20 m Depth

Description	Calculation
Thickness of compressible layer	1.80
Mid depth of clay layer	0.90
Pressure at foundation level	0.216
Po original pressure at mid depth	0.378
Net safe bearing capacity	1.159
Change pressure at foundation level	0.943
Influence factor	0.688
Change pressure at mid layer	0.649
P0+Δ P/ P0	2.717
Log P0+Δ P/ P0	0.434
Void ratio e_o	0.68
Compression Index Cc	0.124
Settlement	5.77
Settlement after applying rigidity factor	4.616

The settlement is less than permissible limit 7.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 11.59 t/m2.

8.2.1 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 1.50 m Depth

Description	Calculation
Thickness of compressible layer	2.25
Mid depth of clay layer	1.125
Pressure at foundation level	0.270
Po original pressure at mid depth	0.473
Net safe bearing capacity	1.177
Change pressure at foundation level	0.907
Influence factor	0.688
Change pressure at mid layer	0.624
P0+Δ P/ P0	2.321
Log P0+Δ P/ P0	0.365
Void ratio e_o	0.68
Compression Index Cc	0.124
Settlement	6.07
Settlement after applying rigidity factor	4.852

The settlement is less than permissible limit 7.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 11.77 t/m2.

8.2.2 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 2.00 m Depth

Description	Calculation
Thickness of compressible layer	3.00
Mid depth of clay layer	1.50
Pressure at foundation level	0.366
Po original pressure at mid depth	0.641
Net safe bearing capacity	1.290
Change pressure at foundation level	0.924
Influence factor	0.688
Change pressure at mid layer	0.636
P0+Δ P/ P0	1.993
Log P0+Δ P/ P0	0.299
Void ratio e_o	0.66
Compression Index Cc	0.130
Settlement	7.02
Settlement after applying rigidity factor	5.618

The settlement is less than permissible limit 7.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 12.90 t/m2.

8.2.3 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 2.00 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	0.366
Po original pressure at mid depth	1.739
Net safe bearing capacity	1.168
Change pressure at foundation level	0.802
Influence factor	0.688
Change pressure at mid layer	0.552
P0+∆P/ P0	1.317
Log P0+∆P/ P0	0.119
Void ratio e_o	0.66
Compression Index Cc	0.130
Settlement	11.97
Settlement after applying rigidity factor	11.180

The settlement is less than permissible limit 12.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 11.68 t/m2.

8.2.4 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 3.00 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	0.549
Po original pressure at mid depth	1.922
Net safe bearing capacity	1.228
Change pressure at foundation level	0.679
Influence factor	0.688
Change pressure at mid layer	0.467
P0+∆P/ P0	1.243
Log P0+∆P/ P0	0.094
Void ratio e_o	0.66
Compression Index Cc	0.130
Settlement	11.04
Settlement after applying rigidity factor	8.831

The settlement is less than permissible limit 12.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 12.28 t/m2.

8.2.5 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 4.50 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	0.833
Po original pressure at mid depth	2.220
Net safe bearing capacity	1.480
Change pressure at foundation level	0.648
Influence factor	0.688
Change pressure at mid layer	0.446
P0+∆P/ P0	1.201
Log P0+∆P/ P0	0.079
Void ratio e_o	0.66
Compression Index Cc	0.122
Settlement	8.73
Settlement after applying rigidity factor	6.982

The settlement is less than permissible limit 12.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 14.80 t/m2.

8.2.6 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 6.00 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	1.128
Po original pressure at mid depth	2.538
Net safe bearing capacity	1.531
Change pressure at foundation level	0.403
Influence factor	0.688
Change pressure at mid layer	0.277
P0+Δ P/ P0	1.109
Log P0+Δ P/ P0	0.045
Void ratio e_o	0.64
Compression Index Cc	0.132
Settlement	5.43
Settlement after applying rigidity factor	4.346

The settlement is less than permissible limit 12.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 15.31 t/m2.

8.2.7 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 7.50 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	1.418
Po original pressure at mid depth	2.835
Net safe bearing capacity	1.866
Change pressure at foundation level	0.449
Influence factor	0.688
Change pressure at mid layer	0.309
P0+Δ P/ P0	1.109
Log P0+Δ P/ P0	0.045
Void ratio e_o	0.65
Compression Index Cc	0.121
Settlement	4.94
Settlement after applying rigidity factor	3.954

The settlement is less than permissible limit 12.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 18.66 t/m2.

8.2.8 BEARING CAPACITY FROM SETTLEMENT FAILURE CRITERIA :

Settlement of Cohesive soil at 9.00 m Depth

Description	Calculation
Thickness of compressible layer	15.00
Mid depth of clay layer	7.50
Pressure at foundation level	1.737
Po original pressure at mid depth	3.185
Net safe bearing capacity	2.115
Change pressure at foundation level	0.378
Influence factor	0.688
Change pressure at mid layer	0.260
P0+Δ P/ P0	1.082
Log P0+Δ P/ P0	0.034
Void ratio e_o	0.63
Compression Index Cc	0.133
Settlement	4.17
Settlement after applying rigidity factor	3.336

The settlement is less than permissible limit 12.5 cm as per I.S: 1904 - 1986.

Then safe Bearing capacity 21.15 t/m2.

9.0 RECOMMENDATION:

9.1 The soil strata are effective zone comprises of cohesive layers. The design load has therefore to ensure safety against failure due to shear failure.

9.2 The water table was met at about of 10.0 m depth below existing ground level. Water is expected 1.00 m rise in post monsoon period. Accordingly, water table is assuming 9.00 m for calculation purpose.

9.3 The values of net safe bearing capacity for Isolated / R.C.C. Raft foundation below existing ground level are tabulated below: -

S. L. No.	Depth (m)	Type of foundation	Width of foundation (m)	Allowable Bearing Capacity	
				Kg/cm^2	T/m^2
1	1.20	Isolated foundation	1.20	1.159	11.59
2	1.50		1.50	1.177	11.77
3	2.00		2.00	1.290	12.90
4	2.00	R.C.C. Raft foundation	(10.00x10.00)	1.168	11.68
5	3.00			1.228	12.28
6	4.50			1.480	14.80
7	6.00			1.531	15.31
8	7.50			1.866	18.66
9	9.00			2.115	21.15

The 'CI' group soil is found in the effective zone below footing level. Accordingly, plinth beam, lintel beam and apron all around the structure will be provided.

The above recommendations are based on the field investigation data and the laboratory test result of the sample collected from site and our experience in this regard.

If the actual sub – soil condition during excavation for foundation differs from that has been reported a reference should be made to us for suggestion.

ABC CONSULTANTS
(Soil Investigations and Laboratory Works)

Authorized Signatory

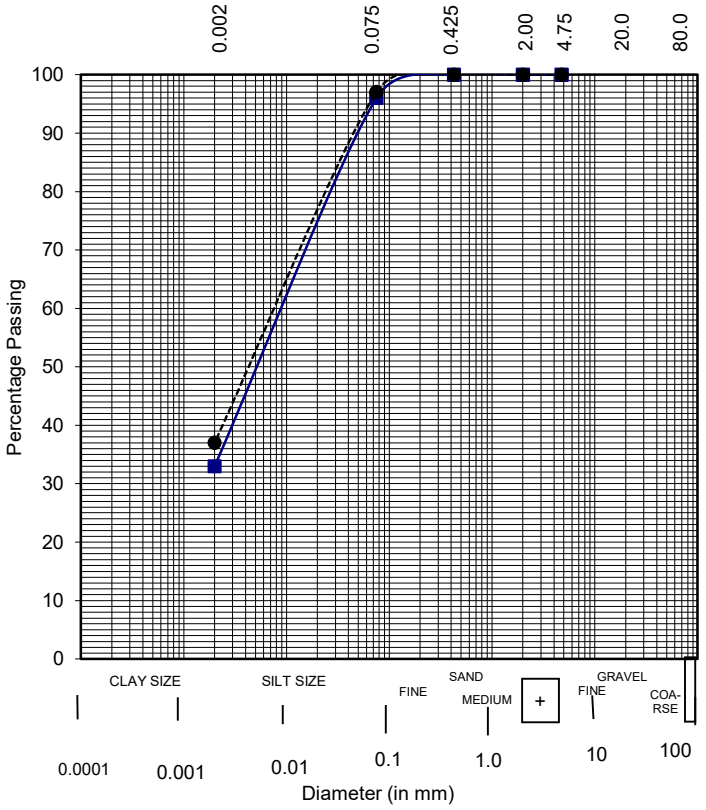

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H2hx+hrh, Sector 19, Ambrahi Village,
Dwarka, New Delhi, Delhi 110075, India
Lat 28.580408° Long 77.050084°
Monday, 16/02/2026 09:28 AM GMT +05:30
Google

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Bore Hole No. 01

Depth 0.00-0.50 1.50-1.85

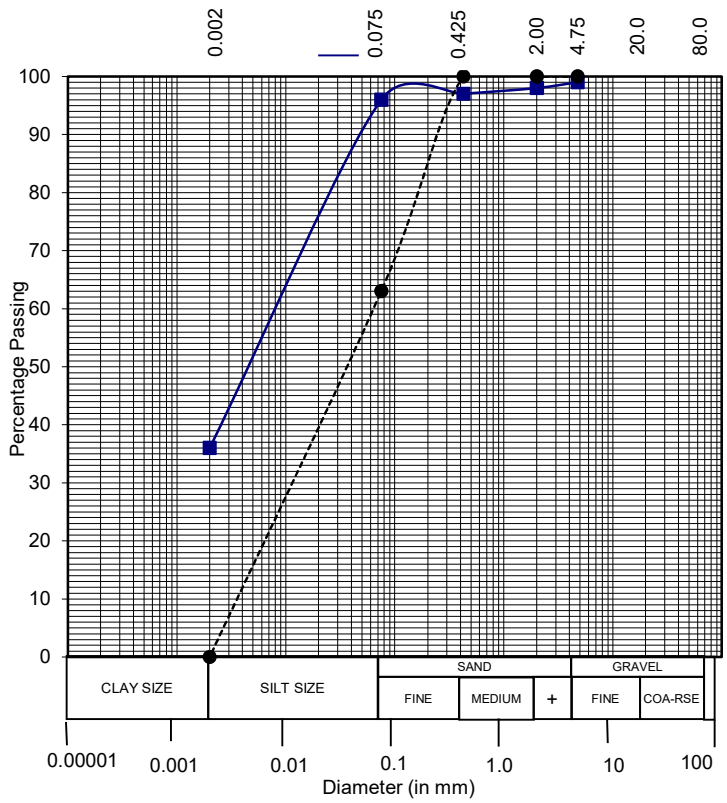


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Bore Hole No. 01

Depth 3.00-3.35 4.50-4.85

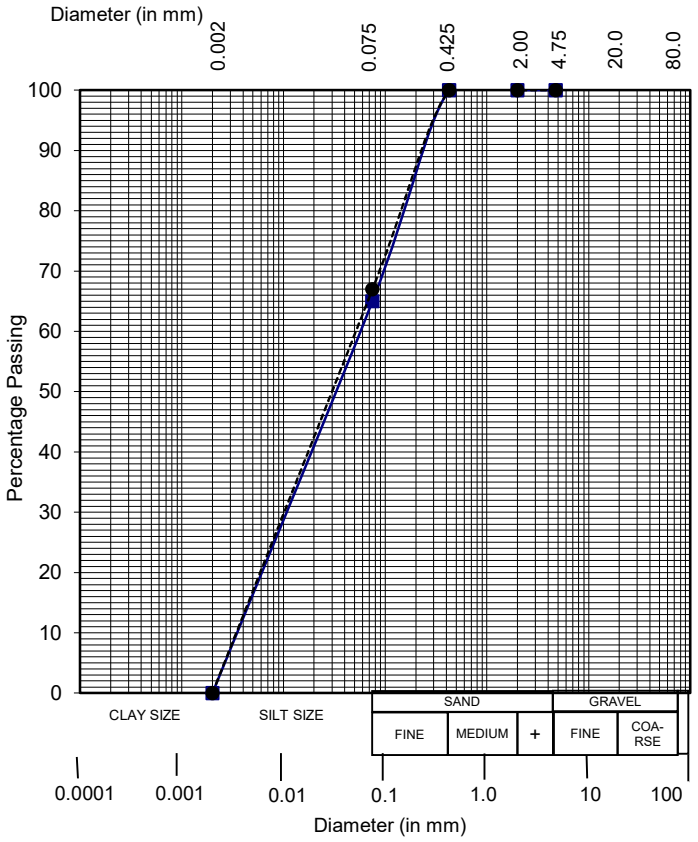


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Bore Hole No. 01

Depth — 6.00-6.35 - - - 7.50-7.85

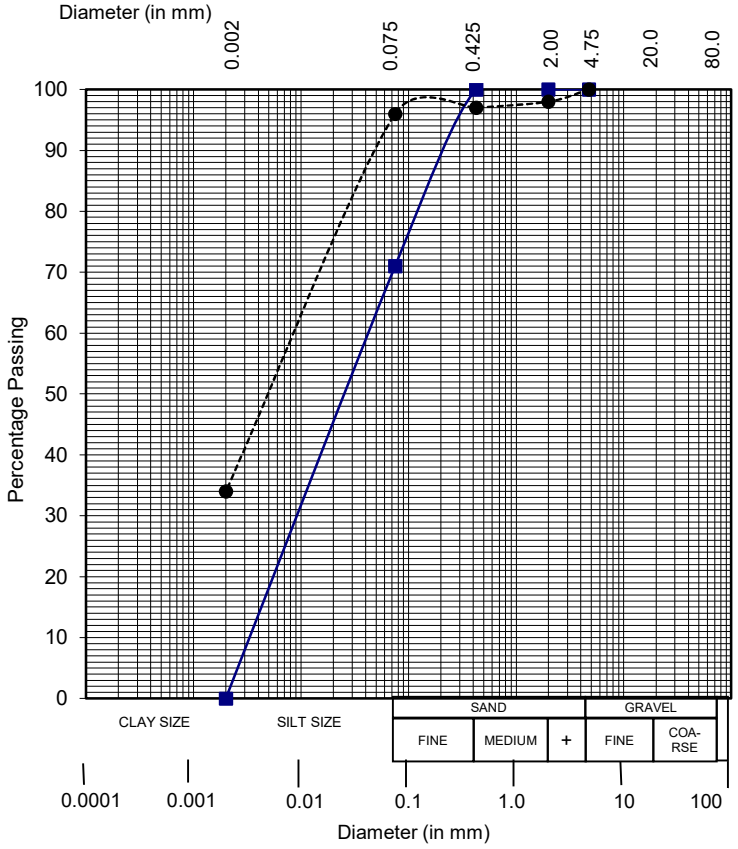


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Bore Hole No. 01

Depth — 9.00-9.35 - - - 10.50-10.85

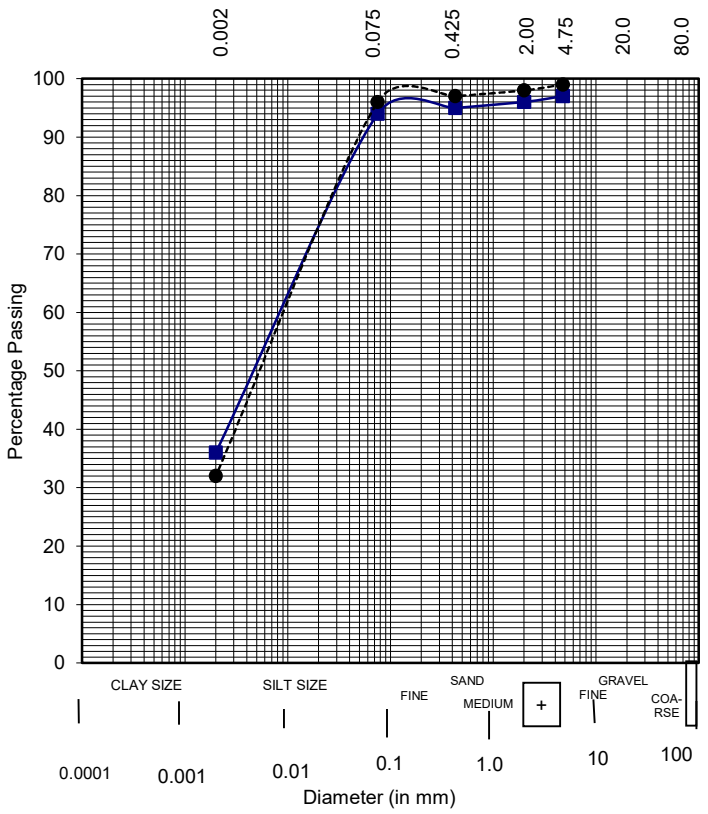


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Bore Hole No. 01

Depth — 12.00-12.35 - - - 13.50-13.85

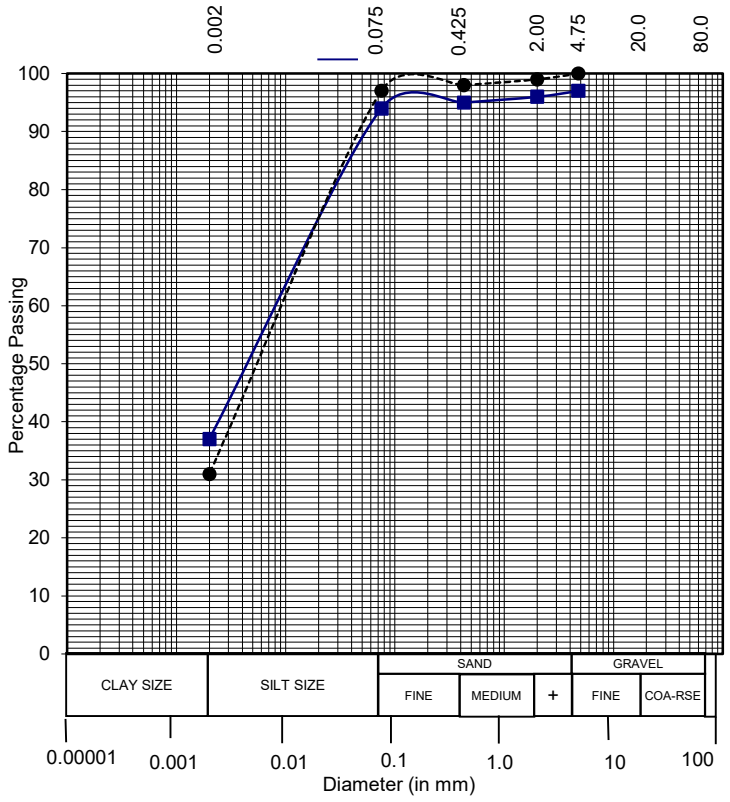


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Bore Hole No. 01

Depth — 15.00-15.35 - - - 16.50-16.85

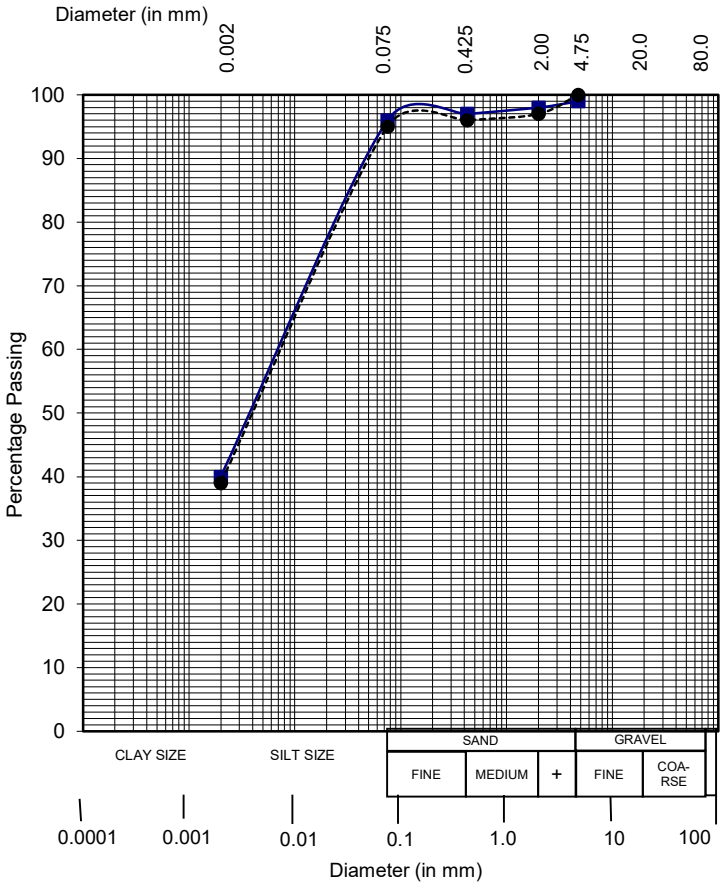


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Bore Hole No. 01

Depth — 18.00-18.35 --- 19.50-19.85

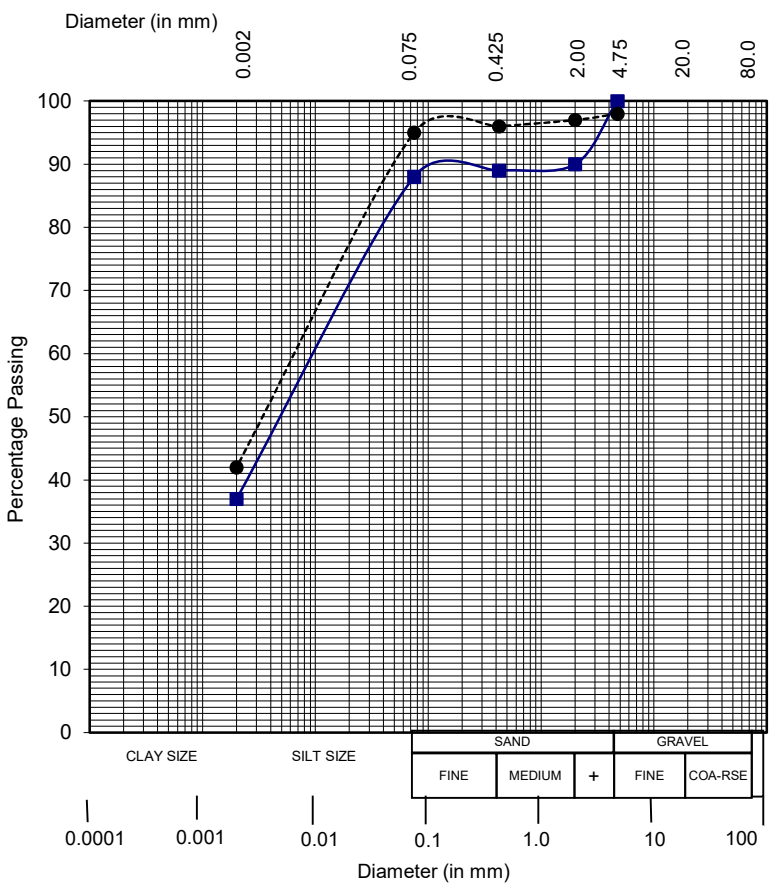


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Bore Hole No. 01

Depth — 21.00-21.35 --- 22.50-22.85

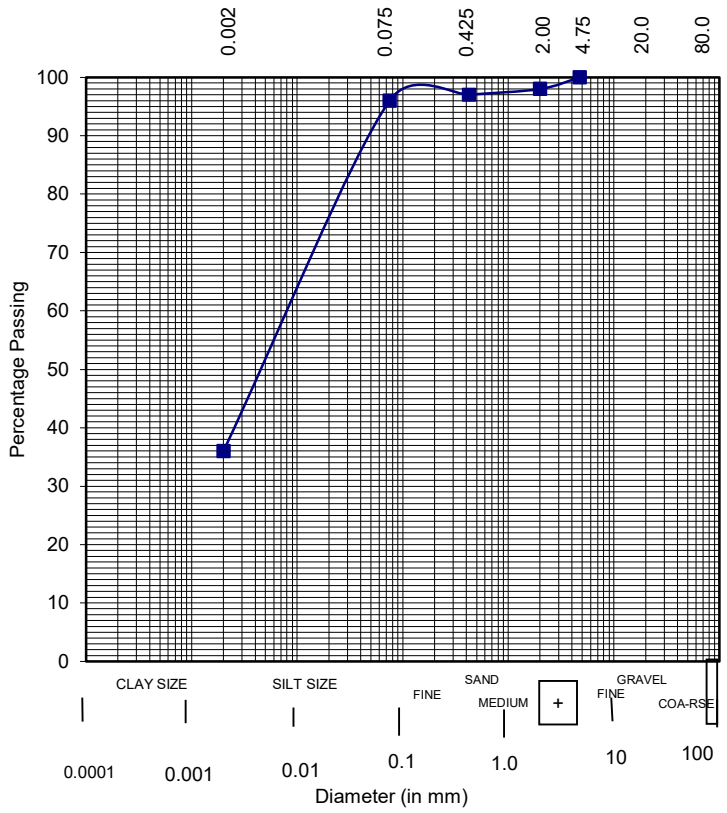


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Bore Hole No. 01

Depth 24.00-24.35

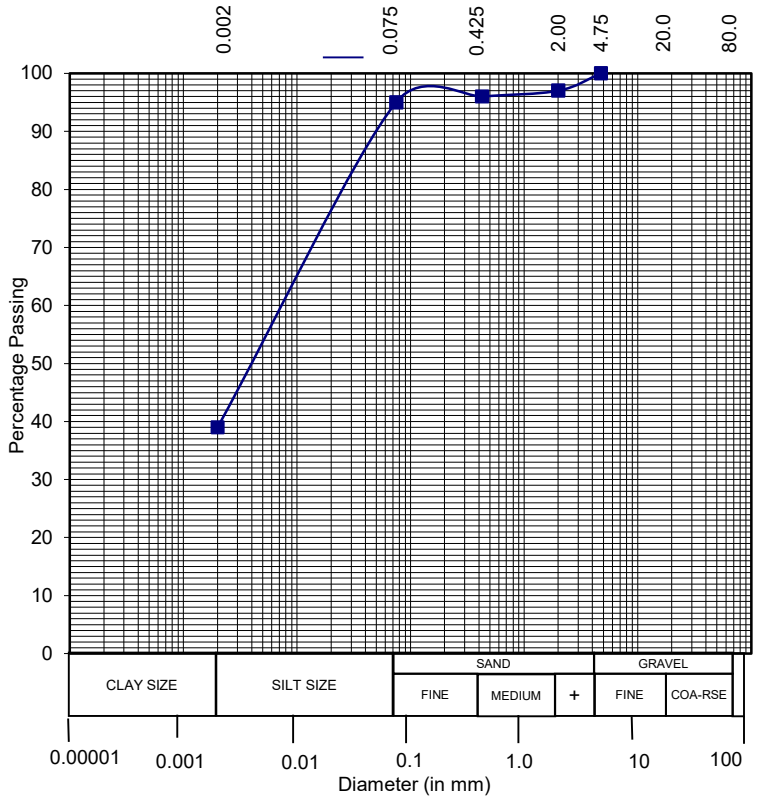


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Bore Hole No. 01

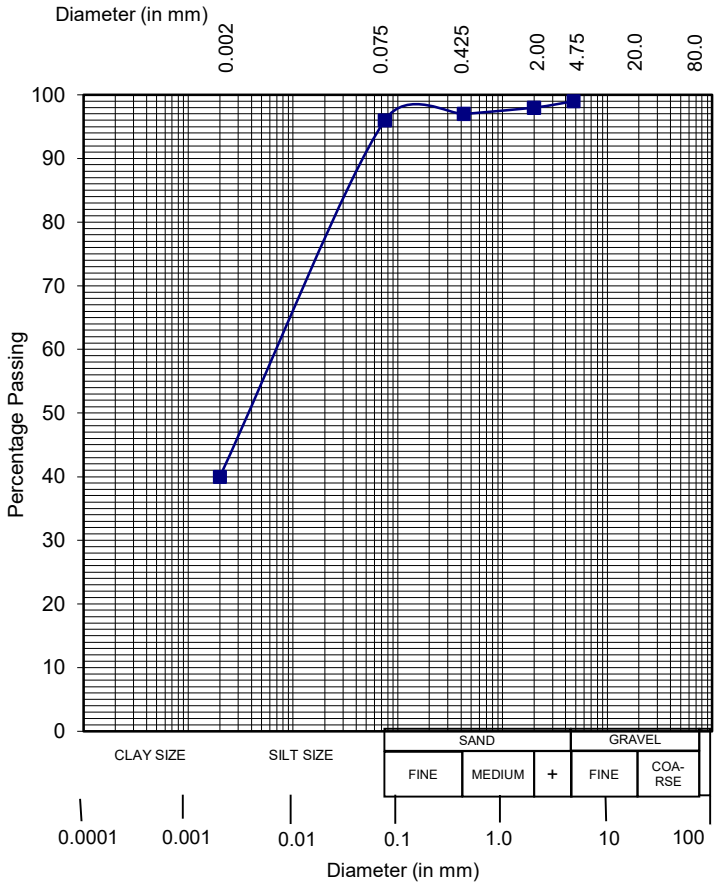
Depth 25.50-25.85



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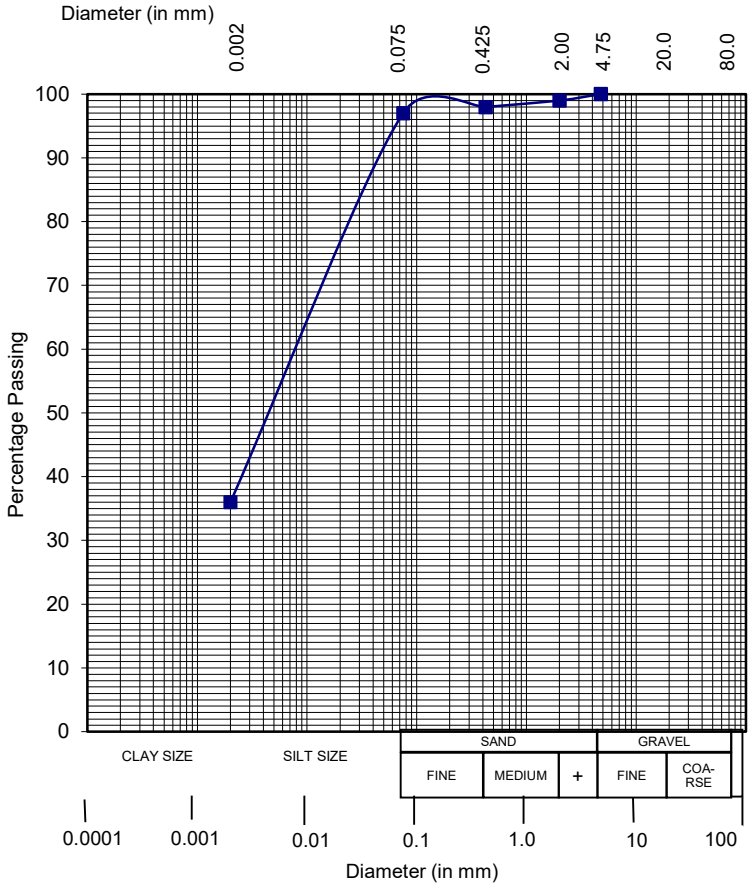
Bore Hole No. 01
Depth — 27.00-24.35



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 01
Depth — 28.50-28.85

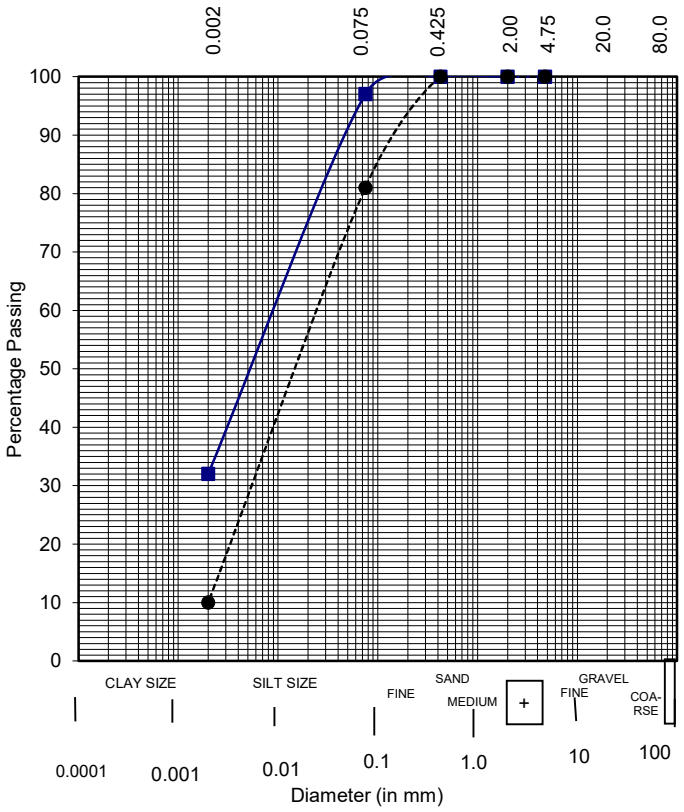


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth 0.00-0.50 1.50-1.85

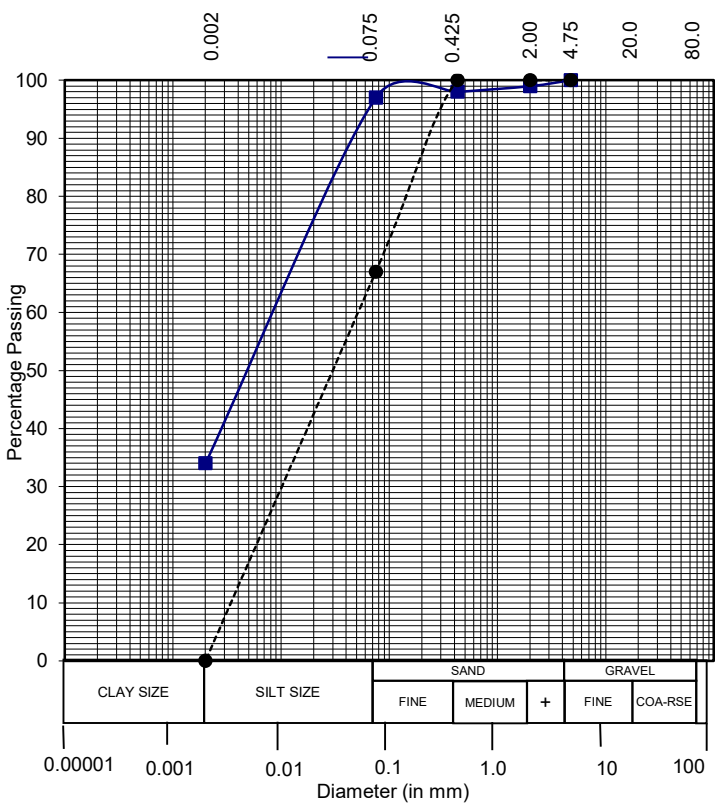


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth 3.00-3.35 4.50-4.85

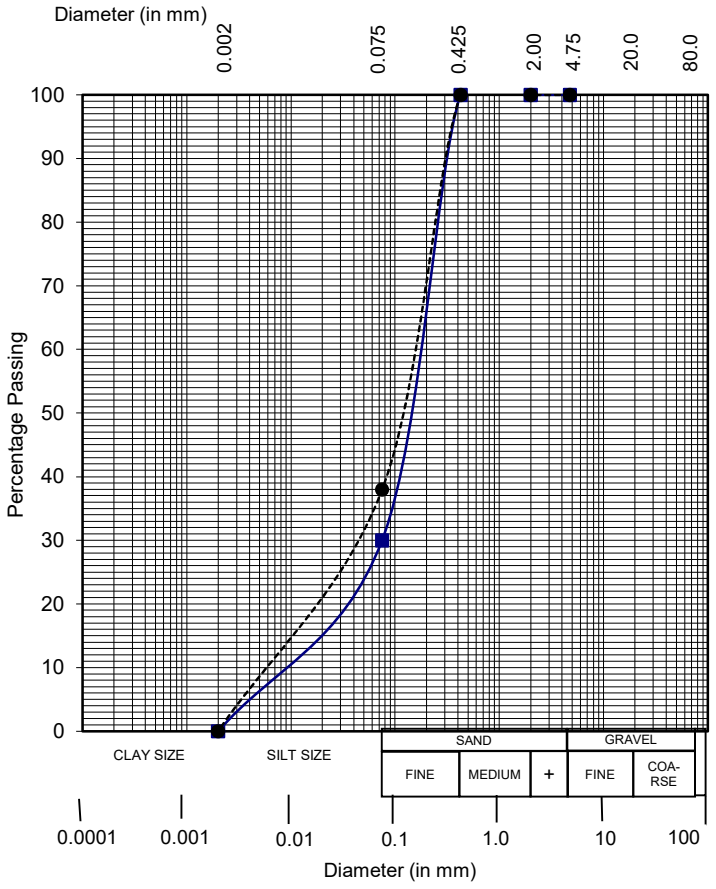


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth — 6.00-6.35 - - - 7.50-7.85

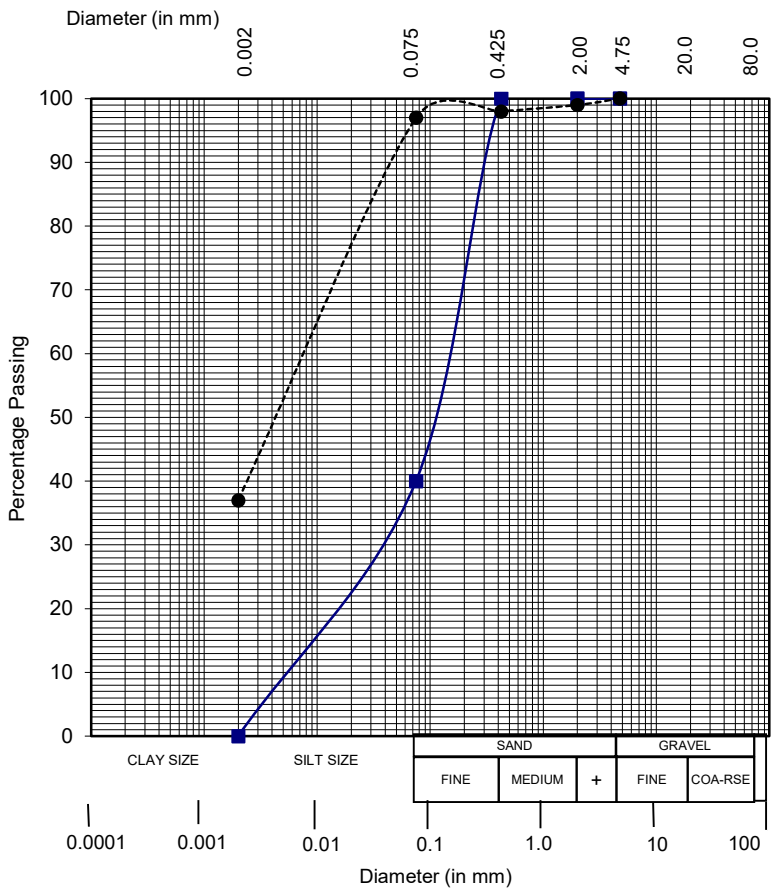


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth — 9.00-9.35 - - - 10.50-10.85

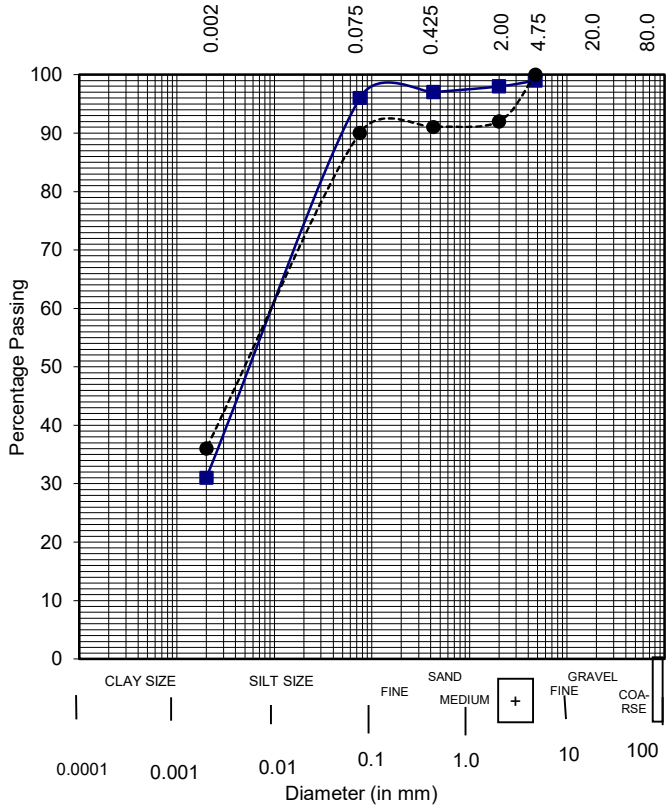


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth — 12.00-12.35 --- 13.50-13.85

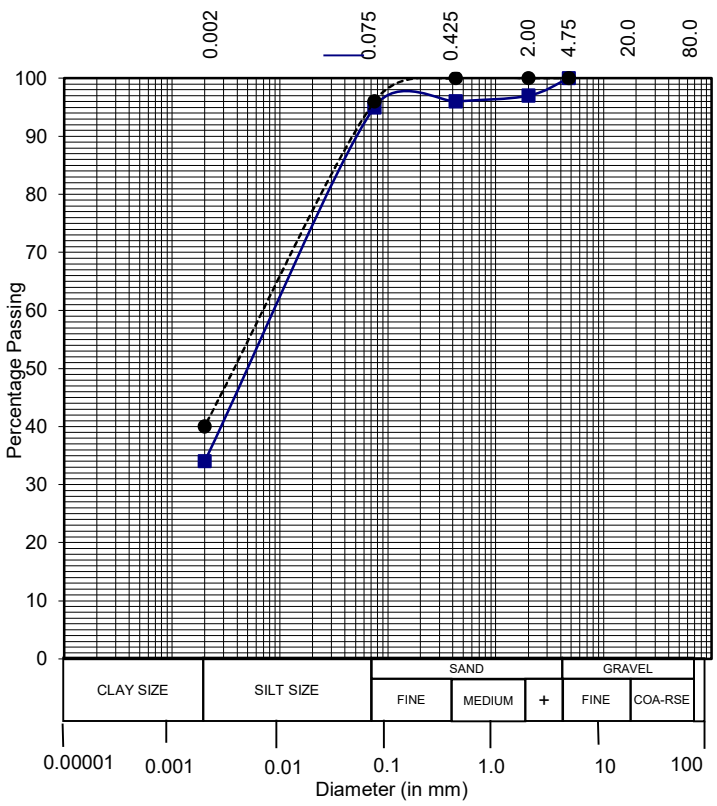


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth — 15.00-15.35 --- 16.50-16.85

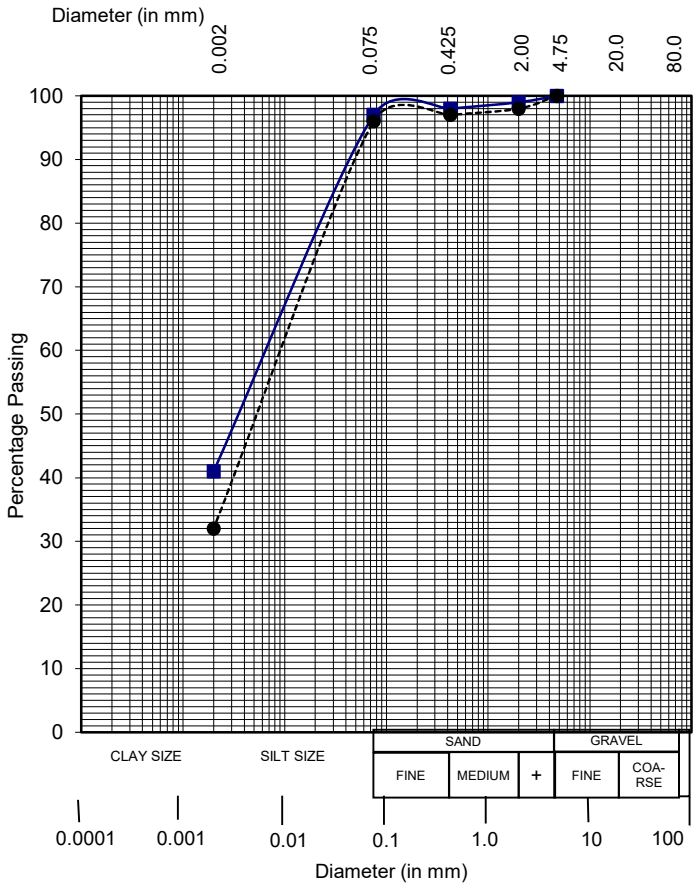


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth — 18.00-18.35 - - - 19.50-19.85

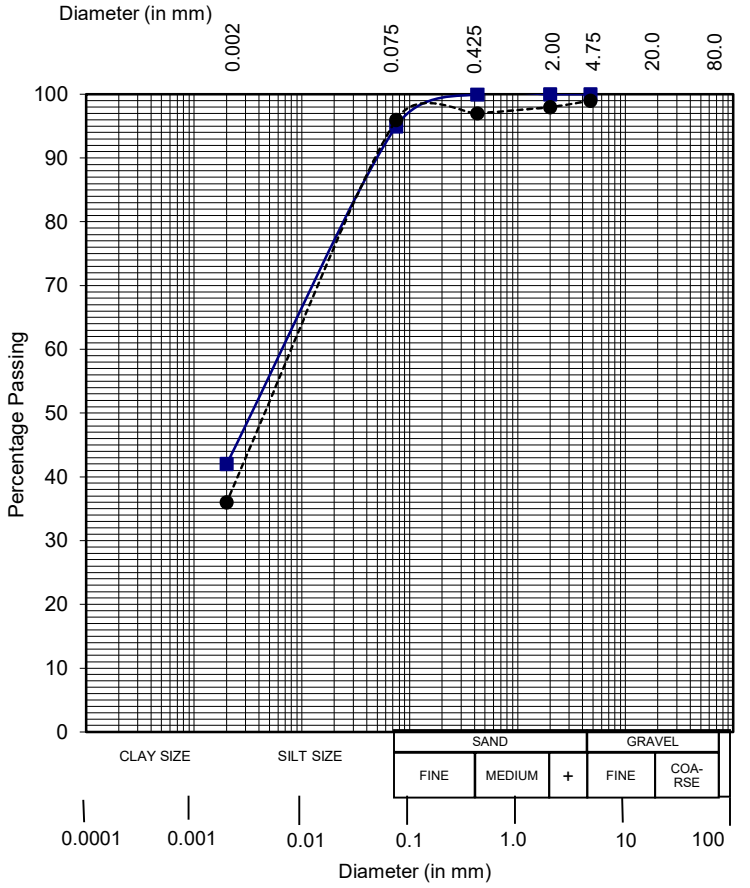


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth — 21.00-21.35 - - - 22.50-22.85

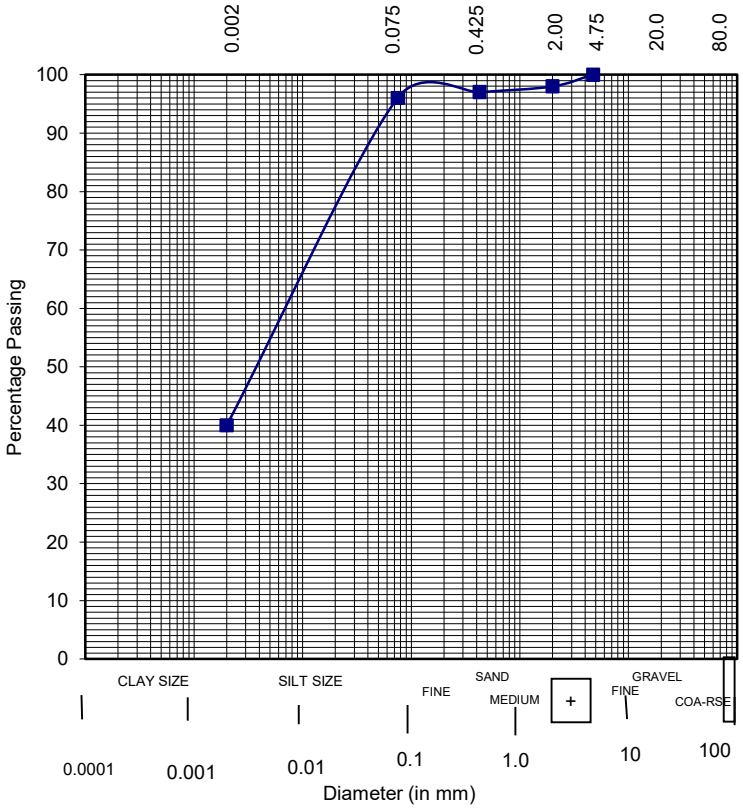


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

Depth 24.00-24.35

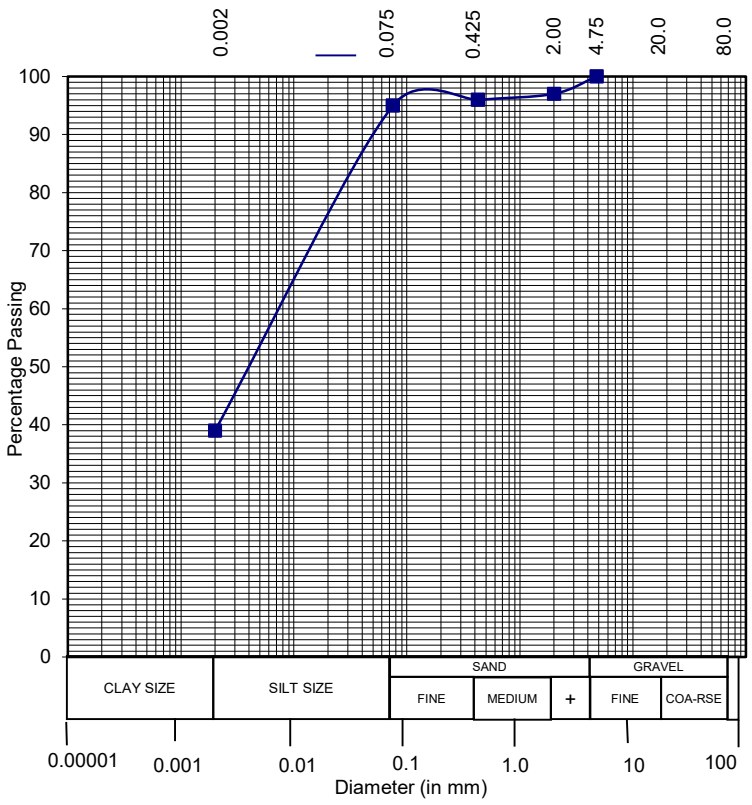


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02

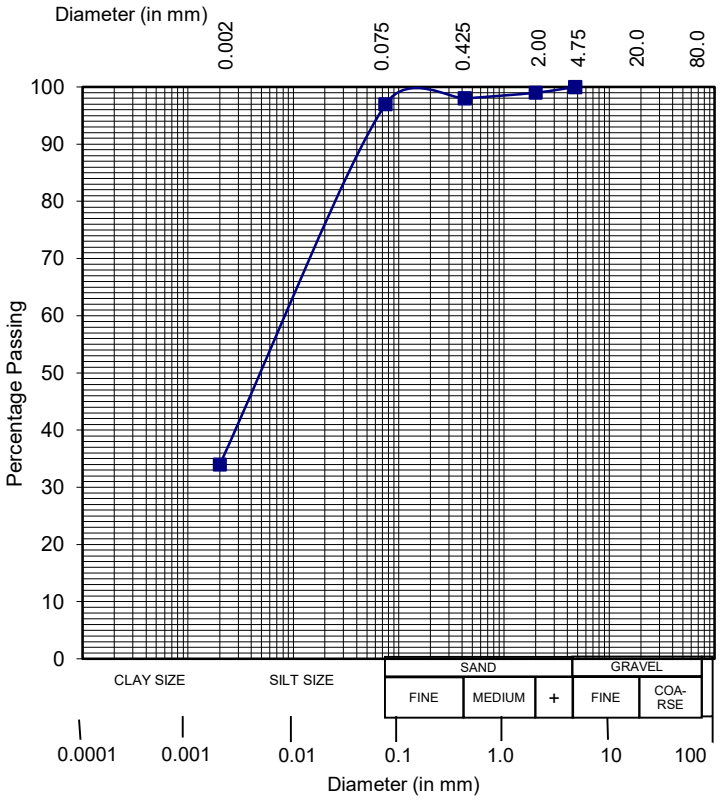
Depth 25.50-25.85



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

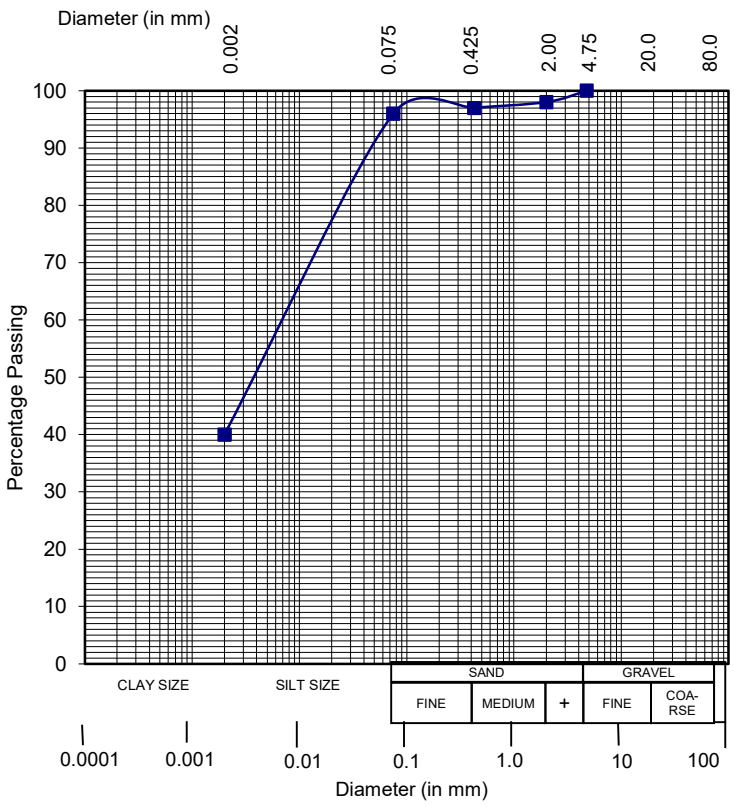
Bore Hole No. 02
Depth 27.00-24.35



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 02
Depth 28.50-28.85

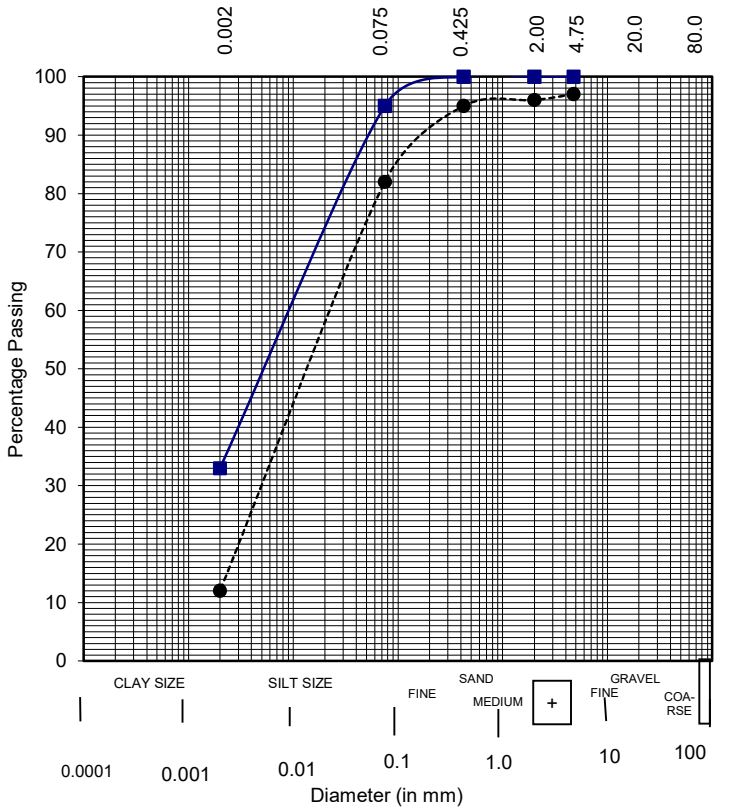


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 0.00-0.50 1.50-1.85

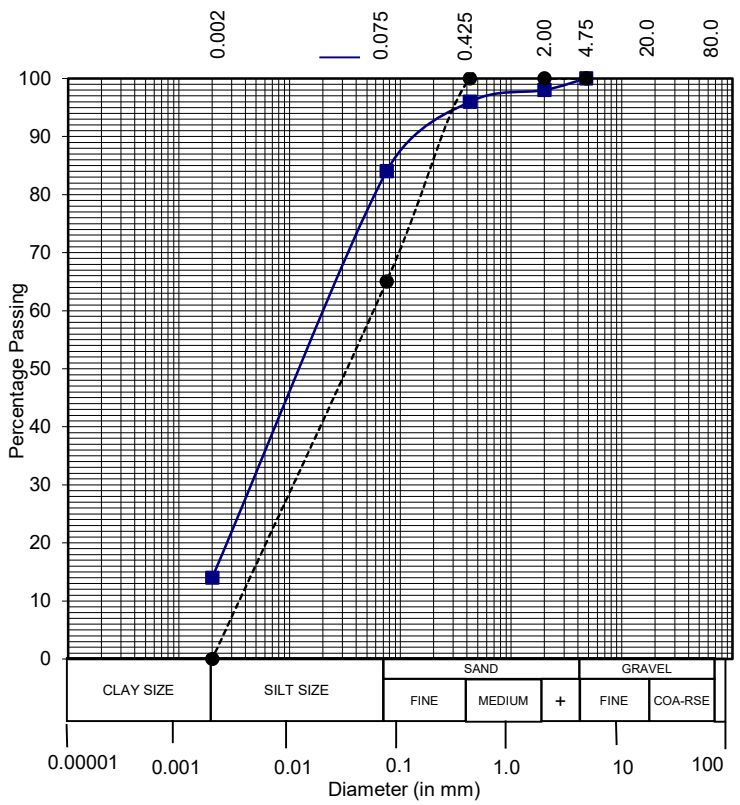


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 3.00-3.35 4.50-4.85

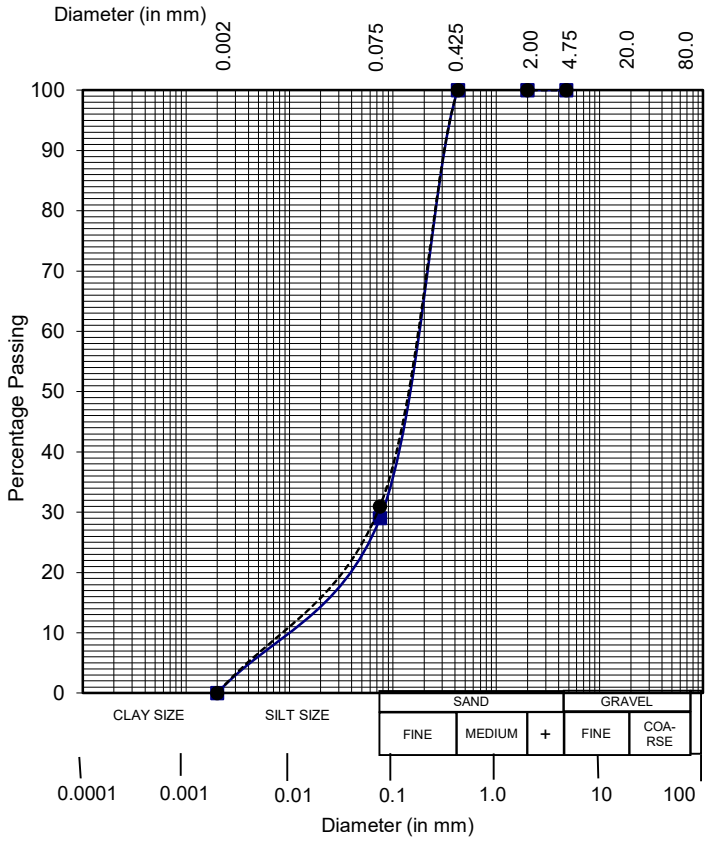


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 6.00-6.35 --- 7.50-7.85

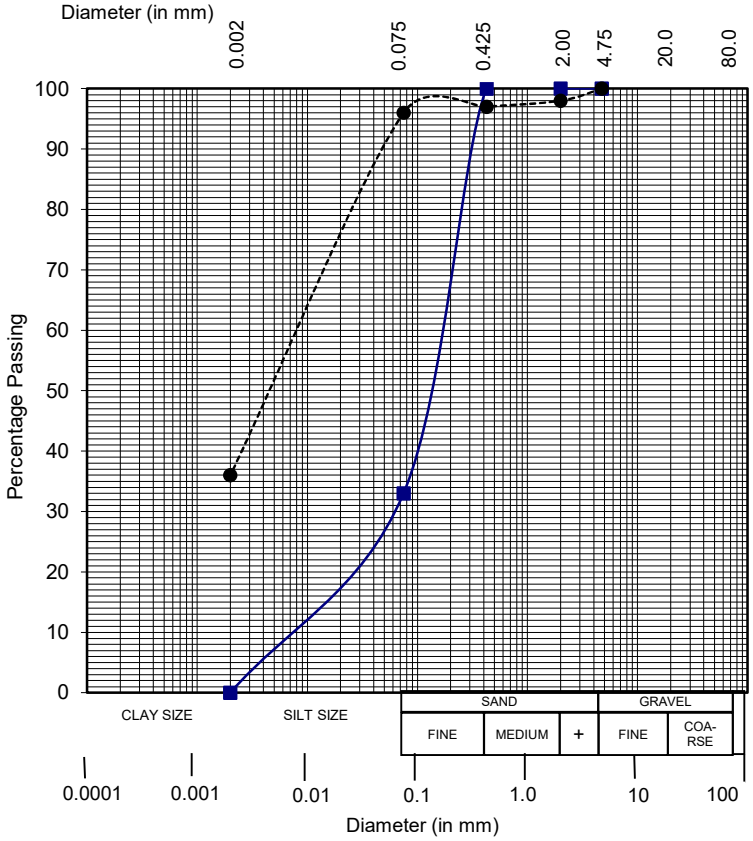


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 9.00-9.35 --- 10.50-10.85

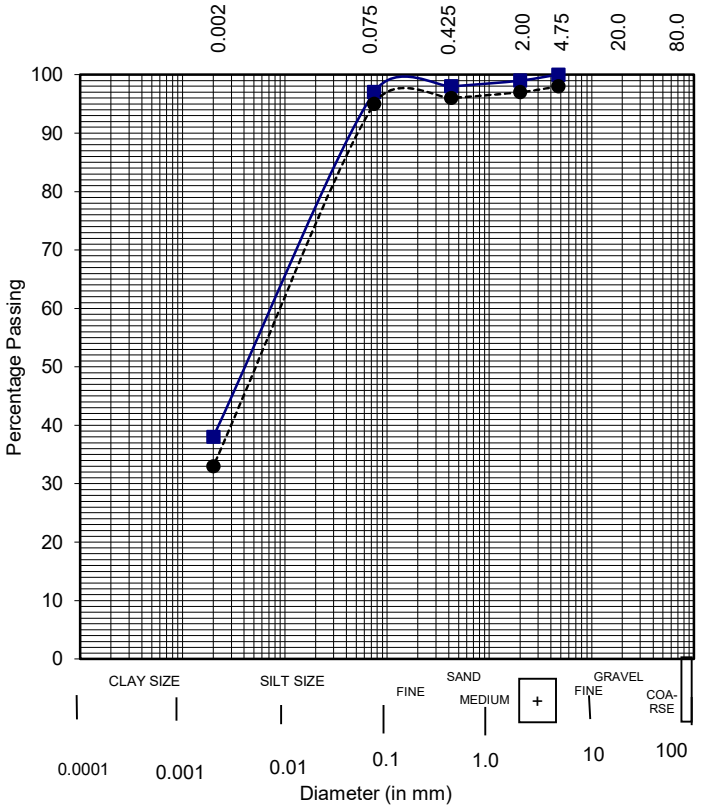


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 12.00-12.35 13.50-13.85

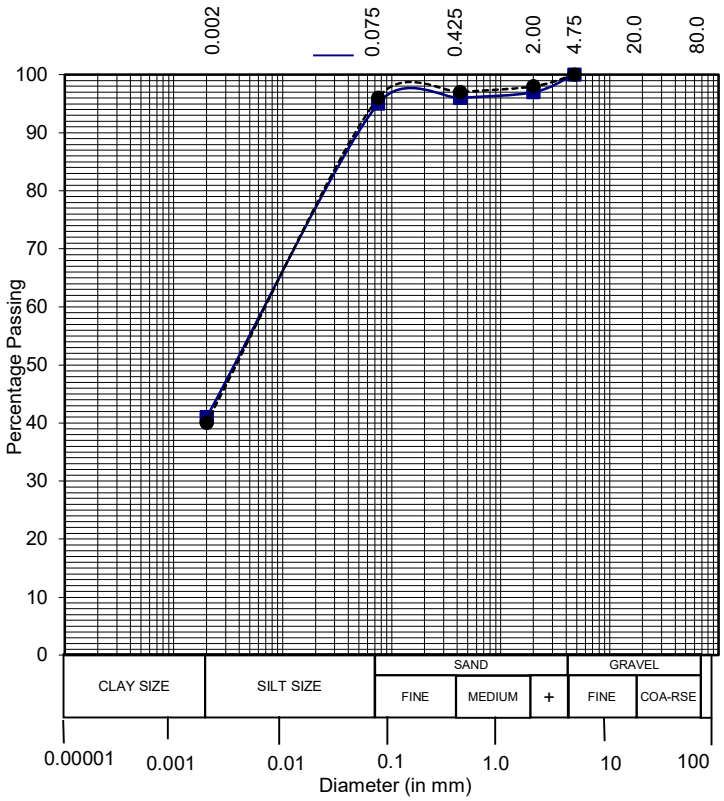


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 15.00-15.35 16.50-16.85

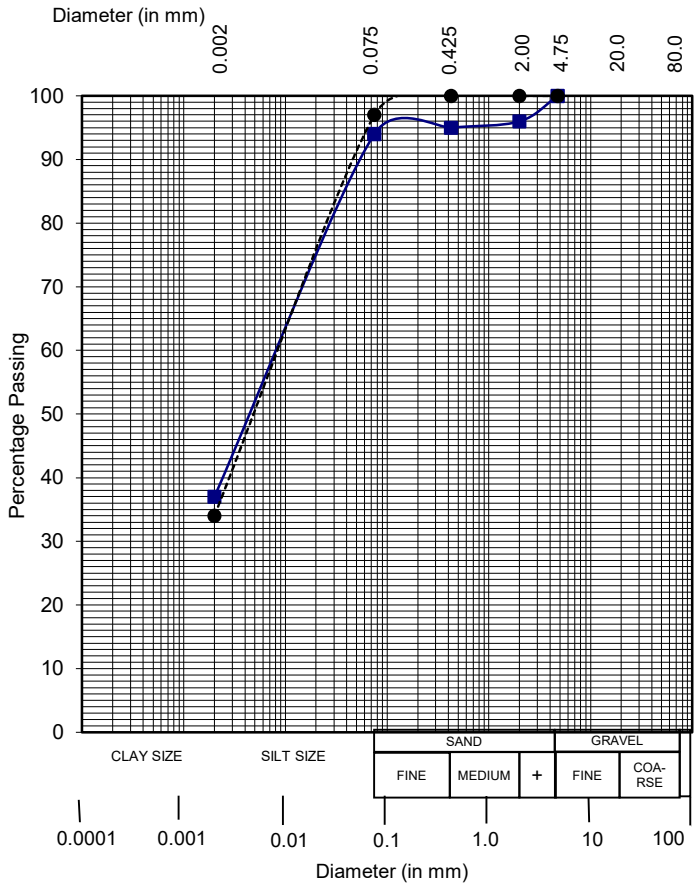


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth — 18.00-18.35 - - - 19.50-19.85

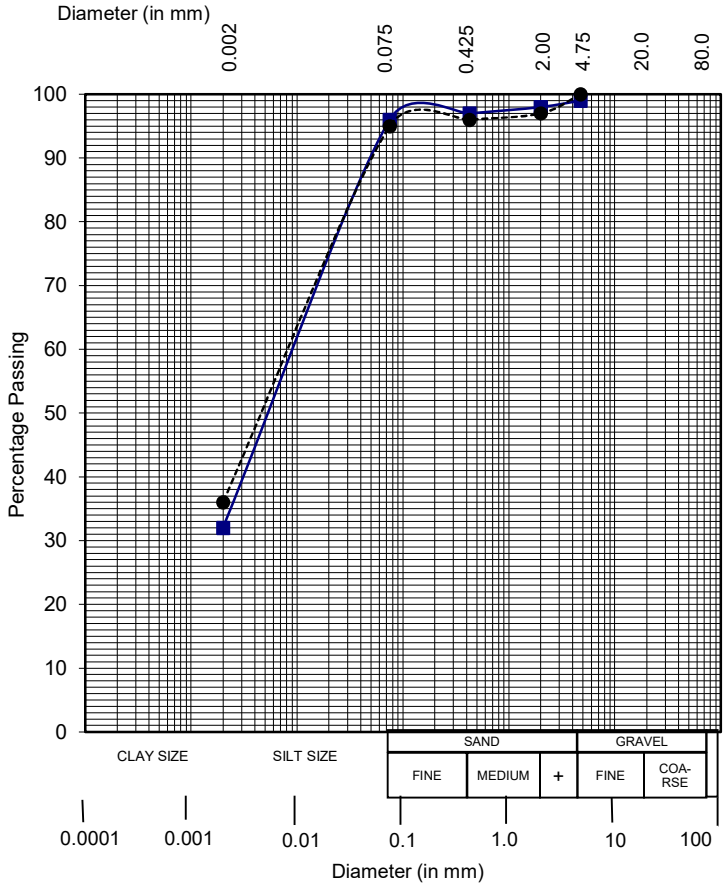


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth — 21.00-21.35 - - - 22.50-22.85

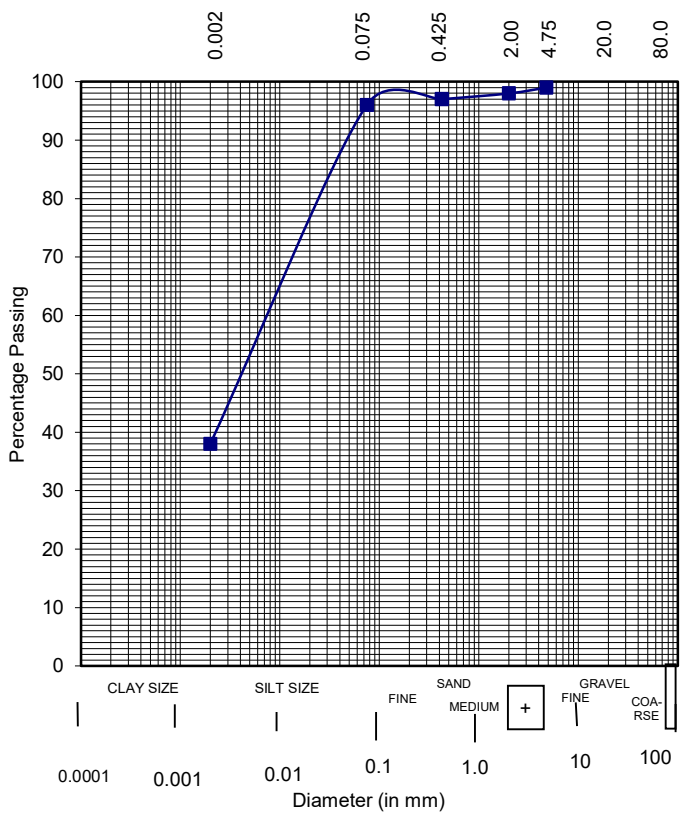


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

Depth 24.00-24.35

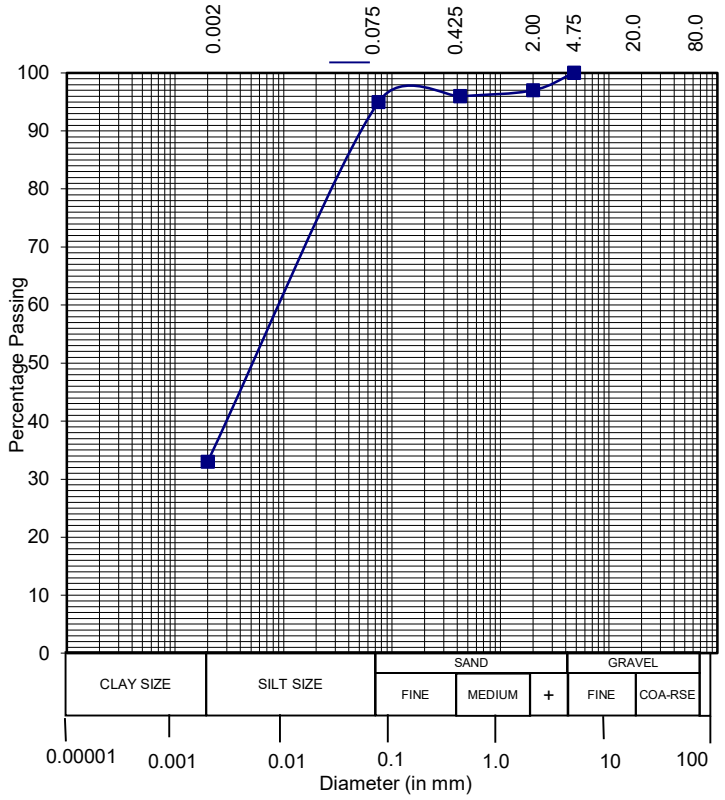


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03

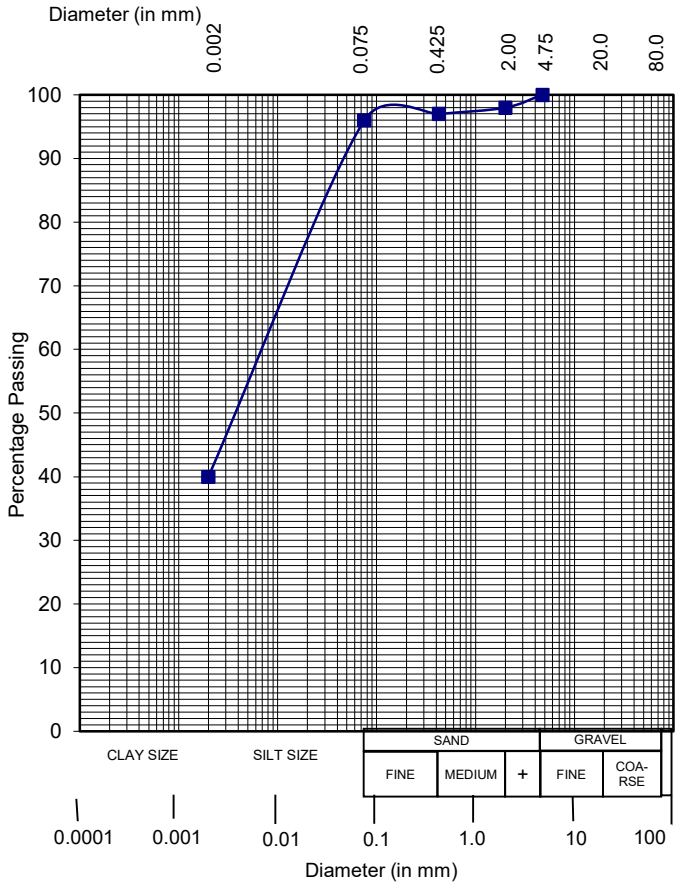
Depth 25.50-25.85



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

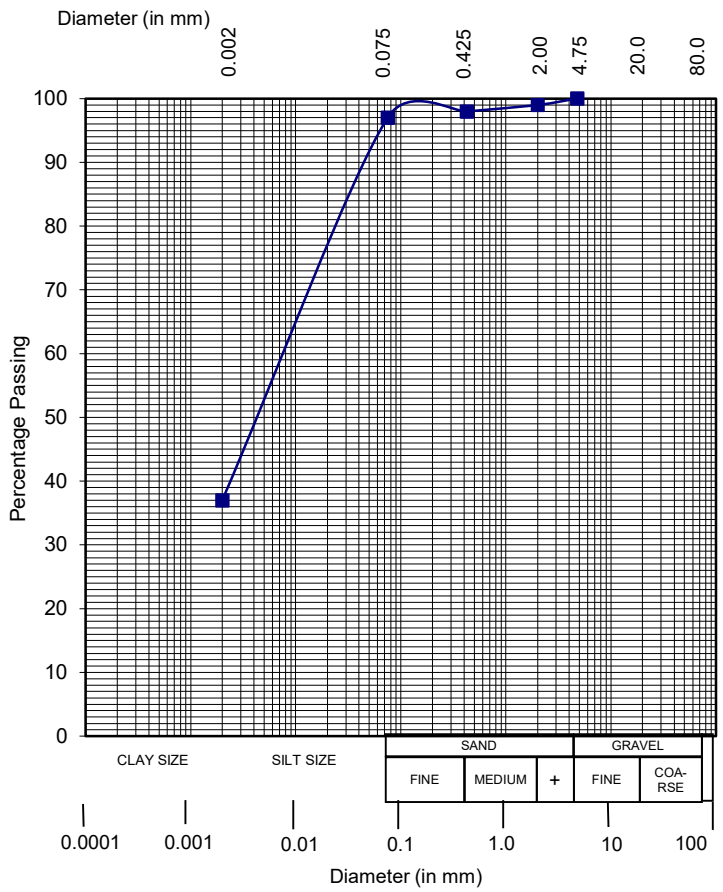
Bore Hole No. 03
Depth 27.00-24.35



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 03
Depth 28.50-28.85

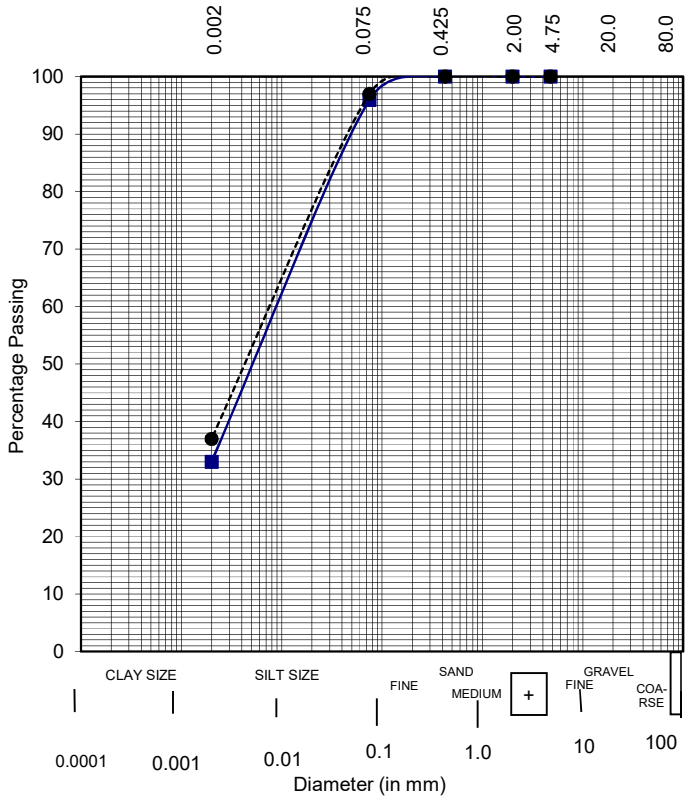


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth 0.00-0.50 1.50-1.85

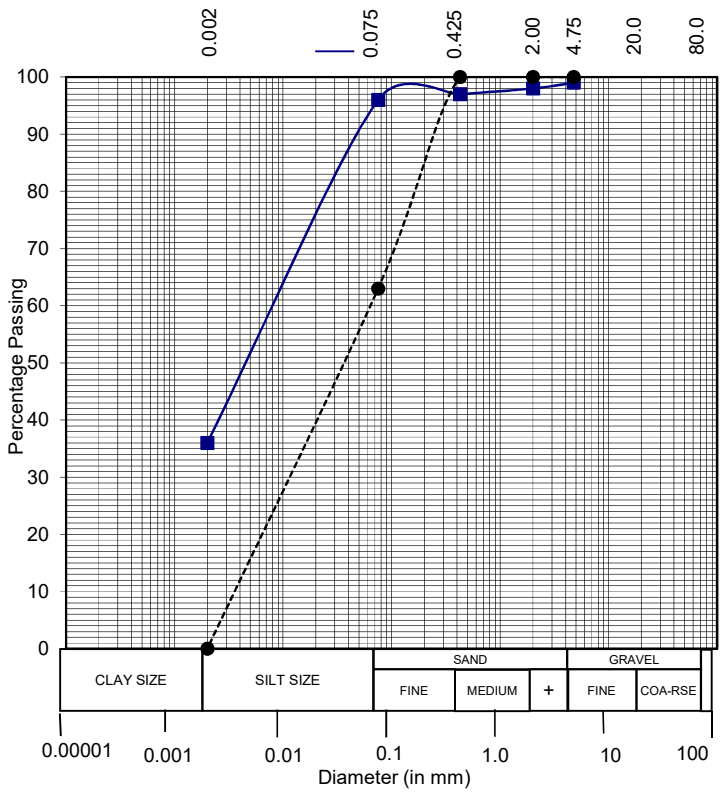


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth 3.00-3.35 4.50-4.85

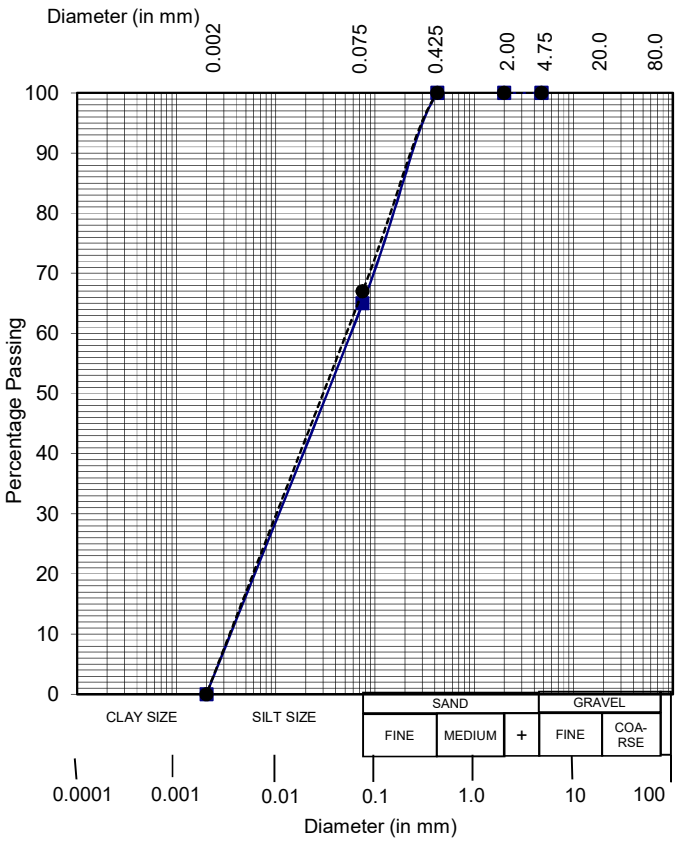


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth — 6.00-6.35 --- 7.50-7.85

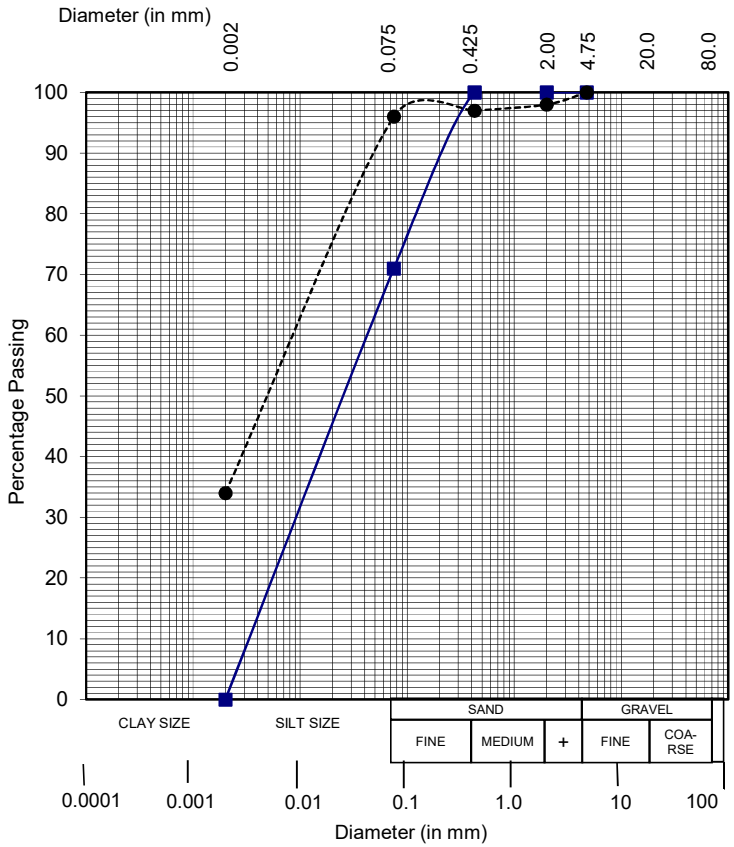


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth — 9.00-9.35 --- 10.50-10.85

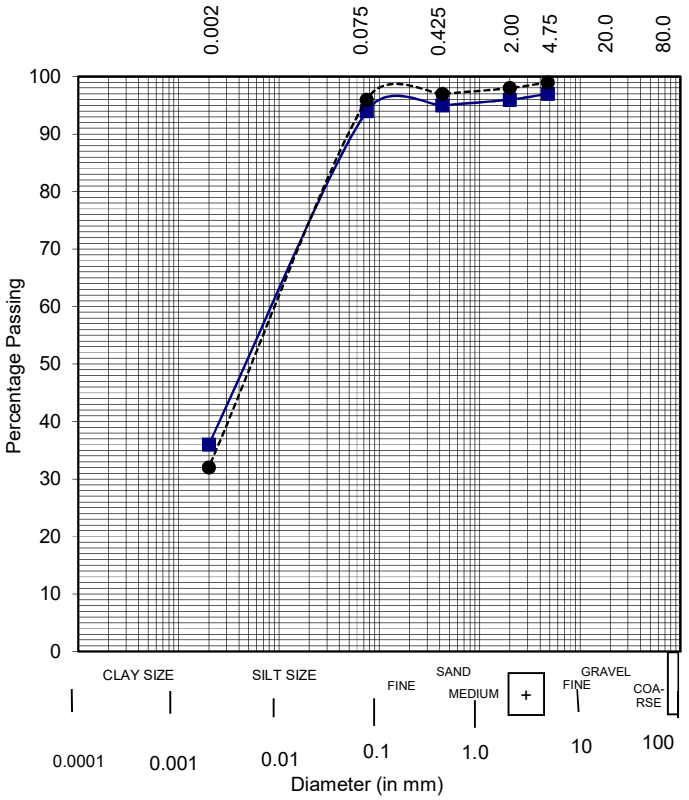


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth — 12.00-12.35 - - - 13.50-13.85

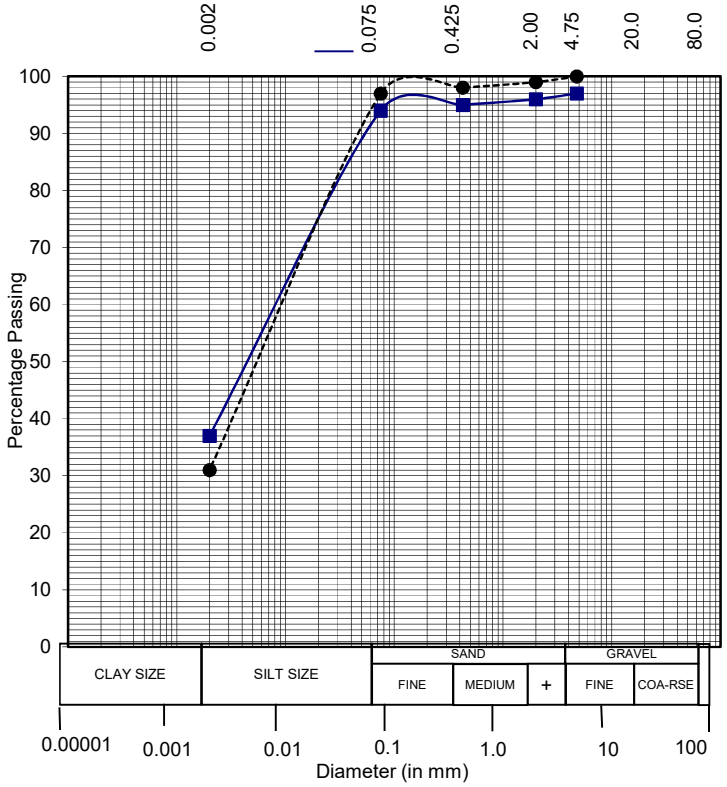


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth — 15.00-15.35 - - - 16.50-16.85

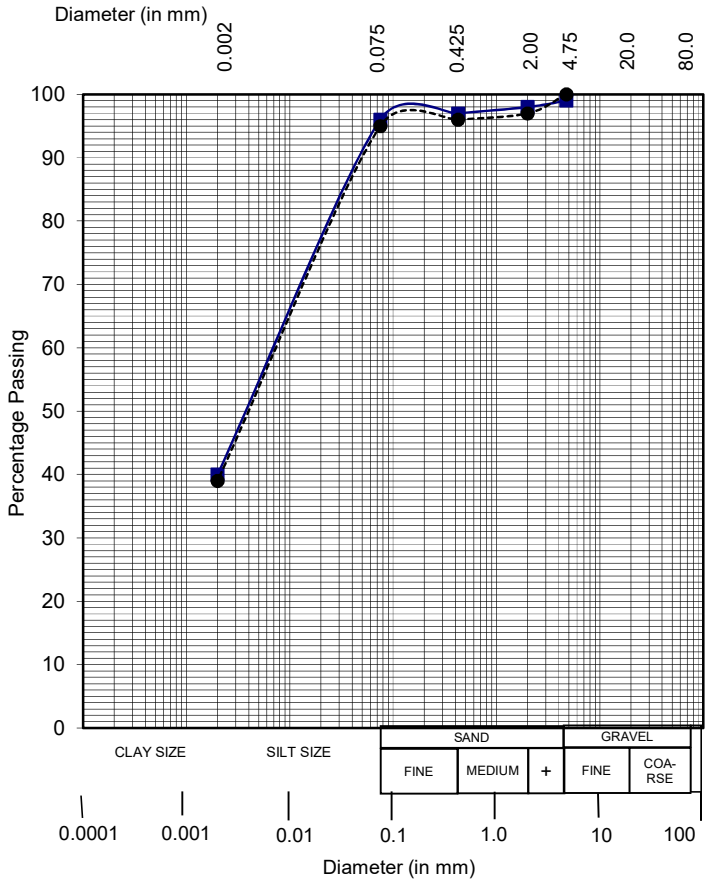


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth — 18.00-18.35 --- 19.50-19.85

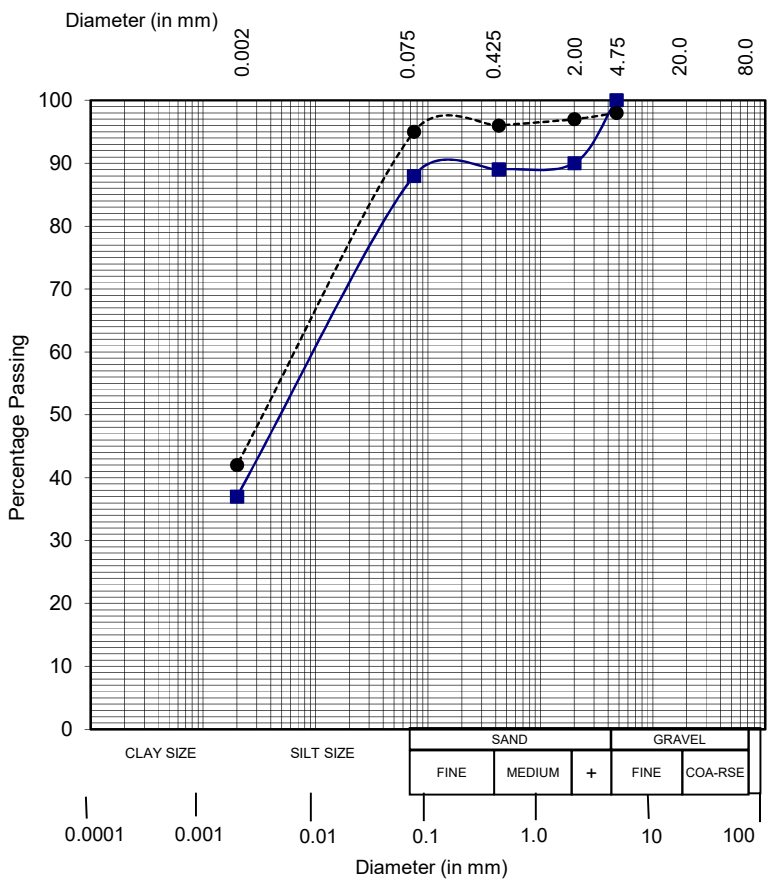


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth — 21.00-21.35 --- 22.50-22.85

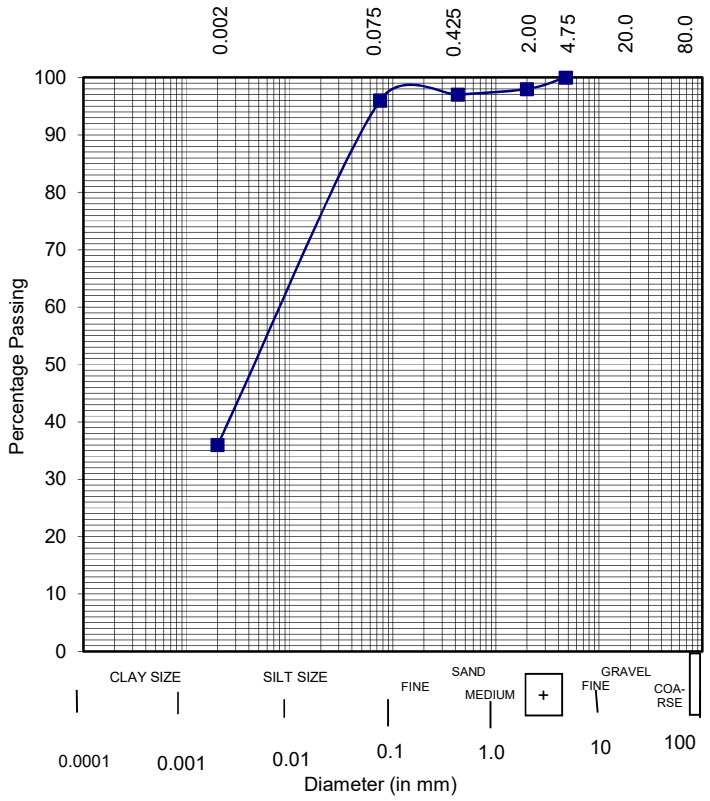


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

Depth —■—■— 24.00-24.35

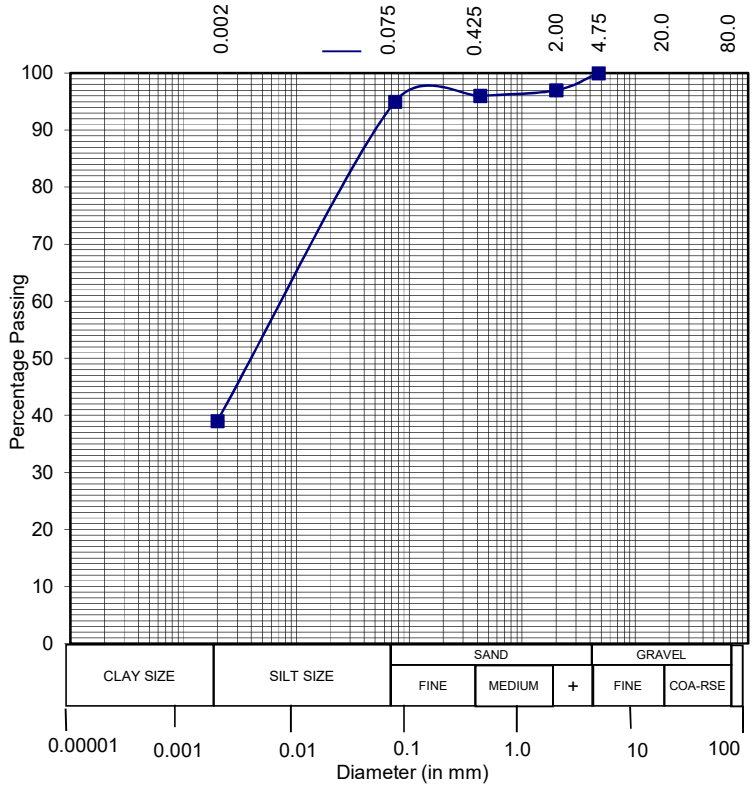


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04

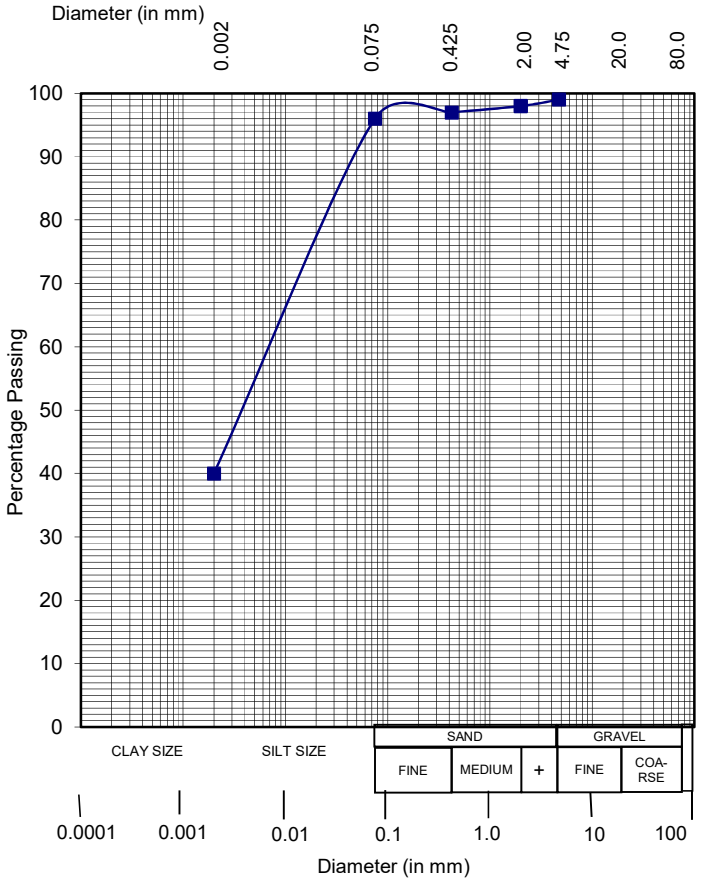
Depth —■—■— 25.50-25.85



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

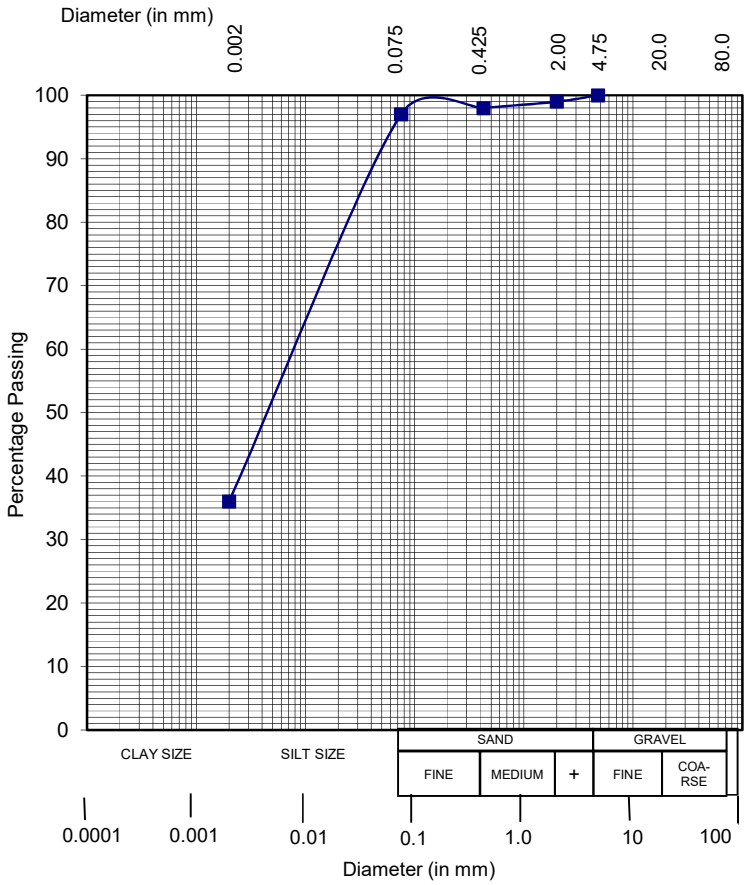
Bore Hole No. 04
Depth 27.00-24.35



ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 04
Depth 28.50-28.85

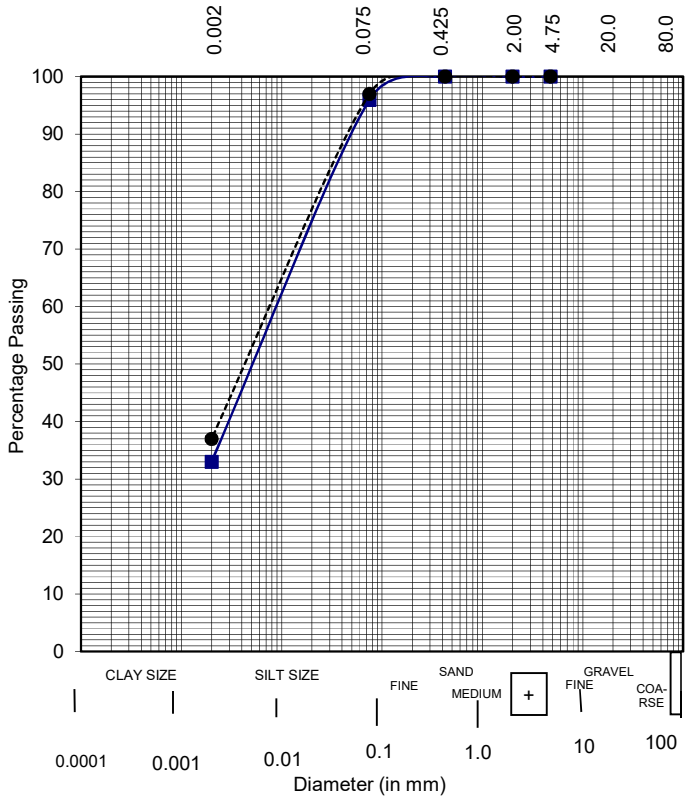


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 05

Depth 0.00-0.50 1.50-1.85

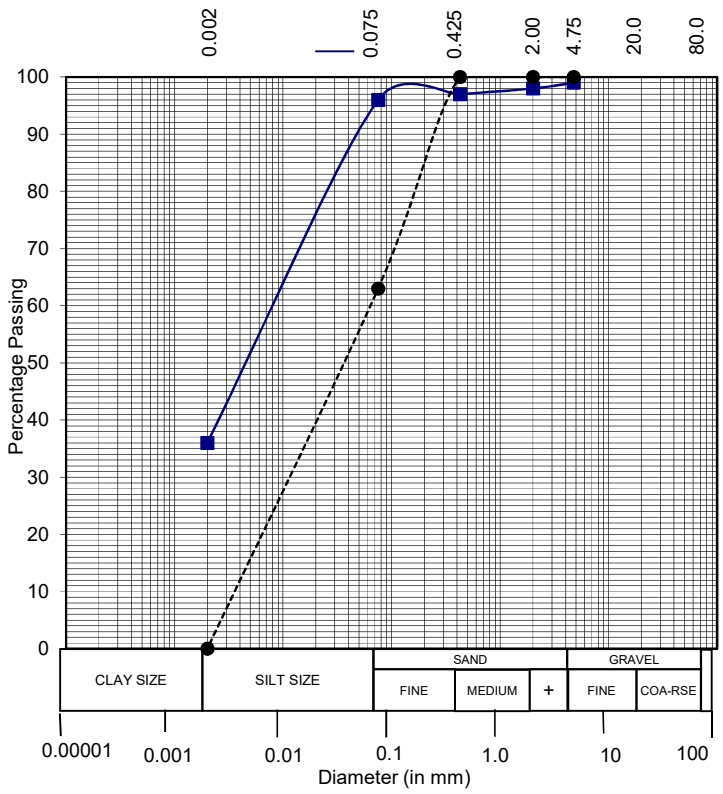


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 05

Depth 3.00-3.35 4.50-4.85

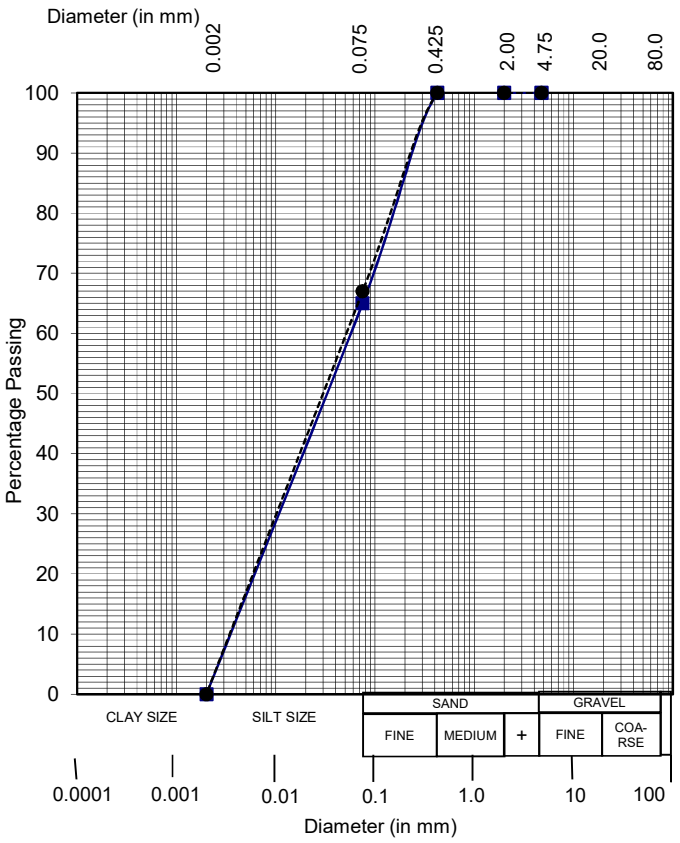


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 05

Depth — 6.00-6.35 --- 7.50-7.85

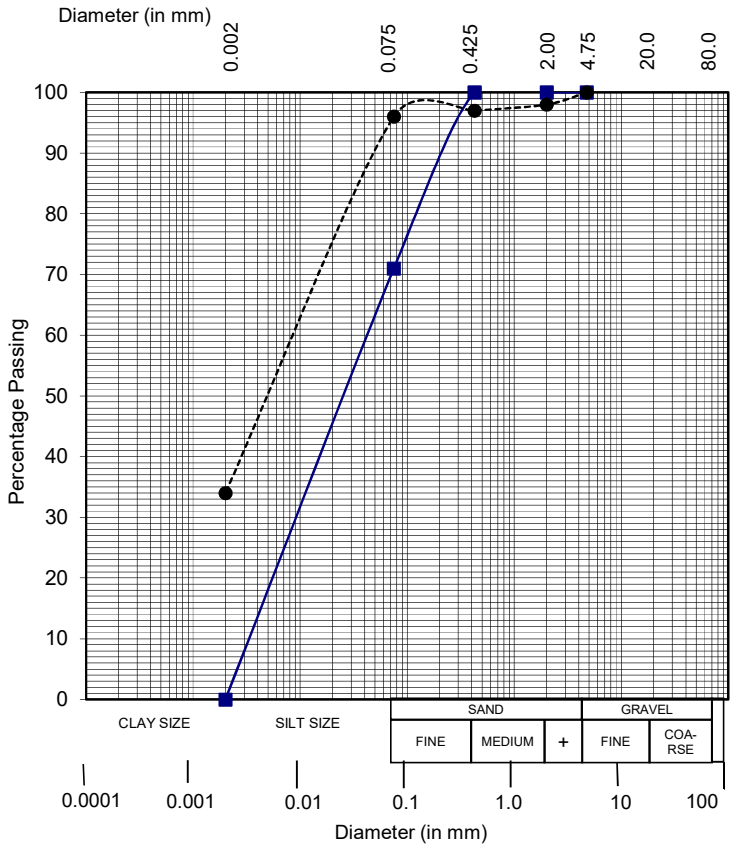


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 05

Depth — 9.00-9.35 --- 10.50-10.85

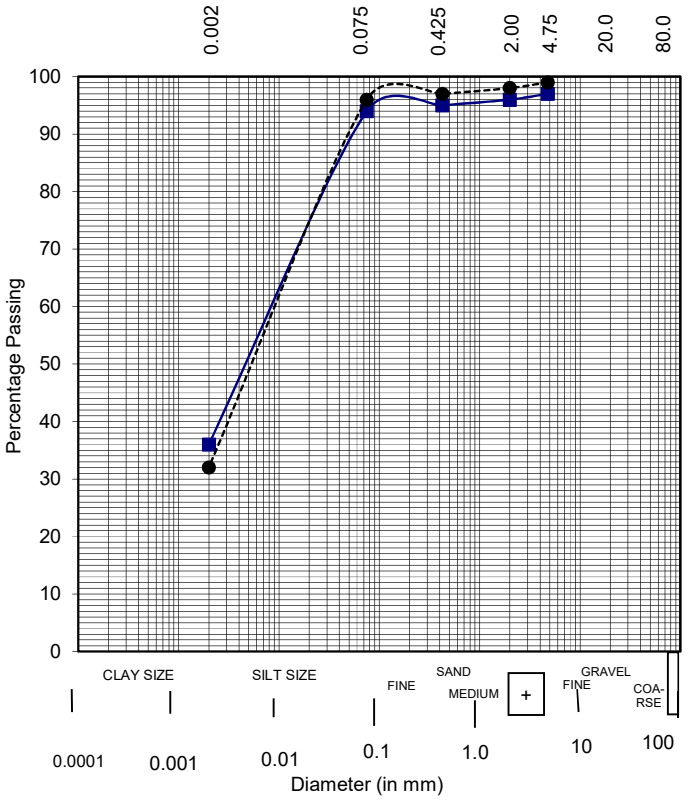


ABC CONSULTANTS

OFFICE : C-1074/75,Sec-B,Mahanagar, LUCKNOW

Bore Hole No. 05

Depth — 12.00-12.35 - - - 13.50-13.85

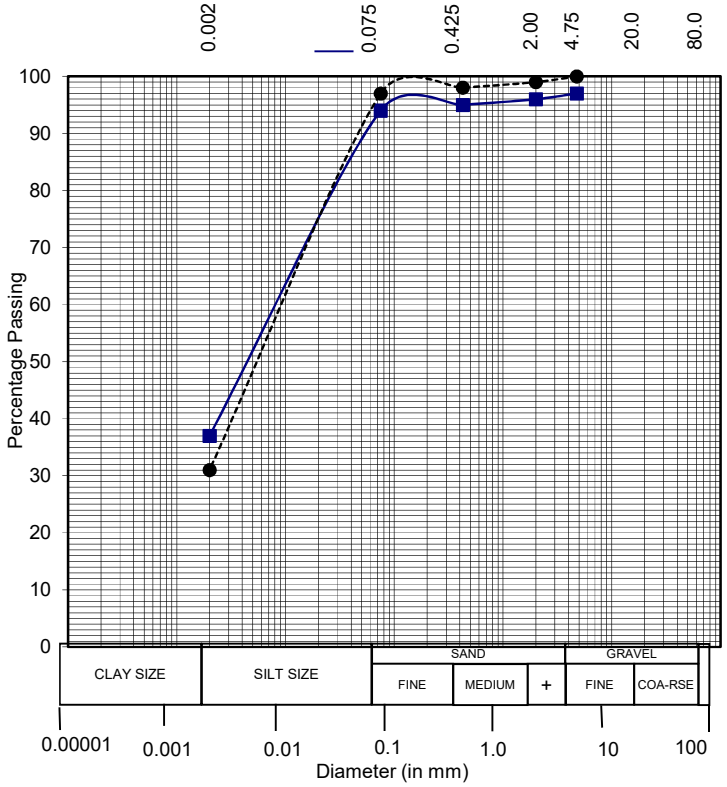


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Bore Hole No. 05

Depth — 15.00-15.35 - - - 16.50-16.85

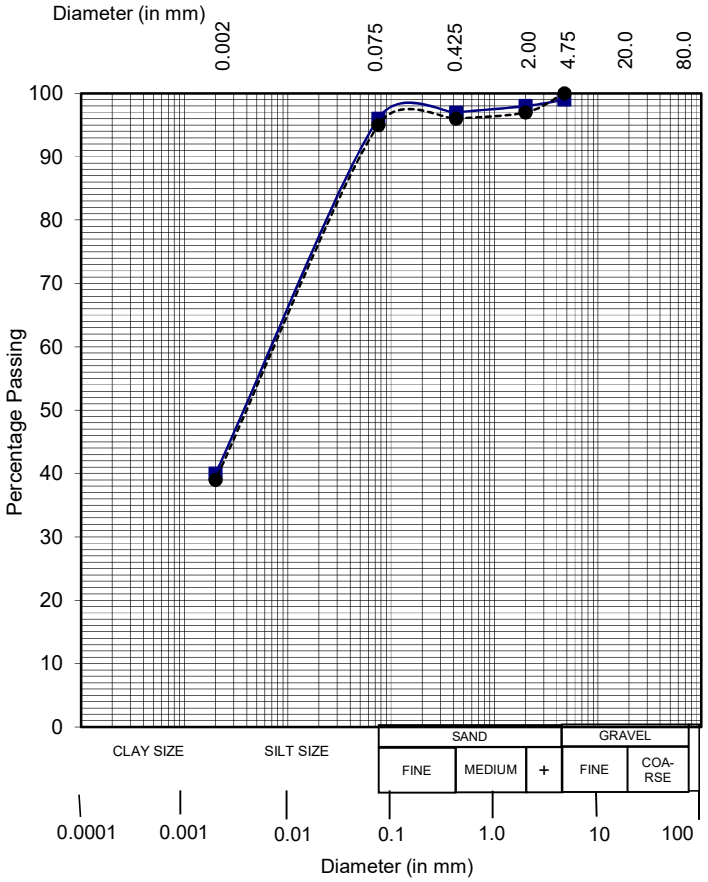


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Bore Hole No. 05

Depth — 18.00-18.35 --- 19.50-19.85

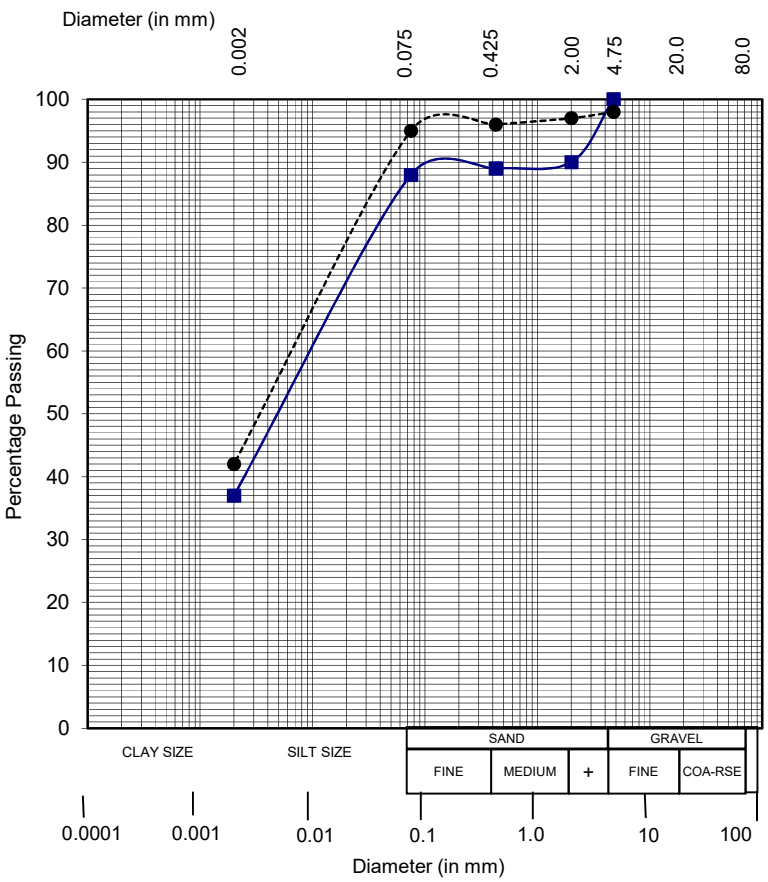


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Bore Hole No. 05

Depth — 21.00-21.35 --- 22.50-22.85

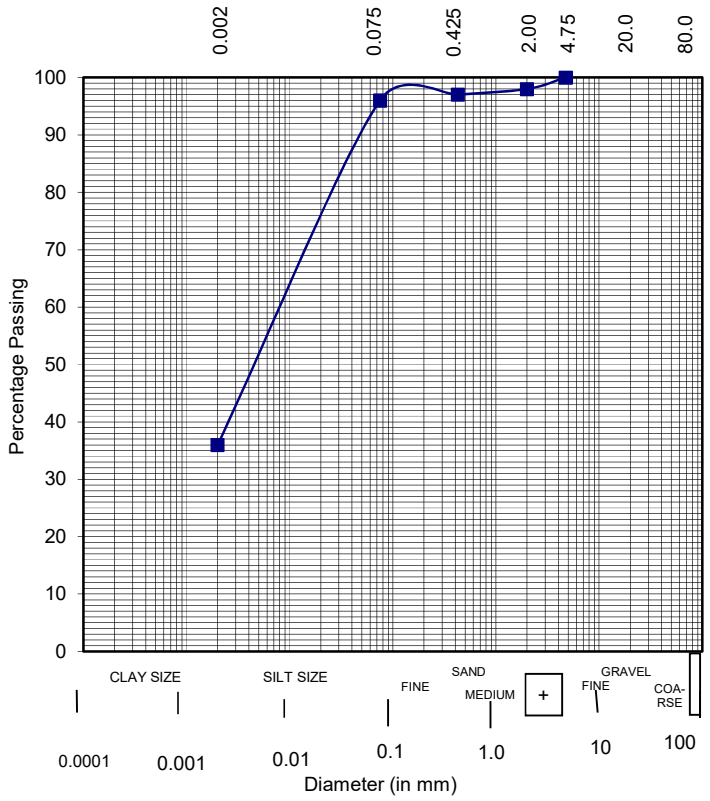


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Bore Hole No. 05

Depth — 24.00-24.35

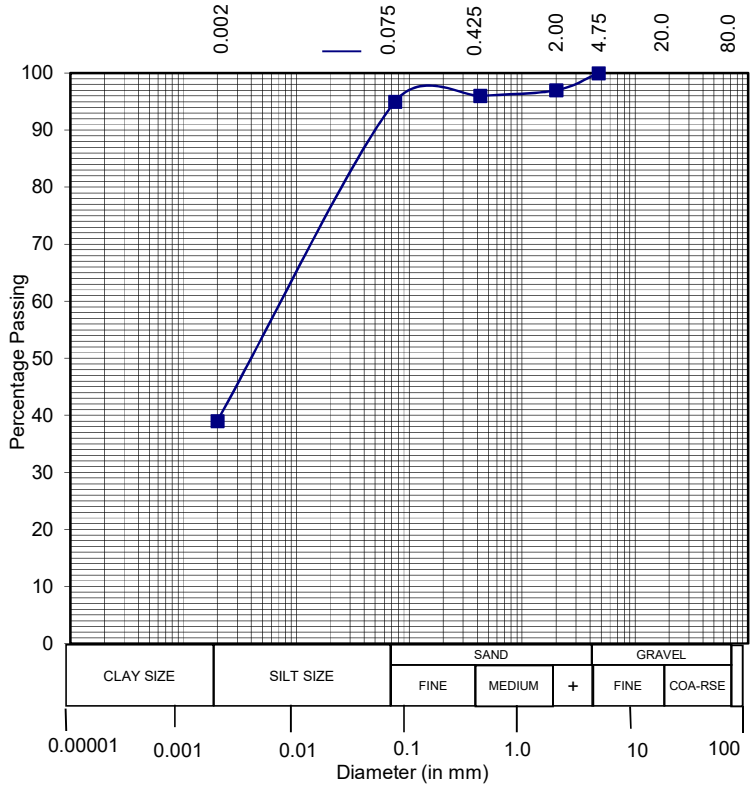


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Bore Hole No. 05

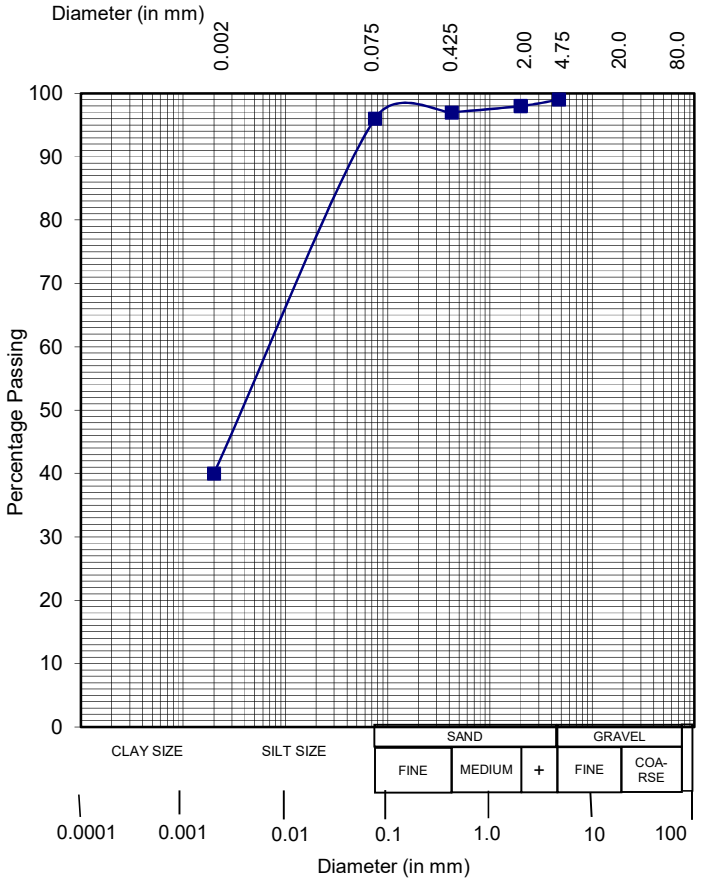
Depth — 25.50-25.85



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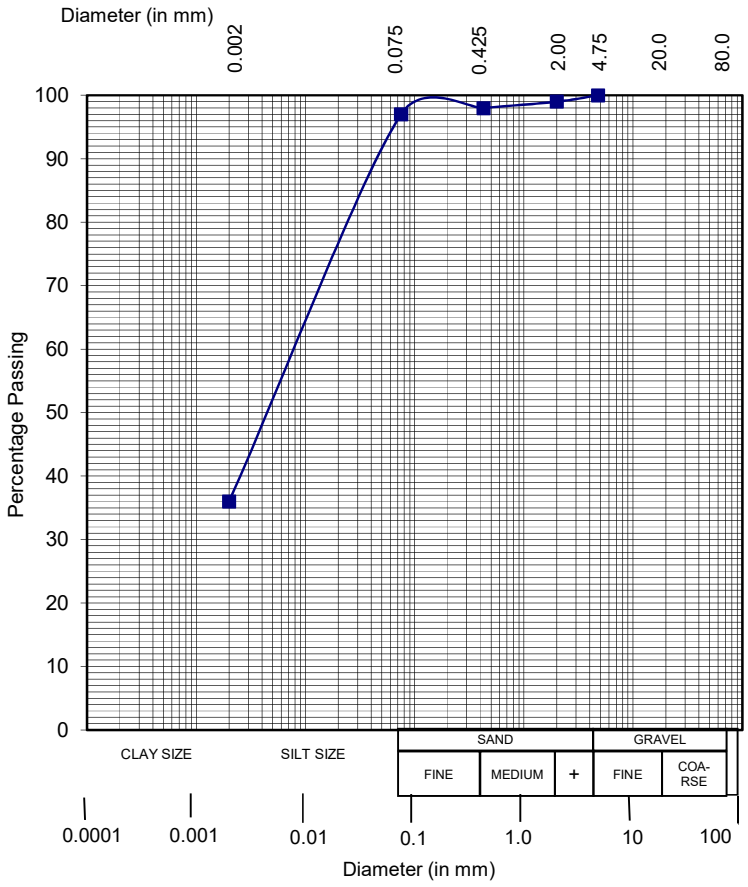
Bore Hole No. 05
Depth 27.00-24.35



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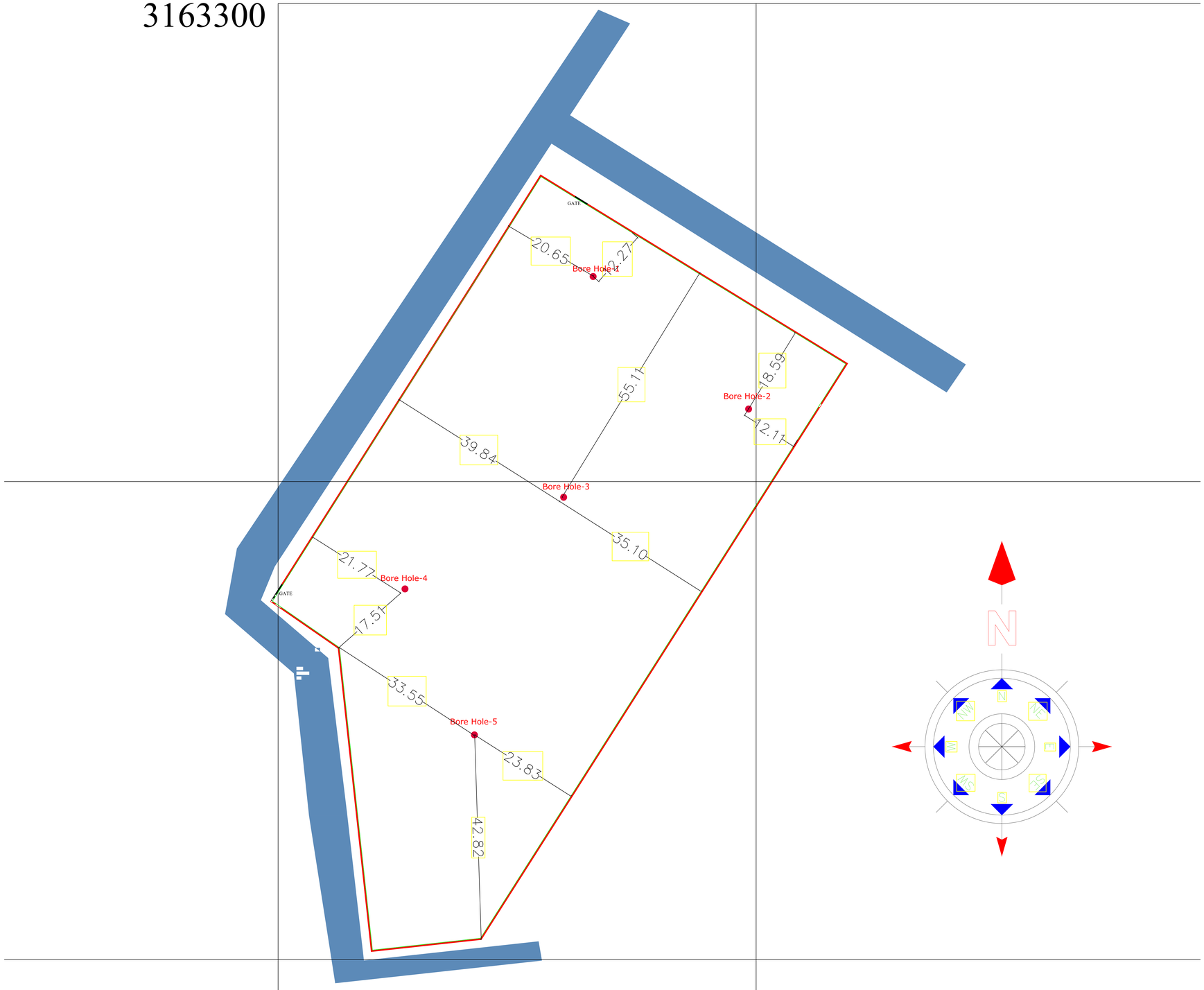
Bore Hole No. 05
Depth 28.50-28.85



700400

700500

3163300



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Project : Proposed Construction of Double Basement+G+12th Storied Judicial Residential Building in Dwarka, at District - Delhi.

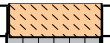
Bore Hole No. 01

Depth of Bore Hole : 30.0M.

Depth of Water table : 11.20m

LABORATORY TEST RESULTS

S. No.	Depth of Bore Hole	Nature of soil Sample	% Passing on IS Sieve				Atterberg's Limit			Particle Size Analysis				S.P.T. Value	IS Group		Natural Moisture Content %	Wet Density gm/cc	Dry Density gm/cc	Specific Gravity 'G'	Void ratio 'e'	Shear Parameter		Compression Index Cc
			4.75 mm	2.00 mm	0.425mm	0.075 mm	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %		Symbol	hatching						Cohesion 'C' in Kg/Sqcm.	Angle of Internal Friction Φ	
1	0.0-0.50	DS	100	100	100	81	25	20	5	0	19	71	10	-	CL/ML		-	-	-	-	-	-	-	-
2	1.50-1.85	UD	100	100	100	96	39	23	16	0	4	65	31	-	CI		11.6	1.82	1.63	2.70	0.66	0.36	8	0.127
3	1.85-2.30	SPT	-	-	-	-	-	-	-	-	-	-	-	8	-		-	-	-	-	-	-	-	-
4	3.00-3.35	UD	100	100	100	82	25	19	6	0	18	70	12	-	CL/ML		12.9	1.77	1.57	2.61	0.66	0.12	18	0.112
5	3.35-3.80	SPT	-	-	-	-	-	-	-	-	-	-	-	10	-		-	-	-	-	-	-	-	-
6	4.50-4.85	UD	100	95	94	93	44	23	21	0	7	54	39	-	CI		13.5	1.88	1.66	2.70	0.63	0.38	9	0.133
7	4.85-5.30	SPT	-	-	-	-	-	-	-	-	-	-	-	12	-		-	-	-	-	-	-	-	-
8	6.00-6.35	UD	100	100	100	84	27	20	7	0	16	70	14	-	CL/ML		14.2	1.79	1.57	2.61	0.66	0.14	17	0.114
9	6.35-6.80	SPT	-	-	-	-	-	-	-	-	-	-	-	14	-		-	-	-	-	-	-	-	-
10	7.50-7.85	U.D.	100	100	100	62	20	17	3	0	38	61	1	-	ML		15.7	1.78	1.54	2.62	0.70	0.08	20	0.109
11	7.85-8.30	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	16	-		-	-	-	-	-	-	-	-
12	9.00-9.35	U.D.	100	100	100	55	20	19	1	0	45	53	2	-	ML		16.5	1.78	1.53	2.63	0.72	0.10	20	0.110
13	9.35-9.80	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	18	-		-	-	-	-	-	-	-	-
14	10.50-10.85	UD	100	98	97	96	40	22	18	0	4	60	36	-	CI		17.1	1.94	1.66	2.69	0.62	0.37	9	-
15	10.85-11.30	SPT	-	-	-	-	-	-	-	-	-	-	-	19	-		-	-	-	-	-	-	-	-
16	12.00-12.35	UD	100	97	96	95	42	23	19	0	5	58	37	-	CI		23.0	2.05	1.67	2.71	0.62	0.40	10	-
17	12.35-12.80	SPT	-	-	-	-	-	-	-	-	-	-	-	15	-		-	-	-	-	-	-	-	-
18	13.50-13.85	UD	100	99	97	91	30	19	11	0	9	69	22	-	CL		24.1	2.01	1.62	2.66	0.64	0.33	11	-
19	13.85-14.30	SPT	-	-	-	-	-	-	-	-	-	-	-	17	-		-	-	-	-	-	-	-	-
20	15.00-15.35	UD	100	100	100	96	40	23	17	0	4	63	33	-	CI		22.5	2.06	1.68	2.70	0.61	0.39	9	-
21	15.35-15.80	SPT	-	-	-	-	-	-	-	-	-	-	-	20	-		-	-	-	-	-	-	-	-
22	16.50-16.85	UD	99	98	97	96	40	22	18	1	3	62	34	-	CI		22.3	2.07	1.69	2.71	0.60	0.43	8	-

23	16.85-17.30	SPT	-	-	-	-	-	-	-	-	-	-	-	22	-		-	-	-	-	-	-	-	-
24	18.00-18.35	UD	97	96	95	90	30	20	10	3	7	70	20	-	CL		23.9	2.02	1.63	2.67	0.64	0.25	12	-
25	18.35-18.80	SPT	-	-	-	-	-	-	-	-	-	-	-	24	-		-	-	-	-	-	-	-	-
26	19.50-19.85	UD	96	94	93	92	31	19	12	4	4	68	24	-	CL		23.6	2.01	1.63	2.65	0.63	0.27	10	-
27	19.85-20.30	SPT	-	-	-	-	-	-	-	-	-	-	-	27	-		-	-	-	-	-	-	-	-
28	21.00-21.35	UD	100	80	78	75	30	21	9	0	25	58	17	-	CL		23.8	2.02	1.63	2.66	0.63	0.19	13	-
29	21.35-21.80	SPT	-	-	-	-	-	-	-	-	-	-	-	29	-		-	-	-	-	-	-	-	-
30	22.50-22.85	UD	100	65	63	60	30	22	8	0	40	44	16	-	CL		23.9	2.02	1.63	2.67	0.64	0.15	14	-
31	22.85-23.30	SPT	-	-	-	-	-	-	-	-	-	-	-	31	-		-	-	-	-	-	-	-	-
32	24.00-24.35	UD	100	85	83	81	30	19	11	0	19	59	22	-	CL		24.0	2.01	1.62	2.65	0.64	0.23	11	-
33	24.35-24.80	SPT	-	-	-	-	-	-	-	-	-	-	-	37	-		-	-	-	-	-	-	-	-
34	25.50-25.85	UD	90	55	49	37	20	18	2	10	53	36	1	-	SC		25.2	1.97	1.57	2.60	0.66	0.01	24	-
35	25.85-26.30	SPT	-	-	-	-	-	-	-	-	-	-	-	39	-		-	-	-	-	-		-	
36	27.00-27.35	UD	85	49	47	41	22	19	3	15	44	38	3	-	SC		25.0	1.97	1.58	2.61	0.65	0.11	19	-
37	27.35-27.80	SPT	-	-	-	-	-	-	-	-	-	-	-	42	-		-	-	-	-	-		-	-
38	28.50-28.85	UD	80	45	43	39	18	17	1	20	41	37	2	-	SC		25.2	1.97	1.57	2.60	0.66	0.13	18	-
39	28.85-29.30	SPT	-	-	-	-	-	-	-	-	-	-	-	45	-		-	-	-	-	-	-	-	
40	29.30-30.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	SC		-	-	-	-	-	-	-	-

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Project : Proposed Construction of Double Basement+G+12th Storied Judicial Residential Building in Dwarka, at District - Delhi.

Bore Hole No. 02

Depth of Bore Hole : 30.0M.

Depth of Water table : 12.00m

LABORATORY TEST RESULTS

S. No.	Depth of Bore Hole	Nature of soil Sample	% Passing on IS Sieve				Atterberg's Limit			Particle Size Analysis				S.P.T. Value	IS Group		Natural Moisture Content %	Wet Density gm/cc	Dry Density gm/cc	Specific Gravity 'G'	Void ratio 'e'	Shear Parameter		Compression Index Cc
			4.75 mm	2.00 mm	0.425mm	0.075 mm	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %		Symbol	hatching						Cohesion 'C' in Kg/Sqcm.	Angle of Internal Friction Φ	
1	0.0-0.50	DS	100	100	100	96	41	22	19	0	4	59	37	-	CI		-	-	-	-	-	-	-	-
2	1.50-1.85	UD	100	100	100	96	41	22	19	0	4	59	37	-	CI		11.5	1.83	1.64	2.70	0.65	0.42	6	0.129
3	1.85-2.30	SPT	-	-	-	-	-	-	-	-	-	-	-	9	-		-	-	-	-	-	-	-	-
4	3.00-3.35	UD	100	99	98	97	41	23	18	0	3	62	35	-	CI		12.8	1.86	1.65	2.69	0.63	0.39	7	0.123
5	3.35-3.80	SPT	-	-	-	-	-	-	-	-	-	-	-	12	-		-	-	-	-	-	-	-	-
6	4.50-4.85	UD	100	100	100	96	44	23	21	0	4	57	39	-	CI		13.3	1.88	1.66	2.70	0.63	0.35	10	0.130
7	4.85-5.30	SPT	-	-	-	-	-	-	-	-	-	-	-	15	-		-	-	-	-	-	-	-	-
8	6.00-6.35	UD	100	100	100	82	26	20	6	0	18	70	12	-	CL/ML		13.9	1.78	1.56	2.61	0.67	0.12	18	0.112
9	6.35-6.80	SPT	-	-	-	-	-	-	-	-	-	-	-	18	-		-	-	-	-	-	-	-	-
10	7.50-7.85	U.D.	100	100	100	60	19	18	1	0	40	58	2	-	ML		14.7	1.78	1.55	2.65	0.71	0.06	21	0.090
11	7.85-8.30	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	20	-		-	-	-	-	-	-	-	-
12	9.00-9.35	U.D.	100	100	100	66	20	17	3	0	34	65	1	-	ML		15.8	1.78	1.54	2.64	0.71	0.05	21	0.085
13	9.35-9.80	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	23	-		-	-	-	-	-	-	-	-
14	10.50-10.85	UD	100	100	100	96	39	23	16	0	4	65	31	-	CI		16.9	1.94	1.66	2.68	0.61	0.36	10	-
15	10.85-11.30	SPT	-	-	-	-	-	-	-	-	-	-	-	25	-		-	-	-	-	-	-	-	-
16	12.00-12.35	UD	100	100	100	96	44	23	21	0	4	57	39	-	CI		22.7	2.05	1.67	2.69	0.61	0.34	11	-
17	12.35-12.80	SPT	-	-	-	-	-	-	-	-	-	-	-	20	-		-	-	-	-	-	-	-	-
18	13.50-13.85	UD	100	93	91	89	30	21	9	0	11	71	18	-	CL		23.9	2.02	1.63	2.67	0.64	0.19	13	-
19	13.85-14.30	SPT	-	-	-	-	-	-	-	-	-	-	-	24	-		-	-	-	-	-	-	-	-
20	15.00-15.35	UD	98	97	96	95	40	23	17	2	3	62	33	-	CI		23.1	2.04	1.66	2.69	0.62	0.39	9	-
21	15.35-15.80	SPT	-	-	-	-	-	-	-	-	-	-	-	26	-		-	-	-	-	-	-	-	-
22	16.50-16.85	UD	100	99	98	97	44	23	21	0	3	58	39	-	CI		22.7	2.05	1.67	2.69	0.61	0.37	11	-

23	16.85-17.30	SPT	-	-	-	-	-	-	-	-	-	-	-	28	-		-	-	-	-	-	-	-	-
24	18.00-18.35	UD	100	85	83	81	29	21	8	0	19	65	16	-	CL		23.8	2.02	1.63	2.66	0.63	0.18	14	-
25	18.35-18.80	SPT	-	-	-	-	-	-	-	-	-	-	-	32	-		-	-	-	-	-	-	-	-
26	19.50-19.85	UD	100	100	100	91	30	19	11	0	9	69	22	-	CL		23.6	2.01	1.63	2.65	0.63	0.24	11	-
27	19.85-20.30	SPT	-	-	-	-	-	-	-	-	-	-	-	35	-		-	-	-	-	-	-	-	-
28	21.00-21.35	UD	100	75	74	73	32	19	13	0	27	47	26	-	CL		23.8	2.02	1.63	2.66	0.63	0.26	9	-
29	21.35-21.80	SPT	-	-	-	-	-	-	-	-	-	-	-	38	-		-	-	-	-	-	-	-	-
30	22.50-22.85	UD	100	100	100	90	30	20	10	0	10	70	20	-	CL		23.8	2.02	1.63	2.66	0.63	0.22	12	-
31	22.85-23.30	SPT	-	-	-	-	-	-	-	-	-	-	-	42	-		-	-	-	-	-	-	-	-
32	24.00-24.35	UD	95	94	93	92	31	19	12	5	3	68	24	-	CL		23.6	2.01	1.63	2.65	0.63	0.27	10	-
33	24.35-24.80	SPT	-	-	-	-	-	-	-	-	-	-	-	45	-		-	-	-	-	-	-	-	-
34	25.50-25.85	UD	80	60	47	35	20	17	3	20	45	33	2	-	SC		25.8	1.96	1.56	2.61	0.67	0.01	23	-
35	25.85-26.30	SPT	-	-	-	-	-	-	-	-	-	-	-	47	-		-	-	-	-	-		-	
36	27.00-27.35	UD	90	56	43	29	21	20	1	10	61	28	1	-	SC		25.5	1.97	1.57	2.62	0.67	0.10	20	-
37	27.35-27.80	SPT	-	-	-	-	-	-	-	-	-	-	-	49	-		-	-	-	-	-		-	-
38	28.50-28.85	UD	75	41	37	33	20	18	2	25	42	30	3	-	SC		26.1	1.97	1.56	2.63	0.69	0.06	21	-
39	28.85-29.30	SPT	-	-	-	-	-	-	-	-	-	-	-	52	-		-	-	-	-	-	-	-	
40	29.30-30.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	SC		-	-	-	-	-	-	-	-

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Project : Proposed Construction of Double Basement+G+12th Storied Judicial Residential Building in Dwarka, at District - Delhi.

Bore Hole No. 03

Depth of Bore Hole : 30.0M.

Depth of Water table : 10.00m

LABORATORY TEST RESULTS

S. No.	Depth of Bore Hole	Nature of soil Sample	% Passing on IS Sieve				Atterberg's Limit			Particle Size Analysis				S.P.T. Value	IS Group		Natural Moisture Content %	Wet Density gm/cc	Dry Density gm/cc	Specific Gravity 'G'	Void ratio 'e'	Shear Parameter		Compression Index Cc
			4.75 mm	2.00 mm	0.425mm	0.075 mm	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %		Symbol	hatching						Cohesion 'C' in Kg/Sqcm.	Angle of Internal Friction Φ	
1	0.0-0.50	DS	100	100	100	96	42	23	19	0	4	59	37	-	Cl		-	-	-	-	-	-	-	-
2	1.50-1.85	UD	100	99	98	97	40	22	18	0	3	64	33	-	Cl		11.1	1.80	1.62	2.72	0.68	0.39	7	0.124
3	1.85-2.30	SPT	-	-	-	-	-	-	-	-	-	-	-	5	-		-	-	-	-	-	-	-	-
4	3.00-3.35	UD	100	100	100	96	41	21	20	0	4	58	38	-	Cl		12.9	1.83	1.62	2.69	0.66	0.42	6	0.130
5	3.35-3.80	SPT	-	-	-	-	-	-	-	-	-	-	-	8	-		-	-	-	-	-	-	-	-
6	4.50-4.85	UD	100	100	100	95	39	22	17	0	5	63	32	-	Cl		13.5	1.85	1.63	2.70	0.66	0.36	9	0.122
7	4.85-5.30	SPT	-	-	-	-	-	-	-	-	-	-	-	10	-		-	-	-	-	-	-	-	-
8	6.00-6.35	UD	100	93	92	91	40	21	19	0	9	54	37	-	Cl		14.6	1.88	1.64	2.69	0.64	0.39	7	0.132
9	6.35-6.80	SPT	-	-	-	-	-	-	-	-	-	-	-	12	-		-	-	-	-	-	-	-	-
10	7.50-7.85	U.D.	100	98	97	96	39	23	16	0	4	65	31	-	Cl		15.2	1.89	1.64	2.71	0.65	0.38	9	0.121
11	7.85-8.30	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	14	-		-	-	-	-	-	-	-	-
12	9.00-9.35	U.D.	100	97	96	95	42	22	20	0	5	57	38	-	Cl		16.5	1.93	1.66	2.70	0.63	0.43	8	0.133
13	9.35-9.80	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	16	-		-	-	-	-	-	-	-	-
14	10.50-10.85	UD	100	90	88	86	41	23	18	0	14	52	34	-	Cl		23.1	2.04	1.66	2.69	0.62	0.37	11	-
15	10.85-11.30	SPT	-	-	-	-	-	-	-	-	-	-	-	18	-		-	-	-	-	-	-	-	-
16	12.00-12.35	UD	99	98	97	96	39	23	16	1	3	64	32	-	Cl		23.7	2.04	1.65	2.71	0.64	0.40	10	-
17	12.35-12.80	SPT	-	-	-	-	-	-	-	-	-	-	-	19	-		-	-	-	-	-	-	-	-
18	13.50-13.85	UD	100	97	96	95	40	22	18	0	5	62	33	-	Cl		23.9	2.03	1.64	2.70	0.65	0.36	12	-
19	13.85-14.30	SPT	-	-	-	-	-	-	-	-	-	-	-	21	-		-	-	-	-	-	-	-	-
20	15.00-15.35	UD	100	99	98	97	42	23	19	0	3	60	37	-	Cl		24.4	2.03	1.63	2.71	0.66	0.37	11	-
21	15.35-15.80	SPT	-	-	-	-	-	-	-	-	-	-	-	23	-		-	-	-	-	-	-	-	-
22	16.50-16.85	UD	100	95	94	93	39	22	17	0	7	61	32	-	Cl		24.2	2.04	1.64	2.72	0.66	0.42	9	-

23	16.85-17.30	SPT	-	-	-	-	-	-	-	-	-	-	-	25	-		-	-	-	-	-	-	-	-
24	18.00-18.35	UD	100	93	92	91	39	23	16	0	9	61	30	-	CI		23.7	2.04	1.65	2.71	0.64	0.36	12	-
25	18.35-18.80	SPT	-	-	-	-	-	-	-	-	-	-	-	27	-		-	-	-	-	-	-	-	-
26	19.50-19.85	UD	80	59	57	42	24	20	4	20	38	36	6	-	SC		25.8	1.96	1.56	2.61	0.67	0.01	23	-
27	19.85-20.30	SPT	-	-	-	-				-	-	-	-	29	-		-	-	-	-	-		-	-
28	21.00-21.35	UD	75	70	65	47	20	18	2	25	28	44	3	-	SC		25.7	1.97	1.57	2.63	0.68	0.10	20	-
29	21.35-21.80	SPT	-	-	-	-				-	-	-	-	31	-		-	-	-	-	-		-	-
30	22.50-22.85	UD	97	67	60	44	23	17	6	3	53	39	5	-	SC		26.3	1.96	1.55	2.62	0.69	0.06	21	-
31	22.85-23.30	SPT	-	-	-	-				-	-	-	-	33	-		-	-	-	-	-		-	-
32	24.00-24.35	UD	90	62	54	47	23	19	4	10	43	40	7	-	SC		27.1	1.96	1.54	2.64	0.71	0.01	23	-
33	24.35-24.80	SPT	-	-	-	-				-	-	-	-	34	-		-	-	-	-	-		-	-
34	25.50-25.85	UD	88	55	51	43	23	20	3	12	45	38	5	-	SC		27.6	1.94	1.52	2.62	0.72	0.10	20	-
35	25.85-26.30	SPT	-	-	-	-				-	-	-	-	37	-		-	-	-	-	-		-	-
36	27.00-27.35	UD	99	60	54	48	24	19	5	1	51	42	6	-	SC		27.6	1.97	1.54	2.68	0.74	0.06	21	-
37	27.35-27.80	SPT	-	-	-	-				-	-	-	-	39	-		-	-	-	-	-		-	-
38	28.50-28.85	UD	85	58	54	41	24	18	6	15	44	34	7	-	SC		28.2	1.95	1.52	2.66	0.75	0.03	22	-
39	28.85-29.30	SPT	-	-	-	-	-			-	-	-	-	42	-		-	-	-	-	-		-	-
40	29.30-30.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	SC		-	-	-	-	-	-	-	-

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Project : Proposed Construction of Double Basement+G+12th Storied Judicial Residential Building in Dwarka, at District - Delhi.

Bore Hole No. 04

Depth of Bore Hole : 30.0M.

Depth of Water table : 11.20m

LABORATORY TEST RESULTS

S. No.	Depth of Bore Hole	Nature of soil Sample	% Passing on IS Sieve				Atterberg's Limit			Particle Size Analysis				S.P.T. Value	IS Group		Natural Moisture Content %	Wet Density gm/cc	Dry Density gm/cc	Specific Gravity 'G'	Void ratio 'e'	Shear Parameter		Compression Index Cc
			4.75 mm	2.00 mm	0.425mm	0.075 mm	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %		Symbol	hatching						Cohesion 'C' in Kg/Sqcm.	Angle of Internal Friction Φ	
1	0.0-0.50	DS	100	100	100	4	25	18	7	0	96	-10	14	-	CL/ML		-	-	-	-	-	-	-	-
2	1.50-1.85	UD	96	95	94	82	26	20	6	4	14	70	12	-	CL/ML		12.3	1.76	1.57	2.61	0.66	0.12	18	0.112
3	1.85-2.30	SPT	-	-	-	-	-	-	-	-	-	-	-	6	-		-	-	-	-	-	-	-	-
4	3.00-3.35	UD	97	96	95	94	39	22	17	3	3	61	33	-	CI		12.8	1.86	1.65	2.71	0.64	0.39	7	0.126
5	3.35-3.80	SPT	-	-	-	-	-	-	-	-	-	-	-	9	-		-	-	-	-	-	-	-	-
6	4.50-4.85	UD	98	97	96	95	41	23	18	2	3	59	36	-	CI		13.2	1.86	1.64	2.69	0.64	0.39	7	0.124
7	4.85-5.30	SPT	-	-	-	-	-	-	-	-	-	-	-	12	-		-	-	-	-	-	-	-	-
8	6.00-6.35	UD	100	100	100	95	42	21	21	0	5	56	39	-	CI		13.7	1.88	1.65	2.70	0.64	0.37	9	0.129
9	6.35-6.80	SPT	-	-	-	-	-	-	-	-	-	-	-	15	-		-	-	-	-	-	-	-	-
10	7.50-7.85	U.D.	97	96	95	94	40	23	17	3	3	60	34	-	CI		14.9	1.91	1.66	2.72	0.64	0.42	8	0.122
11	7.85-8.30	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	18	-		-	-	-	-	-	-	-	-
12	9.00-9.35	U.D.	98	97	96	95	41	22	19	2	3	58	37	-	CI		15.8	1.92	1.66	2.71	0.63	0.35	10	0.126
13	9.35-9.80	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	20	-		-	-	-	-	-	-	-	-
14	10.50-10.85	UD	100	98	97	96	39	21	18	0	4	61	35	-	CI		16.4	1.92	1.65	2.69	0.63	0.37	11	-
15	10.85-11.30	SPT	-	-	-	-	-	-	-	-	-	-	-	22	-		-	-	-	-	-	-	-	-
16	12.00-12.35	UD	100	99	98	97	42	22	20	0	3	59	38	-	CI		17.3	1.94	1.65	2.71	0.64	0.34	12	-
17	12.35-12.80	SPT	-	-	-	-	-	-	-	-	-	-	-	24	-		-	-	-	-	-	-	-	-
18	13.50-13.85	UD	100	97	96	95	42	21	21	0	5	56	39	-	CI		22.7	2.05	1.67	2.69	0.61	0.39	9	-
19	13.85-14.30	SPT	-	-	-	-	-	-	-	-	-	-	-	27	-		-	-	-	-	-	-	-	-
20	15.00-15.35	UD	100	98	97	96	41	22	19	0	4	59	37	-	CI		22.6	2.06	1.68	2.71	0.61	0.35	10	-
21	15.35-15.80	SPT	-	-	-	-	-	-	-	-	-	-	-	29	-		-	-	-	-	-	-	-	-
22	16.50-16.85	UD	98	97	96	95	40	22	18	2	3	59	36	-	CI		22.7	2.05	1.67	2.69	0.61	0.34	11	-

23	16.85-17.30	SPT	-	-	-	-	-	-	-	-	-	-	-	31	-		-	-	-	-	-	-	-	-
24	18.00-18.35	UD	100	96	95	94	43	23	20	0	6	54	40	-	CI		22.1	2.06	1.69	2.70	0.60	0.32	12	-
25	18.35-18.80	SPT	-	-	-	-	-	-	-	-	-	-	-	34	-		-	-	-	-	-	-	-	-
26	19.50-19.85	UD	100	95	94	93	39	22	17	0	7	60	33	-	CI		22.5	2.06	1.68	2.70	0.61	0.43	8	-
27	19.85-20.30	SPT	-	-	-	-	-	-	-	-	-	-	-	37	-		-	-	-	-	-	-	-	-
28	21.00-21.35	UD	100	99	98	97	41	23	18	0	3	61	36	-	CI		22.7	2.05	1.67	2.69	0.61	0.39	9	-
29	21.35-21.80	SPT	-	-	-	-	-	-	-	-	-	-	-	40	-		-	-	-	-	-	-	-	-
30	22.50-22.85	UD	100	85	84	83	38	22	16	0	17	52	31	-	CI		22.6	2.06	1.68	2.71	0.61	0.35	10	-
31	22.85-23.30	SPT	-	-	-	-	-	-	-	-	-	-	-	43	-		-	-	-	-	-	-	-	-
32	24.00-24.35	UD	100	100	100	63	20	19	1	0	37	61	2	-	ML		25.8	1.96	1.56	2.61	0.67	0.05	21	-
33	24.35-24.80	SPT	-	-	-	-	-	-	-	-	-	-	-	46	-		-	-	-	-	-	-	-	-
34	25.50-25.85	UD	100	100	100	58	19	17	2	0	42	57	1	-	ML		26.5	1.95	1.54	2.60	0.69	0.10	20	-
35	25.85-26.30	SPT	-	-	-	-	-	-	-	-	-	-	-	48	-		-	-	-	-	-	-	-	-
36	27.00-27.35	UD	92	53	51	49	23	19	4	8	43	44	5	-	SC		25.8	1.96	1.56	2.61	0.67	0.11	19	-
37	27.35-27.80	SPT	-	-	-	-				-	-	-	-	51	-		-	-	-	-	-		-	
38	28.50-28.85	UD	90	61	59	52	21	18	3	10	38	50	2	-	SC		25.7	1.97	1.57	2.63	0.68	0.06	21	-
39	28.85-29.30	SPT	-	-	-	-				-	-	-	-	53	-		-	-	-	-	-	-	-	
40	29.30-30.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	SC		-	-	-	-	-	-	-	-

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Project : Proposed Construction of Double Basement+G+12th Storied Judicial Residential Building in Dwarka, at District - Delhi.

Bore Hole No. 05

Depth of Bore Hole : 30.0M.

Depth of Water table : 10.00m

LABORATORY TEST RESULTS

S. No.	Depth of Bore Hole	Nature of soil Sample	% Passing on IS Sieve				Atterberg's Limit			Particle Size Analysis				S.P.T. Value	IS Group		Natural Moisture Content %	Wet Density gm/cc	Dry Density gm/cc	Specific Gravity 'G'	Void ratio 'e'	Shear Parameter		Compression Index Cc
			4.75 mm	2.00 mm	0.425mm	0.075 mm	LL %	PL %	PI %	Gravel %	Sand %	Silt %	Clay %		Symbol	hatching						Cohesion 'C' in Kg/Sqcm.	Angle of Internal Friction Φ	
1	0.0-0.50	DS	100	100	100	97	42	22	20	0	3	57	40	-	CI		-	-	-	-	-	-	-	-
2	1.50-1.85	UD	100	100	100	97	41	23	18	0	3	61	36	-	CI		12.6	1.86	1.65	2.72	0.65	0.39	7	0.124
3	1.85-2.30	SPT	-	-	-	-	-	-	-	-	-	-	-	8	-		-	-	-	-	-	-	-	-
4	3.00-3.35	UD	100	100	100	96	38	22	16	0	4	64	32	-	CI		13.9	1.89	1.66	2.70	0.63	0.36	8	0.121
5	3.35-3.80	SPT	-	-	-	-	-	-	-	-	-	-	-	11	-		-	-	-	-	-	-	-	-
6	4.50-4.85	UD	97	96	95	94	42	23	19	3	3	57	37	-	CI		15.2	1.90	1.65	2.71	0.64	0.39	9	0.131
7	4.85-5.30	SPT	-	-	-	-	-	-	-	-	-	-	-	14	-		-	-	-	-	-	-	-	-
8	6.00-6.35	UD	100	100	100	84	25	18	7	0	16	70	14	-	CL/ML		16.5	1.83	1.57	2.61	0.66	0.14	17	0.114
9	6.35-6.80	SPT	-	-	-	-	-	-	-	-	-	-	-	17	-		-	-	-	-	-	-	-	-
10	7.50-7.85	U.D.	100	100	100	97	43	23	20	0	3	57	40	-	CI		17.6	1.95	1.66	2.70	0.63	0.35	10	0.130
11	7.85-8.30	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	19	-		-	-	-	-	-	-	-	-
12	9.00-9.35	U.D.	100	98	97	96	41	22	19	0	4	58	38	-	CI		18.1	1.97	1.67	2.69	0.61	0.42	8	-
13	9.35-9.80	S.P.T.	-	-	-	-	-	-	-	-	-	-	-	21	-		-	-	-	-	-	-	-	-
14	10.50-10.85	UD	99	98	97	96	40	22	18	1	3	60	36	-	CI		22.6	2.06	1.68	2.71	0.61	0.36	11	-
15	10.85-11.30	SPT	-	-	-	-	-	-	-	-	-	-	-	24	-		-	-	-	-	-	-	-	-
16	12.00-12.35	UD	100	97	96	95	42	23	19	0	5	57	38	-	CI		22.7	2.05	1.67	2.69	0.61	0.34	12	-
17	12.35-12.80	SPT	-	-	-	-	-	-	-	-	-	-	-	27	-		-	-	-	-	-	-	-	-
18	13.50-13.85	UD	98	97	96	95	42	22	20	2	3	55	40	-	CI		23.1	2.04	1.66	2.69	0.62	0.38	10	-
19	13.85-14.30	SPT	-	-	-	-	-	-	-	-	-	-	-	30	-		-	-	-	-	-	-	-	-

20	15.00-15.35	UD	99	98	97	96	42	23	19	1	3	59	37	-	CI		22.6	2.06	1.68	2.71	0.61	0.41	8	-
21	15.35-15.80	SPT	-	-	-	-	-	-	-	-	-	-	-	33	-		-	-	-	-	-	-	-	-
22	16.50-16.85	UD	100	97	96	95	40	22	18	0	5	59	36	-	CI		22.7	2.05	1.67	2.69	0.61	0.39	9	-
23	16.85-17.30	SPT	-	-	-	-	-	-	-	-	-	-	-	35	-		-	-	-	-	-	-	-	-
24	18.00-18.35	UD	98	97	96	95	43	21	22	2	3	54	41	-	CI		22.6	2.06	1.68	2.71	0.61	0.37	11	-
25	18.35-18.80	SPT	-	-	-	-	-	-	-	-	-	-	-	38	-		-	-	-	-	-	-	-	-
26	19.50-19.85	UD	75	60	54	38	21	18	3	25	37	36	2	-	SC		25.4	1.97	1.57	2.61	0.66	0.01	23	-
27	19.85-20.30	SPT	-	-	-	-				-	-	-	-	40	-		-	-	-	-	-		-	-
28	21.00-21.35	UD	91	56	48	35	23	19	4	9	56	32	3	-	SC		25.2	1.97	1.57	2.60	0.66	0.10	20	-
29	21.35-21.80	SPT	-	-	-	-				-	-	-	-	43	-		-	-	-	-	-		-	-
30	22.50-22.85	UD	80	54	43	32	22	20	2	20	48	31	1	-	SC		25.1	1.98	1.58	2.62	0.66	0.06	21	-
31	22.85-23.30	SPT	-	-	-	-				-	-	-	-	46	-		-	-	-	-	-		-	-
32	24.00-24.35	UD	70	52	42	29	22	17	5	30	41	25	4	-	SC		25.2	1.97	1.57	2.60	0.66	0.01	23	-
33	24.35-24.80	SPT	-	-	-	-				-	-	-	-	49	-		-	-	-	-	-		-	-
34	25.50-25.85	UD	95	61	58	47	21	20	1	5	48	45	2	-	SC		25.0	1.97	1.58	2.61	0.65	0.10	20	-
35	25.85-26.30	SPT	-	-	-	-				-	-	-	-	52	-		-	-	-	-	-		-	-
36	27.00-27.35	UD	79	53	51	42	22	19	3	21	37	41	1	-	SC		24.7	1.98	1.59	2.62	0.65	0.06	21	-
37	27.35-27.80	SPT	-	-	-	-				-	-	-	-	55	-		-	-	-	-	-		-	-
38	28.50-28.85	UD	80	56	44	37	22	18	4	20	43	34	3	-	SC		25.5	1.96	1.56	2.59	0.66	0.11	20	-
39	28.85-29.30	SPT	-	-	-	-	-			-	-	-	-	57	-		-	-	-	-	-		-	-
40	29.30-30.00	DS	-	-	-	-	-	-	-	-	-	-	-	-	SC		-	-	-	-	-	-	-	-

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Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works

At Sector-19 Dwarka, Delhi

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Volume-III

Technical Specifications and Tender Drawings

Volume-III

Part A

TECHNICAL SPECIFICATIONS, ARCHITECTURE & CIVIL FINISHING

The Technical Specifications for the Following Structures and Facilities are Covered:-

- **COMMON BASEMENT (2 LEVEL)**
- **TYPE V RESIDENTIAL TOWER (B+G+12)**
- **TYPE VI RESIDENTIAL TOWER (B+G+12)**
- **SUB-STATION, PUMP ROOM & UGT**
- **SWIMMING POOL & KIDS PLAY AREA**
- **LANDSCAPE OPEN SPACE**
- **GATE WITH GUARD ROOM & SECURITY INFRASTRUCTURE**
- **CC ROAD WITH KERB STONE**
- **PARKING & PATHWAY**
- **HUME PIPES**
- **BOUNDARY WALL**
- **HORTICULTURE**
- **STP**
- **ETP**

The technical specifications of these structures are given below, detailing the specific requirements and guidelines for the construction and design of each structure and facility. These specifications cover all aspects, including materials, construction methods, safety standards, and quality control measures, ensuring that each component of the project is executed with precision and in compliance with the relevant building codes and regulations. The following sections outline the technical parameters for each structure, providing a comprehensive framework for their successful implementation.

SECTION - 01 : EARTH WORK

EXCAVATION IN ALL KINDS OF SOILS

All excavation operations manually or by mechanical means shall include excavation and 'getting out' the excavated materials. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge of excavation. In all other cases 'getting out' shall include depositing the excavated materials as specified. The subsequent disposal of the excavated material shall be either stated as a separate item or included with the items of excavation stating lead.

During the excavation the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or undercutting shall not be done.

In firm soils, the sides of the trenches shall be kept vertical upto a depth of 2 metres from the bottom. For greater depths, the excavation profiles shall be widened by allowing steps of 50 cms on either side after every 2 metres from the bottom. Alternatively, the excavation can be done so as to give slope of 1:4 (1 horizontal: 4 vertical). Where the soil is soft, loose or slushy, the width of steps shall be suitably increased or sides sloped or the soil shored.

In case of excavation for foundation in trenches or over areas, the bed of excavation shall be to the correct level or slope and consolidated by watering and ramming.The excess depth shall be made good by the contractor with the concrete of the mix used for levelling/ bed concrete for foundations. Soft/defective spots at the bed of the foundations shall be dug out and filled with concrete

While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed.The excess depth shall be made good by the contractor with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required is to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor at his own cost by filling in with earth duly watered, consolidated and rammed.

The excavation shall be done manually or by mechanical means as considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved. Contractor shall ensure every safety measures for the workers.

EXCAVATION IN ORDINARY/HARD ROCK

All excavation operations shall include excavation and 'getting out' the excavated matter. In case of excavation for trenches, basements, water tanks etc. 'getting out' shall include throwing the excavated materials at a distance of at least one metre or half the depth of excavation, whichever is more, clear off the edge or excavation. In all other

cases 'getting out' shall include depositing the excavated materials as specified.

During the excavation, the natural drainage of the area shall be maintained. Excavation shall be done from top to bottom. Undermining or under cutting shall not be done.

Where hard rock is met with and blasting operations are considered necessary, Blasting operations shall be done as specified and chiseling shall be done to obtain correct levels, slopes, shape and pattern of excavation

Where blasting operations are prohibited or are not practicable, excavation in hard rock shall be done by chiseling.

In ordinary rock excavation shall be carried out by crowbars, pick axes or pneumatic drills and blasting operation shall not be generally adopted. Where blasting operations are not prohibited and it is practicable to resort to blasting for excavation in ordinary rock.

While carrying out the excavation for drain work care shall be taken to cut the side and bottom to the required shape, slope and gradient. The surface shall then be properly dressed. If the excess depth shall be made good by the contractor with stiff clay puddle at places where the drains are required to be pitched and with ordinary earth, properly watered and rammed, where the drains are not required to be pitched. In case the drain is required is to be pitched, the back filling with clay puddle, if required, shall be done simultaneously as the pitching work proceeds. The brick pitched storm water drains should be avoided as far as possible in filled-up areas and loose soils.

In all other cases where the excavation is taken deeper by the contractor, it shall be brought to the required level by the contractor by filling in with earth duly watered, consolidated and rammed.

The excavation shall be done manually or by mechanical means as considering feasibility, urgency of work, availability of labour /mechanical equipments and other factors involved. Contractor shall ensure every safety measures for the workers.

Transporting Equipment

This implies horizontal movement primarily but it can involve some vertical movement too.

(i) ***Dumpers:*** These are self-propelled wheeled machines, having an open body. It is designed for the transport of excavated materials and consists of a shallow tipping hopper or skip mounted on a wheeled chassis, such as, power barrow, dumper, multi-skip dumpers, high discharge dumpers, dump truck, etc. These can be rear dump, side dump or bottom dump.

(ii) ***Vibratory Roller:*** It is a single Drum Vibratory Roller for compaction of embankments, etc. The smooth drum version is for compaction of granular and mixed soil. The sheepsfoot Roller consists of a hallow cylindrical steel drum or drums on which projecting feet are mounted. These f eet penetrate into the fill as a roller moves forward and cause compaction. The geometry of the foot may be sheep, club pyramid, cone or cylinder foot. Such rollers are employed for compaction (densification) of cohesive and semi-cohesive soils.

FILLING

The earth used for filling shall be free from all roots, grass, shrubs, rank vegetation, brushwood, tress, sapling and rubbish.

Filling with excavated earth shall be done in regular horizontal layers each not exceeding 20 cm in depth. All lumps and clods exceeding 8 cm in any direction shall be broken. Each layer shall be watered and consolidated with steel rammer or ½ tonne roller. Where specified, every third and top must layer shall also be consolidated with power roller of minimum 8 tonnes. Wherever depth of filling exceeds 1.5 metre vibratory power roller shall be used to consolidate the filing unless otherwise directed by Engineer-in-charge. The top and sides of filling shall be neatly dressed. The contractor shall make good all subsidence and shrinkage in earth fillings, embankments, traverses etc. during execution and till the completion of work unless otherwise specified.

EXCAVATION IN TRENCHES FOR PIPES, CABLES ETC. AND REFILLING

This shall comprise excavation not exceeding 1.5 mts in width or 10 sqm in plan and to any depth trenches for pipes. Cables etc. and returning the excavated material to fill the trenches after pipes, cables etc. are laid and their joints tested and passed and disposal of surplus excavated material upto 50 m lead.

Width of Trench

(a) Upto one metre depth the authorized width of trench for excavation shall be arrived at by adding 25 cm to the external diameter of pipe (not socket/ collar) cable, conduit etc. Where a pipe is laid on concrete bed/ cushioning layer, the authorized width shall be the external diameter of pipe (not socket/ collar) plus 25 cm or the width of concrete bed/ cushioning layer whichever is more.

(b) For depths exceeding one metre, an allowance of 5 cm per metre of depth for each side of the trench shall be added to the authorized width (that is external diameter of pipe plus 25 cm) for excavation. This allowance shall apply to the entire depth of the trench. In firm soils the sides of the trenches shall be kept vertical upto depth of 2 metres from the bottom. For depths greater than 2 metres, the excavation profiles shall be widened by allowing steps of 50 cm on either side after every two metres from bottom.

(c) Where more than one pipe, cable, conduit etc, are laid, the diameter shall be reckoned as the horizontal distance from outside to outside of the outermost pipes, cable, conduit etc.

(d) Where the soil is soft, loose or slushy, width of trench shall be suitably increased or side sloped or the soil shored. It shall be the responsibility of the contractor to increase in the width of trench. Sloping or shoring to be done for excavation in soft, loose or slushy soils.

Refilling

Filling in trenches shall be commenced soon after the joints of pipes, cables, conduits etc. have been tested and passed. The space alround the pipes, cables conduits etc. shall be cleared of all debris, brick bats etc. Where the trenches are excavated in hard/ soft soil, the filling shall be done with earth on the side and top of pipes in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the excavated earth is used for filling. In case of excavation trenches in ordinary/ hard rock,

the filling upto a depth of 30cm above the crown of pipe, cable, conduits etc. shall be done with fine material like earth, moorum or pulverized/ decomposed rock according to the availability at site. The remaining filling shall be done with boulders of size not exceeding 15cm mixed with fine material like decomposed rock, moorum or earth as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30cm. Excavated material containing deleterious material, salt peter earth etc. shall not be used for filling. Ramming shall be done with iron rammers where feasible and with blunt ends of crow bars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, Cables, Conduits etc. laid in the trenches.

PLANKING AND STRUTTING

When the depth of trench in soft/loose soil exceeds 2 metres, stepping, sloping and/ or planking and strutting of sides shall be done. In case of loose and slushy soils, the depths at which these precautions are to be taken, shall be determined by the Engineer-in-Charge according to the nature of soil.

Planking and strutting shall be ‘close’ or ‘open’ depending on the nature of soil and the depth of trench. The type of planking and strutting shall be determined by the Engineer-in-Charge. It shall be the responsibility of the contractor to take all necessary steps to prevent the sides of trenches from collapse. Engineer-in-Charge should take guidance from IS: 3764 for designing the shoring and strutting arrangements and specifying the profile of excavation.

Close Planking and Strutting Close planking and strutting shall be done by completely covering the sides of the trench generally with short upright, members called ‘poling boards’. These shall be 250x38 mm in section or as directed by the Engineer-in-Charge.

The boards shall generally be placed in position vertically in pairs**.** One boards on either side of cutting. These shall be kept apart by horizontal wallings of strong wood at a maximum spacing of 1.2 metres cross strutted with ballies, or as directed by Engineer-in-Charge. The length and diameter of the ballies strut shall depend upon the width of the trench.

Where the soil is very soft and loose, the boards shall be placed horizontally against the sides of the excavation and supported by vertical ‘wallings’ which shall be strutted to similar timber pieces on the opposite face of the trench. The lowest boards supporting the sides shall be taken in the ground for a minimum depth of 75 mm. No portion of the vertical side of the trench shall remain exposed. The withdrawal of the timber members shall be done very carefully to prevent collapse of thetrench. It shall be started at one end and proceeded systematically to the other end. Concrete or masonry shall not be damaged while removing the planks. No claim shall be entertained for any timber which cannot be withdrawn and is lost or buried, unless required by the Engineer-in-Charge to be left permanently in position.

Open Planking and Strutting

In case of open planking and strutting, the entire surface of the side of the trench is not required to be covered. The vertical boards 250 mm wide & 38 mm thick, shall be spaced sufficiency apart to leave unsupported strips of 50 cm average width. The detailed arrangement, sizes of the timber and the distance apart shall be subject to the approval of the Engineer-in- Charge. In all other respect, specifications for close planking and strutting shall apply to open planking and strutting.

EXCAVATION IN WATER. MUD OR FOUL POSITION

All water that may accumulate in excavations during the progress of the work from

springs, tidal or river seepage, broken water mains or drains (not due to the negligence of the contractor), and seepage from subsoil aquifer shall be bailed, pumped out or otherwise removed. The contractor shall take adequate measures for bailing and/or pumping out water from excavations and/or pumping out water from excavations and construct diversion channels, bunds, sumps, coffer dams etc. as may be required. Pumping shall be done directly from the foundation trenches or from a sump out side the excavation in such a manner as to preclude the possibility of movement of water through any fresh concrete or masonry and washing away parts of concrete or mortar. During laying of concrete or masonry and for a period of at least 24 hours thereafter, pumping shall be done from a suitable sump separated from concrete or masonry by effective means.

Capacity and number of pumps, location at which the pumps are to be installed, pumping hours etc. shall be decided from time to time.

Pumping shall be done in such a way as not to cause damage to the work or adjoining property by subsidence etc. Disposal of water shall not cause inconvenience or nuisance in the area or cause damage to the property and structure nearby.

To prevent slipping of sides, planking and strutting may also be done.

Classification

The earth work for various classification of soil shall be categorized as under:

(a) ***Work in or under water and/or liquid mud:*** Excavation, where water is met with from any of the sources specified in 2.21.1 shall fall in this category. Steady water level in the trial pits before the commencement of bailing or pumping operations shall be the sub-soil water level in that area.

(b) ***Work in or under foul position:*** Excavation, where sewage, sewage gases or foul conditions are met with from any source, shall fall in this category.

FILLING IN TRENCHES, PLINTH, UNDER FLOOR ETC.

Earth

Normally excavated earth from same area shall be used for filling. Earth used for filling shall be free from shrubs, rank, vegetation, grass, brushwood, stone shingle and boulders (larger than 75mm in any direction), organic or any other foreign matter. Earth containing deleterious materials, salt peter earth etc. shall not be used for filling. All clods and lumps of earth exceeding 8 cm in any direction shall be broken or removed before the earth is used for filling**.**

Filling

The space around the foundations and drains in trenches shall be cleared of all debris, brick bats etc. The filling shall be done in layers not exceeding 20 cm in depth. Each layer shall be watered, rammed and consolidated. Ramming shall be done with iron rammers where possible and with blunt end of crow bars where rammers cannot be used. Special care shall be taken to ensure that no damage is caused to the pipes, drains, masonry or concrete in the trenches. In case of filling under floor, the finished level of filling shall be kept to the slope intended to be given to the floor.

SAND FILLING IN PLINTH

Sand shall be clean and free from dust organic and foreign matter and its grading shall be within the limits of grading zone IV or V specified

Sand filling shall be done in a manner similar to earth filling in plinth . except that consolidation shall be done by flooding with water. The surface of the consolidated sand filling shall be dressed to the required level or slope and shall not be covered.

SURFACE DRESSING

Surface dressing shall include cutting and filling upto a depth of 15 cm and clearing of shrubs, rank vegetation, grass, brushwood, trees and saplings of all girth measured at all height above the ground level and removal of rubbish and other excavated material upto a distance of 50 metres outside the periphery of the area under surface dressing. High portions of the ground shall be cut down and hollows depression filled upto the required level with the excavated earth so as to give an even, neat and tidy look.

JUNGLE CLEARANCE

Jungle clearance shall comprise uprooting of rank vegetation, grass, brushwood, shrubs, stumps, trees and saplings of all girth measured at all height above the ground level.

Uprooting of Vegetations

The roots of trees and saplings shall be removed all depth below ground level or below formation level or below sub-grade level, whichever is lower. All holes or hollows formed due to removal of roots shall be filled up with earth rammed and levelled. Trees, shrubs, poles, fences, signs, monuments, pipe lines, cable etc., within or adjacent to the area which are not required to be disturbed during jungle clearance shall be properly protected by the contractor.

Stacking and Disposal

All useful materials obtained from clearing and grubbing operation shall be stacked in the manner as specified. Trunks and branches of trees shall be cleared of limbs and tops and stacked neatly at places. The materials shall be the property of the Government. All unserviceable materials shall be removed up to a distance of 50 m outside the periphery of the area under clearance. It shall be ensured by the contractor that unserviceable materials are disposed off in such a manner that there is no likelihood of getting mixed up with the materials meant for construction.

Clearance of Grass

Clearing and grubbing operation involving only the clearance of grass include removal of rubbish upto a distance of 50 m outside the periphery of the area under clearance**.**

ANTI-TERMITE TREATMENT

Sub-terranean termites are responsible for most of the termite damage in buildings. Typically, they form nests or colonies underground. In the soil near ground level in a stump or other suitable piece of timber in a conical or dome shaped mound. The termites find access to the super-structure of the building either through the timber buried in the ground or by means of mud shelter tubes constructed over unprotected foundations.

Termite control in existing as well as new building structures is very important as the damage likely to be caused by the termites to wooden members of building and other

household article like furniture, clothing, stationery etc. is considerable. Anti-termite treatment can be either during the time of construction i.e. pre-constructional chemical treatment or after the building has been constructed i.e. treatment for existing building.

Prevention of the termite from reaching the super-structure of the building and its contents can be achieved by creating a chemical barrier between the ground, from where the termites come and other contents of the building which may form food for the termites. This is achieved by treating the soil beneath the building and around the foundation with a suitable insecticide.

Materials

Chemicals: Any one of the following chemicals in water emulsion to achieve the percentage concentration specified against each chemical shall be used:

(i) Chlorphriphos emulsifiable concentrate of 20%
(ii) Lindane emulsifiable concentrate of 20%

Anti-termite treatment chemical is available in concentrated form in the market and concentration is indicated on the sealed containers. To achieve the specified percentage of concentration, Chemical should be diluted with water in required quantity before it is used. Graduated containers shall be used for dilution of chemical with water in the required proportion to achieve the desired percentage of concentration. For example, to dilute chemical of 20% concentration. 19 parts of water shall be added to one part of chemical for achieving 1% concentration.

The chemical of required concentration in sealed original containers directly from the reputed and authorized dealers, chemical issued for use to meet the day's requirements. Empty containers after washing and concentrated chemical left unused at the end of the day's work

Treatment

Once the termites have ingress into the building, they keep on multiplying and destroy the wooden and cellulosic materials, and as such it becomes essential to take measures for protection against termites. Anti termite measures described below are necessary for the eradication and control of termites in existing building. To facilitate proper penetrations of chemical in to the surface to be treated, hand operated pressure pump shall be used. To have proper check for uniform penetration of chemical, graduated containers shall be used. Proper check should be kept so that the specified quantity of chemical is used for the required area during the operation. Chemical treatment for the eradication and control of sub-terranean termites in existing building shall be done as per IS 6313 (Part III). Treatment shall be got done only from the approved specialized agencies using reputed and authorized dealers.

(i) ***Treatment along outside of foundations:*** The soil in contact with the external wall of the building shall be treated with chemical emulsion at the rate of 7.5 litres per square metre of vertical surface of the sub-structure to a depth of 300 mm. To facilitate this treatment, a shallow channel shall be excavated along and close to the wall face. The chemical emulsion shall be directed towards the wall at 1.75 litres per running metre of the channel. Rodding with 12 mm diameter mild steel rods at 150 mm apart shall be done in the channel. If necessary, for uniform dispersal of the chemical to 300 mm depth from the ground level. The balance chemical of 0.5 litre per running metre shall then be used to treat the backfill earth as it is returned to the channel

directing the spray towards the wall surface.

If there is a concrete or masonry apron around the building, approximately 12 mm diameter holes shall be drilled as close as possible to the plinth wall about 300 mm apart, deep enough to reach the soil below and the chemical emulsion pumped into these holes to soak the soil below at the rate of 2.25 litres per linear metre.

In soils which do not allow percolation of chemicals to desired depth, the uniform disposal of the chemical to a depth of 300 mm shall be obtained by suitably modifying the mode of treatment depending on site condition.

In case of RCC foundations the soil (backfill) in contact with the column sides and plinth beams along with external perimeter of the building shall be treated with chemical emulsion at the rate of
7.5 litres/sqm. of the vertical surface of the structure. To facilitate this treatment, trenches shall be excavated equal to the width of the shovel exposing the sides of the column and plinth beams upto a depth of 300 mm or upto the bottom of the plinth beams, if this level is less than 300 mm. The chemical emulsion shall be sprayed on the backfill earth as it is returned into the trench directing the spray against the concrete surface of the beam or column as the case may be.

(ii) ***Treatment of Soil under Floors :*** The points where the termites are likely to seek entry through the floor are the cracks at the following locations:

(a) At the junction of the floor and walls as result of shrinkage of the concrete;
(b) On the floor surface owing to construction defects;
(c) At construction joints in a concrete floor, cracks in sections; and
(d) Expansion joints in the floor.

Chemical treatment shall be provided in the plinth area of ground floor of the structure, wherever such cracks are noticed by drilling 12 mm holes at the junction of floor and walls along the cracks on the floor and along the construction and expansion joints at the interval of 300 mm to reach the soil below. Chemical emulsion shall be squirted into these holes using a hand operated pressure pump to soak the soil below until refusal or upto a maximum of one litre per hole. The holes shall then be sealed properly with cement mortar 1:2 (1 cement: 2 coarse sand) finished to match the existing floors. The cement mortar applied shall be cured for at least 10.

(iii) ***Treatment of Voids in Masonry:*** The movement of termites through the masonry wall may be arrested by drilling holes in masonry wall at plinth level and squirting chemical emulsions into the holes to soak the masonry. The holes shall be drilled at an angle of 45 degree from both sides of the plinth wall at 300 mm intervals and emulsion squirted through these holes to soak the masonry using a hand operated pump. This treatment shall also be extended to internal walls having foundations in the soil. Holes shall also be drilled at wall corners and where door and window frames are embedded in the masonry or floor at ground. Emulsion shall be squirted through the holes till refusal or to a maximum of one litre per hole. Care shall be taken to seal the holes after the treatment.

(iv) ***Treatment at Points of Contact of Wood Work :*** The wood work which has already been damaged beyond repairs by termites shall be replaced. The new timber shall be dipped or liberally brushed at least twice with chemical in oil or kerosene. All existing wood work in the building which is in contact with the floor or walls and which is infested by termites, shall be treated by spraying at the points of contacts with the adjoining masonry with the chemical emulsion by drilling 6 mm holes at a dowonward angle of about 45 degree at junction of wood work and masonry and squirting chemical emulsion into these holes till refusal or to a maximum of half a litre per hole. The treated holes shall then be sealed.

Infested wood work in chaukhats, shelves, joints, purlins etc., in contact with the floor or the walls shall be provided with protective treatment by drilling holes of about 3 mm diameter with a downward slant to the core of the wood work on the inconspicuous surface of the frame. These holes should be at least 150 mm centre to centre and should cover in entire frame work. Chemicals shall be liberally infused in these holes. If the wood is not protected by paint or varnish two coats of the chemicals shall be given on all the surfaces and crevices adjoining the masonry.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

LIST OF BUREAU OF INDIAN STANDARD CODES

S. No.	I.S. No.	Subject
1	IS 632	Gamma – BHC (Lindane) emulsifiable concentrates
2	IS 1200 (Pt 1)	Method of measurement of earth work
3	IS 1200 (Pt-27)	Method of measurement of earth work (by Mechanical Appliances)
4	IS 4081	Safety code for Blasting and related drilling operation
5	IS 4988 (Part IV)	Excavators
6	IS 6313 (pt-II)	Anti Termite measures in buildings (pre -constructional)
7	IS 6313(pt.-III)	Anti Termite Measures in Buildings for existing buildings
8	IS 6940	Methods of test for pesticides and their formulations
9	IS 8944	Chlorpyrifos emulsifiable concentrates
10	IS 8963	Chlorpyrifos – Technical specifications
11	IS 12138	Earth moving Equipments

SECTION - 02 : CONCRETE WORK - PLAIN

MATERIAL

Water, cement, fine aggregate or sand, surkhi, and fly ash shall be as specified in Chapter 3.0 - Mortar.

Coarse Aggregate

General: Aggregate most of which is retained on 4.75 mm IS Sieve and contains only as much fine material as is permitted in IS 383 for various sizes and grading is known as coarse aggregate. Coarse aggregate shall be specified as stone aggregate, gravel or brick aggregate and it shall be obtained from approved/ authorized sources.

(a) Stone Aggregate: It shall consist of naturally occurring (uncrushed, crushed or broken) stones. It shall be hard, strong, dense, durable and clean. It shall be free from veins, adherent coating, injurious amounts of disintegrated pieces, alkali, vegetable matter and other deleterious substances. It shall be roughly cubical in shape. Flaky and elongated pieces shall be avoided. It shall conform to IS 383 unless otherwise specified.

(b) Gravel: It shall consist of naturally occurring (uncrushed, crushed or broken) river bed shingle or pit gravel. It shall be sound, hard and clean. It shall be free from flat particles of shale or similar laminated material, powdered clay, silt, loam, adherent coating, alkali, vegetable matter and other deleterious substances. Pit gravel shall be washed if it contains soil materials adhering to it. These shall conform to IS 383 unless otherwise specified.

(c) Brick Aggregate: Brick aggregate shall be obtained by breaking well burnt or overburnt dense brick/ brick bats. They shall be homogeneous in texture, roughly cubical in shape and clean. They shall be free from unburnt clay particles. Soluble salt, silt, adherent coating of soil, vegetable matter and other deleterious substances. Such aggregate should not contain more than one percent of sulphates and should not absorb more than 10% of their own mass of water, when used in cement concrete. It shall conform to IS 306 unless otherwise specified.

(d) Light weight aggregate such as sintered fly ash aggregate may also be used provided the Engineer-in-Charge is satisfied with the data on the proportion of concrete made with them.

Deleterious Material: Coarse aggregate shall not contain any deleterious material, such as pyrites, coal, lignite, mica, shale or similar laminated material, clay, alkali, soft fragments, sea shells and organic impurities in such quantity as to affect the strength or durability of the concrete. Coarse aggregate to be used for reinforced cement concrete. Coarse aggregate to be used for reinforced cement concrete shall not contain any material liable to attack the steel reinforcement. Aggregates which are chemically reactive with alkalies of cement shall not be used. The maximum quantity of deleterious material shall not be more than five percent of the weight of coarse aggregate when determined in accordance with IS 2386.

Size and Grading

(i) Stone aggregate and gravel: It shall be either graded or single sized as specified. Nominal size and grading shall be as under:-

(a) Nominal sizes of graded stone aggregate or gravel shall be 40, 20, 16, or 12.5 mm as specified. For any one of the nominal sizes, the proportion of other sizes as determined by the method

Graded Stone Aggregate or Gravel

IS Sieve Designation	Percentage passing (by weight) for nominal size of			
	40 mm	20 mm	16 mm	12.5 mm
80 mm	100	-	-	-
63 mm	-	-	-	-
40 mm	95 to 100	100	-	-
20 mm	30 to 70	95 to 100	100	100
16 mm	-	-	90 to 100	-
12.5 mm	-	-	-	90 to 100
10 mm	10 to 35	25 to 55	30 to 70	40 to 85
4.75 mm	0 to 5	0 to 10	0 to 10	0 to 10

Nominal sizes of single sized stone aggregate or gravel shall be 63, 40, 20, 16, 12.5 or 10 mm as specified. For any one of the nominal size, the proportion of other sizes as determined by the method prescribed

Single Sized (Ungraded) Stone Aggregate or Gravel

IS Sieve Designation	Percentage passing (by weight) for nominal size of					
	63 mm	40 mm	20 mm	16 mm	12.5 mm	10 mm
80 mm	100	-	-	-	-	-
63 mm	85-100	100	-	-	-	-
40 mm	0-30	85-100	100	-	-	-
20 mm	0- 5	0-20	85-100	100	-	-
16 mm	-	-	-	85-100	100	-
12.5 mm	-	-	-	-	85-100	100
10 mm	0-5	0-5	0-20	0-30	0-45	85-100
4.75 mm	-	-	0-5	0-5	0-10	0-20
2.36 mm	-	-	-	-	-	0-5

(a) When stone aggregate or gravel brought to site is single sized (ungraded), it shall be mixed with single sized aggregate of different sizes in the proportion to be determined by field tests to obtain graded aggregate of specified nominal size. For the required nominal size, the proportion of other sizes in mixed aggregate as determined by method prescribed. Recommended proportions by volume for mixing of different sizes of single size (ungraded) aggregate to obtain the required nominal size of graded aggregate are given in Table

Stacking: Aggregate shall be stacked on a hard, dry and level patch of ground. When stack piling, the aggregate shall not form pyramids resulting in segregation of different sized materials. It shall be stacked separately according to nominal size of coarse aggregates. Stacking shall be done in

regular stacks, of height not exceeding 100 cm.

Grades of Cement Concrete

The concrete shall be in grade designated as under:

Grades of Concrete

Group	Grade Designation	Specified characteristic compressive strength of 150 mm Cube at 28 Days in N/mm^2
(1)	(2)	(3)
Ordinary Concrete	M10	10
	M15	15
	M20	20
Standard Concrete	M25	25
	M30	30
	M35	35
	M40	40
	M45	45
	M50	50
	M55	55
High Strength Concrete	M60	60
	M65	65
	M70	70
	M75	75
	M80	80

Notes :

1. In the designation of concrete mix M refers to the mix and the number to the specified compressive strength of 150 mm size cube at 28 days, expressed in N/mm^2.
2. For concrete of compressive strength greater than M55, design parameters given in the standard may not be applicable and the values may be obtained from specialized literatures and experimental results.

The characteristic strength is defined as the strength of material below which not more than 5 percent of the test results are expected to fall.

Concrete Mix Proportioning

The determination of the proportion of cement, aggregate and water to attain the required strength shall be made as follows:

(a) By designing the concrete mix: such concrete shall be called 'Design mix concrete', for details reference may be made to RCC Chapter.
(b) By adopting nominal concrete mix: such concrete shall be called 'Nominal mix concrete'.

Design mix concrete is preferred to nominal mix. If design mix concrete cannot be used for any reason on the work for grades of M20 or lower, nominal mixes which, however, is likely to involve a higher cement content.

Nominal Mix Concrete: Nominal Mix Concrete may be used for concrete of M20 or lower. The proportions of materials for nominal mix concrete

The cement content of the mix specified for any nominal mix shall be proportionately increased if the quantity of water in the mix has to be increased to overcome the difficulty or placement and compaction, so that the water cement ratio as specified is not exceeded.

Proportions for Nominal Mix Concrete

Grade of Concrete	**Total Quantity of Dry Aggregates by Mass per 50 kg of cement, to be taken as the Sum of the Individual Masses of Fine and Coarse Aggregates, Kg. Max**	**Proportion of Fine Aggregate to Coarse Aggregate (by Mass)**	**Quantity of Water per 50 kg of Cement, max Ltr.**
(1)	**(2)**	**(3)**	**(4)**
M5	800	Generally 1:2 but subject to an upper limit of 1: 1 ½ and a lower limit of 1:2 ½	60
M7.5	625		45
M10	480		34
M15	330		32
M20	250		30

Note : - The proportion of the fine to coarse aggregate should be adjusted from upper limit progressively as the grading of fine aggregate becomes finer and the maximum size of coarse aggregate becomes larger. Graded coarse aggregate shall be used.

Note : - Quantity of water required from durability point of view may be less than the value given above.

Mixing

Concrete shall be mixed in mechanical batch type concrete mixers conforming to IS 1791 having two blades and fitted with power loader (lifting hopper type). Half bag mixers and mixers without lifting hoppers shall not be used for mixing concrete. In exceptional circumstances, such as mechanical break down of mixer, work in remote areas or power breakdown and when the quantity of concrete work is very small, hand mixing may be done to adding 10% extra cement. When hand mixing is permitted, it shall be carried out on a water tight platform and care shall be taken to ensure that mixing is continued until the concrete is uniform in colour and consistency. Before mixing the brick aggregate shall be well soaked with water for a minimum period of two hours and stone aggregate or gravel shall be washed with water to remove, dirt, dust and other foreign materials. For guidance, the mixing time may be $1^1/_2$ to 2 minutes, for hydrophobic cement it may be taken as $2^1/_2$ to 3 minutes.

Mixing Efficiency: The mixer shall be tested under normal working conditions in accordance with the method specified in IS 4643 with a view to check its ability to mix the ingredients to obtain concrete having uniformity within the prescribed limits. The uniformity of mixed concrete shall be evaluated by finding the percentage variation in quantity (mass in water) of cement, fine aggregate and coarse aggregate in a freshly mixed batch of concrete.

The percentage variation between the quantities of cement, fine aggregate and coarse aggregates (as found by weighing in water) in the two halves of a batch and average of the two halve of the batch shall not be more than the following limits:

Cement	:	8%
Fine aggregate	:	6%
Coarse aggregate	:	5%

Machine Mixing: The mixer drum shall be flushed clean with water. Measured quantity of coarse aggregate shall be placed first in the hopper. This shall be followed with measured quantity of fine aggregate and then cement. In case fine aggregate is damp, half the required quantity of coarse aggregate shall be placed in the hopper, followed by fine aggregate and cement. Finally the balance quantity of coarse aggregate shall be fed in the hopper, & then the dry materials are slipped into the drum by raising the hopper. The dry material shall be mixed for atleast four turns of the drum. While the drum is rotating, water shall be added gradually to achieve the water cement ratio as specified or as required by the Engineer-in-Charge. After adding water, the mixing shall be continued until concrete of uniform colour, uniformly distributed material and consistency is obtained. Mixing shall be done for atleast two minutes after adding water. If there is segregation after unloading from the mixer, the concrete should be remixed.

The drum shall be emptied before recharging. When the mixer is closed down for the day or at any time exceeding 20 minutes, the drum shall be flushed cleaned with water.

Transportation and Handling : Concrete shall be transported from the mixer to the place of laying as rapidly as possible by methods which will prevent the segregation or loss of any of the ingredients and maintaining the required workability.

During hot or cold weather, concrete shall be transported in deep containers, other suitable methods to reduce the loss of water by evaporation in hot weather and heat loss in cold weather may also be adopted.

Placing

The concrete shall be deposited as nearly as practicable in its final position to avoid rehandling. It shall be laid gently (not thrown) and shall be thoroughly vibrated and compacted before setting commences and should not be subsequently disturbed. Method of placing shall be such as to preclude segregation. Care shall be taken to avoid displacement of reinforcement or movement of form work and damage due to rains. As a general guidance, the maximum free fall of concrete may be taken as 1.5 metre.

Compaction

Concrete shall be thoroughly compacted and fully worked around embedded fixtures and into corners of the form work. Compaction shall be done by mechanical vibrator of appropriate type till a dense concrete is obtained. The mechanical vibrators shall conform to IS 2505, IS 2506, IS 2514 and IS 4656. To prevent segregation, over vibration shall be avoided.

Compaction shall be completed before the initial setting starts. After compaction the

top surface shall be finished even and smooth with wooden trowel before the concrete begins to set.

Construction Joints

Concreting shall be carried out continuously upto construction joints. Number of such joints shall be kept minimum. Joints shall be kept as straight as possible. Construction joints should comply with IS 11817.

When the work has to be resumed on a surface which has hardened, such surface shall be roughened. It shall then be swept clean and thoroughly wetted. For vertical joints, neat cement slurry, of workable consistency by using 2 kgs of cement per sqm shall be applied on the surface before it is dry. For horizontal joints, the surface shall be covered with a layer of mortar about 10-15 mm thick composed of cement and sand in the same ratio as the cement and sand in concrete mix. This layer of cement slurry of mortar shall be freshly mixed and applied immediately before placing of the concrete.

Where the concrete has not fully hardened, all laitance shall be removed by scrubbing the wet surface with wire or bristle brushes, care being taken to avoid dislodgement of particles of coarse aggregate. The surface shall be thoroughly wetted and all free water removed. The surface shall then be coated with neat cement slurry @ 2 kgs of cement per sqm. On this surface, a layer of concrete not exceeding 150 mm in thickness shall first be placed and shall be well rammed against old work particular attention being paid to corners and close spots; work, thereafter, shall proceed in the normal way.

Curing

Curing is the process of preventing loss of moisture from the concrete. The following methods shall be employed for effecting curing.

Moist Curing : Exposed surfaces of concrete shall be kept continuously in a damp or wet condition by ponding or by covering with a layer of sacking, canvas, Hessian or similar materials and kept constantly wet for at least 7 days from the date of placing concrete in case of ordinary Portland cement and at least 10 days where mineral admixtures or blended cements are used. The period of curing shall not be less than 10 days for concrete exposed to dry and hot weather conditions. In the case of concrete where mineral admixtures or blended cements are used, it is recommended that above minimum periods may be extended to 14 days.

Membrane Curing : Approved curing compounds may be used in lieu of moist curing with the permission of the Engineer-in-Charge. Such compound shall be applied to all exposed surfaces of the concrete as soon as possible after the concrete has set. Impermeable membrane such as polythene sheet covering the concrete surface may also be used to provide effective barrier against the evaporation.

Freshly laid concrete shall be protected from rain by suitable covering.

Over the foundation concrete, the masonry work may be started after 48 hours of its compaction but the curing of exposed surfaces of cement concrete shall be continued along with the masonry work for at east 7 days. And where cement concrete is used as base concrete for flooring, the flooring may be commenced before the curing period of

base concrete is over but the curing of base concrete shall be continued along with top layer of flooring for a minimum period of 7 days.

Testing of Concrete

Testing of concrete shall be done as described in chapter of R.C.C.

Form Work

Form work shall be as specified in R.C.C. chapter and shall be paid for separately unless otherwise specified.

Finishes

Plastering and special finishes other than those, obtained through form work shall be specified and paid for separately unless otherwise specified.

Durability of Concrete

A durable concrete is one that performs satisfactorily in the working environment during its anticipated exposure conditions during service. The materials and mix proportions shall be such as to maintain its intergrity and, if applicable, to protect reinforcement from corrosion.

The factors influencing durability include:

(a) The environment;
(b) The cover to embedded steel;
(c) The type and quality of constituent materials;
(d) The cement content and water/ cement ratio of the concrete;
(e) Workmanship, to obtain full compaction and efficient curing; and
(f) The shape and size of the member.

CEMENT- FLY ASH CONCRETE

Fly ash concrete shall be prepared by mixing graded coarse aggregate of nominal size as specified with fine aggregate, ordinary Portland cement and fly ash in specified proportions with required quantity of water. The recommended composition of cement fly ash concrete are as under:

TABLE

Fly Ash Concrete Mixes

Composition (Dry Volume)	Proportion (Dry Volume)	Compressive Strength at seven days
Lean Concrete (1:5:10)		28 kg/cm^2
Cement (Ordinary Portland)	1.0	
Fly ash	2.5	
Sand	4.0	
Stone aggregate	11.0	
Lean Concrete (1:4:8)		37 kg/cm^2
Cement (Ordinary Portland)	1.0	
Fly ash	2.0	
Sand	3.5	
Stone aggregate	9.0	

Note: No fly ash is to be added to Portland Puzzolona cement in any case which itself contains fly ash.

Proportioning

Proportioning shall be done by volume. Boxes of suitable size shall be used for measuring fly ash, sand and aggregate. The internal dimensions of the boxes shall be generally 35x25x40 cm. deep or as otherwise approved by the Engineer-in-charge. The unit of measurement of cement shall be a bag of 50 kg. and this shall be taken as 0.035 cum. While measuring the aggregate, shaking, ramming or heaping shall not be done. The proportioning of sand shall be on the basis of its dry volume and in case of damp sand, allowances for bulkage shall be made as given in the chapter for mortar.

DAMP PROOF COURSE

Cement Concrete Layer

This shall consist of cement concrete of specified proportions and thickness. The surface of brick or stone masonry work shall be levelled and prepared before laying the cement concrete. Edge of damp proof course shall be straight, even and vertical. Side shuttering shall consist of steel forms and shall be strong and properly fixed so that it does not get disturbed during compaction and the mortar does not leak through. The concrete mix shall be of workable consistency and shall be tamped thoroughly to make a dense mass. When the sides are removed, the surface should come out smooth without honey-coming. Continuity shall be maintained while laying the cement concrete layer and laying shall be terminated only at the predetermined location where damp proof course is to be discontinued. There shall be no construction joints in the Damp Proof Course.

Curing

Damp proof course shall be cured for at least seven days, after which it shall be allowed to dry.

Application of Hot Bitumen

Where so directed, hot bitumen in specified quantity shall be applied over the dried up surface of cement concrete, properly cleaned with brushes and finally with a piece of cloth soaked in kerosene oil. Bitumen of penetration A 90 or equivalent where used shall be heated to a temperature of 160º ± 5ºC. The hot bitumen shall be applied uniformly all over, so that no blank spaces are left anywhere.

Water Proofing Materials

Where so specified, water proofing material of approved quality shall be added to the concrete mixture in accordance with the manufacturer's specification stating the quantity of water proofing material in litres or kg per 50 kg or cement

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

LIST OF MANDATORY TESTS

Material	Clause	Test	Field/ Laboratory	Test procedure	Min. qty of Material for Carrying out test	Frequency of Testing
1	2	3	4	5	6	7
Stone aggregate	4.1.2.2	(a) Percentage of soft or deleterious material	Field or Laboratory-Test as required	IS 2386-Part II	As required by Engineer-in-charge	For all quantities
	4.1.2.3	Particle size	Field/ Lab	Appendix 'A'	45 cum	For every 45 cum or part thereof for RCC Work only. For rest of items as decided by Engineer-in-charge
	4.1.2.5	(a) Estimation of organic impurities	Field/ Lab	IS 2386-Part II	10 cum	For every 40 cum or part thereof
		(b) Surface moisture	Field/ Lab	IS 2386	10 cum	-do-
		(c) Determination of 10% fine value	Field/ Lab	IS 2386	10 cum	-do-
		(d) Specific gravity	Field/ Lab	IS 2386	10 cum	-do-
		(e) Bulk density	Field/ Lab	IS 2386	10 cum	-do-
		(f) Aggregate crusing strength	Field/ Lab	IS 2386	10 cum	-do-
		(g) Aggregate impact value	Field/ Lab	IS 2386	10 cum	-do-
Concrete	4.2.2	Slump test	Field	Appendix 'D'	10 cum	15 cum or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

S. No.	I. S. No.	Subject
1.	IS 383	Specification for coarse and fine aggregate from natural sources for concrete.
2.	IS 456	Plain and reinforced concrete - Code of practice
3.	IS 516	Method of test for strength of concrete

S. No.	I. S. No.	Subject
4.	IS 1199	Method of sampling and analysis of concrete
5.	IS 1200 (Part II)	Method of measurement of building and civil engineering work (concrete work)
6.	IS 1322	Specification for bitumen felt for water proofing and damp proofing.
7.	IS 1791	General requirements for batch type conrete mixers
8.	IS 2386	Method of test for aggregates for concrete
		(a) Part I - Particle size and shape
		(b) Part II - Estimation of deleterious materials and organic impurities
		(c) Part III - Specific gravity, density, voids absorption and bulking.
		(d) Part IV - Mechanical properties.
		(e) Part V – Soundness
9.	IS 2505	General requirements for concrete vibrators - immersion type.
10.	IS 2506	General requirements for concrete vibrators - screed board concrete vibrators
11.	IS 2645	Specification for integral water proofing compounds for cement mortar and concrete
12.	IS 3068	Specification for broken brick (burnt clay) coarse aggregate for use in concrete.
13.	IS 3812	Specification for flyash for use as pozzolana and admixture in cement mortar and concrete.
14.	IS 4656	Specification for form vibrators for concrete.
15.	IS 7861 (Part-I)	Code of practice for extreme weather concreting (Part-I) recommended practice for hot weather concreting.
16.	IS 7861 (Part–II)	Code of practice for extreme weather concreting (Part-II) recommended.
17.	IS 9103	Specification for concrete admixtures

SECTION - 3 : REINFORCED CEMENT CONCRETE WORK

GENERAL

Reinforced cement concrete work may be cast-in-situ or Precast according to the nature of work. Reinforced cement concrete work shall comprise.

(a) Form work (Centering and Shuttering)
(b) Reinforcement
(c) Concreting: (1 - Cast-in-situ), (2 - Precast)

MATERIALS

Water, cement, fine and coarse aggregate shall be as specified under respective clauses of chapter 03 mortars and chapter 04 concrete work as applicable.

Fly Ash admixed cement concrete (FACC) and fly ash Blended cements in Cement Concrete (PPCC) in RCC structures.

Fly ash Blended Cements conforming to IS 1489 (Part I) may be used in RCC structures as per guidelines given below :

General

(i) IS 456- 2000 Code of Practice for Plain and Reinforced Concrete (as amended up to date) shall be followed in regard to Concrete Mix Proportion and its production as under :
  (a) The concrete mix design shall be done as “Design Mix Concrete” as prescribed in clause-9 of IS 456 mentioned above.
  (b) Concrete shall be manufactured in accordance with clause 10 of above mentioned IS 456 covering quality assurance measures both technical and organizational, which shall also necessarily require a qualified Concrete Technologist to be available during manufacture of concrete for certification of quality of concrete.

(ii) Minimum M -25 grade of concrete shall be used in all structural elements made with RCC both in load bearing and framed structure.

(iii) The mechanical properties such as modulus of elasticity, tensile strength, creep and shrinkage of fly ash mixed concrete or concrete using fly ash blended cements (PPCs) are not likely to be significantly different and their values are to be taken same as those used for concrete made with OPC.

(iv) To control higher rate of carbonation in early ages of concrete both in fly ash admixed as well as PPC based concrete, water/binder ratio shall be kept as low as possible, which shall be closely monitored during concrete manufacture.
If necessitated due to low water/binder ratio, required workability shall be achieved by use of chloride free chemical admixtures conforming to IS 9103. The compatibility of chemical admixtures and super plasticizers with each set OPC, fly ash and /or PPC received from different sources shall be ensured by trials.

(v) In environment subjected to aggressive chloride or sulphate attach in particular, use of fly ash admixed or PPC based concrete is recommended. In cases, where structural concrete is exposed to excessive magnesium sulphate, flyash substitution/content shall be limited to 18% by weight. Special type of cement with low C3A content may also be alternatively used. Durability

criteria like minimum binder content and maximum water /binder ratio also need to be given due consideration in such environment.

Use of Fly ash Admixed Cement Concrete (FACC) in RCC structures

There shall be no bar on use of FACC in RCC structures subject to following additional conditions.

(i) Fly ash shall have its chemical characteristics and physical requirements etc. conforming to IS 3812 (part I & II) and shall be duly certified.

(ii) To ensure uniform blending of fly ash with cment in conformity with IS 456, a specific facility needs to be created at site with complete computerized automated process control to achieve design quality or with similar facility from Ready Mix Concrete (RMC) plants.

(iii) As per IS 1489 (Part-I) maximum 35% of OPC by mass is permitted to be substituted with fly ash conforming to IS 3812 (Part –I) and same is reiterated.

(iv) Separate storage for dry fly ash shall be provided. Storage bins or silos shall be weather proof and permit a free flow and efficient discharge of fly ash. The filter or dust control system provided in the bins or silos shall be of sufficient size to allow delivery of fly ash maintained at specified pressure to prevent undue emission of fly ash dust, which may interfere weighing accuracy.

Use of Fly Ash Blended Cements in Cement Concrete (PPCC) in RCC Structures

(i) Subject to General Guidelines detailed out as above, PPC manufactured conforming to IS 1489 (Part-I) shall be treated at par with OPC for manufacture of Design Mix concrete for structural use in RCC.

(ii) Till the time, BIS makes it mandatory to print the %age of fly ash on each bag of cement, the certificate from the PPC manufacture indicating the same shall be insisted upon before allowing use of such cements in works.

(iii) While using PPC for structural concrete work, no further admixing of fly ash shall be permitted.

Steel for Reinforcement

Thermo Mechanically treated reinforcement bars:

(a) There is no BIS code for TMT bars. The available code BIS 1786 pertains to HSD Bars. Therefore there should be no stipulation that TMT bars should conform to relevant BIS code.

(b) The TMT bars are being produced under valid licence from either of the firms namely Tempcore, Thermex Evcon Turbo & Turbo Quench. These firms have acquired patents and are giving licences to various producers to produce TMT Bars.

(c) The TMT bars shall conform to IS 1786 pertaining to Fe 415 D or Fe 500 D or more Fe grade of steel as specified.

(d) In design and construction of reinforced concrete building in seismic zone III and above, steel reinforcement of Grade Fe 415 D shall be used. However,

high strength deformed steel bars, produced by thermomechanical treatment process of grade Fe 415, Fe 500 and Fe 550 having elongation more than 14.5. % and conform to other requirements of Fe 415 D, Fe 500 D and Fe 550 D respectively of IS 1786 may also be used for reinforcement. In future, latest provision of IS 456 and IS 13920 or any other relevant code as modified from time to time shall be applicable.

Stacking and Storage

Steel for reinforcement shall be stored in such a way as to prevent distorting and corrosion. Care shall be taken to protect the reinforcement from exposure to saline atmosphere during storage fabrication and use. It may be achieved by treating the surface of reinforcement with cement wash or by suitable methods. Bars of different classifications, sizes and lengths shall be stored separately to facilitate issue in such sizes and lengths to cause minimum wastage in cutting from standard length.

Identification

Care shall also be taken to properly identify these bars at site. The staff shall be specially trained for looking for identification marks on these bars given by the manufacturers which are generally given colour code. It will be advisable to see that only one type/grade of bars are brought to site and used in the project after conducting tests for each lot.

FORM WORK (CENTRING & SHUTTERING)

Form Work

Form work shall include all temporary or permanent forms or moulds required for forming the concrete which is cast-in-situ, together with all temporary construction required for their support.

Material for Form Work

1. *Propping and Centering*: All propping and centering should be either of steel tubes with extension pieces or built up sections of rolled steel.

2. ***Centering/Staging:*** Staging should be as designed with required extension pieces to ensure proper slopes, as per design for slabs/ beams etc. All the staging to be either of Tubular steel structure with adequate bracings as approved or made of built up structural sections made form rolled structural steel sections.

3. In case of structures with two or more floors, the weight of concrete, centering and shuttering of any upper floor being cast shall be suitably supported on one floor below the top most floor already cast.

4. Form work and concreting of upper floor shall not be done until concrete of lower floor has set at least for 14 days.

Shuttering: Shuttering used shall be of sufficient stiffness to avoid excessive deflection and joints shall be tightly butted to avoid leakage of slurry. If required, rubberized lining of material shall be provided in the joints. Steel shuttering used or concreting should be sufficiently stiffened. The steel shuttering should also be properly

repaired before use and properly cleaned to avoid stains, honey combing, seepage of slurry through joints etc.

(a) *Runner Joists:* RSJ, MS Channel or any other suitable section of the required size shall be used as runners.

(b) Assembly of beam head over props. Beam head is an adopter that fits snugly on the head plates of props to provide wider support under beam bottoms.

(c) Only steel shuttering shall be used, except for unavoidable portions and very small works for which 12 mm thick water proofing ply of approved quality may be used.

Form work shall be properly designed for self weight, weight of reinforcement, weight of fresh concrete, and in addition, the various live loads likely to be imposed during the construction process (such as workmen, materials and equipment). In case the height of centering exceeds 3.50 metres, the prop may be provided in multi-stages.

Inspection of Form Work

The completed form work shall be inspected and approved by the Engineer-in-Charge before the reinforcement bars are placed in position.

Proper form work should be adopted for concreting so as to avoid honey combing, blow holes, grout loss, stains or discoloration of concrete etc. Proper and accurate alignment and profile of finished concrete surface will be ensured by proper designing and erection of form work

Shuttering surface before concreting should be free from any defect/ deposits and full cleaned so as to give perfectly straight smooth concrete surface. Shuttering surface should be therefore checked for any damage to its surface and excessive roughness before use.

Erection of Form Work (Centering and shuttering): Following points shall be borne in mind while checking during erection.

(a) Any member which is to remain in position after the general dismantling is done, should be clearly marked.

(b) Material used should be checked to ensure that, wrong items/ rejects are not used.

(c) If there are any excavations nearby which may influence the safety of form works, corrective and strengthening action must be taken.

(d) (i) The bearing soil must be sound and well prepared and the sole plates shall bear well on the ground.
(ii) Sole plates shall be properly seated on their bearing pads or sleepers.
(iii) The bearing plates of steel props shall not be distorted.
(iv) The steel parts on the bearing members shall have adequate bearing areas.

(e) Safety measures to prevent impact of traffic, scour due to water etc. should be

taken. Adequate precautionary measures shall be taken to prevent accidental impacts etc.

(f) Bracing, struts and ties shall be installed along with the progress of form work to ensure strength and stability of form work at intermediate stage. Steel sections (especially deep sections) shall be adequately restrained against tilting, over turning and form work should be restrained against horizontal loads. All the securing devices and bracing shall be tightened.

(g) The stacked materials shall be placed as catered for, in the design.

(h) When adjustable steel props are used. They should:
1. be undamaged and not visibly bent.
2. have the steel pins provided by the manufacturers for use.
3. be restrained laterally near each end.
4. have means for centralizing beams placed in the forkheads.

(i) Screw adjustment of adjustable props shall not be over extended.

(j) Double wedges shall be provided for adjustment of the form to the required position wherever any settlement/ elastic shorting of props occurs. Wedges should be used only at the bottom end of single prop. Wedges should not be too steep and one of the pair should be tightened/ clamped down after adjustment to prevent shifting.

(k) No member shall be eccentric upon vertical member.

(l) The number of nuts and bolts shall be adequate.

(m) All provisions of the design and/or drawings shall be complied with.

(n) Cantilever supports shall be adequate.

(o) Props shall be directly under one another in multistage constructions as far as possible.

(p) Guy ropes or stays shall be tensioned properly.

(q) There shall be adequate provision for the movements and operation of vibrators and other construction plant and equipment.

(r) Required camber shall be provided over long spans.

(s) Supports shall be adequate, and in plumb within the specified tolerances.

REINFORCEMENTS

General Requirements

Steel conforming to para 5.1.3 for reinforcement shall be clear and free from loose mill scales, dust, loose rust, coats of paints, oil or other coating which may destroy or reduce bond. It shall be stored in such a way as to avoid distortion and to prevent deterioration and corrosion. Prior to assembly of reinforcement on no account any oily substance shall be used for removing the rust.

Assembly of Reinforcement : Bars shall be bent correctly and accurately to the size and shape.. Preferably bars of full length shall be used. Necessary cutting and straightening is also included. Overlapping of bars, where necessary shall be done. The overlapping bars shall not touch each other and these shall be kept apart with concrete between them by 25mm or $1^{1}/4$ times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted tight. The overlaps/ splices shall be staggered. But in no case the overlapping shall be provided in more than 50% of cross sectional area at one section.

Bonds and Hooks Forming End Anchorages: Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice of bending and fixing of bars for concrete reinforcement. The details of bends and hooks are shown below for guidance.

(a) *U-Type Hook*

In case of mild steel plain bars standard U type hook shall be provided by bending ends of rod into semicircular hooks having clear diameter equal to four times the diameter of the bar.

Note: In case of work in seismic zone, the size of hooks at the end of the rod shall be eight times the diameter of bar or as given in the structural drawings.

(b) *Bends*

Bend forming anchorage to a M.S. plain bar shall be bent with and internal radius equal to two times the diameter of the bar with a minimum length beyond the bend equal to four times the diameter of the bar.

Anchoring Bars in Tension : Deformed bars may be used without end anchorages provided, development length equipment is satisfied. Hooks should normally be provided for plain bars in tension. Development length of bars will be determined as per IS: 456.

Anchoring Bars in Compression : The anchorage length of straight bar in compression shall be equal to the 'Development length' of bars in compression as specified in IS: 456. The projected length of hooks, bend and straight lengths beyond bend, if provided for a bar in compression, shall be considered for development length.

Binders, stirrups, links etc. : In case of binders, stirrups, links etc. the straight portion beyond the curve at the end shall be not less than eight times and nominal size of bar.

Welding of Bars

Wherever facility for electric **arc** welding **or gas pressure welding** is available, welding of bars shall be done in lieu of overlap. The location and type of welding shall be got . Welding shall be as per IS 2751 and 9417.

Placing in Position

Fabricated reinforcement bars shall be placed in position. The bars crossing one another shall be tied together at every intersection with two strands of annealed steel wire 0.9 to

1.6 mm thickness twisted tight to make the skeleton of the steel work rigid so that the reinforcement does not get displaced during deposition of concrete.

Tack welding in crossing bars shall also be permitted in lieu of binding with steel wire

The bars shall be kept in correct position by the following methods:

(a) In case of beam and slab construction pre-cast cover blocks in cement mortar 1:2 (1 cement : 2 coarse sand) about 4x4 cm section and of thickness equal to the specified cover shall be placed between the bars and shuttering, so as to secure and maintain the requisite cover of concrete over reinforcements.

(b) In case of cantilevered and doubly reinforced beams of slabs, the vertical distance between the horizontal bars shall be maintained by introducing chairs, spacers or support bars of steel at 1.0 mere or at shorter spacing to avoid sagging.

(c) In case of columns and walls, the vertical bars shall be kept in position by means of timber templates with slots accurately cut in them: or with clock of cement mortar 1:2 (1 cement: 2 coarse sand) of required size suitable tied to the reinforcement to ensure that they are in correct position during concreting.

(d) In case of other R.C.C. structure such as arches, domes, shells, storage tanks etc. a combination of cover blocks, spacers and templates

Tolerance on Placing of Reinforcement **:** Unless otherwise specified by the Engineer-in- Charge, reinforcement shall be placed within the following tolerances:

	Tolerance in spacing
(a) For effective depth, 200 mm or less	+10 mm
(b) For effective depth, more than 200 mm	+ 15 mm

Bending at Construction Joints **:** Where reinforcement bars are bent aside at construction joints and afterwards bent back into their original position care should be taken to ensure that at no time the radius of the bend is less than 4 bar diameters for plain mild steel or 6 bar diameter for deformed bars. Care shall also be taken when bending back bars to ensure that the concrete around the bar is not damaged.

STEEL FOR REINFORCEMENT READY TO USE "CUT & BEND"

Cut and bend rebars are customised reinforced steel bars required at construction sites. These shall be made from specialized machinery ensuring exact precision, ready to use pre-cut and pre-bent as per approval drawings. The steel used for reinforcement shall be the following types.

Thermo-mechanically treated (TMT) Bars.

Elongation percent on gauge length is 5.65A, where A is the cross sectional area of the test piece.

Welding of reinforcement bars covered in this specification shall be done in accordance with the requirement of IS 2751.

Nominal mass/weight:- The tolerance on mass/weight for round and square bars shall be the percentage given in Table 5.4A of the mass/weight calculated on the basis that the masses of the bar/wire of nominal diameter and of density 7.85 Kg/cm^3 or 0.00785

kg/mm³.

Tests:- Selection and preparation of Test sample. All the tests piece shall be selected by the Engineerin-charge or his authorized representative either-

(a) From cutting of bars

Or

(b) If he so desires, from any bar after it has been cut to the required or specified size and the test piece taken from and any part of it.

In neither case, the test pieces shall be detached from the bar or coil except in the presence of the Engineer-in-charge or his authorized representative.

The test piece obtained in accordance with as above shall be full sections of the bars as rolled and subsequently cold worked and shall be subjected to physical tests without any further modifications. No deduction in size by machining or otherwise shall be permissible. No test piece shall be enacted or otherwise subject to heat treatment. Any straightening which a test piece may require shall be done cold.

Tensile Test: 0.2% proof stress and percentage elongation-

This shall be done as per IS 1608, read in conjunction with IS 226.

RE-test:- This shall be done as per IS 1786.

Rebend test:- This shall be done as per IS 1786.

Thermo Mechanically treated reinforcement bars:

(a) There is no BIS code for TMT bars. The available code BIS 1786 pertains to HSD Bars.Therefore there should be no stipulation that TMT bars should conform to relevant BIS code.

(b) The TMT bars are being produced under valid licence from either of the firms namely Tempcore, Thermex Evcon Turbo & Turbo Quench. These firms have acquired patents and are giving licences to various producers to produce TMT Bars.

(c) The TMT bars shall conform to IS 1786 pertaining to Fe 500 D or Fe grade of steel as specified.

(d) In design and construction of reinforcement concrete building in seismic zone III and above, steel reinforcement of Grade Fe 415 D shall be used. However, high strength deformed steel bars, produced by thermomechanical treatment process of grade Fe 500 and Fe 550 having elongation more than 14.5% and conform to other equirements of Fe 500 D and Fe 550 D respectively of IS 1786 may also be used for reinforcement. In future, latest provision of IS 456 and IS 13920 or any other relevant code as modified from time to time shall be applicable.

Assembly of Rebars

The rebars shall be bend correctly and precisely to the size and shape as shown in the detailed drawing or as directed by Engineer-in-charge. Overlapping of bars, where necessary shall be done as directed by the Engineer-in-charge. The overlapping bars shall

not touch each other and these shall be kept apart with concrete between them by 25 mm or 1¼ times the maximum size of the coarse aggregate whichever is greater. But where this is not possible, the overlapping bars shall be bound together at intervals not exceeding twice the dia. of such bars with two strands annealed steel wire of 0.90 mm to 1.6 mm twisted light. The overlaps/splices shall be staggered as per direction of the Engineer-in-charge. But in no case the overlapping shall be provided in more than 50% of cross sectional area at one section.

Bonds and Hooks Forming End Anchorages:- Reinforcement shall be bent and fixed in accordance with procedure specified in IS 2502, code of practice of bending and fixing of bars for
concrete reinforcement.

Placing of Concrete
Concreting shall be commenced the centering, shuttering and reinforcement as placed and passed the same. Shuttering shall be clean and free from all shavings, saw dust, pieces of wood, or other foreign material and surfaces shall be treated as prescribed

In case of concreting of slab and beams, wooden plank or cat walks of chequerred MS plated or bamboo chalies or any other suitable material supported directly on the centering by means of wooden blocks or lugs shall be provided to convey the concrete to the place of deposition without disturbing the reinforcement in any way. Labour shall not be allowed to walk over the reinforcement.

In case of columns and wall, it is desirable to place concrete without construction joints. The progress of concreting in the vertical direction, shall be restricted to one metre per hour.

The concrete shall be deposited in its final position in a manner to preclude segregation of ingredients. In deep trenches and footings concrete shall be placed through chutes . In case of columns and walls, the shuttering shall be so adjusted that the vertical drop of concrete is not more than 1.5 metres at a time.

During cold weather, concreting shall not be done when the temperature falls below 4.5^0C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone.

During hot weather precaution shall be taken to see that the temperature of wet concrete does not exceed 38ºC. No concrete shall be laid within half an hour of the closing time of the day.

It is necessary that the time between mixing and placing of concrete shall not exceed 30 minutes so that the initial setting process is not interfered with.

Compaction
It shall be as specified in sub-head of Concrete Work of this specification.

Concrete shall be compacted into dense mass immediately after placing by means of mechanical vibrators designed for continuous operations complying with IS 2505, IS 2506, IS 2514 and IS 4656. The Engineer-in-Charge may however relax this condition at his discretion for certain items depending on the thickness of the members and feasibility of vibrating the same and permit hand compaction instead. Hand

compaction shall be done with the help of tamping rods so that concrete is thoroughly compacted and completely worked around the reinforcement, embedded fixtures, and into corners of the form. The layers of concrete shall be so placed that the bottom layer does not finally set before the top layer is placed. The vibrators shall maintain the whole of concrete under treatment in an adequate state of agitation; such that de-aeration and effective compaction is attained at a rate commensurate with the supply of concrete from the mixers. The vibration shall continue during the whole period occupied by placing of concrete, the vibrators being adjusted so that the centre of vibrations approximates to the centre of the mass being compacted at the time of placing.

Concrete shall be judged to be properly compacted, when the mortar fills the spaces between the coarse aggregate and begins to cream up to form an even surface. When this condition has been attained, the vibrator shall be stopped in case of vibrating tables and external vibrators. Needle vibrators shall be withdrawn slowly so as to prevent formation of loose pockets in case of internal vibration. In case both internal and external vibrators are being used, the internal vibrator shall be first withdrawn slowly after which the external vibrators shall be stopped so that no loose pocket is left in the body of the concrete. The specific instructions of the makers of the particular type of vibrator used shall be strictly complied with. Shaking of reinforcement for the purpose of compaction should be avoided. Compaction shall be completed before the initial setting starts, i.e. with 30 minutes of addition of water to the dry mixture.

1. Shallow patches are first treated with a coat of thin grout composed of one part of cement and one part of fine sand and then filled with mortar similar to that used in the concrete. The mortar is placed in layers not more than 10mm thick and each layer is given a scratch finish to secure bond with the succeeding layer. The last layer is finished to match the surrounding concrete by floating, rubbing or tooling on formed surfaces by pressing the form material against the patch while the mortar is still plastic.

2. Large and deep patches require filling up with concrete held in place by forms. Such patches are reinforced and carefully dowelled to the hardened concrete.

3. Holes left by bolts are filled with mortar carefully packed into places in small amounts. The mortar is mixed as dry as possible, with just enough water so that it will be tightly compacted when forced into place.

4. Tiered holes extending right through the concrete may be filled with mortar with a pressure gun similar to the gun used for greasing motor cars.

5. Normally, patches appear darker than the surrounding concrete, possibly owing to the presence on their surface of less cement laitance. Where uniform surface colour is important, this defect shall be remedied by adding 10 to 20 percent of white Portland cement to the patching mortar, the exact quantity being determined by trial.

6. The same amount of care to cure the materials in the patches should be taken as with the whole structure. Curing must be started as soon as possible, after the patch is finished to prevent early drying. Damp Hessian may be used but in some locations it may be difficult to hold it in place. A membrane curing compound in these cases will be most convenient.

(b) The exposed surface of R.C.C. work shall be plastered with cement mortar 1:3 (1 cement : 3 fine sand) of thickness not exceeding 6 mm to give smooth and even surface true to line and form. Any RCC surface which remains permanently exposed to view in the completed structure, shall be considered exposed surfaced for the purpose of this specification.

Where such exposed surface exceeding 0.5 sqm in each location is not plastered with cement mortar 1:3 (1 cement : 3 fine sand) 6 mm thick, necessary deduction shall be made for plastering not done.

(c) The surface which is to receive plaster or where it is to be joined with brick masonry wall, shall be properly roughened immediately after the shuttering is removed, taking care to remove the laitance completely without disturbing the concrete. The roughening shall be done by hacking. Before the surface is plastered, it shall be cleaned and wetted so as to give bond between concrete and plaster.

RCC work shall be done carefully so that the thickness of plaster required for finishing the surface is not more than 6 mm.

(d) The surface of RCC slab on which the cement concrete or mosaic floor is to be laid shall be roughened with brushes while the concrete is green. This shall be done without disturbing the concrete.

Strength of Concrete

The compressive strength on the work tests for different mixed shall be as given in Table

TABLE

Concrete Mix (Nominal Mix on Volume basis)	**Compressive Strength in (Kg/ sq cm)**	
	7 days'	**28 days'**
1:1:2	210	315
1:1.5:3	175	265
1:2:4	140	210

Testing of Concrete

Regular mandatory tests on the workability of the fresh concrete shall be done to achieve the specified compressive strength of concrete. These will be of two types

(a) Mandatory Lab, Test
(b) Mandatory Field Test

Results of Mandatory Field Test will prevail over mandatory Lab. Test.

Tolerances
Subject to the condition that structural safety is not impaired and architectural concept does not hamper, the tolerances in dimensions of R.C.C. members shall be as specified in the drawings by the designer. Whenever these are not specified, the

permissible tolerance after consultations with the Designer, if necessary.

When tolerances in dimensions are permitted, following procedure for measurement shall apply.

(a) If the actual dimension of R.C.C. members do not exceed or decrease the design dimensions of the members plus or minus tolerance limit specified above, the design dimensions shall be taken for the purpose of measurement.

(b) If the actual dimensions exceed the design dimensions by more than the tolerance limit, the design dimensions only shall be measured for the purpose of payment.

(c) If the actual dimensions decrease more than the tolerance limit specified, the actual dimensions of the RCC members shall be taken for the purpose of measurement and payment.

(d) For acceptance of RCC members whose dimensions are not exactly as per design dimensions,. For the purpose of payment, however, the clarification as given in para a, b & c above shall apply.

PRECAST CEMENT CONCRETE JALI

The jali shall be of cement concrete 1:2:4 (1 cement 2 coarse sand:4 stone aggregate 6 mm nominal size) reinforced with 1.6 mm thick mild steel wire, unless otherwise specified.

Fixing

The jali shall be set in position true to plumb and level before the joints sills and soffits of the openings are plastered. It shall then be properly grouted with cement mortar 1:3 (1 cement :3 coarse sand) and rechecked for levels. Finally the jambs, sills and soffits shall be plastered embedding the jali uniformly on all sides.

DESIGN MIX

Definition

Design mix concrete is that concrete in which the design of mix i.e. the determination of proportions of cement, aggregate & water is arrived as to have target mean strength for specified grade of concrete. **The minimum mix of M40 or above** shall be used in all structural elements in both load bearing & RCC framed construction.

Mix Design and Proportioning

Mix proportions shall be designed to ensure that the workability of fresh concrete is suitable for conditions of handling and placing, so that after compaction it surrounds all reinforcement and completely fills the formwork. When concrete is hardened, it shall have the stipulated strength, durability and impermeability.

Determination of the proportions by weight of cement, aggregates and water shall be based on design of the mix.

As a trial the manufacturer of concrete may prepare a preliminary mix according to provisions of SP: 23. Reference may also be made to ACI 211.1-77 for guidance.

Mix design shall be tried and the mix proportions checked on the basis of tests conducted at a recognized laboratory .

All concrete proportions for various grades of concrete shall be designed separately and the mix proportions established keeping in view the workability for various structural elements, methods of placing and compacting.

Before using an admixture in concrete, its performance shall be evaluated by comparing the properties of concrete with the admixture and concrete without any admixture. Chloride content of admixture should be declared by the manufacturer of admixture and shall be within limits stipulated by IS:9103.

Standard Deviation

Standard deviation calculations of test results based on tests conducted on the same mix design for a particular grade designation shall be done in accordance with IS 456.

Acceptance Criteria

Compressive Strength : The concrete shall be deemed to comply with the strength requirements when both the following condition are met:

(a) The mean strength determined from any group of four consecutive test results complies with the appropriate limits in col 2 of Table 5.6.

(b) Any individual test result complies with the appropriate limits in col. 3 of Table 5.6.

Flexural Strength : When both the following conditions are met, the concrete complies with the specified flexural strength.

(c) The mean strength determined from any group of four consecutive test results exceeds the specified characteristic strength by at least 0.3 N/mm^2

(d) The strength determined from any test result is not less than the specified characteristic strength/ 0.3 N/mm^2.

Quantity of Concrete Represented by Strength Test Results : The quantity of concrete represented by a group of four consecutive test results shall include the batches from which the first and last samples were taken together with all intervening batches.

For the individual test result requirements given in col 3 of Table 5.6 or in item (b). Only the particular batch from which the sample was taken shall be at risk.

Where the mean rate of sampling is not specified the maximum quantity of concrete that four consecutive test results represent shall be limited to 60 m^3.

If the concrete is deemed not to comply pursuant to 5.8.3 the structural adequacy of the parts affected shall be investigated and any consequential action as needed shall be

taken.

Concrete of each grade shall be assessed separately.

Concrete is liable to be rejected if it is porous or honey-combed, its placing has been interrupted without providing a proper construction joint, the reinforcement has been displaced beyond the tolerances specified, or construction tolerances have not been met. However, the hardened concrete may be accepted after carrying out suitable remedial measured .

Cement Content of Concrete

For all grades of concrete manufactured/produced, minimum cement content in the concrete shall be 330 kg per cubic metre of concrete. Also, irrespective of the grade of concrete the maximum cement content shall not be more than 500 kg per cubic metre of concrete. These limitations shall apply for all types of cements of all strengths.

Actual cement content in each grade of concrete for various conditions of variable shall be established by design mixes within the limits

Water Cement Ratio and Slump

In proportioning a particular mix, the manufacturer/ producer/ contractor shall give due consideration to the moisture content in the aggregates, and the mix shall be so designed as to restrict the maximum free water cement ratio to less than 0.5.

Due consideration shall be given to the workability of the concrete thus produced. Slump shall be controlled on the basis of placement in different situations. For normal methods of placing concrete, maximum slump shall be restricted to 100 mm when measured in accordance with IS 1199.

Approval of Design Mix

The producer/ manufacturer/ contractor of concrete shall submit details of each trial mix of each grade of concrete designed for various workability conditions to the Engineer-in-Charge for his comments and approval. Concrete of any particular design mix and grade .

For any change in quality/ quantity in the ingredients of a particular concrete, for which mix has been designed earlier, the mix has to be redesigned and approval obtained again.

Water

(i) **RO Water** to be used in manufacturing and curing of concrete and shall be tested before use.

(ii) Manufacturer/ Contractor responsible for curing concrete shall identify, precisely the location of source of water intended to be used. Each such source of water shall be separately tested. In the event of a change in the source of water all tests specified herein shall have to be repeated.

(iii) In the event water is drawn from tube wells or open-wells, water samples shall be tested for seasonal fluctuations in water table or at intervals.

(iv) Water sample from each source shall be tested as under:-

Test	Number of test for each source
Acidity	3
Alkalinity	3
Presence of solids	3

Mean values of the above test shall be taken as the representative value and the acceptance criteria shall be based on these test results. All testing procedure and computation of test results shall conform to IS 3025.

EXPANSION JOINT SYSTEM

FLOOR JOINT

General requirement of material: The expansion joint system will be of extruded aluminum base members, self aligning /self centering arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor/ floor to wall expansion control system for various vertical locations in load application areas that accommodate multi directional seismic movement without stress to its components. The system shall consist of metal profiles with universal aluminum base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer's pre-engineered self centering arrangement that freely rotates/ moves in all directions. The self-centering arrangements shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of moisture barrier membrane in the joint system to have water tight joint is mandatory requirement. The scope of work includes all labour, materials, equipments and services and perform all operations required for complete installation of expansion joint system.

Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.

Approval of expansion joint system : Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

WALL JOINT

General requirement of material: The expansion joint system related with wall joint (internal/ external) shall be of extruded aluminium base members, self aligning / centering arrangement and support plates as per ASTM B221-02. The material shall be such that it provides an Expansion joints systems suitable for vertical wall to wall/ wall to corner application, both new and existing construction in office buildings & complexes with no slipping down tendency amongst the components of the joint system. The Joint System shall utilize light weight aluminum profiles exhibiting minimal exposed aluminum surfaces

mechanically snap locking the multicellular to facilitate movement. (Material shall confirm to ASTM 6063)

Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.

Approval of expansion joint system : Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

ROOF JOINT

General requirement of material
Theexpansion joint system for various roof locations shall be of extruded aluminum base members with, self aligning and self centering arrangement support plates as per ASTM B221-02. The system shall be such that provides that is capable to accommodating multidirectional seismic movement without stress to its components. System shall consist of metal profile that incorporates a universal aluminum base member designed to accommodate various project conditions and roof treatments.

The cover plate shall be designed of width and thickness required to satisfy movement and loadingrequirements and secured to base members by utilizing manufacturer's pre-engineered self-centering arrangement that freely rotates/ moves in all directions. The self centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexures in all directions including vertical displacement. The joint system shall resists damage or deterioration from the impact of allying ice, exposure to UV, airborne contaminants and occasional foot traffic from maintenance personnel. Provision of moisture barrier membrane in the joint system to have water tight joint is mandatory requirement.

Performance Requirement: Material and works shall conform to the latest edition of reference specifications as specified in the item and to all applicable codes and requirement of local authorities having jurisdiction.

Approval of expansion joint system : Sample of expansion joint system along with manufacturers latest published literature for material specified herein, material test reports, shop drawings etc. shall be submitted for obtaining approval before material are delivered at the site. The expansion joint cover assembly should be from one source (from single manufacturer)

Installation of expansion joint system: In all cases the manufacturer's standard written instruction or specific instructions for installation shall be followed.

OTHER SPECIFICATIONS:
For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

LIST OF MANDATORY TESTS

Material	Clause	Test	Field/ labor-atory test	Test proce-dure	Min, quantity of material for carrying out the test	Frequency of testing
1	2	3	4	5	6	7
Reinforced cement concrete (Nominal Mix)	5.4.1	(a) Slump test	Field/Lab	Appen-dix 'D' of Chapter 4	(i) 5 cum in case of column (ii) 20 cum for slabs, beams and connected columns (iii) 20 cum for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer- in-Charge	(i) Every 5 cum of part thereof (ii) Every 20 cum or part thereof (iii) -Do-
	5.4.9.1	(b) Cube Test	Lab	Appen-dix 'A'	(i) 5 cum in case of column (ii) 20 cum for slabs, beams and connected columns (iii) 20 cum for other R.C.C. work for all other small items and where R.C.C. done in a day is less than 5 cum test may be carried out as required by Engineer- in-Charge	(i) Every 5 cum or part thereof (ii) Every 20cum or part thereof (iii) -Do-
Reinforced Cement	Coarse Aggre-gates				50 cum or part thereof & also on each	

Material	Clause	Test	Field/ labor-atory test	Test proce-dure	Min, quantity of material for carrying out the test	Frequency of testing
1	2	3	4	5	6	7
Concrete (Design Mix)					change of source	
	Fine Aggre-gates				50 cum or part thereof & also on each change of source	
	Cement				50 MT or on each change of source	
	Fresh Concrete	(a) Slump test	Field	Appen-dix 'D' of Chapter 4	10 cum	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
	Fresh Concrete	(b) Cube Test	Lab	Appen-dix 'A'	10 cum or part thereof	50 cum or 10 batches of 5-7 cum each for R.C.C. work in all location taken together. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge
Reinforced Cement Concrete (Ready Mix)	Coarse Aggre-gates				50 cum or part thereof & also on each change of source	
	Fine Aggre-gates				50 cum or part thereof & also on each change of source	
	Cement				50 MT or on each change of source	
	Fresh Concrete	(a) Slump test	Field/Lab	Appendix 'D' of Chapter 4	10 cum	50 cum for R.C.C. work including in all other small location. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer-in-Charge

Material	Clause	Test	Field/ labor-atory test	Test proce-dure	Min, quantity of material for carrying out the test	Frequency of testing	
1	2	3	4	5	6	7	
	Fresh Concrete	(b) Cube Test	Lab	Appen-dix 'A'	10 cum or part thereof	50 cum or 10 batches of 5-7 cum each for R.C.C. work in all location - taken together. R.C.C. done in a day is less than 50 cum test may be carried out as required by Engineer- in-Charge	
Steel for Reinforced cement concrete	5.1.3	(A) Physical Test and chemical tests				(a) For consign-ment below 100 tonnes (i) under 10 mm dia, one sample for each 25 tonnes or part thereof (ii) 10 mm to 16 mm dia one sample for each 35 tonnes or part thereof (iii) over 16 mm dia one sample for each 45 tonnes or part thereof	(b) For consign-ment over 100 tonnes (i) Under 10 mm dia, one sample for each 40 tonnes or part thereof (ii) 10 mm to 16 mm, one sample for each 45 tonnes or part thereof (iii) over 16 mm dia, one sample for each 50 tonnes or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

Sl. No.	I.S. No.	Subject
1.	IS 226	Structural Steel

Sl. No.	I.S. No.	Subject
2.	IS 432 (Part I)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement part-I mild steel and medium tensile steel bars.
3.	IS 432 (Part II)	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement – Part-II hard drawn
4.	IS 456	Code of Practices for plain and Reinforced concrete.
5.	IS 516	Method of test for strength of concrete.
6.	IS 716	Specification for pentachlorophenol
7.	IS 1199	Method of sampling and analysis of concrete.
8.	IS 1200 (Part II)	Method of measurement of building and civil engineering work – concrete work
9.	IS 1200 (Part V)	Method of measurement of building and civil engineering work – concrete work (Part 5- Form work)
10.	IS 1566	Specification for hard drawn steel wire fabric for concrete
11.	IS 1599	Method for bend test
12.	IS 1343	Code of Practice for Prestressed Concrete
13.	IS 1608	Method for tensile testing of steel products
14.	IS 1786	Specification for high strength deformed steel and wires for concrete reinforcement.
15.	IS 1791	Specification for batch type concrete mixes
16.	IS 2502	Code of practice for bending and fixing of bars for concrete reinforcement.
17.	IS 2751	Recommended practice for welding of mild steel plain and deformed bars for reinforced construction.
18.	IS 4925	Batch plants specification for concrete batching and mixing plant
19.	IS 4926	Ready – Mixed Concrete
20.	IS 6523	Specification for precast reinforced concrete door, window frames
21.	IS 10262	Recommended guidelines for concrete mix design
22.	IS 13311 (Part I)	Indian standard for non-destructive testing of concrete. Method of test for ultrasonic pulse velocity
23.	IS 13311 (Part II)	Indian standard for non-destructive testing of concrete. Method of testing by rebound hammer.

SECTION - 04 : BRICK / BLOCK WORK

Bricks used in the masonry may be of the following type.

(a) The **Common Burnt Clay Bricks** shall conform to IS:1077 and shall be hand moulded or machine moulded. They shall be free from nodules of free lime, visible cracks, flaws warpage and organic matter, have a frog 100 mm in length 40 mm in width and 10 mm to 20 mm deep on one of its flat sides. Bricks made by extrusion process and brick tiles may not be provided with frogs. Each brick shall be marked (in the frog where provided) with the manufacturer's identification mark or initials.

(b) **Fly Ash Lime Bricks (FALG Bricks) :** The Fly Ash Lime Bricks (FALG Bricks) shall conform to IS 12894. Visually the bricks shall be sound, compact and uniform in shape free from visible cracks, warpage, flaws and organic matter. The bricks shall be solid and with or without frog on one of its flat side.

Fly Ash: Fly ash shall conform to IS 3812.

(c) **Clay Fly Ash Bricks:** The clay fly ash bricks shall conform to IS 13757. The bricks shall be sound, compact and uniform in shape and colour. Bricks shall have smooth rectangular faces with sharp and square corners. The bricks shall be free from visible cracks, flaws, warpage, nodules of free lime and organic matter, the bricks shall be hand or machine moulded. The bricks shall have frog of 100 mm in length 40 mm width and 10 to 20 mm deep on one of its flat sides. If made by extrusion process may not be provided with frogs. Fly Ash shall conform to grade I or grade II of IS 3812.

(d) Brick work with non modular fly ash bricks conforming to IS:12894, class designation 10 average compressive strength in super structure above plinth level up to all floor level in : Cement mortar 1 :6 (1 cement : 6 Coarse sand)

(e) Half brick masonry with non modular fly ash bricks of class designation 10, conforming to IS :12894, in super structure above plinth upto all floor level in Cement mortar 1 :4 (1 cement: 4 coarse sand)

Specification of Aerated Autoclaved Concrete Blocks:-

- Proving and fixing Aerated Autoclaved Concrete Blocks masonry, AAC Block is to be conforming to IS 2185 (Part 3) -1984. The nominal dimensions should be 625mm x 200/240/250 mm x 150/200/225mm. The compressive strength should be as per Table 1 of IS code 2185 (Part 3) -1984 and minimum of Grade 1 with compressive strength of 4 N/sq mm with density ranges from 550 to 650 Kg/cubic meter in oven dried condition. The comprehensive strength shall be tested after due oven drying for 48 hours and shall be tested on 200 KN UTM machine with digital display. The sample shall be prepared as per and compressive strength shall be determined as per IS :6441 (Part 5) – 1972 and block density to be determined as per IS :6441 (Part 1) – 1972. The AAC blocks should baked at 200 degree centigrade at 12 bar pressure for at least 12 hours before dispatch. The manufacturer shall give documentary proof about same. There shall be a fibre-mesh laid at every alternate course of masonry with 1mm mesh size. For 115 mm thick masonry, two 6mm steel bars shall be laid at every alternate course. The samples need to be in perfect 90 degree perpendicular for all six surfaces.

- These AAC blocks are to be affixed with ready made mortar adhesive with split strength of 0.4 N/ Sq mm and compressive strength of 18 N/ sq mm with 3mm

thickness.

- Tolerance of dimensions shall be +_5mm as per in length and +-2mm in other two dimensions.

Specification of 100 / 115 mm thick Aerated Autoclaved Concrete Blocks:-

- Proving and fixing 100 mm or 115 mm thick Aerated Autoclaved Concrete Blocks masonry, Aerated Autoclaved Concrete Blocks is to be conforming to IS 2185 (Part 3) - 1984. The nominal dimensions should be 625mm x 200/240/250mm x 100/115 mm. The rate includes providing and placing in position 2 Nos 6 mm dia M.S. bars at every course of masonry work after making groves for placing the 6mm bar. The compressive strength should be as per Table 1 of IS code 2185 (Part 3) -1984 and minimum of Grade 1 with compressive strength of 4 N/sq mm with density ranges from 550 to 650 Kg/cubic meter in oven dried condition. The comprehensive strength shall be tested after due oven drying for 48 hours and shall be tested on 200 KN UTM machine with digital display. The sample shall be prepared as per and compressive strength shall be determined as per IS :6441 (Part 5) – 1972 and block density to be determined as per IS :6441 (Part 1) – 1972. The AAC blocks should baked at 200 degree centigrade at 12 bar pressure for at least 12 hours before dispatch. The manufacturer shall give documentary proof about same. There shall be a fibre-mesh laid at every alternate course of masonry with 1mm mesh size. For 115 mm thick masonry, two 6mm steel bars shall be laid at every alternate course. The samples need to be in perfect 90 degree perpendicular for all six surfaces. Rates are to be quoted in cubic meter.

- These AAC blocks are to be affixed with ready-made mortar adhesive with split strength of 0.4 N/ Sq mm and compressive strength of 18 N/ sq mm with 3mm thickness.

- Tolerance of dimensions shall be +_5mm as per in length and +-2mm in other two dimensions.

Work of cutting chases, wherever required to be made in the walls for housing G.I. pipe, CI pipe or any other fixtures shall be carried out in various locations as per guidelines given below :

(a) Cutting of chases in one brick thick and above load bearing walls.
  (i) As far as possible services should be planned with the help of vertical chases. Horizontal chases should be avoided.
  (ii) The depths of vertical chases and horizontal chases shall not exceed one-third and one-sixth of the thickness of the masonry respectively.
  (iii) When narrow stretches of masonry (or short length of walls) such as between doors and windows, cannot be avoided they should not be pierced with openings for soil pipes or waste pipes or timber joints, etc. Where there is a possibility of load concentration such narrow lengths of walls shall be checked for stresses and high strength bricks in mortar or concrete walls provided, if required.
  (iv) Horizontal chases when unavoidable should be located in the upper or lower one-third of height of storey and not more than three chases should be permitted in any stretch of a wall. No continuous horizontal chase shall exceed one metre in length. Where unavoidable, stresses in the affected area should be checked and kept within the permissible limits.
  (v) Vertical chases should not be closer than 2 m in any stretch of a wall.

These shall be kept away from bearings of beams and lintels. If unavoidable, stresses in the affected area should be checked and kept within permissible limits.

(vi) Masonry directly above a recess, if wider than 30 cm horizontal dimension) should be supported on lintel. Holes in masonry may be provided upto 30 cm width and 30 cm height without any lintel. In the case of circular holes in the masonry, no lintel need be provided for holes upto 40 cm in diameter.

(b) Cutting of chases in half brick load bearing walls.
No chase shall be permitted in half brick load bearing walls and as such no reccessed conduits and concealed pipes shall be provided with half brick thick load bearing walls.

(c) Cutting of chases in half brick non-load bearing wall :
Services should be planned with the help of vertical chases. Horizontal chase should be provided only when unavoidable.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

LIST OF MANDATORY TESTS

Sl. No.	Material	Clause	Test	Field/ laboratory Test	Test Procedure	Minimum Qty. of material for carrying out test
(i)	Bricks/ Brick Tiles	6.1.3, 6.1.4, 6.1.5	Testing of Bricks/Brick Tiles for dimensions, Compressive strength, Water absorption and	Laboratory	Appendix A, B, C & D of Chapter 6	As per Table 6.3 and 6.4
(ii)	Sewer Bricks	6.1.4	Dimensions, Compressive strength, Water absorption and Efflorescence	Laboratory	Appendix A, B, C & D of Chapter 6	As per Table 6.3 and 6.4
(iii)	Burnt clay perforated building bricks	6.1.5	--do--	-- do --	-- do--	-- do--

LIST OF BUREAU OF INDIAN STANDARDS CODES

S. No.	IS. No.	Subject
1.	IS 712	Specification for building limes.
2.	IS 1077	Common burnt clay building bricks.
3.	IS 1200 (Part 3)	Method of measurements of brick works
4.	IS 2212	Code of practice for brick work. (1st Revision)
5.	IS 2222	Specification for burnt clay perforated building bricks.
6.	IS 2849	Specification for non load bearing gypsum partition blocks, (Solid and hollow types)
7.	IS 3495	Method of test for burnt clay building bricks.
8.	IS 3812	Specification for fly ash for use as pozzolana and admixture.
9.	IS 4139	Specification of calcium silicate bricks
10.	IS 4885	Specification for sewer brick
11.	IS 5454	Methods of sampling of clay building bricks.
12.	IS 12894	Pulverized fuel ash lime bricks specification,
13.	IS 13757	Specification of burnt clay fly ash bricks.

SECTION - 05 : MARBLE AND GRANITE WORK

GENERAL

Marble shall be hard, sound, dense and homogeneous in texture with crystaline texture as far as possible. It shall generally be uniform in colour and free from stains, cracks, decay and weathering.

Marbles are metamorphic rocks capable of taking polish, formed from the re-crystalization of lime stones or dolomitic lime stones and are distinguished from lime stone by even visibly crystalined nature and nonflaggy stratification.

CLASSIFICATION

The marble blocks, slabs and tiles shall be classified broadly in the following two categories:

White Marble

Raj Nagar (plain white) Marble:

It shall be plain white marble with coarse grains predominantly showing mica particles giving reflection in light.

Coloured Marble

(i) Plain Black Marble
Black marble sawn along veins locally known as 'Peta Pasu sawing' available at Bhainslana.

(ii) Black Zebra Marble
- (a) *Bhainslana Black Zebra Marble:* Black marble having grey or white veins available at Bhainslana.
- (b) *Kishangarh Black Zebra Marble:* Black marble with grey and/or white veins available at Kishangarh.
- (c) *Abu Black Zebra Marble:* Black marble having white patches and streaks available at Abu.
- (d) *Narnaul Black Zebra Marbles:* Black marble with thin white veins available at Narnaul.
- (e) *Makrana Dhobi Doongri Zebra Marble:* Greyish black marble with white flowery pattern available at Dhobi Doongri.

(iii) Green Marble
- (a) *Baroda Green Marble:* Dark green marble with flowery pattern available at Baroda.
- (b) *Abu Green Marble:* Light green marble with green and/or brown streaks on white ground available at Ambaji.
- (c) *Falna Green Marble:* Green marble with prominent yellowish pattern available at Falna.
- (d) *Bundi Green Marble:* Green marble with pinkish shades available at Umar, (Bundi).

(iv) Grey Marble
- (a) *Kumari Grey Marble:* Grey marble having light blue shades available at Makrana.
- (b) *Bundi Grey Marble:* Grey Marble with pink or green or black streaks available at Umar (Bundi).

(v) Brown Marble
- (a) Bar Brown Marble/Brown Marble with light and dark brown shades available at Bar.

(b) Narnaul Brown Marble
Brown marble having teak wood shades available at Narnaul.

Granite Stone
It shall be of any colour and size. Granite shall be plain machine cut and mirror polished. The stone shall be smooth and of even surface without holes or pits.

SAMPLING
In any consignment all the blocks/slabs/tiles of the same group, size and finish shall be grouped together to constitute a lot. Sample shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification. The number of blocks/slabs/tiles to be selected for the samples shall depend upon the size of the lot and shall be in accordance.

MARBLE/GRANITE WORK - TABLE RUBBED AND POLISHED (PLAIN WORK)

Marble work in steps, jambs, columns and other plain work shall be as specified below:

Joints in staircase treads, kitchen platforms shall be permitted only at curvature or when width/length is more than 0.6/2 mtrs. respectively. Number of joints in each direction shall not be more than one number for every 2 mtrs. length beyond the initial 2.00 m length. Additional joints due to curvature or for providing fixture shall be provide judiciously

Dressing, Cutting and Rubbing
Every marble/ granite stone shall be gang saw/machine cut to the required size and shape, chisel dressed machine finished on all beds and joints, so as to be free from any waviness and to give truly vertical, horizontal, radial or circular joints as required. The exposed faces and sides of stones forming joints upto 6mm. from the face shall be fine tooled machine cut such that a straight edge laid along the face of the stone is in contact with every point on it. All window sills, tread of steps, counters vanities moulding edges etc. shall be machine cut & polished to give high gloss mirror finish. These surfaces shall then be rubbed smooth. All visible angles and edges shall be true, square and free from chipping. Beyond the depth of 6 mm from face, the joints shall be dressed with a slight splay so that the thickness of joint increases, in an inverted V shape as shown in Fig. below. The surfaces of the stones coming in contact with backing need not be chisel dressed.

A sample of dressed and rubbed stone shall be prepared for approval and it shall be kept on worksite.

Mortar
The mortar used for jointing shall be as specified.

Laying
All marble stones shall be wetted before placing in position. These shall then be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort.

The walls and pillars shall be carried up truely in plumb or battered as shown in the drawings. All courses shall be laid truely horizontal and all vertical joints shall be truely vertical.

In case of work without backing of brick work or coursed rubble masonry, face stone shall be laid in headers and stretchers alternatively unless otherwise directed. The headers shall be arranged to come as nearly as possible in the middle of stretchers above and below. Stone shall be laid in regular courses of not less than 15 cmFor work facing with backing of brick work or coursed rubble masonry, face stone shall be laid in alternate courses of header and stretchers unless otherwise directed. Face stone and bond stone courses shall have break joint on the face of atleast half the height of the standard course and the bond shall be carefully maintained through out. All the connected masonry in a structure shall be carried up nearly at one uniform level throughout but where breaks are unavoidable the joints shall be made in good long steps so as to prevent cracks developing between new and old work.

When necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these in to correct positions, care being taken that the corners of the stone are not damaged. Stone shall be covered with gunny bags, before putting chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work. The matching of grains shall be carried out.

Joints
The depth of joints 6 mm from the face shall be uniform and as fine as possible but shall be not more than 1.5 mm thick on the exposed face. Beyond the depth of 6 mm from face, the thickness of joints shall increase in an inverted V shape so as to give good mortar bond between two stones. The inverted portion of the joints shall be filled with bedding mortar and the face 6 mm portion with pointing mortar.

Curing
The work shall be kept constantly moist on all faces for a period of atleast seven days.

Finishing
After the marble work is cured, it shall be rubbed with carborandum stone of different grades no. 60, 120 and 320 in succession or with electrical rubbing machines rubbed with carborandum items 0 to 6 nos.in succession, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

Protection
Green work shall be protected from rain by suitable coverings. The work shall also be suitably protected from damage during construction.

Scaffolding
Double scaffolding having two sets of vertical supports shall be provided where necessary. The supports shall be sound and strong, tied together by horizontal pieces over which the scaffolding plank shall be fixed.

WALL LINING/VENEER WORK

Unless and otherwise specified in the nomenclature of the item, the marble slabs used for wall lining/veneer work shall be gang saw cut (polished & machine cut) and conform to dimensions given in Table 8.1 above.

Back shall not be polished/ cut in order to ensure a good grip with the hearting of backing. The cut slabs shall be of the thickness as specified with a tolerance permissible under para 8.2 above. The tolerance in wall lining when straight edge of 3 m length is placed should not be more than 2 mm.

Laying

The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips or under pinning of any sort. Care shall be taken to match the grains of veneer work. For purpose of matching the grains, the marble slabs shall be selected judiciously having uniform pattern of veins/streaks. Preferably the slabs shall be those got out of the same block from the quarry. The area to be veneered shall be reproduced on the ground and the marble slabs laid in position and arranged in the manner to give the desired matching of grains. Any adjustment needed for achieving the best results shall be then carried out by replacing or interchanging the particular slabs. Special care shall be taken to achieve the continuity of grains between the two slabs one above the other along the horizontal joints.

For the facing of the columns also the same procedure as mentioned above shall be followed.

Where so desired, the adjoining stones shall be secured to each other by means of copper pins 75 mm long and 6 mm diameter or as specified.

Marble/Granite Slab Urinal Partitions
The partitions shall be of marble/granite slab embedded in the wall. The size and shape of the marbles slab. The finished thickness shall be 18 mm. The specifications for marble/granite stone work, in general, shall be as specified. The marble granite stone shall be cut into slabs of required thickness and shall be one piece. (Fig. 8.4).

Finishing
The partition of the slab to be embedded in the masonry shall be rough dressed. Dressing and rubbing of the exposed portion of the slab shall be as described. The dressed slab shall be of the thickness as specified with a tolerance of $\pm$ 1.5mm.

Fixing
Shall be as specified except that the recess shall be 7.5 cm wide. Fixing shall be done by cutting chase with chase cutter/fine tools in a recess of 7.5 cm X 7.5 cm filled with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6mm nominal size). Fixing can also be done by epoxy grout in a chase of 2.0 X 7.5 cm.

OTHER SPECIFICATIONS:
For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 06 : WOOD WORK, P.V.C. WORK AND OTHER MISCELLEANIOS WORK

M.S. Tubular frames for doors Materials
Steel door frames shall be manufactured from commercial mild steel sheet of 1.60 mm thickness, conforming to IS 2062 and 4351. Steel door frames shall be made in the profiles as per drawings and/or as directed by the Engineer-in-charge.

Construction
Each door frame shall consist of hinge jamb, lock jamb, head and if required angle threshold. These shall be welded or rigidly fixed together by mechanical means. Where no angle threshold is required, temporary base tie shall be screwed to the feet of frames in order to form a rigid unit. Where so specified base ties shall be pressed mild steel 1.60 mm thick adjustable to suit floor thickness of 35 or 40 mm and removable, or alternatively, threshold of mild steel angle of section 50 x 25 mm, minimum shall be provided for external doors frames.

Fabrication
The M.S hollow rectangular steel door frames shall be got fabricated in an approved workshop as approved by the Chief Engineer.

Fixing Lugs :
There shall be three adjustable lugs with split end tail to each jamb. The head of the fixing lug shall be 120 mm long and made up flat steel strip 25 mm wide and 1.60 mm thick.

Hinges :
100 mm SS butt hinges shall be used. Floor door frames 80 cm wide and under, three hinges shall be rigidly fixed to one jamb and for frames of door above 80 cm wide, four higes shall be rigidly fixed to one jamb, if it is single shutter. Where the height of door shutter exceeds 2.15 metres, one additional hinge shall be provided for every 0.5 m or part thereof of the additional height.

In all cases the hinges shall be so fixed that the distance from the inside of the head rebate to the top of the upper hinge is 20 cm and the distance from the bottom of the door frame to the bottom of the bottom hinge is also kept about 200 mm. The middle hinges shall be at equal distance from lower and upper hinges or as agreed to between the purchaser and the supplier. Hinges shall be made of steel 2.5 mm thick with zinc coated removable pin of 6 mm diameter. The space between the two leaves of the hinge when closed shall be 3 mm and the leaf that is not welded to the frame shall have four counter sunk holes to take Number-10 cross recessed head wood screws.

Aldrops, Sliding Bolts and Tower Bolts : Provisions shall be made for aldrops, sliding bolts and tower bolts in the frames as per the positions given by the purchaser. Necessary mortar guards/metallic or nylon bushes shall be provided inside the frames for aldrops, sliding bolts and tower bolts.

Lock Strike Plate : Provision shall be made to fix lock stricke plates of mortise locks or latches, complying with the relevant Indian Standards. A slot suitable for lock stricke plate shall be pierced into the rebate of the frame and necessary fixing arrangement and mortar guard from the inside of the frame shall be provided.

Shock Absorbers : For side- hung door there shall be not less than three buffers of rubber

or other suitable material inserted in holes in the rebate and one shall be located at the centre of the lock jamb of frame and other two shall be 300 mm from top and bottom of the frame. For double leaf doors two buffers shall be provided.

Finishing
The surface of door frame shall be thoroughly cleaned, free of rust, mill –scale dirt, oil etc. either by mechanical means, for example sand or shot blasting or by chemical means such as picking. After pretreatment of the surface one coat of approved primer i.e. red oxide zinc chrome primer conforming to IS 2074. Two coats of paints as directed by the Engineer-in-Charge shall be applied to the exposed surface.

Fixing
Frames shall be fixed up right in plumb and plane. To avoid sag or bow in width during fixing or during construction phase, temporary struts across the width preventing sides bulging inwards may be provided. Wall shall be built solid on each side and grouted at each course to ensure solid contact with frame leaving no voids behind the frame. Three lugs shall be provided on each jamb with spacing not more than 75 cm the temporary struts
should not be removed till the masonry behind the frame is set. In case screwed base tie is provided, this should be left in position till the flooring is laid when it can be removed. After pretreatment of the surface one coat of steel primer and two coats, of paint, as directed by Engineer-in-charge shall be applied to the exposed surface.

Measurements
The length shall be measured in running metre correct to a cm. along the centre line of the frames.

Teak/Sal Wood Door Frame
Teak Wood (Tectona Grandis):- It is of outstanding merit in retention of shape and durability. The heart wood is one of the most naturally durable woods of the world. It usually remains immune to white ant attack and insect attack for very long periods. It is, however, not always immune from fungus attack (rot). Taken as a whole, good quality teak is very durable, it is relatively easy to saw and work. It can be furnished to a fare surface and takes polish well. It is generally used for making furniture and all important timber construction. ***Superior Class Teak Wood such as Balarsha, Malabar and Dandeli :*** Individual hard and sound knot shall not be more than 12 mm in diameter and the aggregate area of all the knots shall not exceed one half per cent of the area of the piece. It shall be close grained.

Sal is about 30 per cent heavier than teak, 50 per cent harder, and about 20 to 30 per cent stronger. In shock resistance it is about 45 per cent above teak. Its heart wood is a naturally durable wood, and usually remains immune to attack by white ants and fungi for a long period, while its sapwood is very perishable and should not be used. Well dried sal is not a really easy wood to saw and work. It is a rough constructional wood than a carpentary timber. No individual hard and sound knot shall exceed 25 mm in diameter and the aggregate area of all the knots shall not exceed 1% of the area of the piece.

It can be used for a variety of purposes, such as for beams, rafters, flooring, piles, bridging, tool handles, picker arms and tent pegs , Door Frames, etc.

FLUSH DOOR SHUTTERS
Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 35 mm. Thickness and type of shutters shall be as specified.

All four edges of the shutters shall be square. The shutter shall be free from twist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 per cent when tested according to IS 1708.

Core

The core of the flush door shutters shall be a block board having wooden strips held in a frame constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not be less than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the stiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be of one species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

Face Panel

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2 mm. The direction of the veneers adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS 1328.

Lipping

Lipping, where specified, shall be provided internally on all edges of the shutters. Lipping shall be done with battens of first class hardwood or as specified of depth not less than 25 mm. For double leaved shutters, depth of the lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10 mm. The rebating shall be either splayed or square type where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30 mm.

Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25 mm. Opening for glazing shall be provided where specified.

Venetian Opening

Where specified the height of the venetian opening shall be 350 mm from the

bottom of the shutter. The width of the opening shall be as directed but shall provide for a clear space of 75 mm between the edge of the door and venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

Tolerance

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shall be ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8 mm when measured at any two points.

Adhesive

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS 848.

Tests

Samples of flush door shutters shall be subjected to the following tests:

(a) End Immersion Test
(b) Knife Test
(c) Glue Adhesion Test

One end of each sample shutter shall be tested for End Immersion Test. Two specimens of 150 x 150 mm size shall be cut from the two corners at the other end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter.

TABLE-1
Dimensions and Tolerances of Components of Door Shutters

Sl. No.	Description	Width mm	Thickness mm DOOR SHUTTERS
(a)	Vertical Stile, top and freeze rail	100 ± 3	35 ± 1 or 40 ± 1
(b)	Lock rail	50 ± 3	35 ± 1 or 40 ± 1
(c)	Bottom rail	200 ± 3	35 ± 1 or 40 ± 1
(d)	Muntin	100 ± 3	35 ± 1 or 40 ± 1
(e)	Glazing bar	40 ± 3	35 ± 1 or 40 ± 1

Size and Types : Size and types of the timber panels and glazed shutters shall generally conform to modular sizes specified in Table-2 below.

TABLE-2
Dimension of Door Shutters

Sl. No.	Designation of Doors	Width mm	Height mm
(i)	8DS 20	700	1905 (1945)
(ii)	8DS 21	700	2005 (2045)
(iii)	9DS 20	800	1905 (1945)
(iv)	9DS 21	800	2005 (2045)
(v)	10 DS 20	900	1905 (1945)
(vi)	10 DS 21	900	2005 (2045)
(vii)	12 DT 20	11001)	1905 (1945)
(viii)	12 DT 21	11001)	2005 (2045)

Notes :-

(1) The designation refers to modular sizes of door openings. First number stands for width and the last for height in modules (M = 100 mm). Alphabet D refers to doors, 'S' to single and 'T' to double leaf shutter.

(2) Standard sizes of door frames are covered in IS 4021 and IS 4351.

(3) The standard widths and heights for panel doors are arrived at as shown in Fig. 6 of IS 1003 (Pt. 1).

In case the modular height is taken from the finished floor level, the height of the door shall be the one given in bracket. In the case of double leave shutters, the rebate in the shutter shall be as given in 6.15 of IS 1003 (Pt. 1).

Sample Size

Shutters of decorative and non-decorative type from each manufacturer, irrespective of their thickness, shall be grouped separately and each group shall constitute a lot. The number of shutters (sample size) to be selected at random from each lot for testing shall be as specified in below Table. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the
shutter provided the sample does not fail in any of the test specified.

For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of below Table.

TABLE
Sample Size and Criteria for Conformity

Lot Size	***Sample Size***	***Permissible no. of defective***	***Sub. Sample size***
[1]	**[2]**	**[3]**	**[4]**
Upto 26 to 50	8	0	1
51 – 100	13	1	2
101 – 150	20	1	2
151 – 300	32	1	3
301 – 500	50	2	4
501 and above	80	2	5

Iteria for Conformity
All the sample shutters when tested shall satisfy the requirements of the tests laid down as

specified. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of table above. If the number of sample shutters found unsatisfactory for a test IS one, twice the number of samples initially tested shall be selected and tested for the test. All sample shutters so tested shall satisfy the requirement of the test. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

Fixing
This shall be as per CPWD Specifications.

Shelves
Shelves and vertical partitions of cupboards shall be of timber planks fiber board, particle board, block board or veneered particle board as specified. Thickness and type of planks or boards shall be as specified. Each shelf shall be a single piece and vertical partitions between two consecutive shelves shall be without any joint. Exposed edges of boards having particle board core shall be sealed with 3 mm thick single piece teak wood strips of width equal to the thickness of board with headless pins. The arrangement of shelves and vertical partitions shall be as per drawings or as directed by the Engineer-in- Charge.

Fixing
Planks for shelves shall be planned on all faces and edges. In case of boards they shall be sawn to the required size truly straight and square. Timber battens 25 x 40 mm unless otherwise specified shall be planed smooth and fixed inside the cupboard with wooden plugs and screws. Shelves shall be fixed to the battens and vertical portions shall be held in position by fixing them to the battens and shelves using screws. Teakwood strips for edge sealing of the boards shall be planed smooth and fixed with headless nails. Tolerance in width shall be ± 1.5 mm and in thickness 1 mm.

Hold Fasts
These shall be made from mild steel flat 40 × 5 mm size conforming to IS 7196 without any burns or dents. 5 cm length of M.S. flat at one end shall be bent at right angle and one hole 11 mm dia shall be made in it for fixing to wooden frame with 10 mm dia nut bolt. The bolt head shall be sunk into the wooden frame, 10 mm deep and plugged with wooden plug. At the other end 10 cm length of the hold fast flat shall be forked and bent of length as specified at right angle in opposite direction and embedded in cement concrete block of size 30 x 10 x 15 cm of mix 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate, 20 mm nominal size) or as specified.

Fittings

Fitting shall be of SS, brass, aluminium or as specified. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be counter sunk to suit the head of specified wood screws. These shall be of the following types according to the material used.

(a) **Mild Steel Fittings:** These shall be bright finish black stone enameled or copper oxidized (black finish), nickel chromium plated or as specified.

(b) **Brass Fittings:** These shall be finished bright satin finish or nickel chromium plated or copper oxidized or as specified.

(c) **Aluminium Fittings:** These shall be anodized to natural matt finish or dyed anodic

coating not less than grade AC 10 of IS 1868.

(d) **Stainless Steel Fittings:** These shall be of SS grade 316.

The fittings generally used for different type of doors and windows are indicative and shall be used as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-In-Charge.

Screws used for fittings shall be of the same metal, and finish as the fittings. However, chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings.

Fittings shall be fixed in proper position as shown in the drawings or as directed by the Engineer-In-Charge. These shall be truly vertical or horizontal as the case may be. Screws shall be driven home with screw driver and not hammered in. Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

Butt Hinges

These shall be of the following types according to the material used.

a). Mild steel butt hinges (Medium).
b). Cast brass butt hinges light/ordinary or heavy.
c). Extruded aluminium alloy butt hinges.
d). Stainless steel Grade 316

Mild Steel (Medium): These shall be medium type manufactured from M.S. sheet. These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS 1341.

Hinge Pin: Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and riveted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

Knuckles: The number of knuckles in the hinges of different sizes shall be as per IS 1341. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.

Screw Holes*:* The screw holes shall be clean and counter sunk. These shall be suitable for counter sunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of the wood screws. The nos. of screw holes shall as specified in IS 1341.

Sampling and Criteria for Conformity*:* The number of butt hinges to be selected from a lot shall be depend on size of lot and shall be in accordance with Table below. Butt hinges for testing shall be selected at random from at least 10 per cent of the randomly selected packages subjected to minimum of three equal number of hinges being selected from each package. All butt hinges selected shall be checked for dimensions and tolerance requirements. Defects in manufacture and finish shall also be checked and lot shall be considered conforming to the requirement of this specification, if the number of defective hinges among those tested does not exceed the corresponding number given in Table.

TABLE
Scale of Sampling and Criteria for Conformity

Sl. No.	Lot size	Sample Size	Permissible No. of Defective hinges
1.	Upto 150 5 0	5	0
2.	151 to 300 20 1	20	1
3.	301 to 500 32 2	32	2
4.	501 to 1000 50 3	50	3
5.	1001 and above 80 5	80	5

Cast Brass*:* These shall be light/ordinary or heavy as specified. These shall be well made and shall be free from flaws and defects of all kinds. These shall be finished bright or chromium plated or oxidized or as specified. These shall generally conform to IS 205.

Hinge Pin: Hinge pin shall be made of brass or of stainless steel. The hinge pins shall be firmly riveted and shall be properly finished. The movement of the hinge pin shall be free, easy and square and shall not have any play or shake.

Knuckles: The number of knuckles in each hinge shall not be less than five. The number of knuckles in case of sizes less than 40 mm shall be three. The sides of the knuckles shall be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

Screw Holes*:* The screw holes shall be clean and counter sunk and of the specified size for different types and size of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

Extruded Aluminium Alloy*:* These shall be manufactured from extruded sections. These shall be well made and free from flaws and defects of all kinds. These shall generally conform to IS 205.

Hinge Pin: Hinge pin shall be made of mild steel (galvanized or aluminium alloy). The aluminium alloy hinge pin shall be anodized. The hinge pin shall be finally riveted and shall be properly finished. The movement of hinges shall be free easy and square and shall not have any play or shake.

Knuckles: Number of knuckles in each hinge pin shall not be less than 5. The number of knuckles in case of sizes less than 40 mm be straight and at right angle to the flap. The movement of the hinge pin shall be free and easy and working shall not have any play or shake.

Screw Holes*:* The screw holes shall be suitable for counter sunk head wood screws, and of specified sizes for different type of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of counter sunk head of wood screw specified.

Sampling and Criteria for Conformity*:* The number of butt hinges to be selected from a lot

shall depend on the size of lot and shall be in accordance with below Table. Butt hinges for testing shall be taken at random from at least 10 per cent of the package subject to a minimum of three, equal number of hinges being selected from each package. All butt hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table.

TABLE
Scale of Sampling and Criteria for Conformity

Sl. No.	***Lot size***	***Sample size***	***Permissible No. of defective hinges***
1	Upto 200	15	0
2	201 to 300	20	1
3	301 to 500	30	2
4	501 to 800	40	2
5	801 and above	55	3

Note: Any hinge which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge.

Parliament Hinges : These shall be of SS/ mild steel cast brass or as specified, and shall generally conform to IS 362. The size of parliament hinges shall be taken as the width between open flanges. Mild steel parliament hinges shall be copper oxidized (thick finish) or as specified. The brass parliament hinges shall be finished bright, chromium plated or oxidized or as specified.

The hinge pin shall be made of mild steel in the case of brass hinges. The hinge pin shall be mild steel (galvanized) in the case of aluminium alloy hinges. The hinge pin shall be firmly riveted and shall be properly finished. The movement of the hinges shall be free, easy and square, and shall not have any play or shake. All screw holes shall be clean and counter sunk to suit the counter sunk head of wood screws specified.

Sampling Criteria for and Conformity*:* The number of parliament hinges to be selected from a lot shall depend on the size of lot and shall be in accordance with Table below. Parliament hinges for testing shall be taken at random. All hinges selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirements of this specification if the number of defective hinges among those tested does not exceed the corresponding number given in Table below.

TABLE

Lot Size	***Sample Size***	***Permissible No. of Defective hinges***
Upto 150	13	0
151 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	80	5

Note: Any hinge which fails to satisfy the requirements of any one or more of the characteristics shall be considered as defective hinge.

Spring Hinges (Single or double acting)

These shall be single acting when the shutter is to open on one side only or double acting when the shutter opens on both sides. These shall be made of SS/ M.S. , brass or as specified, and shall generally conform to IS 453.

Hinges shall work smoothly and shall hold the door shutter truly vertical in closed position. Each double-acting spring hinge shall withstand the following tests which shall be carried out after fixing it to a swing door in the normal manner.

a). When the door is pushed through 90° and released 2000 times on each side in quick succession the hinge shall show no sign of damage or any appreciable deterioration of the components during or on completion of the test.

b). The door shall require a force of 2.0 ± 0.5 kg for 100 mm hinges and 3.0 ± 0.5 kg for 125 mm and 150 mm hinges at a distance of 45 cm from the hinge pin to move the door through 90º.

The size of spring hinge shall be taken as the length of the plate.

Mild Steel *:* The cylindrical casing shall be made either from M.S. sheet of 1.60 mm thickness, lap jointed and brazed, welded and riveted, or from solid drawn tube of thickness not less than 1.60 mm; or from mild sheet of 1.60 mm thickness pressed to from the two casing and the distance piece. It shall be stove enameled black or copper oxidized or as specified.

Cast Brass*:* The cylindrical casing shall be made either from brass sheet of 1.60 mm thickness, lap jointed and brazed, or from solid drawn brass tube of not less than 1.60 mm thickness. It shall be satin, bright nickel plated or copper oxidized or as specified.

Sampling: The number of spring hinges shall be selected from the lot and this number shall depend on the size of the lot and shall be in accordance with Table below.

TABLE

Lot size	Sample size	Permissible No. of defective spring hinges
Upto 100	13	0
101 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	80	5

Rising Hinges

These shall be made of brass, finished bright or chromium plated or oxidized or as specified. Its shape and pattern shall be approved by the Engineer-In-Charge. The size of the rising hinge shall be taken as the length of its plate.

Continuous Piano Hinges

These shall be made from Stainless steel / mild steel or aluminium alloy sheet, these shall generally conform to IS 3818. All screw holes shall be clean and counter sunk. Piano hinges shall be fixed in the entire length of the cupboard shutters. Its size will be the width of the two flaps when open.

M.S. Piano Hinges
These shall be made from 1 mm or 0.80 mm thick M.S. sheets and shall be protected with anti- corrosive treatment, such as bright polished, chromium plated or oxidized finish.

Hinge pin shall be of galvanized mild steel. It shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge, but shall not cause looseness.

The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy and working shall not have any play and shake.

Aluminium Piano Hinges*:* These shall be made of aluminium alloy sheet and shall be anodized or as specified. The anodic coating shall not be less than the grade AC 15 of IS 1868.

Hinge pin shall be made of aluminium alloy with anodic coating not less than the grade of AC-15 of IS 1868. The hinge pin shall fit in the knuckle firmly so as not to allow any play or shake and shall allow easy movement of hinge but shall not cause looseness.

The sides of the knuckles shall be straight and at right angles to the flap. The movement of the hinge shall be free and easy, and working shall not have any play and shake.

Sampling and Criteria for Conformity: It shall be same as specified in CPWD Specifications.

Tee Hinges
These shall be made from M.S. sheets and shall be either bright finished or stove enameled black or as specified. These shall generally conform to IS 206 (Tee hinges shall be well made, free from burrs, flaws, and defects of any kind. The movement shall be square, and the working shall be free and easy without any play or shake. The hole for the hinge shall be central to the bore and shall be square.

The hinge pin shall be firm and riveted over, so that the heads are well formed. All screw holes shall be clear and counter sunk and shall be suitable for the counter sunk head of wood screws.

Sampling and Criteria for Conformity*:* It shall be same as specified in clause

Sliding Door Bolts

These shall be of SS / mild steel, cast brass, aluminium or as specified, and shall be capable of smooth sliding action.

M.S. Sliding Door Bolts*:* These shall be made of M.S. sheets and M.S. rods and shall generally conform to IS 281. M.S. sliding door bolts shall be copper oxidized (black finish) or as specified.

Cast Brass Sliding Door Bolts: These shall be made from rolled brass and shall generally conform to IS 2681. The hasp shall be of cast brass and secured to the bolt. Alternatively, the hasp and the bolt may be cast in one piece. The fixing and staple bolts shall be cast with 6 mm studs. Bolts shall be finished to shape and have threaded ends and provided with robs washers and nuts of square or hexagon type. All components shall be finished smooth and

polished before assembly.

Cast brass sliding bolts shall be finished bright or chromium plated or oxidized or as specified.

Aluminium Sliding Door Bolts*:* These shall be made of aluminium alloy and shall generally conform to IS 2681. Aluminium sliding door bolts shall be anodized. All screw holes shall be counter sunk to suit the counter sunk head of screws of specified sizes. All edges and corners shall be finished smooth. In case of single leaf door, when iron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot be fixed, hole of suitable size shall be drilled in the door frame and an iron or brass plate cut to shape shall be fixed at the face of the hole. The leading dimensions of the sliding door bolts are illustrated.

Hydraulic Door Closer:- Providing and fixing aluminium extruded section body tubular type universal hydraulic door closer (having brand logo with ISi, IS : 3564, embossed on the body, door weight upto 36 Kg to 80 Kg and door width from 701 mm to 1000 mm), with double speed adjustment with necessary accessories and screws etc. complete.

Aluminium Sliding Door Bolts:- Providing and fixing aluminium sliding door bolts, ISI marked anodised (anodic coating not less than grade AC 10 as per IS : 1868), transparent or dyed to required colour or shade, with nuts and screws etc. complete : 250x16 mm or more as per engineer-in-charge

Aluminium Tower Bolts:- Providing and fixing aluminium tower bolts, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete : 250x10 mm or more as per engineer-in-charge

Aluminium Handles:- Providing and fixing aluminium handles, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete : 125 mm or more as per engineer-in-charge

Aluminium Hanging Floor Door Stopper:- Providing and fixing aluminium hanging floor door stopper, ISI marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour and shade, with necessary screws etc. complete. Twin rubber stopper

Sampling and Criteria for Conformity*:* The number of sliding door bolt to be selected from a lot shall depend on the size of lot and shall be in accordance with Table given below. For testing shall be taken at random from at least 10 percent of the package subject to a minimum of three, equal number of door bolts being selected from each package. All door bolts selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirement of this specification if the number of defects sliding door bolts among those tested does not exceed the corresponding number given in Table below.

TABLE

Lot. size	Sample size	Permissible speed Decorative sliding door bolts
Upto 150	5	0
151 to 300	20	1

301 to 500	32	2
501 to 1000	50	3
1001 and above	81	5

Tower Bolts

These shall generally conform to IS 204 (Part. I) & IS 204 (Part. II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head of wood screws. All sharp edges and corners shall be removed and finished smooth.

The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 meter.

Tower bolts shall be of the following types :-

a). Aluminium barrel tower bolts with barrel and bolt of extruded sections of aluminium alloy. The knob shall be properly screwed to the bolt and riveted at the back.

b). Brass tower bolts with cast brass barrel and rolled or cast brass bolt. Or

Brass tower bolts with barrel of extruded sections of brass and rolled or drawn brass bolt.

The knobs of brass tower bolts shall be cast and the bolt fixed with knob, steel spring and ball shall be provided between the bolt and the barrel.

c). Mild steel barrel tower bolts with mild steel barrel and mild steel bolt. or
Mild steel tower bolts with mild steel barrel and cast iron bolts.

d). Stainless steel barrel tower bolts with mild SS barrel and SS steel bolt. or
Stainless steel tower bolts with SS barrel and SS bolts of specified grades.

The plates and straps after assembly shall be firmly riveted or spot welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

Unless otherwise specified bolt shall have finish as given below :-

(a) Mild steel tower bolts (Types 1 and 2) Bolts bright finished or plated as specified and barrel and socket stove enameled black.

(b) Brass tower bolts (type 3 to 5) Bolt and barrel polished or plated as specified.

(c) Aluminium alloy tower bolts (type 6) Bolt and barrel anodized.

The anodic film may be either transparent or dyed as specified. The quality of anodized finish shall not be less than grade AC-10 of IS 1868.

Sampling and Criteria for Conformity*:* It shall be same as specified.

M.S. Locking Bolt with Holes for Pad Locks

This shall conform to IS 7534.

This shall be of mild steel polished bright or copper oxidized batch electro galvanized or stove enameled. In case of stove enameled locking bolts, the bolt may be finished bright.

Pull Bolt Locks
These shall be of M.S. cast brass or aluminium as specified. M.S. pull bolt locks shall be copper oxidized (black finish) or as specified.

Brass pull bolt locks shall be finished bright, chromium plated or oxidized as specified.
Aluminium pull bolt locks shall be anodized and the anodic coating shall not be less than grade. A.C. 10 of IS 1868. The bolt shall be 10 mm in diameter and the fixing plate 3 mm thick. The stop block shall be screwed to the fixing plate by a small ball and spring over which the bolt shall slide.

The fixing plate shall have four holes for fixing it to the door leaf, two of which shall be square to receive 6 mm dia. bolts with round heads, the remaining two shall receive machine screwed with lock nuts. The receiving plate shall be of the same width and thickness as the fixing plate and shall have 3 counter sunk holes.

Where the bolt slides into wooden members, like the chowkhat, which have a rebate, the receiving plate shall also be correspondingly shaped so as to fit into the rebate. The screws and bolts shall have the same finish as the main bolt. The leading dimensions of pull bolt locks are given in the drawing. The denominating size of the pull bolt locks shall be length of the fixing plate between guides plus the thickness of the guides.

Door Latch
This shall be of mild steel, cast brass, or as specified and shall be capable of smooth sliding action. In case, of mild steel latch, it shall be copper oxidized (black finish) or as specified and in case of brass, it shall be finished bright, chromium plated or oxidized or as specified. The size of door latch shall be taken as the length of the latch.

Indicating Bolt (Vacant/Engaged*)*
These shall be of SS, cast brass finished bright chromium plated, or oxidized or as specified. The shape and pattern shall be approved by the Engineer-In-Charge.

Mortice Lock and Latch
This should generally conform to IS 2209.

The size of the mortice lock shall be denoted by the length of the body towards the face and it shall be 65 mm, 75 mm and 100 mm as specified. The measured length shall not vary more than 3 mm from the length specified.

Non-interchangeable Keys*:* Testing of non-interchangeable keys shall be as per IS 2209.

The clear depth of the body shall not be more than 15 mm. The fore end shall be firmly fitted to the body suitably by counter sunk head screw. The latch bolt shall be of specified material and of section not less than 12 x 16 mm for all sizes of locks. If made of two piece construction both parts shall be riveted. Ordinary lever mechanism with not less than two levers shall be provided. False levers shall not be used. Lever shall be fitted with one spring of phosphor bronze or steel wire and shall withstand the tests as provided in IS 2209.

Locking bolts, spring and strike plate shall conform to IS 2209.

Handles: ***These shall conform to IS 4992.***

Keys: Each lock shall be provided with two keys.

Sampling, Criteria for Conformity*:* It shall be the same as specified.

Tests: The finally assembled locks shall be tested as prescribed.

Mortice Latch (with Locking Bolt)

These are generally used in doors of bath rooms, WC's and private rooms.

Mortice latch shall, in respect of shape, design and mechanism of the latch and its components parts, generally conform to IS 5930. The material used for the different component parts of the latch shall comply with Tables 1 and 2 of IS 5930, unless otherwise specified.

The size of the latch shall be denoted by the length of the body towards the face and shall be 65 mm, 75 mm or 100 mm as specified. The depth of the body shall not be more than 15 mm.

The latch shall be of size 10 × 18 mm of shape as shown in Fig. 1 of IS 5930. The locking bolt shall be of section not less than 8 x 25 mm for all size of locks. The mechanism of the latch bolt, its spring, striking plate etc. shall be as described in IS 5930. The handles provided shall conform to IS 4992.

Mortice Lock and Latch (Rebated)
These are slightly different from mortice lock described in 2.30.16.40 and are designed for use in double leaved doors. These should generally conform to IS 6607.

Handles, Keys, Sampling, Criteria for Conformity and Test*:* These shall be same as specified.

Mortice Night Latch

This is a mortice lock having a single spring bolt withdrawn from the outside by using the key and from inside by turning the knob and with an arrangement whereby the lock can be prevented from being opened by its key from outside while the night latch is used from inside the room.

This should generally conform to IS 3847.

It shall be cast or sheet brass, cast or sheet aluminium alloy or Mild steel as specified and of best quality of approved make. These shall be bright finished or copper oxidized (black) finish as specified. Nominal size of the latch shall be denoted by the length of the face over the body in millimeters. These shall have not less than two levers. False (Dummy) levers shall not be allowed.

Keys: Each latch shall be provided with two keys which should work smoothly and without any appreciable friction in the lock.

Cupboard or Wardrobe Lock

This should generally conform to IS 729. The size of the cupboard lock shall be 40, 50, 65 & 75 mm. This shall be made of cast brass and shall be of the best make of approved quality. These shall be finished bright or chromium plated or oxidized or as specified. The size of the lock shall be denoted by the length of the face across the body in mm.

These locks shall be fitted with four, five or six levers as specified. False (dummy) levers shall not be used.

Kicking Plates

This shall be of brass (finished bright or chromium plated or oxidized) bronze, stainless steel, aluminium or as specified. Aluminium kicking plates shall be anodized and the anodic coating shall not be less than grade AC-10 of IS 1868. It shall be made from a plate of minimum thickness 3.0 mm & 1.5 mm in case of stainless steel. Shape of the plate shall be as specified. This shall have beveled or straight edges and shall be fixed by means of counter sunk or rounded screws of the same material and finish as that of the plate. The shape and pattern shall be according to the drawings and as approved by the Engineer-In-Charge.

Door Handles (Doors and Windows)

These should generally conform to IS 208. The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handle shall be free from casting defects. Where the grip portion of the handle is joined with the base piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

Door handles shall be of the following types according to the material used:

a). **Cast or Sheet Aluminium Alloy Handles*:*** These shall be of aluminium of specified size, and of shape and pattern as approved by the Engineer-In-Charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size unless, otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6. Aluminium handles, shall be anodized and the anodic coating shall not be less than grade AC 15 – IS 1868 as specified. The finish can be bright natural, matt or satin or dyed as specified.

b). **Cast Brass Handles*:*** These shall be of cast brass of specified size and of the shape and pattern as approved by the Engineer-In-Charge. The size of the handle shall be determined by the inside grip of the handle. Door handles shall be of 100 mm size and window handles of 75 mm size, unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No 6. Brass handles shall be finished bright satin or nickel chromium plated or copper oxidized or as specified.

c). **Mild Steel Handles*:*** These shall be of mild steel sheet, pressed into oval section. The size of the handles will be determined by the inside grip of the handle. Door handles shall be 10 mm size and window handles of 75 mm size unless otherwise specified. These shall be fixed with 25 mm long wood screws of designation No. 6., Iron handles shall be copper oxidized (black finish) or stove enameled black or as specified.

Sampling and Criteria for Conformity*:* The number of handles to be selected from a lot shall depend on the size of lot and shall be in accordance with below Table. Handles for testing shall be selected at random for at least 10 percent of packages. Subject to a minimum 3, equal number of door handles being selected from each such package. All door

handles shall be checked for dimensional requirement and finish. Any door handle which fails to satisfy the requirement of dimensions or finish or both shall be considered as defective.

A lot shall be considered as conforming to requirement of this specification, if the number of defective handles among those tested does not exceed the corresponding number of defectives is greater than or equal to rejection number given in column 4 of Table below, the lot shall be deemed as not meeting the requirements of this specification.

TABLE
Scale of Sampling and Criteria for Conformity

Lot size	Sample size	Acceptance no.	Rejection no.
[1]	[2]	[3]	[4]
Upto 50	8	0	1
51 to 90	13	1	2
1 to 150	20	1	2
151 to 280	32	2	3
281 to 500	50	3	4
501 to 1200	80	5	6
1201 and above	125	7	8

Floor Door Stopper
The floor door stopper shall conform to IS 1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-In-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified.

The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four counter sunk holes for fixing the door stoppers to the floor by means of wood screws. The body for housing of the door stopper shall be cast in one piece and it shall be fixed to the cover plate by means of brass or mild steel screws and cover plate shall be of casting or of sheet metal. The spring shall be fixed firmly to the pin. Tongue which would be pressed while closing or opening of the door shall be connected to the lower part by means of copper pin. On the extreme end a rubber piece shall be attached to absorb shock. All parts of the door stopper shall be of good workmanship and finish, burrs and sharp edges removed. It shall be free from surface and casting defects. Aluminium stopper shall be anodized and anodic film shall not be less than grade AC-10 of IS 1868.

Sampling and Criteria for Conformity*:* The number of floor door stoppers to be selected from each lot shall depend on the size of the lot and shall be in accordance with col. 1 and 2 of Table below.

These stoppers shall be selected at random from at least 10 percent of the randomly selected packages subject to a maximum of three equal number of stoppers being selected from each such package.

All the floor stoppers selected shall be checked for dimensional requirement, material, manufacture and finish. Any of door stopper which fails to satisfy any one or more of these requirement shall be considered as defective door stopper.

A lot shall be considered as conforming to the requirements of this specifications if the number of defective floor door stoppers among these tested does not exceed the

corresponding number given in col. 3 of Table-A below. Otherwise it shall be considered as not conformity to the requirements of this specification.

TABLE-A
Scale of Sampling and Criteria for Conformity

Lot Size	Sample Size	Permissible number of defective floor Door stoppers
[1]	[2]	[3]
Upto 100	5	0
101 to 300	0	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	80	5

TABLE-B
Requirements for Rubber for Use in Floor Door Stoppers

Particulars	Requirements	Testing Procedure
Relative density Max.	1.3	IS 3400 (Part IX)
Hardness	60 + 5	IS 3400 (Part 2)
Ageing for 24 hours at 100°C ±	(a) Change in initial hardness (b) Shall not develop brittleness + 5, – 0	IS 3400 (Part II) -do-

Hanging Rubber Door Stopper

These shall be of cast brass, finished bright, chromium plated or as specified. Aluminium stopper shall be anodized and the anodic coating shall not be less than grade AC-10 of IS 1868. The size and pattern of the door stopper shall be approved by the Engineer-In-Charge. The size shall be determined by its length.

Universal Hydraulic Door Closer (Exposed Type)

These shall be made of cast iron/aluminium alloy/zinc alloy and of shape and pattern as approved by the Engineer-In-Charge. These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564. The door closers may be polished or painted and finished with lacquer to desired colour. Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS 3618. The nominal size of door closers in relation to the weight and the width of the door size to which it is intended to be fitted shall be given in Table-C below.

TABLE-C
Type and Designation of Door Closers

Designation of closers	Mass of the door (kg)	Width of the door(mm)	Remarks
1.	Upto 35	Upto 700	For light doors such as double leaved and toilet doors.

2.	36 to 60	701 to 850	Interior doors, such as of bed rooms, kitchen and store
3.	61 to 80	851 to 1000	Main doors in a building, such as entrance doors

Sampling and Criteria for Conformity*:* All the door closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shall depend upon the size of the lot. The sample shall be tested for construction, finish, dimensions, interchangeability of parts and performance in accordance of Table below. Any door closer failing in any one or more of these characteristics shall be considered as defective. If in the first sample, the number of defective door closer is less than or equal to corresponding acceptance number, the lot shall be declared as conforming to the requirement of these characteristics. If the number of defective door closer is greater than or equal to the rejection number, the acceptance number but less than the rejection number, lot shall be deemed as not meeting with requirements of these characteristics. If the number of defectives is greater than the acceptance number, but less than the rejection number, a second sample of the size equivalent to that of the first shall be taken to determine the conformity or otherwise of the lot. The number of defective door closers found in the first and the second sample shall be combined and if the combined number of defective thus obtained is less than or equal to the corresponding acceptance number, the lot shall be declared as conforming to the requirements of these characteristics.

Endurance Test- Two door closer in case of lot size 280 or less and five door closers in case of lot size more than 280 shall be selected from those already found satisfactory. These door closers shall be tested for the endurance test. If all the door closers tested for endurance test satisfy the requirement of this standard, the lot shall be deemed as having satisfied the requirements of endurance test, otherwise not.

TABLE

No. of door closers in the lot	Sample	Sample size	Cumulative sample size	Acceptance Number	Rejection Number
Upto 50	First Second	8 8	8 16	0 1	2 2
51 to 90	First Second	13 13	13 26	0 1	2 2
91 to 150	First Second	20 20	20 40	0 3	3 4
151 to 280	First Second	32 32	32 64	1 4	4 5
281 to 500	First Second	50 50	50 100	2 6	5 7
501 to 1200	First Second	80 80	80 160	3 8	7 9
1201 to 3200	First Second	125 125	125 250	5 12	9 13
3201 and above	First Second	200 200	200 400	7 18	11 19

Performance Requirements *:* After being fitted in its position when the door is opened through 90°, the same should swing back to angle of 20° ± 5° with nominal speed but thereafter, the speed should get automatically retarded and in case of doors with latches, it should be so regulated that in its final position the door smoothly negotiates with the latch.

Panelling: The panel inserts shall be either framed into the grooves or housed in the rebate of stiles and rails. Timber, plywood, and particle board panels as given under sub head and shall be fixed only with grooves. The depth of the groove shall be 12 mm and its width shall accommodate the panel inserts such that the faces are closely fitted to the sides of the groove. Panel inserts shall be framed into the grooves of stiles and rails to the full depth of the groove leaving space of 1.5 mm. Width and depth of the rebate shall be equal to half the thickness of stiles and rails. Glass panels, asbestos panels wire gauze panels and panel inserts of cupboard shutters shall be housed in the rebates of stiles and rails.

Timber Panels*:* Timber panels shall be preferably made of timber of large width; the minimum width and thickness of the panel shall be 100 mm, and 15 mm respectively. When made from more than one piece, the pieces shall be jointed with a continuous tongued and grooved joint glued together and reinforced with headless nails at regular intervals not exceeding 100 mm. Depth and thickness of such joint shall be equal to one-third of thickness of panel. The panels shall be designed such that no single panel exceeds 0.5 square metre in area. The grains of timber panels shall run along the longer dimensions of the panels. All panels shall be of the same species of timber unless otherwise specified.

Plywood Panels: Plywood boards used for panelling of shutters shall be BWP type or grade as specified. Each panels shall be a single piece of thickness, 9 mm for two or more panel construction and 12 mm thickness for single panel construction unless otherwise specified.

Veneered Particle Board Panels: Veneered Particle board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive as specified. Each panel shall be a single piece of thickness 12 mm unless otherwise specified.

Fiber Board Panels*:* Fiber board used for panelling of shutters shall be Exterior Grade bonded with BWP type synthetic resin adhesive, each fiber board panel shall be a single piece unless otherwise specified.

Wire Gauze Panels: Wire Gauze used for panelling of shutters shall be woven with 0.63 mm dia galvanized mild steel wire to form average aperture size of 1.40 mm as specified. Wire gauze shall be securely housed into the rebates of stiles and rails by giving right angles bend turned back and fixed by means of suitable staples at intervals of 75 mm and over this wooden beading shall be fixed. The space between the rebate and the beading shall be fixed with putty to give a neat finish. Each wire gauze panel shall be a single piece, and the panels shall be so designed that no single panels exceeds 0.5 sqm in area. However, care shall be taken to prevent sagging of wire gauge, of panel by providing and fixing 20 x 20 mm square or equivalent beading to the external face to the required patterns as decided by the Engineer-In-Charge.

Glass Panels: Glass panelling (Glazing) shall be done as specified. Glazing in the shutters of doors, windows and ventilators of bath, WC and Lavatories shall be provided with frosted glass the weight of which shall be not less than 10 kg/sqm. Frosted glass panes shall be fixed with frosted face on the inside. Glass panels shall be fixed by providing a thin layer of putty conforming to IS 419 applied between glass pane and all along the length of the rebate and also between glass panes and wooden beading.

Putty can be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil to the mixture to form a stiff paste and adding varnish to the paste at the rate of 1 liter of varnish to 18 kg of paste. Fixing of glass panes without beading shall not be permitted. Glazing shall be done after the shutters have been primed and prepared for painting, so that wood may not draw oil out of putty.

Glazed Shutters for doors

Providing and fixing panelled or panelled and glazed shutters for doors, windows and clerestory windows, fixing with butt hinges of required size with necessary screws, excluding panelling which will be paid for separately, all complete as per direction of Engineer-in-charge. (Note: Butt hinges and necessary screws shall be paid separately) Second class teak wood, 35 mm thick shutters

DECORATIVE HIGH PRESSURE LAMINATED SHEET

Providing & Fixing decorative high pressure laminated sheet of plain / wood grain in gloss / matt/ suede finish with high density protective surface layer and reverse side of adhesive bonding quality conforming to IS : 2046 Type S, including cost of adhesive of approved quality. 1.0 mm thick.

WPC (WOOD POLYMER COMPOSITE) FRAME

Providing and fixing factory made single extruded WPC (Wood Polymer Composite) solid door/window/Ceosetory windows & other Frames/Chowkhat comprising of virgin PVC polymer of K value 58- 60 (Suspension Grade), calcium carbonate and natural fibers (wood powder/ rice husk/wheat husk) and non toxic additives (maximum toxicity index of 12 for 100 gms) fabricated with miter joints after applying PVC solvent cement and screwed with full body threaded star headed SS screws having minimum frame density of 750 kg/ cum, screw withdrawal strength of 2200 N (Face) & 1100 N (Edge), minimum compressive strength of 58 N/mm2, modulus of elasticity 900 N/mm2 and resistance to spread of flame of Class A category with property of being termite/borer proof, water/moisture proof and fire retardant and fixed in position with M.S hold fast/lugs/SS dash fasteners of required dia and length complete as per direction of Engineer-In- Charge. (M.S hold fast/lugs or SS dash fasteners shall be paid for separately).Note: For WPC solid door/window frames, minus 5mm tolerance in dimensions i.e depth and width of profile shall be acceptable. Variation in profile dimensions on plus side shall be acceptable but no extra payment on this account shall be made. Frame size 50 x 100 mm or more as per drawings & engineer-incharge

WPC (WOOD POLYMER COMPOSITE) SOLID PLAIN FLUSH DOOR SHUTTER

Providing and fixing factory made single extruded WPC (Wood Polymer Composite) solid plain flush door shutter of required size comprising of virgin polymer of K value 58-60 (Suspension Grade), calcium carbonate and natural fibers (wood powder/ rice husk/wheat husk) and non toxic additives (maximum toxicity index of 12 for 100 gms) having minimum density of 650 kg/cum and screw withdrawal strength of 1800 N (Face) & 900 N (Edge), minimum compressive strength 50 N/mm2, modulus of elasticity 850 N/mm2 and resistance to spread of flame of Class A category with property of being termite/ borer proof, water/moisture proof and fire retardant and fixing with stainless steel butt hinges of required size with necessary full body threaded star headed counter sunk S.S screws, all as per direction of Engineer-In- Charge. (Note: stainless steel butt hinges and necessary S.S screws shall be paid separately) 30 mm thick or more as per drawings & engineer-incharge

UPVC- DOOR FRAMES

Material

Polyvinyl chloride Resin suspension grade is the basic raw material for forming PVC compound. PVC resin then is mixed with chemicals like Calcium, Stearate,

Hydrocarbon Wax, Titanium Dioxide, Calcium Carbonate, Acrylic processing aids. Further, additives like impact modifiers, pigments, epoxy plasticizer, UV stabilizer, lubricants, chemical blowing agent etc. are added. The purpose of adding the chemicals and additives is to impart cellular structure, strength, surface finish, colour and resistance to fading by light rays. These chemicals are mixed in the desired proportion and shall be used in the formulation of PVC material and for free and smooth extrusion of PVC profiles.

Providing and fixing factory made uPVC glazed/wire mesh windows/ doors comprising of lead free uPVC multi chambered frame, sash and mullion/coupler (where ever required) extruded profiles having minimum wall thickness of 1.70 mm for Series R1 and R2 profiles and 2.10 mm for Series R3 and R4 profiles conforming to EN: 12608 in any shape, colour and design duly reinforced with galvanized mild steel section made of required shape & size as per CPWD Specification, uPVC extruded glazing beads, interlocks and lnline sash adaptor (whereever required) of appropriate dimension, EPDM gasket, hardware, SS 304 grade fasteners of minimum 8 mm dia with countersunk head, comprising of matching polyamide PA6 grade sleeve for fixing frame to finished wall as per IS 1367 : Part 1 to 14, plastic packers, plastic caps and necessary stainless steel screws etc. Profile of frame, sash & mullion (if required) shall be mitred cut and fusion welded/mechanically jointed duly sealed at all comers, including drilling of holes for fixing hardware and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of approved size and quality, all complete as per approved drawing conforming to CPWD specification & direction of Engineer-in-Charge. Section of steel reinforcement and cross sections of uPVC profiles to be as per design approved by Engineer-in-Charge. Wire mesh I Glazing of plain/ toughened/laminated/ double glass unit with I without high performance coatings as per design requirements and conforming to IS: 3548 & IS: 16231 shall be paid separately. Note:- Structural design proof checked from a Government
Engineering Institute, to be provided by the manufacturer for :

(i) Sites with basic wind speed > 45 m/sec as per IS 875 - Part 3
(ii) Sites with structure height more than 20m for all wind speeds.

a) Three track three panels sliding window with two glazed & one wire mesh panels with Aluminium channel for roller track, wool pile, nylon rollers with SS 304 body. Using R3 series with frame (98 mm & above) x (40 mm & above) & both glazed and fly screen sash (30 mm & above) x (55 mm & above with zinc alloy (zamak) powder coated handle on every glazed panel along with multi-point locking system. (Height upto 1.8m).
b) Fixed window I ventilator with mullion I transom. Using R1 series with frame (33 mm & above) x (35 mm & above) & mullion (33 mm & above) x (50 mm & above). {Height upto 0.90 metre)
c) Fixed window I ventilator with mullion I transom. Using R3 series with frame (55 mm & above) x (45 mm & above) & mullion (55 mm & above) x (65 mm & above). (Height upto 2.5 metre)
d) Casement cum fixed panel window having one single casement panel & one fixed panel with S.S 304 friction hinges as per size and weight of sash, multi-point locking system, zinc alloy (zamak) powder coated handle. ing R3 series with frame (55 mm & above) x (45 mm & above) & sash (55 mm & above) x (65 mm & above) & mullion (55 mm & above) x (65 mm & above). (Height upto 1.8 metre; each openable shutter upto 0.8m width)
e) Casement door single panel with zinc alloy (zamak) 3D hinges, multi-point locking system with cylinder, zinc alloy (zamak) powder coated handles on both sides.

Using R3 series with frame (55 mm & above) x (50 mm & above) & sash (55 mm & above) x (85 mm & above) (Height upto 2.5 metre).

UPVC Door Frame

UPVC door frame shall be made of PVC material conforming to IS 10151. The door frame shall be made from extruded UPVC section having overall dimensions of 48 x 40 mm or 42 x 50 mm having wall thickness of 2.0 mm ± 0.2 mm. Corners of the door frame to be jointed by M.S. galvanized brackets. Joints mitred and plastic welded. The hinge side vertical outer frames shall be reinforced by galvanized M.S. Tube of size 19 x 19 mm of wall thickness 1 mm ± 0.1 mm and a tie rod shall be provided at the bottom of the frame. The frame shall be fabricated in factory

Fixing of Frames

The frames are to be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are to be fitted, a 50 mm strip should be left untiled at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall be fitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor. The third anchor bolt shall be fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

PVC DOOR SHUTTERS

The shutters shall be fabricated at factory. Shutter shall be made of PVC material conforming to IS 10151.

UPVC Window

Providing and fixing factory made uPVC white colour casement/casement cum fixed glazed windows comprising of uPVC multi-chambered frame, sash and mullion (where ever required) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), uPVC extruded glazing beads of appropriate dimension, EPDM gasket, stainless steel (SS 304 grade) friction hinges, zinc alloy (white powder coated) casement handles, G.I fasteners 100 x 8 mm size for fixing frame to finished wall, plastic packers, plastic caps and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, mullion (if required) shall be also fusion welded including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of required size and of approved quality, all complete

Casement window double panels with top fixed with S.S. friction hinges (350 x 19 x 1.9 mm) made of (small series) frame 47 x 50 mm, sash 47 x 68 mm & mullion 47 x 68 mm all having wall thickness of 1.9 ± 0.2 mm and single glazing bead of appropriate dimension.

Casement window single panel with S.S. friction hinges (400 x 19 x 1.9 mm) made of (big series)frame 67 x 60 mm & sash 67 x 80 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of appropriate dimension. (Casement window double panels with S.S. friction hinges (350 x 19 x 1.9 mm) made of (big series)frame 67 x

60 mm & sash / mullion 67 x 80 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead/ double glazing bead of appropriate dimension.

Casement cum fixed panel window having both end single casement panel, middle fixed panels and at top completely fixed ventilator with S.S friction hinges (350 x 19 x 1.9) made of (big series) frame 67 x 60 mm , sash 67 x 80 mm & mullion 67 x 80 mm all having wall thickness of 2.3 ± 0.2 mm and single glazing bead/double glazing bead of appropriate dimension.

Providing and fixing factory made uPVC white colour casement/ Casement cum fixed glazed door comprising of uPVC multi-chambered frame, sash and mullion (where ever required) extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), uPVC extruded glazing beads of appropriate dimension, EPDM gasket, zinc alloy (white powder coated) 3D hinges and one handle on each side of panels along with zinc plated mild steel multi point locking having transmission gear, cylinder with keeps and one side key, G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws, etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, mullion (if required) shall be also fusion welded including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete. (Single / double glass panes and silicon sealent shall be paid separately).

Casement door with top hung ventilator with 3D and S.S. friction hinges (400 x 19 x 1.9 mm) made of (big series) frame 67 x 64 mm, sash 67 x 110 mm & mullion 67 x 80 mm all having wall thickness of 2.3 ±. 0.2 mm and single glazing bead / double glazing bead of appropriate dimension.(Area of door upto 2.50 sqm)

Providing and fixing factory made uPVC white colour sliding glazed door comprising of uPVC multi-chambered frame with in-built roller track and sash extruded profiles duly reinforced with 1.60 ± 0.2 mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), appropriate dimension uPVC extruded glazing beads, uPVC extruded interlock and uPVC extruded Inline sash adaptor (if required), EPDM gasket, wool pile, zinc alloy (white powder coated) handle with key on one side of extreme panels along with zinc plated mild steel multi point locking having transmission gear with keeps, zinc alloy (white powder coated) cresent lock (if required), stainless steel (SS 304 grade) body with adjustable double nylon rollers (weight bearing capacity to be 120 kg), G.I fasteners 100 x 8 mm size for fixing frame to finished wall and necessary stainless steel screws etc. Profile of frame & sash shall be mitred cut and fusion welded at all corners, including drilling of holes for fixing hardware's and drainage of water etc. After fixing frame the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealent over backer rod of required size and of approved quality, all complete.

Two track two panels sliding door made of (big series) frame 67 x 50 mm & sash 46 x 82 mm both having wall thickness of 2.3 ± 0.2 mm and single glazing bead / double glazing bead of

appropriate dimension.

FIRE RESISTANT DOOR FRAME SHUTTER AND GLAZING

A:-Providing and fixing fire resistant door frame of section 50 x 60 mm on horizontal side & 35 x 60 mm on vertical sides having built in rebate made out of 1.6 mm thick GI sheet (Zinc coating not less than 120gm/m^2) suitable for mounting 120 min Fire Rated Glazed Door Shutters. The frame shall be filled with Mineral wool Insulation having density min 96Kg/m^3 . The frame will have a provision of G.I. Anchor fastners 14 nos (5 Each on vertical style & 4 on horizontal style of size M10 x 80) suitable for fixing in the opening along with Factory made Template for SS Ball Bearing Hinges of Size 100x89x3mm for fixing of fire rated glazed shutter . The frame shall be finished with a approved fire resistant primer or Powder coating of not less than 30 micron in desired shade .

Providing and fixing 60 mm thick glazed fire resistant door shutters of 120 min Fire Rating confirming to IS:3614 (Part II) or EN1634-1:1999, tested and certified as per laboratory approved by Engineer-in-charge, with suitable mounting on door frame, consisting of vertical styles, top rail & side rail 60 mm x 60 mm wide and bottom rail of 110 mm x 60 mm made out of 1.6mm thick G.I. sheet (zinc coating not less than 120gm/m^2) duly filled mineral wool insulation having density min 96 Kg/m^3 and fixing with necessary stainless steel ball bearing hinges of size 100x89x3mm of approved make, including applying a coat of approved fire resistant primer or powder coating not less than 30 micron etc all complete .

Providing and fixing glazing in fire resistant door shutters, fixed panels & partitions etc., with G.I. beading made out of 1.6 mm thick G.I. sheet (zinc coating not less than 120 gm/m^2) of size 20 x 33 mm screwed with M4 x 38 mm SS screws at distance 75 mm from the edges and 150 mm c/c , including applying a coat of approved fire resistant primer/ powder coating of not less than 30 micron on G.I. beading, & special ceramic tape of 5 x 20 mm size etc complete in all respect as per NBC 2016, IS 16231 (Part 3):2016 and as per direction of Engineer-incharge with glass of required thickness having 120 minutes of fire resistance both integrity & radiation control (EW120) and minimum 20 minutes of insulation (EI20). The manufacturer have to give test report/certification of fire glass and the glass should have the stamp showing the value of E, EW & EI. The glass shall be tested in approved NABL accredited lab or by any other accreditation body which operates in accordance with ISO/IEC 17011 and accredits labs as per ISO/IEC 17025 for testing and calibration scopes shall be eligible. The maximum glazing size shall not be more than 1100x2200 mm (w x h) or 2.42 sqm.

b:-Providing and fixing factory made ISI marked partially insulated metal fire rated doorset assembly, for staircase / exit pathway and refuge areas applications, consisting of galvanized iron steel frame and double leaf shutter including necessary hardware accessories, conforming to FD 120 PI classification of IS 3614:2021 with fire rating of 120 minutes integrity and 30 minutes insulation. The door frame and shutter shall be made out of minimum 1.20 mm thick GI Sheet with minimum 120 GSM Zinc coating as per IS: 277. The entire fire rated doorset assembly shall be tested as per IS 17518 (Part -1): 2022

Frame:

The frame shall be of minimum size 90 x 60 mm with grooved profile to take appropriate fire

rated smoke seal, having mitred cut joint (self tab/screwed assembled at site) and provided with appropriate reinforcement suitable for taking hardware and flush fixing as per IS 4351. The smoke seal material shall be of EPDM or any other material tested in accordane with BS 476 (Part-22) ASTM E-84 of minimum size 10 x 4mm, fixed within the inbuilt groove or stuck with adhesive on the entire perimeter of the frame. The door frame shall be fixed to the three sides to masonary wall opening with CSK headed fastner of minimum 8 mm dia size and minimum 80mm long hot dip galvanized with 8mm dia Polyamide sleeves 5 number at each on vertical sides and 3 number on top side.

Door shutter:

The double skinned double leaf partially insulated door shutters shall be consisting of minimum 50 mm thickness and having box like structure, slots cut and holes punched, for fixing of hardwares with stiffners as per IS: 16074 including resin bonded mineral wool/ceremic wool infill material of minimum density 96 kg/cum. Each door leaf shall be provided with vision panel, having maximum area of 0.06 sqm, of 120 minute fire rated minimum 6 mm thick clear borosilicate glass pane fixed with clip-on arrangement and fire rated ceramic tape having minimum size 13x2 mm to be fixed all around the glass on both the sides. The intumescent seal of minimum size 15x1.5 mm or of size as per test evidence shall be fixed on all the three edges of the door leaves. Integral astragals to be provided for double leaf door on the meeting style each on active and inactive leaf. The door shutters shall be mounted on the frame with SS 304 grade ball bearing hinges as per EN 1935: 2002 or butt hinges as per IS 12817, of minimum size 100x75x3 mm 5 numbers hinges upto 2400mm height or as per test evidence, whichever is more. fixed with M6 25 screws. All doors shall be factory prepared for receiving appropriate hardware and provided with necessary reinforcement for hardware accessories.

Accessories Hardware:

Fire doorset assembly shall be provided with one number of single point panic push bar (cross bar) for active leaf and one number double point panic push bar (cross bar) of desired finish with verticle shoot bolts on top and bottom for inacitvie leaf of double leaf door as per EN 1125, one number external trim with half cylinder 42 mm long with one side key as per EN 1125, two number heavy duty door closers of size 3-5 with standard arm with of desired finish (suitable for 1250 mm wide door leaf) conforming to IS 3564/EN 1154, and one number surface mounted door coordinator with integral shock absorber.

Finishing:

Both frame and door shutters shall be factory finished with polyester powder coating of minimum 50 microns thick and shall have passed salt spray test as per IS: 13871 of approved colour and shade all complete as per manufacturer's specifications and as per direction of the Engineer-in-charge.

Installation: The hollow space in the door frame shall be filled with fire rated self extinguishing type polyurethane foam (PUF) after installation at site of work. The rate shall be inclusive of complete door assembly, supply and installation by the approved manufacturer. Double leaf partially Insulated metal fire rated doorset of FD 120 PI classification with 120 minutes integrity and 30 minutes insulation as per IS 3614:2021 for Staircase/ Exit pathway / Refuge area etc

C:- Providing and fixing factory made ISI marked un-insulated metal fire rated doorset assembly for all egress areas like utility rooms and service areas consisting of galvanized iron steel frame and double leaf shutter including necessary hardware accessories, conforming to FD 120 classification of IS 3614:2021 with fire rating of 120 minutes integrity. The door frame and shutter shall be made out of minimum 1.20 mm thick GI Sheet with minimum 120 GSM Zinc coating as per 15: 277. The entire fire rated doorset assembly shall be tested as per IS 17518 (Part-1): 2022.

Frame:

The frame shall be of minimum size 90 x 60 mm with grooved profile to take appropriate fire rated smoke seal, having mitred cut joints (self tab/screwed assembled at site) and provided with appropriate reinforcement suitable for taking hardware and flush fixing as per IS: 4351. The smoke seal material shall be of EPDM or any other material tested in accordance with BS 476 (Part-22)/ASTM E-84 of minimum size 10x4 mm, fixed within the inbuilt groove or stuck with adhesive on the entire perimeter of the frame. The door frame shall be fixed in all three sides to masonry wall opening with CSK headed fasteners of minimum 8 mm dia size and minimum 80 mm long hot dip galvanized with 8mm dia polyamide sleeves 5 numbers at each on vertical side and 3 numbers on top side.

Door shutter:

The double skin double leaf door shutter shall be consisting of minimum 46 mm thick and having box like structure, slots cut and holes punched for fixing of hardware with stiffener as per IS 16074 including Resin bonded honey comb paper core infill material of density 5 kg/cum. Each door leaf shall be provided with vision panel, having maximum area of 0.12 sqm, of 120 minute fire rated minimum 6 mm thick clear borosilicate glass pane fixed with clip-on arrangement and fire rated ceramic tape having minimum size 13x2mm to be fixed all around the glass on both the sides. Integral astragals to be provided for double leaf doors on the meeting style each on active and inactive leaf. The door shutters shall be mounted on the frame with SS 304 grade ball bearing hinges as per EN 1935: 2002 or butt hinges as per IS 12817 both, of minimum size 100x75x3 mm 5 numbers hinges per door leaf upto 2400 mm height or as per test evidence, which ever is more, fixed with M6 25 screws. All doors shall be factory prepared for receiving appropriate hardware and provided with necessary reinforcement for hardware accessories.

Hardware Accessories:

Fire doorset shall provided with one number fire rated SS 304 grade Mortise dead lock, 50-80 mm Back Set, minimum 20 mm Square forend with allen key Escutcheon of Stainless Steel, and 65/70 mm cylinder with both side key conforming to EN12209/IS: 3614:2021, two pair of D type Pull handle of SS 304 grade of minimum 22 mm dia Centre to centre distance of 300 mm back to back fixing with spindle, one number 300 mm long Concealed lever action flush bolt (Dye-Cast Stainless Steel Finish) at bottom with SS dust proof socket and one number 600 mm long Concealed lever action flush bolt (Dye-Cast Stainless Steel Finish) on top of inactive leaf of double door. Two number fire rated surface mounted heavy duty door closer of size 2-4 with standard arm, of desired finish conforming to IS 3564/EN 1154.

Finishing:

Both frame and door shutters shall be factory finished with polyester powder coating of minimum 50 microns thick and shall have passed salt spray test as per IS:13871 of approved colour and shade all complete as per manufacturer's specifications and as per direction of the Engineer-in-charge

Installation: The hollow space in the door frame shall be filled with fire rated self extinguishing type polyurethane foam (PUF) after installation at site of work. The rate shall be inclusive of complete door assembly, supply and installation by the approved manufacturer.

Double leaf un-insulated metal fire rated doorset of FD 120 classification with 120 minutes integrity only as per IS 3614:2021-For egress application like utility and service area.

Test

The door shutters shall be subjected to the following tests in accordance with IS 4020 (Part 1 to 16).

(a) *Dimension and Squareness Test :* Door shutters when tested in accordance with IS 4020 (Part 2) the dimensions of nominal width and height will be within a limit of ± 5 mm. The door shutter shall not deviate by more than 1 mm on a length of 500 mm. The thickness of the door shutter shall be uniform throughout with the permissible variation of not more than 0.8 mm between any two points. The nominal thickness of the shutter shall be within a limit of ± 1.5 mm.

(b) *General Flatness Test :* Door shutter, when tested in accordance with IS 4020 (Part 3) the twist, cupping and warping shall not exceed 6 mm.

(c) *Local Planeness Test :* Door shutters, when tested in accordance with IS 4020 (Part 4), the depth of deviation measured at any point shall not be more than 0.5 mm.

(d) *Impact Indentation Test :* Door shutters, when tested in accordance with IS 4020 (Part 5), shall have no defects such as cracking, tearing or delamination and the depth of indentation shall not be more than 0.2 mm.

(e) *Edge Loading Test :* Door shutters, when tested in accordance with IS 4020 (Part 7) the deflection of the edge at the maximum load shall not be more than 5 mm. On removal of the loads, the residual deflection shall not be more than 0.5 mm, failing which the test may be repeated on the other edge in the reverse direction. Also there shall be no lateral buckling by more than 2 mm during loaded condition and no residual lateral buckling after removal of the load.

(f) *Shock Resistance Test :* Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 8) , there shall be no visible damage in any part of the door after twenty five blows on each end.

(g) *Buckling Test :* Door shutters, when tested in accordance with IS 4020 (Part 9), shall not show any deterioration and any residual deformation more than 5 mm

after 15 min. of unloading and the initial deflection also shall not be more than 50 mm.

(h) *Slamming Test :* Door shutters, when tested in accordance with 2.1 of IS 4020 (Part 10), shall not have any damage in any part of the door at the end of successive impacts.

Door shutters, when tested in accordance with 3.1 of IS 4020 (Part 10), shall not have any visible damage in part of the door at the end of 100 successive impacts.

(i) *Misuse Test :* Door shutters, when tested in accordance with IS 4020 (Part 11), there shall not be any permanent deformation of the fixing or any other part of the door set in hindering its normal working after the test.

(j) *Screw Holding Test :* Door shutters, when tested in accordance with IS 4020-Part 16, the load shall not be less than 1000 N.

(k) *End Immersion Test :* Door shutters, when tested in accordance with IS 4020- Part 13, the shutter shall not show any delamination.

(l) *Knife Test :* Door shutter, when tested in accordance with IS 4020 – Part 14, the grading shall be standard & excellent.

(m) *Glue Adhesion Test :* Door shutters shall be tested in accordance with IS 4020 – Part 15. There should be no delamination.

Fixing of Shutters

PVC door shutter shall be side hung on three bolt hinges of size 100 mm, one at the centre and the other two at 200 mm from the top and bottom of the shutter. The flat of the hinges shall be neatly counter sunk in to the recesses cut out to the exact dimensions of the hinge flap. The door shall be drilled on the thickness to fit hinges. Screws for fixing the hinges shall be screwed in with screwdrivers and not hammered. The length of the screws should be 8 mm/30 mm. The hinges used should be of stainless steel.

Tolerance

The tolerance on the width and the height of the door shall be $\pm$ 5 mm and the tolerance on the nominal thickness of the door shall be $\pm$ 2 mm.

Fittings

Fittings shall be provided as per schedule of fittings. In moisture prone areas M.S. fittings and screws should not be used. Hardware such as handles, tower bolt, stopper, buffer etc. should be directly screwed (not pre-drilled) and fitted on the door.

PVC DOOR FRAME

Solid PVC door frame and shutter

Solid PVC Door Frames consisting of section 50 x 47 mm shall be fabricated from 5 mm PVC sheet having density of 600 kg./cum. The sheet used may be in plain colour, printed design or prelam veneer shade as approved by the Engineer-in-Charge. The weight per running metre of the door frame including reinforcement should be a minimum of 1.5 kg./sq. mtr. The depth of the rebate of door frame shall be 10 mm. Frames shall have smooth surface, without any warping or bending in any member. All the parts of the door

frame are to be joined to each other using solvent adhesive conforming to IS 14182. A tolerance of ± 3 mm shall be permitted in the specified dimension of PVC section in the door frames.

The solid PVC door frames shall be fabricated in factory as per nomenclature of the item and directions of the Engineer-in-charge.

PANEL PVC DOOR SHUTTER

Panel PVC Shutters are factory made shutter and shall be brought to site fully assembled. The Solid Panel PVC Door shall be fabricated from 5 mm PVC sheet. The sheets used may be in plain colour, printed design or prelam veneer shade. The shutters shall be fabricated at factory as per nomenclature of the item and directions of the Engineer-in-charge.

30 mm thick panel PVC door shutters

Fixing of Shutters
In addition, it may be ensured that while fixing hinges the screws pass through the two opposites surfaces of the M.S. reinforcement.

WIRE GAUZE FLY PROOF SHUTTERS

Specified timber shall be used, and it shall be sawn in the direction of the grains. Sawing shall be truly straight and square. The timber shall be planed smooth and accurate to the full dimensions, rebates, roundings and mouldings, before assembly. Patching or plugging of any kind shall not be permitted except as provided.

Stile and Rails
The Specifications shall be as described. The stiles and rails shall be given a rebate to receive the wire gauze which shall form the panels.

Wire Gauze
This shall be unless specified otherwise conform. The wire gauze shall be bent at right angles in the rebates of stiles and rails, turned back and fixed tight with blue tacks at about 75 mm centres, fixed alternately in the two faces of the rebates. Over this, wooden beading shall be fixed with brads or small screws at about 75 mm centres.

The space between the beading and rebates, where the wire gauze is bent, shall be neatly finished with putty, so that the end of the wire gauze may not be visible.

6MM THICK HIGH PERFORMANCE TOUGHENED GLASS
Providing and fixing 6mm thick High Performance Toughened Glass having properties of visible Light transmittance (VLT) 28%, ER 27%, IR 10 %, Solar Heat Gain Coefficient (SHGC) 0.30 and U-value 3.7 W/m2 degree-K etc. The performance values declared should be tested by third party as well. The thickness/ combination of the glass can vary as per the architects/consultants' suggestions after checking structural stability of the finalized glass panel.

Fixing Fittings, Wooden cleats, blocks and Measurement shall be as specified.

ROLLING SHUTTERS
Supplying and fixing rolling shutters of approved make, made of required size M.S. laths,

interlocked together through their entire length and jointed together at the end by end locks, mounted on specially designed pipe shaft with brackets, side guides and arrangements for inside and outside locking with push and pull operation complete, including the cost of providing and fixing necessary 27.5 em long wire springs manufactured from high tensile steel wire of adequate strength conforming to IS: 4454 - part 1 and M.S. top cover of required thickness for rolling shutters. Providing and fixing ball bearing for rolling shutters.

Rolling shutters shall conform to IS 6248. These shall include necessary locking arrangement and handles etc. These shall be suitable for fixing in the position as specified i.e. outside or inside on or below lintel or between jambs of the opening. The door shall be either push and pull type or operated with mechanical device supplied by the firm. Shutters upto 10 sq. metre shall be of push and pull type and shutters with an area of over 10 sq. metre shall generally be provided with reduction gear operated by mechanical device with chain or handle, if bearings are specified for each of operation, these shall be paid for separately.

Shutter : The shutter be built up of inter locking lath section formed from cold rolled steel strips.

The thickness of the sheets from which the lath sections have been rolled shall be not less than 0.90 mm for the shutters upto 3.5 m width. Shutters above 9 metres width should be divided in 2 parts with provision of one middle fixed or movable guide channel or supported from the back side to resist wind pressure. The lath section shall be rolled so as to have interlocking curls at both edges and a deep corrugation at the centre with a bridge depth of not less than 12 mm to provide sufficient curtain of stiffness for resisting manual pressures and normal wind pressure. Each lath section shall be continuous single piece without any welded joint. When interlocked, the lath sections shall have a distance of 75 mm rolling centers.

Each alternate lath section shall be fitted with malleable cast iron or mild steel clips securely riveted at either

ends, thus locking in the lath section at both ends preventing lateral movement of the individual lath

sections. The clips shall be so designed as to fit the contour of the lath sections.

Spring : The spring shall be of coiled type. The spring shall be manufactured from high tensile spring steel wire or strips of adequate strength conforming to IS 4454- Part I .

Roller and Brackets : The suspension shaft of the roller shall be made of steel pipe conforming to heavy duty as per IS 1161. For shutter upto 6 metre width and height not exceeding 5 metre, steel pipes of 50 mm nominal bore shall be used. The shaft shall be supported on mild steel brackets of size 375 x 375 x 3.15 mm for shutters upto a clear height of 3.5 metre. The size of mild steel brackets shall be 500 x 500 x 10 mm for shutters of clear height above 3.5 m and upto 6.5 m. The suspension shaft clamped to the brackets shall be fitted with rotatable cast iron pulleys to which the shutter is attached. The pulleys and pipe shaft shall connected by means of pretensioned helical springs to counter balance the weight of the shutter and to keep the shutter in equilibrium in any partly open position.

When the width of the opening is greater than 3.5 mtr. The cast iron pulleys shall be interconnected with a cage formed out of mild steel flats of at least 32 x 6 mm and mild steel dummy rings made of similar flats to distribute the torque uniformly. Self aligning two row ball bearing with special cast iron casings shall be provided at the extreme pulley and caging

rings shall have a minimum spacing of 15mm and at least 4 number flats running throughout length of roller shall be provided.

In case of shutters of large opening with mechanical device for opening the shutter the roller shall be fitted with a purion wheel at one end which in contact with a worm fitted to the bracket plate, caging and pulley with two ball bearing shall be provided.

Guide Channel : The width of guide channel shall be 25 mm the minimum depth of guide channels shall be as follows:

Clear width of shutters Depth of guide channel
Upto 3.5 m 65 mm
3.5 m upto 8 m 75 mm
8 m and above 100 mm

The gap between the two legs of the guide channels shall be sufficient to allow the free movement of the shutter and at the same time close enough to prevent rattling of the shutter due to wind.

Each guide channel shall be provided with a minimum of three fixing cleats or supports for attachment to the wall or column by means of bolts or screws. The spacing of cleats shall not exceed 0.75 m. Alternatively, the guide channels may also be provided with suitable dowels, hooks or pins for embedding in the walls.

The guide channels shall be attached to the jambs, plumb and true either in the overlapping fashion or embedded in grooves, depending on the method of fixing.

Cover : Top cover shall be of mild steel sheets not less than 0.90 mm thick and stiffened with angle or flat stiffeners at top and bottom edges to retain shape.

Lock plates with sliding bolts, handles and anchoring rods shall be as per IS 6248.

Fixing
The arrangement for fixing in different situations in the opening shall be as per IS 6248.

Brackets shall be fixed on the lintel or under the lintel as specified with rawl. Plugs and screws bolts etc. The shaft along with the spring shall then be fixed on the brackets.

The lath portion (shutter) shall be laid on ground and the side guide channels shall be bound with ropes etc. The shutter shall then be placed in position and top fixed with pipe shaft with bolts and nuts. The side guide channels and cover frames shall then be fixed to the walls through the plate welded to the guides. These plates and bracket shall be fixed by means of steel screws bolts, and rawl plugs concealed in plaster to make their location invisible. Fixing shall be done accurately in a workmen like manner that the operation of the shutter is easy and smooth.

Measurements
Clear width and clear height of the opening for rolling shutter shall be measured correct to a mm.

The clear distance between the two jambs of the opening shall be clear width and the clear distance between the sill and the soffit (bottom of lintel) of the opening shall be the clear height. The area shall be calculated in square metres correct to two places of decimal.

ROLLING GRILLS - SHUTTERS

Rolling grill shutter is meant to provide visibility or ventilation or both, the degree of protection and safety is less as compared to a rolling shutter. The situations where a certain amount of ventilation combined with safety is required rolling shutter-cum-grill may be provided in which the rolling shutter may have a rolling grill portion either at the top or at the bottom or at both places. In addition, the rolling grill portion may also be provided in the middle of the shutter. The total height of the grill portion in all the segments of rolling shutter-cum-grill shall not exceed 1.0 m and the height of the grill portion in any individual segment shall not be more than 0.5 m.

Rolling grills shutters are similar in design, construction and operation to rolling shutters and all the provisions of Para 10.8 shall be applicable to rolling grills shuters except in respect of the shutterportion, and shall conform to IS 6248.

Shutters

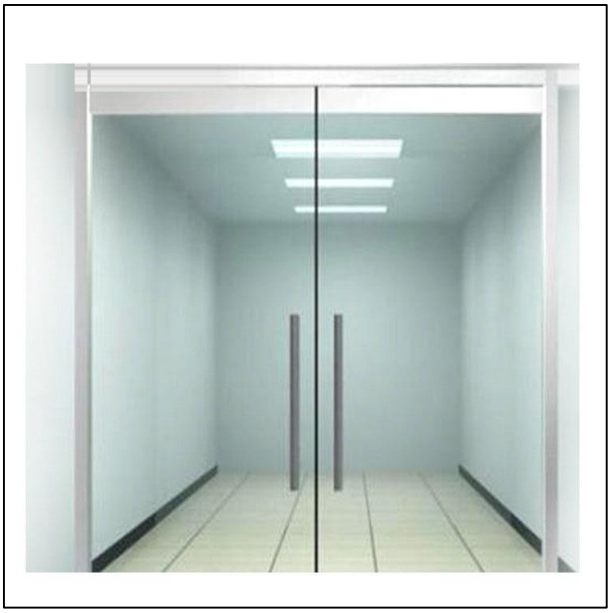
Rolling grill shutter and the rolling grill portion of the rolling shutter-cum-grill shall be fabricated with 8 mm diameter mild steel round bars. Straight bars and bars bent to the required profile are placed alternatively and held in position with 20 mm wide and 5 mm thick mild steel flat links. Straight bars shall be spaced not exceeding 150 mm centre to centre and the bars bent to required profile shall be placed symmetrically between two consecutive straight bars. Unless otherwise specified or directed by the Engineer-in-charge, bars placed alternatively with straight bars shall be bent to form a corrugated profile such that the pitch of the corrugation is 100 to 120 mm and the depth of corrugation is 80 to 100 mm. all the bent bars shall have uniform profile. Straight bar along with the adjoining bent bars on it both sides shall be held in position by passing the bars through holes in the links. Each link shall have three holes and the length of the links shall be such that the distance from the centre of the hole to the nearest edge of the flat is not less than the diameter of the hole. The corner of the links shall be rounded. All links shall be of uniform size and shape. The spacing of the links measured along the straight bar shall be the same as centre to centre distance between two consecutive crests/ troughs of the bars bent to the required profile. Each bar and link shall be continuous single piece without any joint.

Measurement & Rate

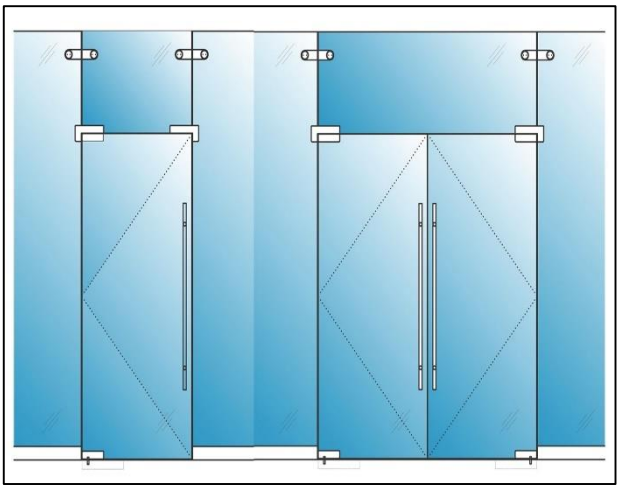
The measurement and rate shall be as specified in 10.8.3 and 10.8.4 respectively. In case of Rolling Shutter-cum-Grill, where the area of the grill portion is half or less than half the area of opening, it shall be measured and paid as rolling shutter and where the area of grill portion is more than half the area of opening, it shall be measured and paid as rolling grill.

Frameless Glass Doors

12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & double action hydraulic floor spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of Engineer-in charge including all fittings Door handle, lock and stopper etc. complete.



Frameless Glass Door



OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 07: STEEL WORK

STEEL WORK IN SINGLE SECTION FIXED INDEPENDENTLY WITH CONNECTING PLATE

The steel work in single section of R.S. joists, flats, Tees Angles fixed independently with or without connecting plate, is described in these clauses.

Fabrication
The steel sections as specified shall be straightened and cut square to correct lengths and measured with a steel tape. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of member.

All straightening and shaping to form, shall be done by pressure. Bending or cutting shall be carried out in such a manner as not to impair the strength of the metal.

Painting
All surfaces which are to be painted, oiled or otherwise treated shall be dry and thoroughly cleaned to remove all loose scale and loose rust. Surfaces not in contact but inaccessible after shop assembly, shall receive the full specified protective treatment before assembly. This does not apply to the interior of sealed hollow sections. Part to be encased in concrete shall not be painted or oiled. A priming coat of approved steel primer such as Red Oxide/Zinc Chromate primer conforming to IS 2074 shall be applied before any member of steel structure are placed in position or taken out of workshop.

Erection
Steel work shall be hoisted and placed in position carefully without any damage to itself and other building work and injury to workmen. Where necessary mechanical appliances such as lifting tackle winch etc. shall be used. The suitability and capacity of all plant and equipment used for erection shall be upto the satisfaction.

STEEL WORK IN BUILT UP SECTIONS (RIVETED AND BOLTED)

The steel work in built up section (Riveted and bolted) such as trusses, framed work etc. is specified in this clause.

Laying Out
A figure of the steel structure to be fabricated shall be drawn on a level platform to full scale. This may be done in full or in parts. Steel tape shall be used for measurements.

Fabrication
Fabrication shall generally be done as specified in IS 800. In major works or where so specified, shop drawings giving complete information for the fabrication of the component parts of the structure including the location, type, size, length and details or rivets, bolts or welds, shall be prepared in advance of the actual fabrication. The drawings shall indicate the shop and field rivets, bolts and welds. The steel members shall be distinctly marked or stenciled with paint with the identification marks as given.

Great accuracy shall be observed in the fabrication of various members, so that these can be assembled without being unduly packed, strained or forced into position and when built up, shall be true and free from twist, kinks, buckles or open joints.

Wooden or metal sheet templates shall be made to correspond to each member, and position of rivet holes shall be marked accurately on them and holes drilled. The templates shall then be laid on the steel members, and holes for riveting and bolting marked on them. The ends of the steel members shall also be marked for cutting as per required dimensions. The base of steel columns and the positions of anchor bolts shall be carefully set out at the required location.

The steel section shall be straight or to be straightened or flattened by pressure unless required to be of curvilinear form and shall free from twists. These shall be cut square either by shearing or sawing to correct length and measured by steel tape. No tow pieces shall be welded or joined to make up for the required length of member.

ELECTRODES

Electrodes shall be best heavy coated type and shall be in accordance with IS:814 - "Specification for Covered Electrodes for Metal Arc Welding of Mild Steel".

FABRICATION:

Shop Drawings:

The contractor shall prepare, wherever necessary, detailed shop drawings giving complete information necessary for the fabrication of the structures. All information shall be clearly given and the drawings shall be in conformity with the best modern practice. A marking diagram allotting distinct identification marks to each separate piece of steel work shall be prepared in sufficient detail to ensure convenient assembly and erection. Symbols for welding, used in the drawings, shall be in accordance with IS:813 "scheme of symbols for welding". The contractor shall prepare comprehensive bill of materials sheets for each shop drawing giving therein all the items shown on the drawing together with their weights, mark numbers, cutting lengths etc. Three copies of all working drawings and bill of material sheets shall be submitted for the approval of the Consultant.

Fabrication shall not commence until the approval of the relevant drawings has been obtained from the Consultant. While the shop drawings prepared by the Contractor and approved by the Consultant, are deemed to be done, the Contractor is not relieved of responsibility for accuracy of detailed dimensions shown thereon.

Templates

All fabrication shall be in accordance with IS: 800 "Code of Practice for use of Structural Steel in General Building Construction" and IS:1915 "Code of Practice for Steel Fridges". Extensive use of templates shall be made. The templates shall be steel bushed where considered necessary by the Consultant. In case actual members are used as templates for drilling similar pieces, it will be at the discretion of the Consultant to decide whether such pieces are fit to be incorporated in the finished structure. The Contractor shall arrange for corresponding parts of each unit manufactured from the same drawings to be inter-changeable, as far as economic manufacturing conditions permit, and shall seek approval of the Consultant, of the precise agreements made in this respect.

Straightening

All material shall be straight and, if necessary shall be straightened and/or flattened by pressure, unless required to be of curvilinear form and shall be free from twists. Heating of rolled sections and plates for purposes of straightening will not be permitted. Limited

straightening may, however, be effected by local applications of heat with a gas torch.

Cutting

Gas cutting shall preferably be done by machine. Gas cut edges shall be free of gauges; any gauges that remain after cutting shall be removed by grinding. Gas cutting shall, normally, only be permitted for mild steel. Gas cutting of high tensile steel may also be permitted, provided special care is taken to leave sufficient metal to be removed by machining so that all metal that has been hardened by flame is removed. Hand flame cutting may only be permitted. Rolled sections shall be sheared or cropped to size. Sawing, shearing and cropping shall be clean and free from any distortion; if necessary, the edges shall be ground afterwards.

Holing

Where punching is permitted, the hole shall be punched 3mm less in diameter than the required size and reamed after assembly to the full size. In any case, the thickness of material punched shall not be greater than 16mm.

Holes through more than one thickness of material or members, such as compound stanchions and girder flanges shall be drilled after the members are assembled and tightly clamped or bolted together. They shall be separated and the burrs removed.

Holes for bolts shall not be more than 1.5mm/2.0mm (as the case may be depending upon whether the diameter of bolt is less than or more than 25mm) larger in diameter than the nominal diameter of bolt. Holes for bolts shall in no event be formed by gas cutting.

Assembly

All steel work, which is bolted together shall be in close contact over the whole surface. Drifting done during assembly shall not distort the metal or enlarge the holes. Holes that must be enlarged due to mismatching shall be reamed. Poor matching of holes shall be cause for rejection. The component parts shall be assembled in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified cambers, if any, are provided.

Bolting

All bolts shall be provided with washers under the nuts and the washers shall be tapered on the insides of the flanges of R.S. Joists and channels. Bolts and studs shall project not less than one full thread through the nut after tightening. Unless otherwise specified, the ends of the bolts shall be burred after erection to prevent the removal of the nuts.

WELDING

Welding, where called for on the drawing shall be metal are welding conforming to IS:816-1969.

Unless otherwise specified, all welds shall be 6mm, single fillet welds.

The welding shall be carried out by workmen skilled in the trade. The Contractor shall employ a certified welding to ensure that the standard of workmanship shall comply with the best practices of the trade.

Preparation of Surfaces: Surfaces which are to be welded shall be free from loose mill scale, rust, paint, grease, gas cutting burns or any other foreign matter.

Workmanship: Welds shall be made in the flat position wherever practicable.

Are length, voltage and amperage shall be suited to the type of electrode and nature of work.

Before commencing welding the various members shall first be brought together and firmly held in position by spot welds at specified distance. The spot welds shall be strong enough to hold the parts accurately in place without any disturbance. Freedom of movement of one member of the joint shall be allowed wherever possible.

The sequence of welding shall be such that where possible the members which offer the greatest resistance to compression are welded first.

The electrode manipulation during welding shall ensure:

1. The base metal is in a fused state when filler metal makes contact with it.

2. The filler metal does not overflow upon any unused base metal.

3. The base metal is not under-cut along the weld edges.

4. The welds shall be free from cracks, discontinuity and other defects such as under size, under cutting and over-cutting etc.

The welding of the joint shall be so arranged that the resulting tensile and compressive stresses produced by each portion of the weld tend to balance each other.

The step back method of welding shall be adopted for continuous runs. Fusion faces shall be cut by shearing, chipping, machining or machine gas cutting. Hand cutting by gas may be permitted under special circumstances, provided the cutter shall be adequately guided so that the cut edge is clean and uniform. If the fusion face is rough it shall be dressed by chipping, filing or grinding to an approved finish.

All slag shall be removed from each run before a subsequent run is superimposed. When cold the final run shall be protected with clean boiled linseed oil and shall not be painted

All exposed welds shall be ground smooth. All welds which have not been ground shall be scrubbed with a 10% solution of hydrochloric acid which shall be washed off with water before painting is applied. All welds shall be subject to the inspection. The welded joints shall be tested by the Dye Penetration or other methods to detect any inherent defect in welding. Any defects noticed as a result of above test shall be rectified including replacement of the components/members which might get damaged in the process of tests.

SHOP ERECTION

Steel work shall be temporarily shop erected completely, so that the accuracy of fit may be checked before dispatch. The parts shall be assembled with a sufficient number of parallel drifts to bring and keep the components in place. In the case of parts drilled or punched through steel jigs with holes resulting in similar parts being interchangeable for portions of the steel work, trial assembly shall be carried out to the extent required by IS:1915.

MATCH-MARKING

All erection marks shall be die-stamped and also distinctly stenciled in paint. The marking shall be as per the marking diagram.

DESPATCH OF MATERIALS

The Contractor shall deliver the fabricated steel work to place of erection as far as possible, in the same sequence as that of erection. Dispatches should be scheduled to avoid cluttering up of the site. The bolts required for erection shall be bagged according to size prior to dispatch.

ERECTION

Erection drawings

The Contractor shall prepare comprehensive erection drawings for the structural steel work. The drawings should be made in sufficient details to ensure convenient assembly and speedy and proper erection at site. The drawings should indicate, in detail, the sequence of erection that is proposed to be followed and the method being adopted

Plant and Equipment

The suitability and capacity of all plant and equipment used for erection

Stacking and Handling

The Contractor shall ensure that steel work is not damaged due to careless or haphazard stacking. All structural steel work should be so stored and handled at the site that the members are not subject to excessive stresses. The steel work shall be stacked at site in such a manner that it shall be free from dirt.

Stacking shall, as far as practicable, be done in the sequence of erection but heavy members shall not be stacked on top of light ones. Arrangements shall always be made at the time of handling; the damaged piece will be rejected

Method of Erection

All structural steel work shall be erected in accordance with IS:800 and IS:1915.

The steel work shall be erected true and plumb and temporary bracing or staging shall be introduced wherever necessary, to ensure that the structure is not overstressed and to take care of all erection loads. attachment of such temporary steel work to the permanent steel work shall only be done . Temporary steel work, like bracing and staging, shall remain in position until the structure is stable and self-supporting and all the joints making the structure stable and self-supporting are permanently bolted. After removal of temporary steel work the permanent structure shall be made good, to the complete. No riveting, permanent bolting or welding shall be done until proper alignment has been obtained. Erection of the parts with any moderate amount of reaming, chipping or cutting. The steel work shall be rejected

Erection Tolerances

Unless otherwise specified, the underside of base plates of steel members shall be within plus or minus 3mm from the elevations shown on the drawings. The lateral deviations of the base plates shall not exceed 5mm from the theoretical centre line.

Alignment of individual beams, girders, etc. shall not deviate more than plus minus 5mm

PAINTING

Painting i.e. the preparation of surfaces, phosphating, application of primer and finishing coats and other details shall be carried out in accordance with the requirements laid down under “Painting”.

Shop Painting

The structural steel work shall be thoroughly cleaned, phosphated and painted with one coat of red oxide primer in the fabrication shop. Where two surfaces are to be in permanent contact after assembly and fabrication, each surface shall be thoroughly cleaned, phosphated and painted with one coat of red oxide primer.

Final Painting

Where called for, three coats of enamel paint of approved shade shall be applied to all steel work after erection. Particular care shall be taken to clean, wire brush, spot prime welded and other areas where priming coat has been marred during the course of erection before application of final painting.

OTHER SPECIFICATIONS:
For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

LIST OF MANDATORY TESTS

Material	Clause	Test	Field/ laboratory test	Test procedure	Min. quantity of material for carrying out the test	Frequency of testing
1	2	3	4	5	6	7
Steel if arranged by the contractor	10.1.1	(a) Tensile strength (b) Bend test	Laboratory	IS 1599	20 tonne	Every 20 tonne or part thereof.
Steel tubular pipes	10.13	(a) Tensile Test (b) Bend Test (c) Flattening Test	Laboratory	IS 1608 IS 2329 IS 2328	Every 8 tonne or part thereof	Every 8 tonne or part thereof

LIST OF BUREAU OF INDIAN STANDARDS CODES

Sl. No.	Code No.	Subject
1	IS 63	Whiting for paints and putty
2	IS 198	Varnish gold size

Sl. No.	Code No.	Subject
3	IS 228	Structural steel (Standard quality)
4	IS 277	Specification for galvanized steel sheets (Plain and corrugated)
5	IS 800	Code of practice for use of structural steel in general in steel construction
6	IS 806	Code of practice for use of steel Tubes in general building construction
7.	IS 808	Dimensions for Hot rolled steel beams, columns, channel and angle sections
8.	IS 812	Glossary of terms relating to welding and cutting metals
9.	IS 813	Scheme of symbols for welding
10	IS 814	Covered electrodes for manual metal arc welding of carbon and carbon manganese steel
11	IS 816	Code of practice for use of metal arc welding for general construction in mild steel
12	IS 817	Code of practice for training and testing of metal arc welders
13	IS 818	Code of practice for safety and healthy requirements in electric and gas welding and cutting operations
14	IS 822	Code of procedure for inspection of welds
15	IS 823	Manual for metal arc welding in mild steel
16	IS 1038	Steel doors, windows and ventilators
17	IS 1081	Code of practice for fixing and glazing of metal (Steel and aluminium) doors, windows and ventilators
18	IS 1148	Hot rolled steel rivet bars (upto 40 mm diameters) for structural purposes
19	IS 1161	Steel tubes for structural purposes
20	IS 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates
21	IS 1200- (Pt. VIII)	Method of measurements of steel work and iron works
22	IS 1363 Part I	Haxagon head bolts, screws, and nuts of product grade C (Hexagon Head bolt)
23	IS 1363 Part II	Haxagon Head Bolts, screws and nuts of product Grade ‘C’
24	IS 1363 Part-III	Haxagan Head Bolts, screws and Nuts of product grade ‘C’
25	IS 1367	Technical supply conditions for threaded steel fasteners
26	IS 1599	Method for bend test
27	IS 1608	Metallic materials – Tensile Testing at Ambient Temperature.
28	IS 1821	Dimensions for clearance holes for bolts and screws
29	IS 1852	Rolling and cutting tolerance for hot rolled steel products
30	IS 1894	Method for tensile testing of steel tubes
31	IS 1977	Structural steel (ordinary quality)
32	IS 2062	Hot Rolled low, medium and high tensile structural steel
33	IS 2074	Ready mixed paint, air drying redoxide zinc chrome priming
34	IS 4351	Specification for steel door frames
35	IS 4454 (Part I)	Steel wires for mechanical springs. Cold drawn unalloyed steel wire.
36	IS 4711	Methods for sampling of steel pipes, tube and fittings.
37	IS 4736	Hot – dip zinc coating on mild steel tubes
38	IS 4923	Hollow Steel Sections for Structural Use - Specification
39	IS 6248	Metal rolling shutters and rolling grills
40	IS 7452	Specification for hot rolled steel sections for doors, windows

Sl. No.	Code No.	Subject
		and ventilators.

STAINLESS STEEL KITCHEN SINK

Stainless steel kitchen sink shall be of sizes as specified and shall be conforming to IS 13983. The kitchen sink shall be of one piece construction with or without rim but without overflow.

They shall be Stainless steel of best quality and shall be supported on necessary brackets. Each sink shall be provided with waste coupling, waste pipe, wall flanges, connection pipe, angle valve, long nose bibcock etc. including all the fixing materials.

STAINLESS STEEL RAILINGS AND STAINLESS STEEL SHUTTER WITH STAINLESS STEEL JALI FABRICATION

a) The scope of the work includes preparation of the shop drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing and Stainless Steel shutter with stainless steel Jali till completion and handing over of the work.

b) The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-In-Charge.

c) The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing and Stainless Steel shutter with stainless steel Jali with detailing of M.S. stiffener frame work backing along with the fixing details of the M.S. frame work to the R.C.C columns or frame. The details of the joints in the stainless steel work including location, etc. shall also be shown in the shop drawings.

d) The Contractor shall procure and submit to the Engineer-In-Charge, samples of various materials for the railing work and jali Shutter with its fixtures, for approval. After approval of samples, the Contractor shall prepare a mock up for approval of Engineer-In-Charge. The material shall be procured and the mass work taken up only after the approval of the mock up by the Engineer-In-Charge. The mock-up shall be dismantled and removed by the contractor as per the directions of the Engineer-in-Charge.

e) The stainless steel shall be of grade 316 with brushed steel satin finish and procured from the approved manufacturer. It shall be without any dents, waviness, scratches, stains etc.

f) The required joints in the S. S Work shall be provided as per the architectural drawings, shall be welded in a workmanlike manner including grinding, polishing, buffing etc. all complete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade.

g) One test (three specimens) for each lot shall be conducted for the stainless steel pipe in the approved laboratory. Therefore, the material shall preferably be

procured in one lot from one manufacturer.

h) The finished surface shall be free of any defects like dents, waviness, scratches, stains etc. and shall have uniform brushed steel satin finish.

Any defective work shall be rejected and redone by the Contractor. The finished surface shall therefore be protected using protective tape which shall be removed at the time of completion of the work. The surface shall then be suitably cleaned using nonabrasive approved cleaner for the material.

i) The item includes all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc. including providing and fixing M.S. frames), T & P other incidental items, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

j) The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc. The Jali shutter shall be fixed in position using stainless steel rectangular pipes of required thickness and size and SS Jali as shown in the drawing, including hinges, latching and locking arrangements, and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

k) The item includes all inputs of labour, materials, T&P, other incidental items, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-In-Charge.

Providing and fixing stainless steel (Grade 304) railing made of Hollow tubes, channels, plates etc., including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts complete, i/c fixing the railing with necessary accessories & stainless steel dash fasteners , stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-charge, (for payment purpose only weight of stainless steel members shall be considered excluding fixing accessories such as nuts, bolts, fasteners etc.).

SS GLASS RAILING

Designing, Supplying, fabricating, installing & erection of Railing in position including S.S Handrail fabricated out of heavy duty Stainless Steel (Grade-304) extruded profiles as shown in drawing including all necessary accessory & arrangement, bending to profile as per drawing, welding. grinding, polishing in desired finish, cutting holes in RCC/Stone work, grouting the balustrades in position, fastners, all necessary fixing arrangement & all incidentals etc. complete as per drawing including providing & fixing 8.89mm thick Laminated taughened glass (4mm+0.89mm Sentry Glass+4mm) of approved make fixed to railing including necessary fittings, making holes in glass, all suitable EPDM gasket, all necssary accessory & arrangement complete as per details in drawing. (Note: The contractor shall submit shop drawings & sample of all profiles to the Project Manager/ Architect for approval before commencement of Work.) Galvanizing the MS base plate of balustrade & providing and fixing of MS packing of 80X32X3mm, 80X32X5mm and 80X32X10mm wherever required for leveling the plinth & providing and fixing of Sika top 122 HS compound to fill properly in between base-plate & plinth as per approved drawings.

M.S. WORK

M.S. RAILING

Steel work welded in built up sections/framed worK including cutting hoisting, rixing in position and applying a priming coat of approved steel primer using structural steel, etc. as required:
In stringers, treads, landings etc. of stair cases, including use of chequered plate wherever required, all complete AND In gratings, frames, guard bar, ladders, railings, brackts. gates & similar works. Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In gratings, frames, guard bar, ladder, railings, brackets, gates and similar works

M.S. ANGLE FRAME

Providing and fixing angle iron frames for doors, windows and ventilators of mild steel Angle sections of size 35x35x5 mm, joints mitred and welded by angle iron 35x35x5 mm or 35x 5 mm flat pieces to the existingT-iron frame or to the wall with dash fastener, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer, all complete as per the direction of Engineer-In-charge.

Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design: With 20x20 mm square bar.

M.S. TUBULAR FRAME

Providing and fixing M.S. Tubular frames for doors, windows, ventilators and cupboard with rectangular/ L-Type sections, made of 1.60 mm thick M.S. Sheet, joints mitred, welded and grinded finish, with profiles of required size, including fixing of necessary butt hinges and screws and applying a priming coat of approved steel primer.
Fixing with 15x3 mm lugs 10 cm long embedded in cementconcrete block 15x10x10 cm of C.C. 1:3:6 (1 Cement : 3 coarsesand : 6 graded stone aggregate 20 mm nominal size).

FIXING

Providing and fixing carbon steel galvanised (minimum coating 5 micron) dash fastener of 10 mm dia double threaded 6.8 grade (yield strength 480 N/mm2), counter sunk head, comprising of 10 m dia polyamide PA 6 grade sleeve, including drilling of hole in frame , concrete/ masonry, etc. as per direction of Engineer-in-charge: 10 x 60 mm EACH.

M.S. FOOTREST

Providing M.S. foot rests including fixing in manholes with 20x20x10 cm cement concrete blocks 1:3:6 (1 cement : 3 coarse sand : 6 graded stone aggregate 20 mm nominal size) as per standard design : With 20x20 mm square bar.

PRECAST RCC COVER

Providing and fixing in position pre-cast R.C.C. manhole cover and frame of required shape and approved quality- H D – 20, Circular shape 560 mm internal diameter.

CUPBOARDS AND WARDROBES

Built in cupboard 650 mm wide upto ceiling height with 18 mm thk pre-laminated non decorative particle board as shelves and 18 mm thk pre laminated decorative particle board as shutters/steel almirahas with auto soft closing hinges with SS 304 finish bar handle of 160cd.
Factory made wardrobe carcass, shelves, drawers etc. All ends should have edge banding tape of M/s Rehau / Dolkin 0.8mm thickness for cabinet. Back Panel pre laminated 5mm thk. pre-laminated non decorative particle board. Carcass to be supplied in knock down condition with pre factory drill for mini fix, dowels, Shelf with shelf supports.

M.S. SHEET DOOR

Providing and fixing 1mm thick M.S. sheet door with frame of 40x40x6 mm angle iron and 3 mm M.S. gusset plates at the junctions and corners, all necessary fittings complete, including applying a priming coat of approved steel primer. Using M.S. angels 40x40x6 mm for diagonal braces

STEEL WORK IN BUILT UP TUBULAR FRAME

Steel work in built up tubular (round, square or rectangular hollow tubes etc.) trusses etc., including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer, including welding and bolted with special shaped washers etc. complete. Hot finished welded type tubes.

LAMINATED VENEER LUMBER (LVL)

Laminated Veneer Lumber door frames and shutters shall conform to IS 14616.

Material

Laminated Veneer Lumber (LVL)

(a) Laminated Veneer Lumber is made of rubber wood silver oak, eucalyptus, Poplars, acacias etc. veneers glued together having grains of all the veneers in one direction under high temperature and pressure to develop high Modulus of Rapture & Modulus of elasticity. Veneers for LVL shall be of thickness between 1.5 to 2.5 mm.

(b) Veneers shall be free from knot holes, decayed knots except pin knots, unfilled splits wider than 3 mm, concentrated borer holes, shakes, objectionable decay or termite attack, except that for the face veneers none of these defects nor cross grain exceeding 1 in 10 shall be permitted. The nominal thickness of all the veneers used shall be identical and uniform within a tolerance of + 5 percent.

(c) **Adhesives:** Only BWP grade adhesive conforming to IS 848 shall be used for making LVL.

(d) **Preservatives***:* Veneers used for LVL shall be given suitable preservative treatment before lamination, with a preservative that is compatible with the adhesive to be used. Only fixed type of water soluble preservatives, CCA or CCB, or non-leachable, solvent soluble preservatives as per IS 401 shall be used for treating the veneers. Retentions of preservatives shall be as per IS 401 depending upon the proposed end use.

All the Veneers shall be given preservative treatment by one of the water soluble fixed type treatment, Copper Chrome-Boron Composition. (CCB) as per IS 401. The treated Veneers shall then be dried having moisture content less than 6%. The Veneers shall be glued together, by keeping all the grains in one direction, with BWP grade synthetic resin adhesive conforming to IS 848. The Veneers having moisture content less than 6% so glued, shall be pressed in hot press at high temperature of 140 degree C to 180 degree C. and pressure 1.4 to 1.8 MPa. The net absorption of preservative in LVL when tested as per IS 2753 shall not be less than 8.0 kg/m3 Veneers shall be scarf jointed only length wise and not in the direction of width with EWP type synthetic resin adhesive. However, the length of individual Veneer shall not be less than 600 mm.

Moisture Content

The average moisture content of three test specimens, when determined in accordance with IS 1734 (Part 1) shall be between 5 to 15%.

Tests

The tests as per Table-1 of IS 14616 shall be carried out by the manufacturer on the LVL (Laminated Veneer Lumber) sections on each batch.

The manufacturer shall get the tests done on at least three samples of each batch by the standard method of test to ensure quality and performance of the material as per para 8.2 of IS 14616.

The manufacturer shall provide a certificate with the delivery challan indicating that the material conforms to IS 14616 along with the copy of the test report of the relevant batch.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 08 : FLOORING WORK

MARBLE STONE IN RISERS OF STEPS AND SKIRTING

Marble Stone Slabs and Dressing of Slabs shall be as specified in 11.19.1 and 11.19.2 except that the thickness of slabs shall be 18 mm. A tolerance of ± 3% mm shall be allowed, unless otherwise specified

Preparation of Surface

It shall be as specified in 11.18.2 where necessary, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall. In no case the skirting should project by more than thickness of stone.

Laying

The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm and at no place the width shall be less than 10 mm, if necessary, the slabs shall be held in position by temporary M.S. hooks fixed into the wall at suitable intervals. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement : 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.

The joints shall be as fine as possible but not more than 1 mm. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched

Curing, Polishing and Finishing

It shall be as specified as far as applicable, except that cement slurry with or without pigment shall not be applied on the surface and polishing shall be done only with hand. The face and top of skirting shall be polished.

KOTA STONE FLOORING

Kota Stone Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs .

Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

Preparation of Surface and Laying

The specification shall be as described in 11.19.3 except that the edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab. The thickness of the joints should be minimum as possible. In any location, it shall not exceed 1 mm.

Polishing and Finishing

The specifications shall be as described except that (a) first polishing with coarse grade carborundum stone shall not be done, (b) cement slurry with or without pigment shall not be applied on the surface before polishing.

KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO

Kota Stone Slabs and Dressing shall be as specified in 11.21.1 and 11.21.2 except that the thickness of the slabs shall be 25 mm or as specified in the description of the item. The slabs may be of uniform size if required. Preparation of surface shall be as specified in 11.20.2.

Laying shall be as specified in 11.20.3 except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs.

Curing, Polishing and Finishing shall be as specified in 11.20.4 except that first polishing with coarse grade carborundum stone shall not be done.

Anti-Skid Grooves for Staircase Treads and Ramps
Tread: Provide 3 Nos. 5mmx5mm grooves with a gap of 25mm centre to centre at a distance of 50mm from nosing of the tread.Pedestrian Ramp: Provide 5mm x 5mm groove throughout the length of the pedestrian ramp with a gap of 100mm centre to centre.

CEMENT CONCRETE FLOORING

Cement Concrete
Cement concrete of specified mix grade shall be used and it shall generally conform to the specifications.

Base Concrete
Flooring shall be laid on base concrete where so provided. The base concrete shall be provided with the slopes required for the flooring. Flooring in verandah, Courtyard, kitchens

& baths shall have slope ranging from 1 : 48 to 1 : 60 depending upon location and as decided by the Engineer-In- Charge.

Floors in water closet portion shall have slope of 1:30 or as decided by the Engineer-In-Charge to drain off washing water. Further, necessary drop in flooring in bath, WC, kitchen near floor traps ranging from 6 mm to 10 mm will also be provided to avoid spread of water. Necessary margin to accommodate this drop shall be made in base concrete. Plinth masonry off set shall be depressed so as to allow the base concrete to rest on it.The flooring shall be commenced preferably within 48 hours of the laying of base concrete. The surface of the base shall be roughened with steel wire brushes without disturbing the concrete.

Immediately before laying the flooring, the base shall be wetted and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

If the cement concrete flooring is to be laid directly on the RCC slab, the top surface of RCC slab shall be cleaned and the laitance shall be removed and a coat of cement slurry @ 2 kg of cement spread over an area of one sqm so as to get a good bond between the base and concrete floor.

Thickness
The thickness of floor shall be as specified in the Indicative item/specification/drawing.

Laying

Panels: Flooring of specified thickness shall be laid in the pattern including the border as given in the drawings or as directed by the Engineer-In-Charge. The border panels shall not exceed 450 mm in width and the joints in the border shall be in line with panel joints. The panels shall be of uniform size and no dimension of a panel shall exceed 2 m and the area of a panel shall not be more than 2 sqm.

The joints of borders at corners shall be mitred for provision of strips.

Laying of Flooring with Strips:
Normally cement concrete flooring shall be laid in one operation using glass/ aluminium/PVC/brass strips/stainless steel strips or any other strips as required as per drawing or instructions of the Engineer-In-Charge, at the junction of two panels. This method ensures uniformity in colour of all the panels and straightness at the junction of the panels. 4 mm thick glass strips or 2 mm PVC strips or 2 mm aluminium or brass strips shall be fixed with their tops at proper level, giving required slopes. Use of glass and metallic strips shall be avoided in areas exposed to sun.

Concreting:
Cement concrete shall be placed in the panels and be levelled with the help of straight edge and trowel and beaten with thapy or mason’s trowel. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given. Beating shall cease as soon as the surface is found covered with a thin layer of cream of mortar. The evenness of the surface shall be tested with straight edge. Surface of flooring be true to required slopes. While laying concrete, care shall be taken to see that the strips are not damaged/disturbed by the labourers. The tops of strips shall be visible clearly after finishing with cement slurry.

Laying of Flooring without Strips
The laying of cement concrete flooring in alternate panels may be allowed by the Engineer-In-

Charge in case strips are not to be provided.

Shuttering
The panels shall be bounded by angle iron or flats. The angle iron/flat shall have the same depth as the concrete flooring. These shall be fixed in position, with their top at proper level giving required slopes. The surface of the angle iron or flats, to come in contact with concrete shall be smeared with soap solution or non-sticking oil (Form oil or raw linseed oil) before concreting. The flooring shall butt against the unplastered masonry wall.

Concreting
The concreting shall be done in the manner as described below.

The angle iron/ flats used for shuttering, shall be removed on the next day of the laying of cement concrete. The ends thus exposed shall be repaired, if damaged with cement mortar 1: 2 (1 cement: 2 coarse sand) and allowed to set for minimum period of 24 hours. The alternate panels shall then be cleaned of dust, mortar, droppings etc. and concrete laid. While laying concrete, care shall be taken to see that the edges of the previously laid panels are not damaged and fresh mortar is not splashed over them. The joints between the panels should come out as fine straight lines.

Finishing
The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some time, till moisture disappears from it or surplus water can be mopped up. Use of dry cement or cement and sand mixture stiffening the concrete to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided.

Fresh cement shall be mixed with water to form a thick slurry and spread @ 2 kg of cement over an area of one sqm of flooring while the flooring concrete is still green. The cement slurry shall then be properly processed and finished smooth.

The edges of sunk floors shall be finished and rounded with cement mortar 1:2 (1 cement: 2 coarse sand) and finished with a floating coat of neat cement.
The junctions of floor with wall plaster, dado or skirting shall be rounded off where so specified.

The men engaged on finishing operations shall be provided with raised wooden platform to sit on so as to prevent damage to new work.

Curing
The curing shall be done for a minimum period of ten days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies bag shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

Precautions
Flooring in lavatories and bath room shall be laid only after fixing of water closet and squatting pans and floor traps. Traps shall be plugged while laying the floors and opened after the floors are cured and cleaned. Any damage done to W.C.'s squatting pans and floor traps during the execution of work shall be made good.

During cold weather, concreting shall not be done when the temperature falls below 4°C. The concrete placed shall be protected against frost by suitable covering. Concrete damaged by frost shall be removed and work redone. During hot weather, precautions shall

be taken to see that the temperature of wet concrete does not exceed 38° C. No concreting shall be laid within half an hour of the closing time of the day, unless permitted by the Engineer-In-Charge. To facilitate rounding of junction of skirting, dado and floor, the skirting/dado shall be laid along with the border or adjacent panels of floor.

CEMENT CONCRETE PAVEMENT IN COURTYARD, RAMP AND TERRACE ETC.

Specifications described shall hold good as far as applicable except that:

(i) The panels shall be of uniform size and no dimension of a panel shall exceed 1.25 m and the area of
panel should not exceed 1.25 sqm for the thickness of panel's upto 50 mm.

(ii) Concreting shall be done in alternate panels only and no glass/asbestos strips shall be provided.

Finishing
The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some-time, till moisture disappears from it or surplus water can be mopped up.

Use of dry cement or cement and sand mix on the surface to stiffen the concrete or to absorb excessive moisture shall not be permitted. Excessive trowelling shall be avoided. When the surface becomes fairly stiff, it shall be finished rough with wooden floats or where so specified chequered uniformly by pressing a piece of expanded metal of approved size.

TILE FLOORING

Ceramic Tile Flooring

Ceramic Tiles
The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS 13630. Classification and Characteristics of ceramic tiles shall be as per IS 13712.

The tiles shall be square or rectangular of nominal size. Table 1, 3, 5, and 7 of IS 15622 give the modular preferred sizes and table 2, 4, 6 and 8 give the most common non modular sizes. Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side.

Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width up to 2mm for unrectified floor tiles and up to 1mm for rectified floor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table10 of IS 15622 with water absorption 3 to 6% (Group BII).

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only up to 50 per cent of the surface area of the edges.

Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over an area up to one square meter. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

Vitrified Tile Flooring

Vitrified Tiles

The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS 13630. Classification and Characteristics of Vitrified tiles shall be as per IS 13712.

The tiles shall be square or rectangular of nominal size. Table 12 of IS 15622 give the modular
preferred sizes (Tiles with water absorption E ≤ 0.08 per cent Group B1a) and the joint thickness in

flooring shall not be more than 1mm Thickness shall be specified by the manufacturer. It includes the profiles on the visible face and on the rear side.

Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width shall not be more than 1mm for rectified floor tiles. Table 12 of IS 15622 give the modular preferred sizes (Tiles with water absorption E ≤ 0.08 per cent Group B1a) and the joint thickness in flooring shall not be more than 1mm.

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only up to 50 per cent of the surface area of the edges.

Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square meter over an area up to one square meter. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. In bath, toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown in drawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado.

After tiles have been laid surplus cement slurry shall be cleaned off.

Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

The vitrified tiles shall be of approved make and shall generally conform to IS 15622 (Tiles

with water absorption E d" 0.08 per cent Group BIa) and the joint thickness in flooring shall not be more than 1mm. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The vitrified tiles shall be square or rectangular of nominal size. Thickness shall be specified by the manufacturer. The top surface of the tiles shall be double charged. Glaze shall be either glossy or matt as specified. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be preferably free from glaze. However, any glaze if unavoidable, shall be permissible on only upto 50 per cent of the surface area of the edges. Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement : 4 coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than 10 mm. Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to offer a fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it. Over this mortar bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 3.3 kg of cement per square metre over an area upto one square metre. Tiles shall be soaked in water washed clean and shall be fixed in this grout one after another, each tile gently being tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern. The surface of the flooring during laying shall be frequently checked with a straight edge about 2 m long, so as to obtain a true surface with the required slope. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting or dado. After tiles have been laid surplus cement slurry shall be cleaned off. The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with polysulphide or as specified on top with under filling with cement grout without the lugs remaining exposed. The floor shall then be kept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

FLAMED FINISH GRANITE STONE FLOORING

The process is often referred to as a "flamed" or "thermal" finish and can be best described as creating a textured look. To achieve the style, an intense flame is held at the stone's wet surface. While firing it, the surface becomes so hot it bursts and a layer flakes away to reveal a rough, even texture. It is especially used at a location of high importance to have a great finish for designs requiring a modern aesthetic.

Flamed Finish Granite Stone

Other granite details shall be as specified in sub head 8.0 . The flamed finish granite stone details shall be as specified in sub head 8.0. Other details such as dressing of slabs, laying ,polishing , finishing, measurement and rates shall be as specified in clause 11.19 with flamed finish granite stone in place of Indian marble stone.

ABRASION TEST FOR CONCRETE HARDENING COMPOUNDS

A-1 Preparation of Sample

25 mm cylinder shall be prepared in ratio 1:2 mix (1 cement: 2 grades stone aggregate 6 mm nominal size by weight) one each with and without the admixture of concrete hardening compound. The concrete hardening compound shall be used in the proportion by weight of cement as recommended by the firm. The cylinder shall be placed inside a damp box for 24

hours and then cured in water for 27 days. After that, they shall be subject to abrasion test on 'Dorry Type Avery Abrasion Testing Machine, using Emery powder No 80 as the abrasing medium under the condition given in para A-2 below:

A-2 Conditions of Test
(a) Area of rubbing surface shall be same in both the cylinders.
(b) Age of cylinder 28 days
(c) Duration of Test 60 minutes
(d) Total distance traverse
During rubbing About 2.4 km
(e) Pressure on rubbing 0.04 kg/cm2surface

A -3 Results of Tests
The following observations shall be made in both the cases.
(a) Composition of the Test specimen
(b) Mean thickness rubbed away
(c) Percentage loss in weight

A -4 Remarks
Percentage loss in weight in the case of cylinders with concrete hardening compound, should not be more than 40% of the percentage loss in the case of cylinder without concrete hardening compound.

VACUUM DEWATERED CEMENT CONCRETE PAVEMENT

Cement concrete to be compacted by screed board vibrator of the type approved by Engineer in-Charge and by vaccum dewatering process complete as per directions of Engineer-in-charge.

Measurements
It shall be measured in cubic meteres correct to two place of decimal.

GRANULAR SUB–BASE

Scope
This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer-in-charge.

Materials
The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 16.44 and physical requirement given in Table 16.45 Gradings III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm. If the water absorption of the aggregate determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the aggregate shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, Brick ballast and laterite shall also be tested for Wet AIV (IS: 5640).

GRADING FOR GRANULAR SUB-BASE MATERIALS

Construction Operations
Preparation of Sub-Grade:
The surface of the sub grade to receive the Granular Sub-base shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials.

Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80 – 100 kN smooth wheeled roller until firm surface is obtained if necessary by sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for GSB. Where the existing surface over which the sub base of GSB is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the GSB is laid.

Spreading and compacting:
The sub-base material of grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing.

So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer-in-charge.

Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 per cent below the optimum moisture content (OMC).

IS Sieve
Designation
Percent by Weight Passing the IS Sieve
Grading I Grading II Grading III Grading IV Grading V Grading VI
75.0 mm 100 -- -- -- 100 --
53.0 mm 80-100 100 100 100 80-100 100
26.5 mm 55-90 70-100 55-75 50-80 55-90 75-100
9.50 mm 35-65 50-80 -- -- 35-65 55-75
4.75 mm 25-55 40-65 10-30 15-35 25-50 30-55
2.36 mm 20-40 30-50 -- -- 10-20 10-25
0.85 mm -- -- -- -- 2-10 --
0.425 mm 10-15 10-15 -- -- 0-5 0-8
0.075 mm <5 <5 <5 <5 -- 0-3

TABLE No. 16.45
PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE
Aggregate Impact Value (AIV) IS:2386 (Part 4) or IS:5640 40 Maximum
Liquid Limit IS:2720 (Part 5) Maximum 25
Plasticity Index IS:2720 (Part 5) Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)

IS:2720 (Part 5) Minimum 30 unless otherwise specified in the Contract

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown. Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour. Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS : 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

Measurements

Granular sub-base shall be measured as finished work in position in cubic metres. The length and breadth shall be measured to the nearest centimetre. The depth of consolidated layer shall be computed to nearest half centimetre by taking average of depths at the centre and at 30 cm from the left and right edges at a cross section taken at 100 metre interval or less as decided by the Engineer-in-Charge by making small pits. The consolidated cubical contents shall be calculated in cubic metres correct to two places of decimal. The protection of edges of granular sub-base extended over the full formation as shown in the drawing shall be considered incidental to the work of providing granular sub-base and as such no extra payment shall be made for the same.

HEAT RESISTANCE TERRACE TILES

Terrace tiles

Heat resistance terrace tiles are basically ceramic floor tiles which reflects solar radiation. These tiles are used on the floor of the terrace to prevent building from getting heated. These are used on the roof of any building or balcony. These can be used on wall of a building which are directly exposed to sunlight.

Solar Refractive Index (SRI)

It is a measure of the constructed surface’s ability to stay cool in the sun by reflecting solar radiation and emitting thermal radiation. SRI is calculated according to ASTM E1980.

Benefits of Heat Resistance Tiles:-

1. Reduce inside building temperature.
2. Save electricity.
3. Lower power demand.
4. Save burning fossil fuel by power plants.
5. Lower emission of green house.
6. Reduction of global warming.
7. Reduce conduction of heat into building.

Requirement for Heat Resistance Terrace Tiles

S. No.	Characteristics	Requirement
1	Size	300mm x 300mm x 20mm
2	Solar refractive index	Not less than 78
3	Solar reflection	Not less than 0.70
4	Initial emittance	Not less than 0.75

Tolerance

Tolerances on length and breadth shall be plus or minus one millimeter, and tolerance on thickness shall be plus 5 mm. The variation of dimensions in any one delivery of tiles shall not exceed 1 mm on length and breadth and in thickness not less than plus 3 mm.

Laying

Base concrete or RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. Cement mortar 1:4 (1 Cement : 4 coarse sand) bedding shall be used. Average thickness of the bedding mortar shall be 20 mm and the thickness at any place shall not be less than 10 mm.

Cement mortar bedding shall be spread, tamped and corrected to proper levels. If cement mortar is laid in bedding the tiles, then tiles shall be set immediately after laying the mortar. Over this bedding neat grey cement slurry of honey like consistency shall be spread at the rate of 4.4 kg of cement per square metre over such an area as would accommodate about twenty tiles. Tiles shall be washed clean and shall be fixed in this grout one after another, each tile being gently tapped with a wooden mallet till it is properly bedded, and in level with the adjoining tiles. The joints shall be kept as thin as possible not exceeding 1 mm and in straight lines or to suit the required pattern. The joints shall be properly cleaned before filling with grout of mix of white cement and marble powder in the ratio of 1:1.

The surface of the flooring during laying shall be frequently checked with a straight edge of length at least 2 metre, so as to obtain a true surface with the required slope.

Where full tiles or half tiles can not be fixed, tiles shall be cut (sawn) from full tiles to the required size and their edges rubbed smooth to ensure a straight and true joint.

Tiles which are fixed in the floor adjoining the wall shall enter not less than 12 mm under the skirting which shall be fixed upto 150mm height along the parapet walls in the same manner.

After the tiles have been laid, surplus cement grout that may have come out of the joints shall be cleared off.

Curing, Polishing and Finishing

The day after the tiles are laid all joints shall be cleaned of the grey cement with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with white cement mixed marble powder in the ratio of 1:1. The same cement slurry shall be applied to the entire surface of the tiles in a thin coat with a view to protect the surface from abrasive damage and fill the pin holes that may exist on the surface.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grounded evenly with machine fitted with coarse grade grit block (No. 60). Water shall be used profusely during grinding. After grinding, the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block

(No. 120).

The final grinding with machine fitted with the finest grade grit blocks (No. 320) shall be carried out the day after the second grinding described in the preceding para or before handing over the floor, as ordered by the Engineer-in-Charge.

For small areas or where circumstances so require, hand grinding/polishing with hand grinder may be permitted in lieu of machine polishing after laying. For hand polishing the following carborundum stones, shall be used:

1st grinding — coarse grade stone (No. 60)
Second grinding — medium grade (No. 80)
Final grinding — fine grade (No. 120)

In all other respects, the process shall be similar as for machine polishing.
After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woollen rags). The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished. The finished floor shall not sound hollow when tapped with a wooden mallet.

Measurements
Heat resistance terrace tiles shall be measured as laid in square metre correct to two places of decimal. For length and breadth dimensions correct to a cm including skirting shall be taken. No deduction shall be made nor extra paid for voids not exceeding 0.20 sqm. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metre. Nothing extra shall be paid for use of cut tiles nor for laying the floor at different levels in the same terrace.

CHEQUERRED PRECAST CEMENT CONCRETE TILES
Chequerred precast cement concrete tiles 22 mm thick in footpath & courtyard, jointed with neat cement slurry mixed with pigment to match the shade of tiles, including rubbing and cleaning etc. complete, on 20 mm thick bed of cement mortar 1:4 (1 cement: 4 coarse sand). Light shade pigment using white cement

TACTILE TILE
Providing and laying tactile tile (for vision impaired persons as per standards) of size 300x300x9.8 mm having with water absorption less than 0.5% and conforming to IS:15622 of approved make in all colours and shades in for outdoor floors such as footpath, court yard, multi modals location etc., laid on 20 mm thick base of cement mortar 1:4 (1 cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc. complete as per direction of Engineer-in-Charge.

SPORTS FLOORING
(Area as specified in finishing schedule/ as per approval by the Architect/ Engineer-incharge)
Supply & fixing of sports Wooden Series flooring in 6.5 mm thickness with wear layer thick 0.80 mm in the size of 1.8 mtr X 15 mtr use area classification multiple indoor stadium weight 4.895 kg/m2 construction in multiple layer. It shall be ball bounce >97%, vertical deformation 2.8 mm ,shock absobation > 37%,sound insulation 23-25 db, pur coating with UV treatment . The flooring shall incorporated a specially (PUR) sports flooring , good

resistant to scratch, slip ,fire ,chemical & does not favor in growth fungi & bacteria duly installed on smooth and hard surface on self levelling compound with company recommended adhesive & seamless protection (Design & Colour As Per Engineer-In-Charge) Above Cement concrete flooring 1 :2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slurry,. complete. 40 mm thick with 20 mm nominal size stone aggregate

CEMENT CONCRETE FLOORING

Cement concrete flooring 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate) finished with a floating coat of neat cement, including cement slury, but excluding the cost of nosing of steps etc. complete. 40mm & 60 mm as required thick with 20mm nominal size stone aggregate.

GLASS MOSAIC TILES

Providing and fixing Glass mosaic tiles on finished plain wall surface of size 20 mm x 20 mm x 4 mm in all colour, design , fixing in customize design as per direction of Engineer-in-Charge. The glass mosaic tiles to be fixed on the wall surface with the help of approved adhesive applied at the rate of 2.5 kg per sqm and grouting of the same. The rate is inclusive of all operation, material and required pattern approved by Engineer-in- Charge:

ENGINEERED WOODEN FLOORING

Providing and fixing three-layer construction, wooden plank size 185—200 mm X 2000-2426 mm of 3 strip oak with a total thickness of 15 mm and a wear layer thickness of 3.5mm should be re-sandable up to 2 to 3 times. Surface Treatment: Matt/ Ultra matt Lacquer, Core: Pine/ Spruce/ Alder. Joint: Woodloc 5S, fifth-generation locking system, Moisture Content as per EN 13183: 7%, Reaction to fire as per EN13501-2:1 Dfl- s1CARB 2 compliant, Biological Durability as per EN350-2 Class1 confirming to strict quality and environment norms. It should be certified by PEFC, FSC, Blue Angel, and Real Wood. Matching Accessories like skirting & profile with,. Installation should be done by a trained and authorized team on Zero level of the hard surface.

RUBBER FLOORING

Supply & Fixing of 7.5 mm thick Rubber flooring roll size,1220 mm X 10 mtr ,weight 1025 kg/m3,density ASTM D2240-97,flexibilityASTM F137-71,abrasion0.24%,no surface attack or colour change,tear ASTM D624-98 result >0.8MPa duly installed with recommended adhesive on smooth and hard surface. All work completed as per directed or approved by Engineer-in-Charge

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 09 : WATERPROOFING

WATER PROOFING TREATMENT TO VERTICAL AND HORIZONTAL SURFACE OF DEPRESSED PORTION OF WC, KITCHEN AND THE LIKE

Before the Water Proofing Treatment

Before the water proofing treatment, the internal plaster of ceiling and walls of WC block leaving the portion for dado/skirting should be completed. Grooving / chasing for doing the concealed work of GI/CI pipes/Electrical conduits should be completed. Cleaning the depressed/sunken portion of WC of all debris, extra mortar sticking to the vertical and horizontal surface etc. Necessary holes for 'P' trap /Nhani trap/Water escape pipe etc should be completed.

Preparing Surface and Fixing Pipes and Fittings

Before the water proofing treatment work, proper key in the concrete surface should be provided. The depressed/sunken portion should be hacked by a hacking tool, after the concrete slab is cast and when this concrete is still green.

The vertical surfaces of the depressed /sunken portion should be hacked with a hacking tool just after the shuttering is removed.

In case of old work, the water proofing treatment on such surfaces shall be permitted after making proper spatter dash key.

Fixing the 'P' trap in position and all other pipes work including the water escape pipe shall be fixed properly and the holes should be plugged carefully before taking up the water proofing work.

1st Course

Cement duly blended with water proofing compound as explained in clause 22.1 shall be used for preparing the cement slurry.

The consistency of the slurry should be such that 4.4 kg. of blended cement with water proofing compound is used per sq. metre area of surface to be treated. The slurry should be started from the vertical faces towards the bottom of the floor as shown in Fig. 22.4. Particular care should be taken to see that the slurry is applied to corners without leaving any gap.

2nd Course

Immediately on applying the blended cement slurry on the surface to be treated cement plaster 20 mm thick in CM 1:3 (1 blended cement: 3 coarse sand) shall be applied both on vertical and horizontal surfaces taking particular care to complete the entire depressed/ sunken portion of WC within a day so that the plaster can be done without any joint. Junctions shall be properly rounded. The surfaces of the plaster shall be left rough but finished in one plain and cured for a week.

On completion of the curing period both horizontal and vertical surfaces shall be cleaned properly and gently and allowed to dry.

3rd Course

Only after the surface is completely dried the blown or residual bitumen shall be applied @ 1.7 kg. of bitumen per sqm area.

4th Course

PVC sheet 400 micron thick shall be spread evenly without any kink immediately, so that the PVC sheet sticks to the surface firmly. PVC sheet shall be continued to be laid over the main slab upto 100 mm.

Overlapping of PVC sheet should be done with a minimum overlap of 100 mm, duly pasting the overlapped sheet with an application of bitumen @ 1.7 kg./ sqm.

The projections of pipes and 'P' trap outlet etc. inside the depressed/sunken portion of WC shall also be cladded with water proofing treatment layer upto a height of 150 mm, using a coat of bitumen with PVC sheet complete.

The surfaces of depressed/sunken portion of WC shall not be left without covering with specified filling material and base concrete, otherwise the PVC sheet layer may be tampered by the labour working in the vicinity.

Fixing up of WC pan, filling specified material and the top base concrete should be done as early as possible and the top horizontal layer of water proofing may be taken up later i.e. just before laying the floor tiles.

WATER PROOFING TREATMENT IN SUNKEN PORTION OF WCs, BATHROOMS ETC.

Preliminaries to be Attended

The preliminaries shall be attended as described in clause.
Preparing Surface, Fixing Pipes and Fittings

In this case, unlike as described in clause, no hacking of surface need be made, but only extra mortar sticking to the surface should be removed and the surface should be cleaned thoroughly. Fixing 'P' trap etc. shall be done as described in Clause.

Providing and Laying of Slurry for First Layer
The consistency of the slurry should be such as to cover the desired area by using 0.488 kg of blended cement per sqm of area.

On deciding the correct quantity of water required per sqm. area the required quantity of slurry should be prepared which can be applied over the desired surface within half an hour of mixing with 0.488 kg. of grey cement + 0.253 kg. water proofing compound as per manufacturer specifications + x litres of water per sqm. area and the required quantity of slurry thus prepared should only be used for first application.

The first layer shall be applied with painting brushes over the specified and dampened area carefully including the corners, holes on the surfaces and joints of

pipes in concrete etc. and the application should continue at least upto 150 mm height of fixtures of pipes from the surface. The surface on application shall be air cured for 4 hours.

Providing and Laying of Slurry for Second Layer
The quantity of slurry required for second application to be covered within an hour of mixing shall be prepared with 0.242 kg. cement + 0.126 kg. water proofing compound + y litres of water per sqm. area and the required quantity of slurry thus prepared should only be used for second application.

The application of 2nd layer of slurry is same as for first layer as detailed in clause 22.5.3.

The applied surface shall be allowed to air cure for 4 hours and thereafter water curing shall be done for full 48 hours.

In case no further work as described above is to be taken up immediately on completion of water proofing treatment due to any reason it is recommended to protect the treated portion with cement plaster 1:4 as a protective layer .

INTEGRAL CEMENT BASED WATER PROOFING TREATMENT WITH BRICK BAT COBA

Before taking up the work the preliminaries to be attended shall be exactly same as described in clause.

Preparing the Surface
The surface of the slab should be roughened by scrapping when the slab concrete is still green, however, the surface need not be hacked. In case the slab is already cast and surface fairly finished, the same shall be cleaned neatly of all mortar droppings, loose materials etc with brooms/cloth.

Providing and Laying of Slurry under Base Coat
The quantity of water required to prepare the slurry with 2.75 kg. of blended cement to be painted over an area of 1 sqm. shall be calculated exactly as described in clause.

Depending upon the area of surface that has to be covered, the required quantity of slurry should be prepared using 2.75 kg. blended cement + water per sqm. area to be covered, taking particular care to see that only that much quantity of slurry shall be prepared which can be used within half an hour of preparation i.e. before the initial setting time of cement.

The prepared slurry shall be applied over the dampened surface with brushes very carefully, including the joints between the floor slab and the parapet wall, holes on the surfaces, joints of pipes, masonry/concrete etc.

The application of the slurry should continue upto a height of 300 mm on the parapet wall and also the groove. The slurry should also be applied upto a height of 150 mm over pipe projections etc.

Laying Base Coat 20 mm thick
Immediately after the application of slurry and when the application is still green, 20 mm thick cement plaster as base coat with cement mortar 1:5 (1 blended cement : 5 coarse sand) shall be evenly applied over the concrete surface taking particular care to see that all the corners and joints are properly packed and the application of the base coat shall

be continued upto a height of 300 mm over the parapet wall.

Laying Brick Bat Coba
Brick bat of size 25 mm to 115 mm out of well burnt bricks shall be used for the purpose of brick bat coba.

The brick bats shall be properly dampened for six hours before laying.

Brick bats shall be laid to required slope/gradient over the base coat of mortar leaving 15-25 mm gap between two bats. Cement mortar 1:5 (1 blended cement: 5 coarse sand) shall be poured over the brick bats and joints filled properly. Under no circumstances dry brick bats should be laid over the base coat.

The haunches/gola at the junction of parapet wall and the roof shall be formed only with brick bat coba.

In case the brick bat coba is laid on the base coat immediately on initial set there will be no necessity of applying cement slurry over the base coat before laying the brick bat coba. However, if the brick bat coba is to be laid on the subsequent day, cement slurry prepared as described in clause 22.7.3 shall be applied over the top surface of the base coat, then only the brick bat coba shall be laid.

Application of Slurry over Brick Bat Coba
After two days of curing of brick bat coba cement slurry prepared as per clause shall be applied on the surface of brick bat coba The application of slurry shall be the same as described in clause which should cover the haunches/gola, and the remaining small portion of parapet wall and also inside the groove as shown in the figure.

Laying Finishing Layer (Protective Coat)
Immediately on applying the cement slurry over the surface of the brick bat coba and when the slurry applied is still green, the fibre glass cloth as specified in clause 22.6.4 shall be spread evenly on the surface without any kink & pressed to see that no air spaces exist. The fibre glass cloth shall be taken up to a height of 300 mm on parapet walls & tucked in the groove specially prepared at that height. 20 mm thick layer of cement plaster, without leaving any joints shall be applied with cement mortar 1:4 (1 blended cement: 4 coarse sand) over the entire fibre glass cloth including the haunches/gola and the small portion on the parapet wall. The groove in the parapet wall over the haunches shall also be filled neatly packing the mortar firmly in the groove.

The surface of the finishing layer (protective coat) shall be neatly finished with cement slurry prepared as per clause 22.7.3. The finished surface shall be allowed to dry for a while and then pattern of 300 mm x 300 mm groove, 8 mm deep shall be made over the entire surface.

Curing and Testing the Treatment
The entire surface thus treated shall be flooded with water by making kiaries with weak cement mortar, for a minimum period of two weeks.

WATER PROOFING

STANDARDS

Indian and other International Standards are followed for this section. Any discrepancies or ambiguities seen shall be brought to the notice of the LDA and clarification / confirmation sought. Engineer-In-Charge's decision shall be final. However, as a general rule, more stringent specifications shall be followed.

WATERPROOFING SYSTEMS

Note: The waterproofing system for foundation, underground structures and basement (if any) to be finalized as per soil conditions, water table, basement level and foundation design. The waterproofing system shall be finalized from the below mentioned systems and approved by the Architect based on the mentioned criterias.

A) Providing and applying integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservior, sewage & water treatment plant, tunnels / subway and bridge deck etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the engineerin-charge. The product performance shall carry guarantee for 10 years against any leakage.

For vertical surface two coats @0.70 kg per sqm For horizontal surface one coat @1.10 kg per sqm.

B) Providing and applying crystalline mortar by mixing in the ratio of 4.5 : 1 (4.5 parts crystalline mortar : 1 part water) for the treatment of faulty construction joints, cracks, tie rod holes and spalled & honeycombed surface of RCC underground structures like basement, water tanks, bridge deck etc. to ensure water tightness. The crystallie mortar shall conform to the EN 1504-3 having compressive strength Class R4 (45 MPa) and adhesive bond strength Class R3 (?1.5

MPa). The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years. For sealing cracks and faulty construction joints, routed out/making U-shape groove size 25x25mm and then primed the area with integral crystalline slurry @0.05kg/running meter and while the surface is tacky filled the groove upto surface with crystalline mortar @1.50kg/running meter. Once crystalline mortar is touch dry then finally applied two coats of integral crystalline slurry @0.05kg/running meter per coat.

C) Supplying and installing of 1.2mm thick pre-applied HDPE membrane having puncture resistance of 1000N as per ASTM E 154), tensile strength of 25 Mpa, and hydrostatic head resistance not less than 70m water head as per ASTM D 5385 & elongation of 500% as per ASTM D 412, peel adhesion to concrete of 1200 N/m as per ASTM D 903, Lap peel adhesion > 450N/m as per ASTM D1876. The pre-applied, fully bonded HDPE sheet membrane shall be loosely laid on PCC and gets bonded to the underneath of the poured concrete of base/ raft slab and confined retaining wall. The fully bonded HDPE sheet membrane shall consist of a high performance PE film, self adhesive polymer layer and unique particulate layer with pressure sensitive adhesive,

which bonds fully to the poured concrete of base slab/confined retaining wall. The membrane shall have minimum of 75mm side laps and end laps which shall be sealed with double sided adhesive tape.,etc complete as per manufactures specification and instructions. This system must have 15 years performance warranty and should be 100% backed by manufacturer as per format attached. In addition to this Providing and applying integral crystalline (dry shake) of hydrophilic in nature for waterproofing treatment to the RCC structures like basement raft, foundation slab, sewage & water treatment plant slab, warehouses floor, parking structures and water tank base slab etc. sprinkled @0.60kg per sqm or higher as recommended by the manufacturer's specification over the lean concrete of above cited structures. The material shall meet the requirements as specified in ACI-212-3R-2010 i.e. by reducing permeability of concrete by more than 85%, compared control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline dryshake shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out all complete as per specification and the direction of the Engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage. This system must have 15 years performance warranty should be 100% backed by manufacturer as per format attached. Works will be executed as per approved methodology and drawing.

D) Supplying and installing Prebond W -1.5 mm composite thick fully bonded weldable HDPE membrane conforming to IS 16471:2017 requirements of UG waterproofing structures, requirements to provide Type A fully bonded protection of UG waterproofing structures. The membrane shall exhibit 25 years of service life tested and complied in accordance with EN 13251:2016 durability certification. The membrane should be minimum 2.4 m wide comprising of an HDPE layer and a pressure sensitive adhesive layer which is covered by a weatherproof protective layer with lap Joint Strength at overlaps >15000 N/m ASTM D 1876. The membrane shall have minimum of 100 mm side and end laps which shall be thermofused with leister machines at all the joints for assuring watertightness and achieving monolithic membrane. End laps and side laps should be a minimum of 100 mm with the weld size of minimum 60 mm in case of a single weld system. In case of a double weld system, comprising of two parallel welds of 15 mm wide each with a 15 mm air channel gap in between the two weld lines.The size of the membrane should not be less than 2.4 Mtr. x 20 Mtr. to minimize the joints. This membrane shall be continued over the vertical surface but terminated minimum 100mm below the top edge of the raft slab/footings and fixed as per recommendation. The HDPE membrane should have the below mentioned techncial properties- 1) Lap Joint(side and end lap) Strength at overlaps 15000 N/m ASTM D 1876 2) Resist hydrostatic pressure of 70 m head of water as per ASTM D5385 3) Puncture Resistance of 1000 N as per ASTM E154 4) Peel Adhesion to concrete of 1500 N/m as per ASTM D 903 5) Tensile strength (Bare HDPE membrane) of 25 N/mm2 as per ASTM D412 6) Elongation (Bare HDPE Membrane) of 500% as per ASTM D 412 7) Low temperature Flexibility -25deg C - Pass as per ASTM D 1970 8) UV Resistance: 45 days

E) Providing & applying Superseal 4500 PUH- 2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using plural component airless spray equipment, to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m2. The membrane shall have 100% Solids, VOC Free, Tensile strength > 15 Mpa as per ASTM D 412, Elongation > 450% as per ASTM D 412, Static Crack bridging up to 2mm as per ASTM C 836, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154, Water Head Resistance > 7 Bar as per ASTM D 5385.The coating

should pass Dynamic Crack Bridging as per EN 1062-7, Method B for 20,000 cycles at -20-degree temperature. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage @ 5-6 m2/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200-300 micron (dried sand) on wet primer at coverage of 0.8-1 kg/m2 and allow to come to touch dry condition before application of Membrane Providing and fixing HDPE protection having dimple height of 6 to 8 mm, as a protection board, over the waterproofing membrane for vertical surface stuck to the membrane by spot bonding method, using synthetic adhesive with butt joints etc. complete. Note-Necessary back filling to be done by the main civil contractor within 2-3 days time progressively after installation of the membrane and protection board , taking care not to cause damage to the waterproofing treatment .

F) Kota Stone: Providing and laying integral cement based treatment for waterproofing on horizontal surface at all depth below ground level for under ground structures as directed by Engineer-in- Charge and consisting of :

(i) Ist layer of 22 mm to 25 mm thick approved and specified rough stone slab over a 25 mm thick base of cement mortar 1:3 (1 cement : 3 coarse sand) mixed with water proofing compound conforming to IS:2645 in the recommended proportion over the leveling course (leveling course to be paid separately). Joints sealed and grouted with cement slurry mixed with water proofing compound.
(ii) 2nd layer of 25 mm thick cement mortar 1:3 (1 cement: 3 coarse sand) mixed with water proofing compound in recommended proportions.
(iii) Finishing top with stone aggregate of 10 mm to 12 mm nominal size spreading @ 8 cudm/sqm thoroughly embedded in the 2nd layer.
Using rough kota stone.

Providing and laying integral cement based treatment for water proofing on the vertical surface by fixing specified stone slab 22 mm to 25 mm thick with cement slurry mixed with water proofing compound conforming to IS:2645 in recommended proportion with a gap of 20 mm (minimum) between stone slabs and the receiving surfaces and filling the gaps with neat cement slurry mixed with water proofing compound and finishing the exterior of stone slab with cement mortar 1:3 (1 cement : 3 coarse sand) 20 mm thick with neat cement punning mixed with water proofing compound in recommended proportion complete at all levels and as directed by Engineer-in- charge : Using rough kota stone.

Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations:

(a) Applying a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with water proofing compound conforming to IS. 2645 and approved by Engineer in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment.
(b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs.
(c) After two days of proper curing applying a second coat of cement slurry using 2.75

kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin- charge.
(d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin- charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep.
(e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test.“All above operations to be done in order and as directed and specified by the Engineer-in-Charge : With average thickness of 120 mm and minimum thickness at khurra as 65 mm.

G) Waterproofing of Podium/ Basement slab top/ landscape area: Surface Preparation: Minor cleaning work, removal of loose concrete and filling cracks with polymer modified mortar using SBR polymer, Making of angle fillets all around the periphery of the wall with polymer modified mortar using SBR polymer. Supplying & grouting the gaps around the pipe / inserts with GP2, a non shrink cementitious waterproof grout. The “Nahani” trap, etc is to be fitted securely in the same manner & the gaps around it to be grouted with non shrink Grout. This shall conform the following standards: ASTM C 109 - 1999 18, ASTM C 1107, Grade C complete as per instructiions. Providing 3 coats of high solid content 92% polyurethane coating and 40-50 gms polyester fleece sandwiched between 1st and 2nd coats completely up to the top edge of the pipe etc. complete as per manufacturer's instructions.

H) Supplying and applying High performance hybrid polyurea elastomeric waterproofing coating cold applied of spray applied, 2 comp , antiroot property based liquid membrane with an elongation of 600% and tensile strength of 12.6 N/mm2 as per ASTM D 2370, crack bridging ability of 3mm as per ASTM C1305, shore A Hardness of min. 75 as per ASTM D 2240. The system includes final base preparation, epoxy primer application and applying hybrid Polyurea or approved equivalent in two coats at 1.2 kg per Sqm etc, complete as per Manufacturer specifications. Loosely lay 150 GSM Geotextile (non-woven polyester) with a min of 100mm wide overlap after which drain boards and soiling can be allowed. Laying protective screed of M20 grade 75 mm avg thickness, sandwiching 24 guage wire mesh in concrete with slope 1:100 containing 12 mm, admixed with waterproofing admixture confirming IS:2645, also it should be broom finish, well compacted, curing for 7 days etc. complete. The screed shall be laid in panels with 10mm wide construction joint and filling the panel joints with polysulphide sealant / PU Sealant.

I) Plantation Areas: Only Drainage Board to be added to approved waterproofing systems: Providing & laying high density polyethylene (HDPE) dimpled protection and drainage sheet; over the waterproofing membrane on the podium and landscape area. The protection and drainage sheet shall consist of a dimpled HDPE sheet with a fused on hydrophilic polypropylene geotextile. flow rate 200 L/Min/M, compressive strength 550 kn/m2, drain boad height should ne min 13mm.

J) Terraces: (a) Applying a slurry coat of water proofing compound conforming to IS. 2645 and approved by Engineer-in-charge over the RCC slab including adjoining walls upto 300 mm height including cleaning the surface before treatment. Supplying and applying flexible, breathable, two components, polymer modified, cementitious coating system applied in 1 coat using (hydrophobic, elastomeric, elongation>150% and tensile strength > 1.0 MPa with minimum crack bridging of 1 mm), to be applied by brush in two coats using 1.3 -1.5 Kg/ Sqm. Rates should including cleaning of mother concrete

surface to remove dust, loosely adhering particles, oil, grease, etc. completely using suitable means. Making of Corner fillets 50 mm x 50 mm and repairing all Cracks & Construction Joints by Cutting and filling with SBR Polymer modified mortar. Waterproofing coating to be terminated on parapet wall in a V groove of size 25 mm x 25 mm atleast 300 mm above FFL which should be sealed with Polymer Mortar. Providing and laying integral cement based water proofing treatment including preparation of surface as required for treatment of roofs, balconies, terraces etc consisting of following operations: (b) Laying brick bats with mortar using broken bricks/brick bats 25 mm to 115 mm size with 50% of cement mortar 1:5 (1 cement : 5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge over 20 mm thick layer of cement mortar of mix 1:5 (1 cement :5 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineer-in-charge to required slope and treating similarly the adjoining walls upto 300 mm height including rounding of junctions of walls and slabs. (c) After two days of proper curing applying a second coat of cement slurry using 2.75 kg/ sqm of cement admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin- charge. (d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement :4 coarse sand) admixed with water proofing compound conforming to IS : 2645 and approved by Engineerin- charge including laying glass fibre cloth of approved quality in top layer of plaster and finally finishing the surface with trowel with neat cement slurry and making pattern of 300x300 mm square 3 mm deep. (e) The whole terrace so finished shall be flooded with water for a minimum period of two weeks for curing and for final test.“All above operations to be done in order and as directed and specified by the Engineer-in-Charge : avg thickness will be 120 mm.

K) Terrace Waterproofing cum insulation system: Providing and applying roof insulation with 40 mm spray applied PUFF foam, which is a two component system. 2 parts are Polyol and Isocyanate are used in combination to produce rigid low density polyurethane spray foam. It gives good thermal insulationwith 40 mm thick impervious sprayed, closed cell free Rigid Polyurethane foam - over deck insulation conforming to IS - 12432 Pt. III (density of foam being 40-45 kg/ cum), over a coat of polyurethane primer applied @ 6-8 sqm per litre, The surface on which spray is applied to be cleaned properly, the moisture content in the surface shall be less than 5% and is to be dried before the application of spray, Polyurethane chemical (A side and B side) shall be sprayed in layers to produce overall 40 mm average thick closed cell polyurethane foam over the spraying surface with the help of appropriate foaming Reactor Machine. Precautions shall be taken to cover the nearby areas to avoid Spray of PU Foam on the other areas. The termination of spray at the corners shall be done as per IS:12432 (part 3):2000. 2 Comp. Spray Applied Solvent free Polyurethane Waterproofing : The waterproofing basecoat shall be solvent free, fast setting, seamless spray applied aliphatic 100% pure Polyurethane membrane installed over the roof on primed substrate as per manufactues specification using only Pneumatic machine in aa fixed ratio of 2 parts proportional, 1:0.7 by volume unless approved by Engineer. The 2 comp spray applied Polyurthane membrane for base shall be of total avg DFT 200 microns, (excluding primer and top coat), Poyurethane membrane shall poses following properties: Solid content- more than 95% as per ASTM D2697, Density >1.0 gram/CM3 as per ASTM D1475, Adhesion Strength min 3.0 N/MM2 as per ASTM D4541, Tensile Strength > 8mpa and < 12 mpa as per ASTM G14, Elangation at break 300% to 450% as per ASTM D412, Puncture Resistance >250 N as per ASTM E154, Crack Bridging - No crack till 5 mm as per ASTM C836, Shore Hardness A >65 as per ASTM D2240, Taber abrasion resistance <70 mg ASTM D4060. WaterVapor Transmission 0.11 G/M2 per day as per ASTM E96, Root resistance - No penetration as per DIN 4062, Impact Strength >180 N/ MM2 as per ASTM G14. Laying protective

screed of M20 grade 75 mm avg thickness, sandwiching 24 guage wire mesh in concrete with slope 1:100 containing 12 mm, admixed with waterproofing admixture confirming IS:2645, also it should be broom finish, well compacted, curing for 7 days etc. complete. The screed shall be laid in panels with 10mm wide construction joint and filling the panel joints with polysulphide sealant / PU Sealant. Also, the joints of outlet pipes and concrete/masonry are to be sealed with PMC mortar. In case of PVC pipes, the joints should be sealed with epoxy putty. Making of angle fillets all around the periphery of the wall with polymer modified mortar using SBR polymer. Supplying & grouting the gaps around the pipe / inserts with General Purpose Grout (GP2), a non shrink cementitious waterproof grout. The “drain pipes, etc is to be fitted securely in the same manner & the gaps around it to be grouted with non shrink Grout. This shall conform the following standards: ASTM C 109 - 1999 18, ASTM C 1107, Grade C complete as per instructiions. Providing 3 coats of 92% solid content PU coating and 40-50 gms polyester fleece sandwiched between 1st and 2nd coats completely up to the top edge of the pipe etc. complete as per manufacturer's instructions.

K) Providing and applying of swellable type water stop tape, 19mm x 25mm thick in linear meter (expansive nature) for construction joints treatment of RCC structure such as raft slab, retaining walls, water storage tank and at the junctions of raft slab with the retaining walls etc.. After cleaning the surface, one coat of required primer for swellable water stop tape shall be applied throughout the length of the joint @3.78 litre per 240 running meter. Over the primed surface swellable type water stop tape shall be placed. The work shall be carried out all complete as per specification and the direction of the engineer-in-charge. The product performance shall carry guarantee for 10 years against any leakage.

L) Providing and laying water proofing treatment in sunken portion of WCs, bathroom etc., by applying cement slurry mixed with water proofing cement compound consisting of applying : i) First layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/ sqm. This layer will be allowed to air cure for 4 hours. ii) Second layer of slurry of cement @ 0.242 kg/sqm mixed with water proofing cement compound @ 0.126 kg/sqm. This layer will be allowed to air cure for 4 hours followed with water curing (The item includes preparation of surface, treatment and sealing of all joints, corners, junctions of pipes and masonry with polymer mixed slurry.)

M) Supplying and Stacking Filling sunken floor with over burnt jhama brick aggregate 120mm to 40mm including compacting of materials complete as specified and directed for all levels.

N) Providing and laying integral cement based water proofing treatment including prepatation of surface as required for treatment of roofs, balconies, terraces etc, consisting of following operations. (a) Applying and grouting a slurry coat of neat cement using 2.75 kg/sqm of cement admixed with proprietary water - proofing compound cleaning the surface before treatment, (b) Laying cement concrete using broken bricks / brick bats 25 mm to 100 mm size with 50 % of cement mortar 1:5 (1 cement: 5 coarse sand) admixed with proprietary water proofing compound conforming to IS : 2645 over 20 mm thick layer of cement mortar of mix 1:5 (1 cement: 5 coarse sand) admixed with proprietary water Proofing compound conforming to IS 2545 to reuired slope and treating similary the adjoining walls upto 300 mm height including rounding of junctions, or walls ad slabs. (c) After two days of proper curing applying a secoung coat of cement slurry admixed with proprietary water proofing compound conforming to IS : 2645. (d) Finishing the surface with 20 mm thick jointless cement mortar of mix 1:4 (1 cement: 4 coarse sand) admixed with proprietary water proofing

compound conforming to IS : 2645 and finally finishing i 22.7.1 With average thickness of 120 mm and minimum thickness at khurras point to be 65 .

O) Surface preparation-Wash the surface and remove all loose concrete, grease, oil using wire brush or by surface grinder. All critical areas such as joints, junctions, movement zones, penetrations drainage points and cracks are to be correctly sealed and detailed prior to waterproofing. All hairline cracks < 1mm should be cut and open up to 5mm width to fill with Polymer modified mortar.

P)

Providing and applying angle fillet of 50 mm X 50mm on the right angles of wall junction floor junctions and properly dressed by preparing polymer modified mortar admixed with Pidicrete URP 10 % by weight of cement in the ratio of 1:3 etc., complete
Providing & applying Superseal 4500 PUH -2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using plural component airless spray equipment, to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m2. The membrane shall have 100% Solids, VOC Free, Tensile strength > 15 Mpa as per ASTM D 412, Elongation > 450% as per ASTM D 412, Static Crack bridging up to 2mm as per ASTM C 836, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154, Water Head Resistance > 7 Bar as per ASTM D 5385.The coating should pass Dynamic Crack Bridging as per EN 1062-7, Method B for 20,000 cycles at -20-degree temperature. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage @ 5-6 m2/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200-300 micron (dried sand) on wet primer at coverage of 0.8-1 kg/m2 and allow to come.

Termination of Membrane at 300mm above G.L.-The waterproofing membrane shall be terminated on the vertical surface. The membrane shall be terminated either by creating a "U" shaped groove of approx. 10 mm x 10 mm size within the RCC retaining wall, tucking the membrane within the groove, followed by sealing the groove with polyurethane sealant/ epoxy mortar .

Supplying & laying 200 gsm Geotextile (non woven polyester) over the entire membrane on horizontal area maintaining proper overlaps
Horizontal Slope & Protection:Laying minimum 75 mm THK at drainage point protective concrete screed of M20 grade of average 100 mm THK with slope 1:100 reinforced with Poly propylene fibre @ 0.9 kg / per Cu.m. After the application of screed, provide control joints by using a saw cutting machine attached with a 3 mm blade within 18-24 hrs. of application of screed. The panel size for providing joints should be up to max 15 sq.mt. Finishing. etc.,

Vertical Protection:Over the waterproofing membrane apply a coat of Epoxy bonding Agent conforming to Shear Bond strength as per ASTM C 881. Sprinkle fine sand over the primed surface at 2-3 Kg/sqm when the bonding agent is wet. Allow it to dry to form firm key for the plaster. Laying 15mm THK protective plaster of C:M – 1:4 admixed with integral waterproof compound conforming to IS 2645:2003 @ 220ml per bag of cement, over the waterproofing membrane for vertical protection including application of epoxy bonding agent conforming to ASTM C 881 and sprinkling of sand to create key for the plaster.

Fixing of 10mm thick polypropylene geotextile laminated dimpled board, of compressive strength not less than 400kN/m2 before soil filling.

Terrace waterproofing

Q) Surface preparation-Wash the surface and remove all loose concrete, grease, oil using wire brush or by surface grinder. All critical areas such as joints, junctions, movement zones, penetrations drainage points and cracks are to be correctly sealed and detailed prior to waterproofing. All hairline cracks < 1mm should be cut and open up to 5mm width to fill with Polymer modified mortar.

Providing and applying angle fillet of 50 mm X 50mm on the right angles of wall junction floor junctions and properly dressed by preparing polymer modified mortar admixed with Pidicrete URP 10 % by weight of cement in the ratio of 1:3 etc., complete Providing & applying PUH -2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using plural component airless spray equipment, to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m2 prior to application of insulation layer. The membrane shall have 100% Solids, VOC Free, Tensile strength > 15 Mpa as per ASTM D 412, Elongation > 450% as per ASTM D 412, Static Crack bridging up to 2mm as per ASTM C 836, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154, Water Head Resistance > 7 Bar as per ASTM D 5385.The coating should pass Dynamic Crack Bridging as per EN 1062-7, Method B for 20,000 cycles at -20-degree temperature. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage @ 5-6 m2/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200-300 micron (dried sand) on wet primer at coverage of 0.8-1 kg/m2 and allow to come to touch dry condition before application of Membrane.

Insulation Layer: Spray applying an average minimum Dr.Fixit Foamshield -60mm thick GRIHA enlisted CFC & HCFC free spray applied polyurethane foam satisfying the requirements of application as per IS 12423-Part3 which is applied in multiple passes with each spray pass of average 10-12mm thick with a skin formation on the top of each layer to enhance imperviousness of the layer. The spray applied polyurethane foam must have a free rise density of 33-35 kg/m³ and a spray density in the range of 45- 50 kg/m³(as per ASTM D1622), initial thermal conductivity of 0.023 W/m.k at 24°C (as per ASTM C518), tensile strength of >400kPa (as per ASTM D 1623), compressive strength greater than 300kPa (as per ASTM D-1621), closed cell content greater than 95% (as per IS 11239 Part5) , water absorption less than 1.5% (asper ASTM D2856), fire test property conforming to Class B2 as per DIN 4102 and Dimensional Stability of < 1.5% for 7 days when tested at -15& +70°C (as per ASTM D2126).

Waterproof coating over PU Foam: Providing & applying PUH -2 components, solvent free, liquid applied elastomeric seamless hybrid Polyurea Polyurethane Membrane, using plural component airless spray equipment, to form a minimum system thickness of 1.5 mm in two alternative coats with a total consumption of 1.5-1.6 kg / m2. The membrane shall have 100% Solids, VOC Free, Tensile strength > 15 Mpa as per ASTM D 412, Elongation > 450% as per ASTM D 412, Static Crack bridging up to 2mm as per ASTM C 836, Shore A Hardness > 85 ASTM D 2240, Puncture Resistance > 1000 N as per ASTM E 154, Water Head Resistance > 7 Bar as per ASTM D 5385.The coating should pass Dynamic Crack Bridging as per EN 1062-7, Method B for 20,000 cycles at -20-degree temperature. Apply primer coat of epoxy primer by roller/ airless spray guideline and coverage @ 5-6 m2/ltr depends on porosity of concrete. Allow to cure for max 5-6 hours. Broadcast anti slip grains of 200-300 micron (dried sand) on wet primer at coverage of 0.8-1 kg/m2 and allow to come
Protection of screed: Supplying & laying 150 gsm Geotextile (non-woven polyester) over the entire membrane on horizontal areas maintaining proper overlaps Horizontal Slope & Protection:Supplying and applying an avg of 100 mm thick M20 grade PP fiber reinforced concrete screed with Min. 75 mm thick at the rain water outlets, laid to a

slope of 1 : 120, including saw cuting (approx 6mm W x 30mm D) at 3MX4M pannels within 24 hours of concrete placement and filling the groove with Expanded Polytheylene backer rod keeping the top approx 10 mm depth open and sealing the groove on the top after 28 days of concrete placement with PU sealant or equivalent, and making angle fillet of 100mmX100mm using M20 grade concrete at the corners, compaction , curing for 7 days etc complete

POTABLE WATER TANK Waterproofing

R) Surface preparation-Wash the surface and remove all loose concrete, grease, oil using wire brush or by surface grinder. All critical areas such as joints, junctions, movement zones, penetrations drainage points and cracks are to be correctly sealed and detailed prior to waterproofing. All hairline cracks < 1mm should be cut and open up to 5mm width to fill with PMM.

Providing and applying angle fillet of 50 mm X 50mm on the right angles of wall junction floor junctions and properly dressed by preparing polymer modified mortar admixed with Pidicrete URP 10 % by weight of cement in the ratio of 1:3 etc., complete Sealing of pipe inserts, annular space, bore pack in the floor & walls.-The gaps around the Horizontal pipe inserts through the masonry / concrete wall should be sealed using double sided bituminous adhesive tape Bathseal, wrap around PVC/CI pipes and filling the grout gaps around the pipe and screed with non- shrink free flow grout Pidigrout 10M. All concealed pipe lines grooves should be covered using cement, sand mortar mixed with Pidicrete URP 10 % by weight of cement in the ratio of 1:3.

Treating of construction joints:Grouting the porous slab area with non-shrink by Drilling holes and injecting cement slurry admix with shrink compensating plasticizing compound Pidicrete AM @ 225 gms/50kg bag of cement through the nozzles under mechanical pressure grouting pump, Fixing nozzles of 12mm dia with @ 500 mm c/c at an inclined angle over the surface of RCC/ beam/ etc. and along the construction joint line or where honeycombing is present in concrete structures or cracks are dormant/ as per the requirement.

Waterproof Coating:Providing and applying 3 coats of Dr.Fixit Fastflex-acrylic polymer modified cementitious coating having elongation at break 120%; 5 Bar resistance to positive water pressure, Adhesive Strength ASTM D 7234- 1 N/mm2, Water Vapor Transmission as per ASTM E96 of 0.7 Perms and Crack bridging ability as per EN 1062-7 up to 2mm. Apply 3 coats of Fastflex slurry @ 3 Kg per sqm. prepare the mix by adding pre packed powed content to liquid component in the mix ratio (1 part polymer & 1.4 part powder). Provide and lay 45 gsm glass fibre mesh over the angle fillet when the first coat in still wet. Allow the first coat to dry for 6 to 8 hours. Then, apply the second coat at a direction perpendicular to first coat. Extend coating over the masonry walls up to the complete height of tank & sprinkle the quartz sand / fine sand over the second and final coat when it is still wet on the vertical wall surface for creating a firm key for plastering to ensure complete waterproofing. Allow the coating to air cure for 5 days before conducting water ponding test fir 24 Hrs.

Horizontal Protection Plaster / Screed:Laying 50 mm Thick protective screed of Cement Concrete of 1:1.5:3 mixes with integral compound conforming to IS 2645:2003, Pidiproof LW+ @ 200ml per bag of cement, to provide slope to the horizontal surface towards drain outlet and also to protect the waterproofing, keeping the surface broomed, curing and testing for water tightness for 7 days etc. complete.

Vertical Protection:Providing & applying 15 mm THK protective plaster of C: M –1:4

admixed with integral waterproof compound conforming to IS 2645:2003, Pidiproof LW+ @ 220ml per bag of cement, over the waterproof coating for vertical protection.

FOOD GRADE EPOXY COATING FOR POTABLE WATER TANKS Providing & applying two coats of Dr.Fixit Dampgaurd-antibacterial antifungal food grade epoxy coating at a consumption of @250/Gms/sq.mtr as per CFTRI 21 CFR 175 - 300 of US - FDA , Water absorption nil as per ASTMC 870:90, adhesion strength of 2.5 N/mm2 as per ASTM D4541:02 applied with an interval of 6-8 hrs between each coat over the cured plastered surface as per manufacturer's instruction.

QUALITY ASSURANCE

Manufacturer's qualification

A) Not less than five years' experience in manufacturing of membrane roofing.

I) Obtain primary materials from single manufacturer. Manufacturer's name shall be approved by Engineer- In- Charge.

II) Provide secondary materials as required by manufacturer of primary materials.

APPLICATORS QUALIFICATION

B) Approved by manufacturer prior to execution of this work order, with experience on at least five projects.

C) Foreman of field crew: minimum five years' experience with system of waterproofing being installed.

CERTIFICATIONS

Manufacturer's certifications on manufacturer's letterhead:

I) Certify system design; penetration, transition, and perimeter details; and system.

II) Certify products proposed for use comply with standards.

III) Certify materials ordered and supplied are compatible with each other suited for local and purpose intended and shipped in sufficient quantity to ensure proper timely installation.

IV) Certify materials have express warranty of merchantability and fitness for particular purposes of this project.

V) Certify manufacturer has reviewed project and will issue warranty upon successful completion of installation.

VI) Certify materials shipped to site meet membrane manufacturer's published performance standards and requirements of this specification.

VII) Membrane manufacturer's approval of insulation type and method of

installation.

VIII) Manufacturer's approval of installer.

SUBMITTALS

PRODUCT DATA

Contractor to submit along with his proposal product data for material he proposes to use.

INFORMATIONAL SUBMITTALS.

A) Certifications specified in quality assurances

B) Manufacturer's instructions

WATERPROOFING COMPOUNDS

Waterproofing compounds shall be cementious (cement based) non-shrinking, self-curing mixtures with following qualities: -

A) Free from sodium and chlorides

B) Free from material detrimental to concrete and reinforcement.

C) Able to create a membrane in one or multiple coats as per manufacturer's instruction.

D) Membrane capable to prevent infiltration when applied to interior faces and ponded.

E) Permeability, shear bond strength, compressive strength, volume changes meets minimum requirements of codes.

ACCESSORIES

All other accessories materials such as primers, bonding agents, polymers etc. Shall be as recommended by waterproofing manufacturer.

GUARANTEE

GUARANTEE/TRANSFER OF GUARANTEE

For works like water-proofing, acid and alkali resisting materials, Pre or Post construction soil treatment against termite or any other specialized works etc. the CONTRACTOR shall invariably engage SUB-CONTRACTORS who are specialists in the field and firms of repute and such a SUB- CONTRACTOR shall furnish guarantees for their workmanship to the OWNER, through the CONTRACTOR.

Water proofing and anti-termite works shall be guaranteed for 10 years from date of virtual completion.10% of the value of the work pertaining to water proofing and anti-termite treatment works shall be retained as Security against water proofing /anti-termite works.

50% of retention money against water proofing/anti-termite treatment works shall be released to the contractor on virtual completion of works on submission of equivalent amount of bank guarantee valid up to 10 years from Virtual completion. Balance 50% of this retention money shall be released on satisfactory completion of DLP (Defect Liability Period) subject to submission of bank guarantee for the balance amount for balance period of 10 years from date of virtual completion.

MATERIALS

Cement

Cement shall be Ordinary Portland Cement conforming to IS and shall be of grade 43 or 53.

Sand
As per CPWD Specifications with upto date correction slips and relevant IS Codes.

WATER

As per CPWD Specifications with upto date correction slips and relevant IS Codes.

WATERPROOFING FOR WATER RETAINING STRUCTURES SUCH AS WATER TANKS/STP.

Cleaning the internal surface areas thoroughly so that they are free of all contaminants like dirt and laitance & to remove all the loose materials by various mechanical means. Removal of all surface imperfections, protrusions, loose concrete & filling of cracks using SBR latex modified Mortar in the ratio Cement: Sand (1:4) and 5% by weight of cement.

Providing & grouting at construction joints cementitious grout into each nozzles (1 mtr c/c) at regular intervals as per the requirements.

Applying 3 coats of 2 components, prepacked, polymer modified cementitious coating@ 3kg/sq.mtr all over the slab including the angular fillets and extendable over the vertical walls. Finally sprinkling sand over the third coat for better adhesion with plaster. The interval between each coat of coating application is 6-8 hrs.

Providing & laying a protection layer of 25 mm thick cement mortar admixed with integral waterproofing compound.

Technical Features of acrylic cementitious coating:

Product	Test Standard	Results
Tensile Strength	ASTM D 412	5 N/Sq.mm
Elongation at Break	ASTM D 412	120 % minimum
Crack Bridging	ASTM D 836	No cracking up to 2 mm
Adhesion Strength	ASTM D 4541	0.8 N/Sq.mm minimum

Food grade epoxy coating for potable water tanks

Providing & applying two coats antibacterial antifungal food grade coating with an interval of 6-8 hrs
between each coat over the cured plastered surface as per manufacturer’s instruction.

STP Tanks-Coal tar epoxy coating

Providing & laying Coal Tar Epoxy in two coats at a consumption of 3-4 sq.mtr/Kg complete as per manufacturer's instruction

Method Statement

- Ensure a properly clean, sound & leveled substrate, as they should be free from oil, grease, dust & debris. Ensure that the moisture content is less than 10%.
- Make surface smooth, even & free from local depressions with sand –cement mortar modified with SBR latex and cure it for minimum 3 days.
- The slurry to be grouted is prepared as per the mixing instructions with non-shrink compound for cementitious grout. Carry out injection grouting either by gravity or with grouting pump using the mixed material. Allow it to cure for at least 24 hrs.
- Providing and laying gola of 75X75mm thickness all along the angular joints of wall and slab with cement mortar of mix 1:3 admixed with waterproofing compound
- Clean the surface again thoroughly to make free from dirt, dust laitance etc. and saturate the cleaned concrete surface with ample amount of water.
- Apply 1st coat of Acrylic coating on all the surfaces as per instructions & cure it for 6-8 Hrs.
- Apply the second coat of Acrylic cementitious coating over the properly cured first coat and let the complete treatment air cure for 7 days and so on for the third coat.
- Provide a protection layer over the waterproofing treatment with a 25 mm sand cement plaster admixed with integral waterproofing compound as per instructions & cure it for 7 days.
- Mix the components of food grade coating as per the instructions given & apply two coats on all the plastered surfaces by brush with an interval of 6-8 hrs between each coats.

INTEGRAL CEMENT BASED TREATMENT FOR WATER PROOFING ON HORIZONTAL SURFACE OF UNDER-GROUND STRUCTURE AT ALL DEPTH

Water Proofing of Horizontal Internal Surfaces of Under-ground Structure
(i) Preparation of Surface
The Water Proofing Treatment over the lean concrete/levelling course surface should adhere to the surface firmly, the surface of levelling course should be roughened properly when the concrete is still green. In case the surface is not made rough before the concrete is set, the work of water proofing should not be executed till proper key is provided for the base layer of Cement Mortar 1:3.

(ii) Blending Cement/Water with Water Proofing Compound
The required quantity of cement bags to be used for a particular portion of work should be emptied on a dry platform. Water proofing compound bearing ISI mark and conforming to IS 2645 should then be mixed properly with the cement. The quantity of water proofing compound to be mixed should be as prescribed by the manufacturer but not exceeding 3% by weight of cement. The quantity of cement and water proofing compound thus mixed should be thoroughly blended and the blended cement should again be packed in bags. For the water proofing compound in liquid form, the blending is to be done with water. This can be done by taking the just required quantity of water to be mixed in the particular batch of dry cement mortar.

The required quantity of water thus collected per batch of dry cement mortar to be prepared should be mixed with liquid water proofing compound from sealed tins with ISI mark. The water thus mixed with water proofing compound shall be thoroughly stirred so that the water is blended with water proofing compound properly.

(iii) Rough Kota Stone 22 to 25 mm Thick
The stone slabs to be used for this item shall be in thickness of 22 mm to 25 mm. Larger size of stone slabs i.e. 550 mm x 550 mm or 550 mm x 850 mm shall be used to minimise the number of joints. General requirement of Kota stone shall be as laid down in CPWD Specifications of Kota Stone flooring.

(iv) Preparation of Cement Slurry
Cement slurry shall be prepared by using 2.2 kg of blended cement per sqm. area. Each time only that much quantity shall be prepared which can be covered on the surface and the surface in turn would be covered with 25 mm thick cement mortar base within half an hour. Slurry prepared and remained unused for more than half an hour shall be totally rejected.

(v) Preparation of Cement Mortar
Cement mortar 1:3 (1 blended cement: 3 coarse sand) shall be prepared with cement/ water duly blended as explained in clause 22.1.1 (ii). Only that much quantity of cement mortar which can be consumed within half an hour, shall be prepared. Any cement mortar that is prepared and remains unused for more than half an hour shall not be used in the work and shall be rejected.

(vi) Laying Water Proofing Course
Before laying the base course of cement mortar 1:3, the lean concrete surface shall be cleaned neatly with water. Cement slurry prepared as per clause 22.1.1 (ii), shall be applied only on the area of the concrete surface, that can be covered with the cement mortar (1:3) base course within half an hour. The cement slurry should cover every spot of the surface and no place shall remain uncovered. Just after the application of cement slurry on the surface, the cement mortar prepared as per clause 22.1.1 (v) should be used for laying the base course. Base Course should be laid to a perfect level with wooden/aluminium straight edge of at least 2 mtrs. long. The top surface of cement mortar should be finished neatly and later scratched when green with a suitable instrument before the base course dries and gets hard that is just before the base course takes up initial set.

When the 25 mm thick base course is just getting set the cement slurry prepared as per clause 22.1.1 (iv) should be spread over the base course upto the area that shall be covered with just two to three stone slabs. The cement slurry shall be spread in such a way that the area of base course to be covered immediately shall be covered with slurry without any gap or dry spots. Immediately on applying cement slurry on the base course the Rough Kota Stone slab shall be laid over the base course and pressed gently so that the air gap can be removed. The slurry applied on the surface which gets spread when the stone slab is pressed shall get accumulated in the joints of adjacent stone slabs and if any gap still remains between the stone slabs the same should also be filled with additional quantity of cement slurry. For laying the stone slabs in perfect level, two stone slabs at adjacent concerns/ends shall be fixed firmly to the required level and a string stretched over the two slabs, the intermediate slabs shall then be set to the level of the string.

After filling all the joints of the Rough Kota stone Slabs with cement slurry the area of stone slab shall be laid with cement mortar 1:3. The surface of stone slabs shall be cleaned and lightly watered. Cement mortar 1: 3 prepared as per clause 22.1.1 (iv) shall be used for laying this course. For laying this course 25 mm high wooden strips shall be used and the

top surface shall be finished smooth without using additional cement or slurry.

After laying 3rd course and before the mortar layer takes the initial set, Stone aggregate of 10 mm to 12 mm nominal size shall be uniformly spread and lightly pressed into the finished surface @ 8 cudm./sqm. The aggregates shall not be embedded totally inside the mortar and shall be visible on the top surface.

In cases where slope is to be provided for the water proofing layer, grading with additional cement concrete/cement mortar shall be provided and then the water proofing layer shall be laid on the graded surface. Extra payment shall however be made for the grading course.
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(vii) Curing
Immediately after completing the fourth layer, arrangements shall be made for the top RCC slab as quickly as possible and in the mean time till the top slab is casted the water proofing treatment shall be kept wet continuously. In case the concreting of slab gets delayed for more than 2 weeks the curing can be stopped after 14 days.

(viii) Measurement
Length and breadth shall be measured along the finished surface correct to a cm and the area shall be worked out to nearest 0.01 sqm.

CPWD specifications and guidelines to be followed for any item not mentioned in the given document but specified in the drawings and schedules.

OTHER SPECIFICATIONS:
For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 10 : WALL FINISHES

EXTENT AND INTENT

The Contractor shall furnish all materials, labour, scaffolding, equipment, tools, plant and incidentals necessary and required for the completion of all plaster and wall finishes. The Contractor shall be responsible to take proper precautions to protect already installed work from damage.

GENERAL

Plaster as herein specified shall be applied to all internal and external surfaces where called for. Glazed tile dado, Stone dado, and other wall finishes are to be provided as per schedules. Areas called for on drawings and typical shall be considered to apply to appropriate, adjoining areas whether shown on same drawings or not and whether indicated or not. All plaster work and other wall finishes shall be executed by skilled workmen in a workmanlike manner and shall be of the best workmanship.

PLASTER WORK

The primary requirements of the plaster work shall be to provide an absolutely water tight enclosures, dense, smooth and hard and devoid of cracks on the interior and exterior. The Contractor shall do all that is necessary to ensure this result. All plastering shall be finished to true plane, without imperfections and square with adjoining work and shall form proper foundations for finishing materials such as paint etc.

Masonry and concrete surfaces to which plaster is to be applied shall be clean, free from efflorescence, damp and sufficiently rough and keyed to ensure proper bond.

Wherever directed all joints between concrete frames and masonry in-filling shall be expressed by a groove cut in the plaster. Said groove to exactly coincide with the joint beneath.

Where grooves are not called for the joints between concrete members and masonry in-filling shall be covered by 245 gauge galvanised chicken mesh strips 40mm wide or as shown, installed before plastering.

POLYMER MODIFIED COARSE PUTTY

GENERAL

Polymer modified coarse putty is used as a finishing coat to cover the unevenness and pinholes created by plastering or on concrete and to prepare the wall / surface for painting.

PREPARATION OF SURFACE

The surface should be free from loose particle, grease or any other foreign particle. The surface shall be scrubbed clean with wire brushes. The plastered surface/ RCC Surface shall be pock marked with painted tool, at spacing of not more than 4 cm centers and depth of pocks to be approx. 3 mm deep.

APPLICATION

The material will be mixed with water to a workable consistency. Putty shall be applied directly on the wall plasters/RCC Surface in suitable sizes panels and finished to smooth surfaces by steel trowels. The plaster shall be applied in such a manner that it fully fills the gaps the thickness over the plastered surface is as specified in the description of the indicative item/drawing. The finished surfaces shall be smooth and true to plane, slopes or curves as required.

CHASING
All chasing, installation of conduits, boxes etc. to be completed before any plastering or other wall finish is commenced on a surface. Chasing or cutting of plaster or other finish will not be permitted. Broken corners shall be cut back not less than 150mm on both sides and patched with Plaster of Paris as directed. All corners shall be rounded to a radius of 8mm.

SAMPLES
Samples of each type of plaster and other wall finish shall be prepared for approval by the Consultant

MATERIALS

Cement : As specified under Concrete work.
Water : As specified under Concrete work.
Sand : For internal plaster - Washed Fine Sand

For external plaster - Washed fine sand and/or stone aggregate as called for - Sand and stone aggregate to conform to the requirements given under “Concrete Work”

Waterproofing Compound: CICO No.1 or approved equal

PROPORTIONS
The materials used for plastering shall be proportioned by volume by means of gauge boxes.

PREPARATION OF SURFACE
The joints in all walls, both existing and freshly built shall be raked into a depth of 15mm, brushed clean with wire brushes dusted and thoroughly washed before starting plaster work. Concrete surfaces shall be roughened by hacking over the entire surface to ensure proper key for the plaster.

INTERNAL PLASTER TO WALLS
Plaster to internal faces of walls shall be 15mm/12mm thick as called for, consisting of 1 part cement and 6 parts clean fine sand.

MORTAR MIXING
Mortar shall be prepared as specified under ‘Brick Work’. It shall be made in small quantities only as required and applied within 15 minutes of mixing.

APPLIANCES
Plaster application shall be commenced only after the preparatory work. Correct thickness of plaster shall be obtained by laying plaster screeds (gauges) at intervals of 1.50 metres.

Mortar shall be firmly applied, well pressed into the joints, rubbed and finished as approved by the Consultant to give a smooth and even surface.

CURING
Finished plaster shall be kept wet for 10 days after completion. In hot weather walls exposed to sun shall be screened with matting kept wet or any other approved means.

CEILING PLASTER
Plaster to ceiling, soffits of stair flight slabs and similar locations where called for shall be

6mm thick and consist of 1 cement and 4 parts clean fine sand.

PREPARATION OF SURFACE
The surface to be plastered shall be prepared by a close hacking with pointed chisel as directed, to provide necessary bonding for the plaster. The surface shall be brushed, swept clean and thoroughly wetted before plastering.

APPLICATION
Mortar shall be applied firmly, pressed to the surface, rubbed and finished to a smooth and even surface.

CURING
Finished plaster shall be kept wet for 10 days after completion.

CHICKEN MESH TO WALLS
Galvanised chicken mesh(24 gauge, 12mm size) shall be provided at all junctions of concrete members and masonry walls besides other locations as called for, properly stretched and nailed, ensuring equal thickness of plaster on both sides of the mesh.

CURING
The finished surface be kept wet for at least 7 days.

V GROOVES
Where called for V Grooves of size as approved shall be formed in the dado and finished neat as directed. The grooves shall be straight, of uniform width and depth and neatly formed.

GLAZED TILE DADO
Glazed tile dado where called for on drawings or schedule of finishes shall be of different size, white/coloured glazed tiles approved manufacturer equivalent. The tiles shall be uniform size and colour. The rear face of the tiles shall be grooved and/or recessed to provide and adequate key for the Plaster. The tiles shall be laid true and plumb over a cement screed 15mm thick composed of 1 part cement and 3 parts coarse sand. Before laying the tiles the plaster shall be allowed to harden and then roughened with wire brushes. The back of the tiles shall be buttered with a coat of grey cement slurry and set in the bedding mortar. The tiles shall be firmly set in the mortar bedding and tamped and corrected to proper plane and lines. The joints shall be tight, regular, and uniform and shall be as fine as possible and finished neat in pigmented white cement slurry. The joint shall be truly vertical and horizontal to form required

CEMENT PLASTER
The cement plaster shall be 12 mm, 15 mm or 20 mm thick as specified in the item.

Scaffolding
For all exposed brick work or tile work double scaffolding independent of the work having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with

horizontal pieces over which scaffolding planks shall be fixed. For all other work in buildings, single scaffolding shall be permitted. In such cases the inner end of the horizontal scaffolding pole shall rest in a hole provided only in the header course for the purpose. Only one header for each pole shall be left out. Such holes for scaffolding shall, however, not be allowed in pillars/columns less than one metre in width or immediately near the skew backs of arches. The holes left in masonry works for scaffolding purposes shall be filled and made good

before plastering.

Note : In case of special type of brick work, scaffolding shall be got approved from Engineer-incharge

in advance.

Preparation of Surface

The joints shall be raked out properly. Dust and loose mortar shall be brushed out. Efflorescence if any shall be removed by brushing and scrapping. The surface shall then be thoroughly washed with water, cleaned and kept wet before plastering is commenced. In case of concrete surface if a chemical retarder has been applied to the form work, the surface shall be roughened by wire brushing and all the resulting dust and loose particles cleaned off and care shall be taken that none of the retarders is left on the surface.

Mortar

The mortar of the specified mix using the type of sand described in the item shall be used. It shall be as specified in Subhead 3.0. For external work and under coat work, the fine aggregate shall conform to grading IV. For finishing coat work the fine aggregate conforming to grading zone V shall be used.

Application of Plaster

Ceiling plaster shall be completed before commencement of wall plaster.

Plastering shall be started from the top and worked down towards the floor. All putlog holes

shall be properly filled in advance of the plastering as the scaffolding is being taken down. To ensure even thickness and a true surface, plaster about 15 × 15 cm shall be first applied, horizontally and vertically, at not more than 2 metres intervals over the entire surface to serve as gauges. The surfaces of these gauged areas shall be truly in the plane of the finished plaster surface. The mortar shall then be laid on the wall, between the gauges with trowel. The mortar shall be applied in a uniform surface slightly more than the specified thickness. This shall be brought to a true surface, by working a wooden straight edge reaching across the gauges, with small upward and side ways movements at a time. Finally the surface shall be finished off true with trowel or wooden float according as a smooth or a sandy granular texture is required. Excessive troweling or over working the float shall be avoided.

All corners, arrises, angles and junctions shall be truly vertical or horizontal as the case may be and shall be carefully finished. Rounding or chamfering corners, arrises, provision of grooves at junctions etc. where required shall be done without any extra payment. Such rounding, chamfering or grooving shall be carried out with proper templates or battens to the sizes required.

When suspending work at the end of the day, the plaster shall be left, cut clean to line both horizontally and vertically. When recommencing the plastering, the edge of the old work shall be scrapped cleaned and wetted with cement slurry before plaster is applied to the adjacent areas, to enable the two to properly join together. Plastering work shall be closed at the end of the day on the body of wall and not nearer than 15 cm to any corners or arrises. It shall not be closed on the body of the features such as plasters, bands and cornices, nor at the corners of arrises. Horizontal joints in plaster work shall not also occur on parapet tops and copings as these invariably lead to leakages. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar. No portion of the surface shall be left out initially to be patched up later on. The plastering and finishing shall be completed within half an hour of adding water to the dry mortar.

Thickness

Where the thickness required as per description of the item is 20 mm the average thickness of the plaster shall not be less than 20 mm whether the wall treated is of brick or stone. In the case of brick work, the minimum thickness over any portion of the surface shall be not less than 15 mm while in case of stone work the minimum thickness over the bushings shall be not less than 12 mm.

Curing

Curing shall be started as soon as the plaster has hardened sufficiently not to be damaged when watered. The plaster shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages at the contractor's expense by such means as the Engineer-in-Charge may approve. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be watched.

Finish The plaster shall be finished to a true and plumb surface and to the proper degree of smoothness as required. The work shall be tested frequently as the work proceeds with a true straight edge not less than 2.5 m long and with plumb bobs. All horizontal lines and surfaces shall be tested with a level and all jambs and corners with a plumb bob as the work proceeds.

Precaution Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut out in rectangular shape and redone as directed by the Engineer-in-Charge.

(i) When ceiling plaster is done, it shall be finished to chamfered edge at an angle at its junction with a suitable tool when plaster is being done. Similarly when the wall plaster is being done, it shall be kept separate from the ceiling plaster by a thin straight groove not deeper than 6 mm drawn with any suitable method with the wall while the plaster is green. (ii) To prevent surface cracks appearing between junctions of column/beam and walls, 150 mm widechicken wire mesh should be fixed with U nails 150 mm centre to centre before plastering the junction. The plastering of walls and beam/column in one vertical plane should be carried out in

one go. For providing and fixing chicken wire mesh with U nails payment shall be made separately.

Measurements

Length and breadth shall be measured correct to a cm and its area shall be calculated in square metres correct to two places of decimal. Thickness of the plaster shall be exclusive of the thickness of the key i.e. grooves, or open joints in brick work.

The measurement of wall plaster shall be taken between the walls or partitions (the dimensions

before the plaster shall be taken) for the length and from the top of the floor or skirting to the ceiling for the height. Depth of coves or cornices if any shall be deducted.

The following shall be measured separately from wall plaster.

(a) Plaster bands 30 cm wide and under

(b) Cornice beadings and architraves or architraves moulded wholly in plaster.

(c) Circular work not exceeding 6 m in radius.

Plaster over masonry pilasters will be measured and paid for as plaster only.

A coefficient of 1.63 shall be adopted for the measurement of one side plastering on honey comb work having 6 x 10 cm. opening.

Moulded cornices and coves.

(a) Length shall be measured at the centre of the girth.

(b) Moulded cornices and coves shall be given in square metres the area being arrived at by multiplying length by the girth.

(c) Flat or weathered top to cornices when exceeding 15 cm in width shall not be included in the girth but measured with the general plaster work.

(d) Cornices which are curved in their length shall be measured separately.

Exterior plastering at a height greater than 10 m from average ground level shall be measured separately in each storey height. Patch plastering (in repairs) shall be measured as plastering new work, where the patch exceed 2.5 sqm. extra payment being made for preparing old wall, such as dismantling old plaster, raking out the joints and cleaning the surface. Where the patch does not exceed 2.5 sqm in area it shall be measured under the appropriate item under sub head ‘Repairs to Buildings.’

Deductions in measurements, for opening etc. will be regulated as follows:

(a) No deduction will be made for openings or ends of joists, beams, posts, girders, steps etc. upto 0.5 sqm in area and no additions shall be made either, for the jambs, soffits and sills of such openings.

The above procedure will apply to both faces of wall.

(b) Deduction for opening exceeding 0.5 sqm but not exceeding 3 sqm each shall be made for reveals, jambs, soffits sills, sills, etc. of these openings.

(i) When both faces of walls are plastered with same plaster, deductions shall be made for one face only.

(ii) When two faces of walls are plastered with different types of plaster or if one face is plastered and other is pointed or one face is plastered and other is unplastered, deduction shall be made from the plaster or pointing on the side of the frame for the doors, windows etc. on which width of reveals is less than that on the other side but no deduction shall be made on the other side. Where width of reveals on both faces of wall are equal, deduction of 50% of area of opening on each face shall be made from area of plaster and/or pointing as the case may be.

(iii) For opening having door frame equal to or projecting beyond thickness of wall, full deduction for opening shall be made from each plastered face of wall.

(c) For opening exceeding 3 sqm in area, deduction will be made in the measurements for the full opening of the wall treatment on both faces, while at the same time, jambs, sills and soffits will bemeasured for payment.

In measuring jambs, sills and soffits, deduction shall not be made for the area in contact with the frame of doors, windows etc.

CEMENT PLASTER WITH A FLOATING COAT OF NEAT CEMENT

The cement plaster shall be 12, 15 or 20 mm thick, finished with a floating coat of neat cement, as described in the item.

Specifications for this item of work shall be same as described in 13.1 except for the additional floating coat which shall be carried out as below.

When the plaster has been brought to a true surface with the wooden straight edge it shall be uniformly treated over its entire area with a paste of neat cement and rubbed smooth, so that the whole surface is covered with neat cement coating. The quantity of cement applied for floating coat shall be 1 kg per sqm. Smooth finishing shall be completed with trowel immediately and in no case later than half an hour of adding water to the plaster mix.

WHITE WASHING WITH LIME

Scaffolding

Wherever scaffolding is necessary, it shall be erected on double supports tied together by horizontal pieces, over which scaffolding planks shall be fixed. No ballies, bamboos or planks shall rest on or touch the surface which is being white washed.

For all exposed brick work or tile work, double scaffolding having two sets of vertical supports shall be provided. The supports shall be sound and strong, tied together with horizontal pieces over which scaffolding planks shall be fixed.

Note: In case of special type of brick work, scaffolding shall be got approved from Engineer-in- Charge in advance.

Where ladders are used, pieces of old gunny bags shall be tied on their tops to avoid damage or scratches to walls.

For white washing the ceiling, proper stage scaffolding shall be erected.

Preparation of Surface

Before new work is white washed, the surface shall be thoroughly brushed free from mortar droppings an foreign matter.

Preparation of Lime Wash

The lime wash shall be prepared from fresh stone white lime (Narnaul or Dehradun quality). The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm of gum dissolved in hot water, shall be added to each 10 cubic dicimetre of the cream. The approximate quantity of water to be added in making the cream will be 5 litres of water to one kg of lime.

Indigo (Neel) upto 3 gm per kg of lime dissolved in water, shall then be added and stirred well. Water shall then be added at the rate of about 5 litres per kg. of lime to produce a milky solution.

Application

The white wash shall be applied with moonj brushes to the specified number of coats. The operation for each coat shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first stroke, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Engineer-in-Charge before the subsequent coat is applied. No portion of the surface shall be left out initially to be patched up later on.

For new work, three or more coats shall be applied till the surface presents a smooth and uniform finish through which the plaster does not show. The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

Protective Measures

Doors, windows, floors, articles of furniture etc. and such other parts of the building not to be white washed, shall be protected from being splashed upon. Splashings and droppings, if any shall be removed by the contractor at his own cost and the surfaces cleaned. Damages if any to furniture or fittings and fixtures shall be recoverable from the contractor.

Measurements

Length and breadth shall be measured correct to a cm. and area shall be calculated in sqm correct to two places of decimals.

Measurements for Jambs, Soffits and Fills etc. for openings shall be as described in 13.1.9.

Corrugated surfaces shall be measured flat as fixed and the area so measured shall be increased by the following percentages to allow for the girthed area. Corrugated non-asbestos cement sheet 20% Semi corrugated non-asbestos cement sheet 10%

Cornices and other such wall or ceiling features, shall be measured along the girth and included in the measurements.

The number of coats of each treatment shall be stated. The item shall include removing nails, making good holes, cracks, patches etc. not exceeding 50 sq. cm. each with material similar in composition to the surface to be prepared.

SATNA LIME WASHING

Satna lime wash shall be used as a base coat where so specified. The specifications for ‘white washing with lime’ shall apply except that Satna or Katni quality lime shall be used in place of Narnaul or Dehradun quality lime and the wash will be mixed to a thicker consistency.

WHITE WASHING WITH WHITING

Preparation of Mix

Whiting (ground white chalk) shall be dissolved in sufficient quantity of warm water and thoroughly stirred to form a thin slurry which shall then be screened through a clean coarse cloth. Two kg of gum and 0.4 kg of copper sulphate dissolved separately in hot water shall be added for every cum of the slurry which shall then be diluted with water to the consistency of milk so as to make a wash ready for use.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 11 : HARDWARE

EXTENT AND INTENT

The intention of the contract is that the building as shown shall be completely equipped with required hardware. Any required item not noted or listed shall be finished in a grade equal to and in harmony with similar item listed.

The contractor shall furnish all labour, materials, tools, appliances and incidentals required to complete the hardware work specified herein or listed in the schedule of hardware, or as may be required by the actual conditions at the building. Include the necessary screws, special screws, bolts, expansion bolts and other devices necessary shall be of sufficient size to securely and permanently fix the hardware in place. No steel or iron screws shall be used. Screws shall match material and finish of article being fastened.

GENERAL

All hardware shall be of the best quality of its type and strictly in conformity with the materials and finish described in schedule of hardware. If called upon to do so the contractor shall arrange to get hardware specially manufactured to the design, requirements and standards.

SAMPLES

Samples of each different item of hardware including screws or any particular item of hardware shall be submitted for approval.

QUALITY

All hardware shall be of perfect fit, uniform in finish and free from imperfections that affect serviceability or mar the appearance.

INSTALLATION

All hardware shall be installed by skilled workmen, equipped with proper and adequate tools. The hardware shall be installed true, plumb and square in accordance with the hardware schedule and the manufacturer's instructions.

PROTECTION

Hardware shall not be installed earlier than necessary and it shall be the responsibility of the contractor to protect all hardware, removing some when necessary for protection and deliver all in good working order and unblemished. Any defective or marred items shall be made good to the satisfaction

GUARANTEE

The contractor shall be responsible for the proper working of all hardware, for a period of one year from the date of the completion and acceptance of the building.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 12 : CARPENTRY AND JOINERY

EXTENT AND INTENT
It is the intent of this specification to include all carpentry and joinery work in connection with doors, windows, glazing, partitions, ceilings, paneling, cabinets and other items of wood work called for in the drawings.

GENERAL
The carpentry and joinery work shall include the furnishing of all labour, materials, equipment, incidentals and appliances required to complete the work including the provision and installation of fastening devices and hardware in accordance with the drawings and the attached hardware schedule.

TIMBER
Teakwood where called for, shall be of selected best quality Indian teakwood. All timber shall be uniform in texture, free from large, loose, dead or cluster knots, wanes, injurious open shaken bore holes, rot, decay discolouration, soft or spongy spots, hollow pockets, pith or centre heart and all other defects and blemishes.

SAMPLES AND SHOP DRAWINGS
The contractor shall before proceeding with the work, submit to the Consultant for his approval complete samples of the various materials including hardware and fastening devices and shop drawings and large scale details covering all joinery work.

ROUGH CARPENTRY
Materials Unless otherwise called for, all framing and other concealed wood members shall be of first class Indian teakwood and shall be seasoned to a moisture content of not less than 10% or more than 15%. Wood of greater moisture content shall not be used in any part of the structure.

WORKMANSHIP
All carpenter's work shall be done by skilled workmen using proper tools. All joints shall as far as possible, be mortised and tenoned and glued with best quality approved waterproof glue. Where mortise tenon joints are not possible, the joints shall be securely nailed with the longest nails that may be used without splitting the wood. Wherever it is necessary or an adequate joint cannot be formed by nailing, the members shall be lapped or jointed by GI straps or extra wood blocks. All joints shall be done with neatness. Cross bracing, solid blocking and bracing shall be provided according to best practice.

JOINERY
Materials: Finished wood work and joinery in teakwood, where called for shall be surfaced with straight grained best quality Indian teakwood free from knots and other blemishes and imperfections. All finished woodwork and joinery shall be seasoned to not less than 10% or more than 12½ % moisture content. All finished woodwork and joinery shall be wrought and planed smooth to the correct dimensions and profiles.

All joinery work shall be securely mortised and tenoned and glued with best quality waterproof glue. Or all joinery work use of nails shall not be permitted, and wood screws of appropriate size and of approved make shall be used. Wherever practicable, means of fastening the various parts together shall be concealed. All work (both carpentry and joinery) shall be to the dimensions shown on the drawings.

All interior wood finish, doors and cabinet work shall be smoothly treated and sanded at the building after erection, until all defects are entirely removed. Any material showing splits saw, sand paper or other defacing marks or other defects shall be rejected. All exposed wood and plywood shall be straight grained of matched grain and colour before being fabricated.

Installation Doors, Windows, partitions and cabinet work shall be installed in position after the plaster in the section for which it is intended is sufficiently dry. All interior and exterior doors, partitions, glazing cabinet work and other fixed wooden equipment shall be properly installed, level, plumb and true. But joints shall be avoided wherever possible; if unavoidable the joints shall be beveled. All exterior angles shall be mitered. Adjoining interior wood members shall match and harmonise.

INTERIOR DOOR SHUTTERS

Interior wood door shutters, unless otherwise noted or specified, shall be 38mm thick solid core phenol formaldehyde resin bonded, flush shutters, commercial ply faced on both faces. Specification IS: 2202 (Part I)- 1966.

Shutters shall be ordered on the manufacturer to sizes as called for and shall be provided with first class teakwood edging, glued and nailed on the edges of the shutter, as shown on drawings.

BLOCK BOARD ANY PLY

Block boards and ply for partitions, cupboards and all other cabinet work shall be solid core, phenol formaldehyde resin bounded of approved make as called for.

Unless otherwise shown all block boards and ply shall be commercial ply veneered on both faces. Samples of flush doors, ply, block boards, etc., and all shutters, boards, etc., to be used in the work shall conform to the approved sample in all respects.

PARTITIONS AND CABINET WORK

General: Partitions, cabinets, etc., shall be fabricated and assembled in the workshop as far as practicable and then brought inside the building ready to set in place. The various members shall be worked in the best manner known to the trade, mortised and tenoned, dowelled, blocked and glued together so as to avoid the use of nails as much as possible. The details shall be closely followed, moulding clearly cut and miters accurately made. Free edge of shutters, shelves, partitions, sides, etc., shall be provided with first class teakwood edging, glued and nailed in approved manner. Shelves, where shown fixed, shall be supported on aluminum or other cleats or in other manner. Adjustable shelves shall have brass sockets and pins as detailed on drawings.

Drawer bottoms shall be of 6mm commercial ply, unless otherwise shown. Drawer front, sides and back shall be of first class teakwood. The drawers shall slide on wooden bearers.

Timber skirting where called for shall be of first class teakwood, cut to required sizes, planed smooth on visible faces and fixed in position in approved manner. Cut-outs, openings, etc., shall be provided in the counters and cabinets to accommodate sinks, washbasins, cooking ranges, pipes, etc., as shown on drawings and as required at site.

HARDWARE FITTINGS

Hinges, handles, knobs, locks, ball catches, adjustable, shelf fitting, and other hardware fittings for doors and cabinet work shall be of the best quality and specified make. The number, size, etc., shall be as per the hardware schedule.

PRESERVATIVE TREATMENT

All wood work in contact with masonry shall be painted with approved asphalt or bitumen paint before placing. Care shall be taken to keep exposed surfaces clear from tar, etc. The felt shall be used to isolate wood from masonry wherever practicable. All concealed wood etc., shall be treated fully and liberally with soling before placing in position.

PAINTING AND POLISHING

All exposed teak faces of partitions, glazing, doors, cabinet work etc., shall be painted/polished oiled to approved finish. Door shutters, internal faces of cupboards and cabinets, etc., shall be enamel painted to approved finish. Drawer bottoms, sides of drawers, etc., oiling, etc., shall be carried out as specified under “Painting”.

PROTECTION OF WORK

The contractor shall be responsible for the temporary doors and closing in opening necessary for the protection of the work during progress. We shall also provide and maintain any other temporary covering required for the protection of finished wood work that may be damaged during the progress of the work if left unprotected.

OTHER SPECIFICATIONS

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 13 : PAINTING

EXTENT AND INTENT

The contractor shall supply all materials, labour, tools, ladders, scaffolding and other equipment necessary for the completion and protection of all painting work. Painting, as herein specified shall be applied to all surfaces requiring painting throughout the interior and exterior of the buildings as given in the schedule of finishes or elsewhere. The painting shall be carried out by a specialist, approved by the Consultant.

STORAGE

Storage of materials to be used on the job shall be only in a single place. Such storage place shall not be located within any of the buildings included in the contract.

MATERIALS

Materials used in the work shall be of manufacture approved. Ready mixed paints, varnishes, enamels, lacquers, stains, paste fillers, distempers and other materials must be delivered to the job site in the original containers, with the seals unbroken and labels intact. Each container shall give the manufacturer's name, type of paint, colour of paint and instructions for reducing. Thinning shall be done only in accordance with directions. Remove rejected materials immediately from the premises.

COLOUR

All colours, as provided in the colour schedule. The contractor shall as far as possible use pre-mixed manufacturer's colours and shall prepare painted samples of the colours selected. No work is to proceed until the Consultant has given his approval, preferably in writing, of the colour samples.

COMMENCEMENT OF WORK

Painting shall not be started until the surfaces to be painted are in a condition fit to receive painting.

Painting work shall be taken in hand only after all other builders work is completed.

Buildings where painting work is to be commenced shall be thoroughly swept and cleaned up before commencement of painting.

SCAFFOLDING

Only double scaffolding having two sets of vertical supports shall be provided for all painting work. The supports shall be tied together with horizontal pieces over which the scaffolding planks shall be fixed.

All the vertical and horizontal members of the scaffolding shall be placed sufficiently away from the surfaces to be painted to ensure proper and uninterrupted application.

WORKMANSHIP

The workmanship shall be of the very best, all materials evenly spread and smoothly flowed as without runser sags, using good quality tools, brushes, etc., as required. Only skilled painters shall be employed. A properly qualified foreman shall be constantly on the job whilst the work is proceeding. All surfaces to be painted shall be cleaned free of all loose dirt and dust before painting is started. All work where a coat of material has been applied must be inspected and approved before application of the succeeding specified coat. Each undercoat shall be distinct shade of the approved colour.

Before painting, remorse hardware, accessories, plates and similar items or provide sample protection to all such items. Upon completion of each space, replace all fixtures removed. Remove doors if necessary to paint bottom edge. Use only skilled mechanics for the removal and replacement of above items.

CONCEALED SURFACES
All interior and exterior trim, door frames, doors, shelving, cabinet work shall be thoroughly and carefully back painted as all surfaces and edges which will be concealed when installed. Such surfaces shall be clean, dry, sanded and properly prepared to receive the paint. Tops, bottom and edges of doors shall be finished same as the rest of the door.

PROTECT AND CLEAN
Contractor shall protect not only his own work at all times, but shall also protect all adjacent work and materials by suitable covering during progress of his work. Upon completion of his work, he shall remove all paint and varnish spots from floors, glass and other surfaces. Any defaced surfaces shall be cleaned and the original finish restored. He shall remove from the premises all rubbish and accumulated material and shall leave the work in clean, orderly and acceptable conditions.

PREPARATION OF SURFACES
WOOD: Sand paper to a smooth even surface and then dust off and wipe clean. Touch up all knots and pit pockets with shellac on interior wood and without desealer on exterior work. After priming coat has been applied thoroughly fill all nail holes, irregularities and cracks. Use plaster wood filler for stained or natural finish and putty for painted work.

PLASTER WORK:
Fill all holes, cracks and abrasions with plaster of paris, properly prepared and applied and smoothed off to match adjoining surfaces. Do not use sand paper on plaster surfaces. Plaster shall be allowed to dry for at least 12 (twelve) weeks before the application of paint.

STEEL AND IRON:
All surfaces shall be washed with mineral spirits to remove any dirt or grease before applying paint. Where rust or scale is present, it shall be wire brushed and sand papered clean. All cleaned surfaces shall be given one coat of approved phosphate before prime coat in accordance with the manufacturer's instructions. Shop coats of paint that have become marred shall be cleaned off, wire brushed, and spot primed over the affected areas.

GALVANISED METAL
Galvanised metal shall be thoroughly cleaned with naphta and treated with a solution consisting of 5 gallons of 36% accetic acid, 1.36 kg of blue vitriol and 1.36 kg of powdered alum dissolved in 225 litres of water, prepared in a wooden container and applied with a brush. Allow to dry thoroughly and brush off before applying paint.

APPLICATION
The paint shall be continuously stirred in the container so that its consistency is kept uniform throughout.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the latter in the direction of the grain of the wood. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternatively in opposite directions, two or three times and then finally brushing lightly in a direction at right angles to the same. In this process no brush marks shall be left after the laying-off is finished. The full process of crossing and laying off will constitute one coat.

Where so stipulated, the painting shall be carried out using spray machines suited for the nature and location of the work to be carried out. Only skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner. Spraying shall be carried out only in dry conditions. No exterior painting shall be done in damp foggy or rainy weather. Surface to be painted shall be clean, dry, smooth and adequately protected from dampness. Each coat shall be applied in sufficient quantity to obtain complete coverage, shall be well brushed and evenly worked out over the entire surface and into all corners, angles and crevices allowed to thoroughly dry. Second coat shall be of suitable shade to match final colour, and shall be approved by the Consultant before final coat is started. Allow at least 48 hours drying time between coats for interior and 7 days for exterior work, and if in the judgments of the Consultant more time is required it shall be allowed. Finished surfaces shall be protected from dampness and dust until completely dry. Finished work shall be uniform, of approved colour, smooth and free from runs, sags, defective brushing and clogging. Make edges of paints adjoining other materials of colours sharp and clean, without overlapping.

In order to achieve a superior finished surface, putty paste fillers shall be used on, all surfaces to be painted, to fill pores, dents, etc. The putty/paste fillers shall be approved quality and manufacture and shall be applied to the surface with a knife or other sharp edged tools after the priming coat as well as after each undercoat. The surface, after filling with putty/paste filler, shall be rubbed down with fine sand paper and dusted off before the application of the subsequent coat.

Paste wood filler. When set, shall be wiped across the grains of the wood and then with the grain to secure a clean surface. Surface to be stained shall be covered with a uniform coat of stain wiped off if required.

FINISH

The painted surfaces shall be finished to required texture. Matt finish shall be achieved by use of sponge rollers or stippling brushes as called for.

TYPES OF PAINT FINISHES

Enamel Paint:

a) **Wood or Plastered Surfaces**: Pigmented priming coat followed by one undercoat and two more finishing coats of enamel paint. Paste filler to be applied after every coat excepting the final finishing coat and sanded.

b) **Non-Galvanized Steel Surfaces**: Coat of red oxide primer after phosphating followed by the three or more coats of synthetic enamel paint. Paste filler to be applied after every coat excepting final finishing coat and sanded.

c) **Galvanized Steel Surfaces**: Priming coat of galvanized metal primer after washing with galvanized metal cleaner, followed by three or more coats of synthetic enamel paint. Paste filler to be applied after every coat excepting final finishing coat and sanded.

Plastic Emulsion Paint:
Pigmented priming coat (emulsion thinned with water) followed by three or more finishing coats of plastic emulsion paint. Paste filler to be applied after every coat excepting the final finishing coat and sanded.

Oil Bounded Distemper
Pigmented primer (cement primer) coat followed by three of more finishing coats of oil bound distemper. Paste filler to be applied after every coat excepting the final finishing coat and sanded.

Oiling
Three coats of linseed oil (conforming to IS:75-1950) applied with brushes. Each coat to be applied after the previous coat is thoroughly dried. Grains to be filled with approved powder and surface rubbed smooth before oiling.

SPIRIT POLISHING
Polish: Polishing material shall be prepared by dissolving pure shellac, varying in shade from pale orange to lemon yellow, free from dirt and other materials, in methylated spirit at the rate of 0.15 kg. shellac to 1 liter of spirit. Suitable pigment to achieve the required shade of polish .

Preparation of Surface: The surface, cleaned of all dirt, etc., shall be rubbed down smooth with sand paper and well dusted. Knots if visible shall be covered with a preparation of red lead and glue size laid on while hot. Holes and indentations shall be stopped with glazier's putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit at the rate of 1.5 kg of whiting to one liter of spirit. The surface shall again be rubbed down perfectly smooth with fine sand paper and wiped clean.

Application: Three or more coats of polish shall be applied over the above surface, to achieve a finish. The polish shall be applied with a pad of woolen cloth covered by a fine cloth. The pad moistured with polish shall be rubbed hard on the wood surface in a series of overlapping movements, applying the material uniformly over the entire area to give an even finish. Subsequent coats shall be applied in a similar manner after the previous coat is allowed to dry. The finishing shall be done with a fresh piece of clean fine cloth, damped with methylated spirit and applied by light rubbing. The finished surface shall have a uniform texture and high gloss.

WAX POLISHING
Wax polishing shall be done with ready made wax polish of approved brand and manufacture.

Preparation of Surface: The surface to be polished shall have been finished smooth. Knots, cracks and holes on the surface shall be cleaned and filled with wood putty (fine saw dust mixed with bees wax). The fittings when dry shall be rubbed down with a carpenter's file and then the entire surface shall be rubbed down perfectly smooth and wiped clean. In no case shall sand papers be rubbed across the grains so that even fine marks are not seen on the surface.

Application: The polish shall be applied evenly with a clean soft pad of cotton cloth in such a way that the surface is completely and fully covered. The surface is then continuously rubbed for half an hour. When the surface is quite dry a second and third coat shall be applied in the same manner and rubbed continuously until the surface is dry.

The final coat shall then be applied and rubbed for two hours more until the surface has

assumed a uniform gloss and is dry, showing no sign of stickiness. The finished surface shall have a uniform glossy finish.

PAINTING OF PLUMBING, HEATING AND ELECTRICAL EQUIPMENT
All exposed unfinished plumbing; heating, electrical equipment shall receive a painted finish as specified above.

CLEANING
All rubbish waste or surplus material shall be removed from time to time, and all wood work, hardware, floors, or other adjacent work shall be cleaned.

All glass throughout shall have all paint or varnish spots and brush marks removed and upon completion of the painting work, shall be washed and polished on both sides. All glass that is scratched and damaged by contractor's work, or while cleaning off the paint from the glass shall be replaced by the contractor at his cost.

Hardware and other unpainted surfaces shall be cleaned using lacquer thinner or paint remover.

The contractor shall apply the final coat of paint to all internal walls and other surfaces just before the expiry of the defects liability period.

Powder coat Paint - Base coat

Powder coating is sprayed with an electrostatic spray gun with a potential difference of about 270 Volts (approx.) after this the subtrait/object is kept in an oven at a temperature of 180 degree C. for 30 minutes.

EXTERIOR PAINTING ON WALL

Material
The paint shall be (Textured exterior paint/Acrylic smooth exterior paint/premium acrylic smooth exterior paint) of approved brand and manufacture. This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty containers shall not be removed from the site of work till the relevant item of work has been all completed.

Preparation of Surface
For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae, fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received after inspection before painting is commenced.

Application
Base coat of water proofing cement paint

All specifications in respect of base coat of water proofing cement paint shall be as described under 13.21.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers

so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions shall be followed meticulously. The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust.

Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks.

PAINTING

Scope of work
The work covered under these specifications consists of furnishing the various types of paints and also the workmanship for these items, in strict compliance with the specifications.

Materials
Paints, oils varnishes etc. of approved brand and manufacture shall be used. Ready mixed paints as recovered from the manufacturer without any admixture shall be used. If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinner recommended by the manufacturer or as instructed by the Engineer-In-Charge shall be used. Approved paints, oils or varnishes shall be brought to the site of work by the contractor in their original containers in sealed condition.

The contractor shall associate the chemist of paint manufacturers before commencement of work, during and after the completion of work who shall certify the suitability of the surface to receive painting and the paint before use etc.

Commencing Work

Scaffolding
Wherever scaffolding is necessary, it shall be erected on double supports ties together by horizontal pieces, over which scaffolding planks shall be fixed. No bellies, bamboos or planks shall rest on or touch the surface which is being painted. Were ladders are used; pieces of old gunny bags shall be ties on their tops to avoid damage or scratches to walls.
For painting of the ceiling, proper stage scaffolding shall be erected.

Preparation of Surface
The surface shall be thoroughly cleaned. All dirt, rust, scales, smoke and grease shall be thoroughly removed before painting is started. Minor patches if any in plastered / form finished surfaces shall be repaired and finished in line and level in C.M/ 1:1 and cracks and crevices shall be filled with approved filler, to the full satisfaction of the Engineer- In - Charge. The prepared surface shall have received the approval of the Engineer-In-Charge after inspection, before painting is commenced.

Application
Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its containers. When applying also, the paint shall be continuously stirred in the smaller containers so that consistency is kept uniform.

The external surfaces of the buildings under reference including the R.C.C. Jali, fins and the panels above and the panels above and below the window etc. shall be finished with colours

of approved shade. The contractor will make suitable samples at site for approval before taking up the work in hand and they will be allowed to proceed with the work only after getting approval for the same.

The painting shall be laid on evenly and smoothly by means of crossing and laying off, the later in the direction of the grain in case of wood. The crossing and laying off consists of covering the area with paint, brushing the surface hard for the first time and then brushing alternately in opposite directions two or three time and then finally brushing lightly in direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying will constitute one coat.

Where so stipulated, the painting shall be done with spraying. Spray machine used may be (a) a high pressure or (b) a low pressure (large air gap), depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner. Spraying should be done only when dry condition prevails.

Each coat shall be allowed to dry cut thoroughly and rubbed smooth before the next coat is applied. This should be facilitated by thorough ventilation.

Each coat except the last coat shall be tightly rubbed down with sand paper or fine pumice stone and cleaned of dust before the next coat is laid.

No left over paint shall be put back into the stock tins. When not in use, containers shall be kept properly closed.

The final painted surface shall present a uniform appearance and no streaks, blisters, hair marks from the brush or clogging of paint puddles in the corners of panels, angles of moldings etc. shall be left on the work. In case of cement based paints / primers, the absorbent surfaces shall be evenly damped so as to give even suction. In any weather, freshly painted surfaces shall be kept damp for at least two days.

In painting doors and windows, the putty around the glass panes must also be painted, but care must be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out while painting. Prospect covers of electrical switch boxes have to be painted from inside by removing them. Care shall be taken while removing them in position after painting with respective approved paints. In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

Any damage caused during painting work to the existing works / surfaces shall be made good by the contractor.

Painting, except the priming coat, shall generally be taken in hand after all other builders work, practically finished.

Precautions

All furniture, lightings, fixture, sanitary, fittings, glazing, floors etc. shall be protected by covering and stains, smears, splashing, if any shall be removed and any damage done shall be made good by the contractor.

PAINTING, PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACES

The primer for wood work, iron work or plastered surface shall be as specified in the description of the Indicative item/specification/drawing.

Primer for wood work / Iron & Steel / Plastered / Aluminium surfaces shall be as specified below:-

Sl.No.	Surfaces	Primer to be used
a)	Wood work (hard and soft wood)	conforming to IS 3536 – 1966
b)	Resinous wood and ply wood	Aluminium Primer
c)	Iron & Steel, aluminium and galvanized steel Work :	Zinc chromate primer conforming to IS 104-1962
d)	Plastered surfaces, cement brick work, Asbestos surfaces for oil bound	Cement primer

The primer shall be ready mixed primer of approved band and manufacture.

Preparation of Surface

Wood work
The wood work to be painted shall be dry and free from moisture.

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any, shall be covered with preparation of red lead made by grinding red lead in water and mixing with strong glue sized and used hot. Appropriate filler material with same shade as paint shall be used where so desired by the Engineer-In-Charge.

The surface treated for knotting shall be dry before painting is applied. After the priming coat is applied, the holes and indentation on the surface shall be stopped with glaziers putty or wood putty (for specifications for glaziers putty and wood putty – refer as mentioned herein before). Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is therefore liable to crack.

Iron and Steel Work:

All rust and scales shall be removed by scrapping or by brushing with steel wire brushes. Hard skin of oxide formed on the surface of wrought iron during rolling which becomes loose by rusting, shall be removed.

All dust and dirt shall be thoroughly wiped away from the surface.

If the surface is wet, it shall be dried before priming coat is undertaken.

Plastered Surface
The surface shall ordinarily not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and where drying is satisfactory, painting shall be taken in hand. Before primer is applied, holes and undulations, shall be filled up with plaster of Paris / putty and rubbed smooth.

a) Application:

The primer shall be applied with brushes, worked well into the surface and spread even and smooth. The painting shall be done by crossing and laying off as described herein before.

b) Other details:

The specifications for Painting (General) shall hold good so far it is applicable.

FRENCH SPIRIT POLISHING

Polish
Pure shellac varying from pale orange to lemon yellow colour, free from resin or dirt shall be dissolved in methylated spirit at the rate of 140 gm. of shellac to 1 liter of spirit. Suitable pigment shall be added to get the required shade.

Preparation of surface
The surface shall be cleaned. All unevenness shall be rubbed down smooth with sand paper and well dusted off. Knots if visible shall be covered with a preparation to red lead and glue size laid on while hot. Holes and indentations on the surface shall be stopped with glaziers putty. The surface shall then be given a coat of wood filler made by mixing whiting (ground chalk) in methylated spirit, the surface shall again be rubbed down perfectly smooth with glass paper and wiped clean.

Application
The number of coats of polish to be applied shall be as described in the Indicative item/specification/drawing. A pad of wooden cloth covered by fine cloth shall be used to apply the polish and shall be moistened with the polish and rubbed hard on the wood, in a series of overlapping circles applying the mixture sparingly but uniformly over the entire area to give an even level surface. A trace of linseed oil on the face of the pad facilitates this operation. The surface shall be allowed to dry and the remaining coats applied in the same way. To finish off, the pad shall be covered with a fresh piece of clean fine cotton cloth, slightly damped with methylated spirit and rubbed lightly and quickly with circular motions. The finished surface shall have a uniform texture and high gloss.

WHITE WASHING WITH LIME

Preparation of surface
Before work which is to white washed, the surface shall be thoroughly brushed free from mortar dropping and foreign matter.

Preparation of lime wash:
The wash shall be prepared from fresh lime stone white lime. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thin cream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth. 40 gm. of gum dissolved in hot water or Binder which shall be added to each 10 cubic decimeter of the cream. The approximate quantity of water to be added in making the cream will be 5 liters of water to one kg. of lime. Indigo (Robin Blue) up to 3 gm per kg of lime dissolved in water, shall then be added and wash stirred well. Water shall then be added at the rate of about 5 liters per kg. of lime to produce a milky solution. The lime shall be tested in a chemical laboratory and test certificate submitted, to conform the quality of lime with regard to its physical and chemical properties.

Application of White washing:
The white wash shall be applied with brushes or by spray in the specified number of coats. The operation for each coat in the case of brush application shall consist of a stroke of the brush given from the top downwards, another from the bottom upwards over the first strike, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. No portion of the surface shall be left out initially to be patched up later on.

The finished dry surface shall not show any sign of cracking and peeling nor shall it come off readily on the hand when rubbed.

DISTEMPERING

Acrylic Distemper
As per (IS 428-1969) of approved brand and manufacture, colour and required shade shall be used. The primer where used as on new work shall be cement primer or distemper primer as specified in the Indicative item/specification/drawing. These shall be of the same manufacture as distemper. The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by manufacture. Only quality of distemper required for days work shall be prepared.

Preparation of surfaces

The surface shall be prepared as described herein before for painting work in so far as it is applicable and approved putty / filler shall be applied to the entire area to get uniform and smooth surface before application of primer.

Application
The cement primer or distemper primer shall be applied by brushing and not by spraying. Hurried priming work shall be avoided, particularly on absorbent surfaces. The surfaces shall be finished as uniformly as possible leaving no brush marks, priming coat shall be allowed to dry for at least 48 hours. Before applying distemper, the surface shall be lightly sand prepared to make it smooth for receiving, the oil bound distemper, taking care not to rub out the priming coat. A time interval of at least 24 hours shall be allowed between consecutive coats to permit the proper drying of the preceding coat. Two or more coats of distemper as are found necessary shall be applied over the priming coat to obtain an even shade.

All paints have to be low VOC paints and certificates of the same should be provided by the contractor.

WALL PAINTING WITH PLASTIC EMULSION PAINT
The plastic emulsion paint is not suitable for application on external, wood and iron surface and surfaces which are liable to heavy condensation. These paints are to be used on internal surfaces except wooden and steel.

Plastic emulsion paint as per IS 5411 of approved brand and manufacture and of the required shade shall be used.

Painting on New Surface
The wall surface shall be prepared as specified in 13.31.

Application *:* The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush, spray or roller. The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine. Thinning with water will be particularly required for the under coat which is applied on the absorbent surface. The quantity of water to be added shall be as per manufacturer's instructions.
The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

Precautions

a). Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water. Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.
b). In the preparation of wall for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.
c). Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.
d). Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application. Other details shall be as specified in 13.23 as far as they are applicable.

PAINTING WITH SYNTHETIC ENAMEL PAINT

Synthetic enamel paint (conforming to IS 2932) of approved brand and manufacture and of the required colour shall be used for the top coat and an undercoat of ordinary paint of shade to match the top coat as recommended by the same manufacturer as far the top coat shall be used.

Painting on New Surface

Preparation of surface shall be as specified in 13.25.1.1 as the case may be.

Application : The number of coats including the undercoat shall be as stipulated in the item.

a). *Under Coat :* One coat of the specified ordinary paint of shade suited to the shade of the top coat, shall be applied and allowed to dry overnight. It shall be rubbed next day with the finest grade of wet abrasive paper to ensure a smooth and even surface, free from brush marks and all loose particles dusted off.
b). *Top Coat :* Top coats of synthetic enamel paint of desired shade shall be applied after the undercoat is thoroughly dry.

TEXTURE PAINT
(Work to be carried out as per Manufacturer Specification)

Material

The paint shall be textured exterior paint of required shade : (Two or more coats applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containers in sealed condition. The material shall be brought in at a time in adequate quantities to suffice for the whole work or at least a fortnight's work. The materials shall be kept in the joint custody of the contractor and the Engineer-In-Charge. The empty containers shall not be removed from the site of work till the relevant Indicative item/specification of work/drawing has been completed and permission obtained from the Engineer-In-Charge.

Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust, algae,

fungus or moth, grease and other foreign matter of brushing and washing, pitting in plaster shall make good, surface imperfections such as cracks, holes etc. should be repaired using white cement. The prepared surface shall have received the approval of the Engineer-In-Charge after inspection before painting is commenced.

Application
Base coat of water proofing cement paint. All specifications in respect of base coat of water proofing cement paint shall be as describe.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its container, when applying also the paint shall be continuously stirred in the smaller containers so that its consistency is kept uniform. Dilution ratio of paint with potable water can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-In-Charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure to atmosphere the paint may thicken and also be kept safe from dust. Paint shall be applied with a brush on the cleaned and smooth surface. Horizontal strokes shall be given, First and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished as uniformly as possible leaving no brush marks. The specifications in respect of scaffolding and protective measures shall be as described.

External Texture finish of approved makes as per approved design and pattern. Texture finish shall be applied over the plastered surface with required thickness shall 2 to 2.5 mm thickness to form the necessary approved design by using trowel / putty blade and it should be allowed for drying minimum 12 hrs., before the application of top painting, 2 coats or more of external weather proof water based emulsion shall be applied over this and a coat of primer may be applied based on the approved texture pattern. Including surface preparation like through cleaning, pre wetting & removal of loose mortars, etc.

Painting Steel work
Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications : Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 Sqm over an under coat of primer applied @ 0.80 ltr/10 Sqm of approved brand and manufacture.

PLASTER OF PARIS PUTTY
Providing and applying plaster of paris putty of 2 mm thickness over plastered surface to prepare the surface even and smooth complete

DELUXE MULTI SURFACE PAINT
Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications : Painting wood work with Deluxe Multi Surface Paint of required shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @0.75 ltr/10 sqm of approved brand and manufacture

ACRYLIC EMULSION PAINT
Wall painting with acrylic emulsion paint, having VOC (Volatile Organic Compound) content less than 50 grams/ litre, of approved brand and manufacture, including applying additional coats wherever required, to achieve even shade and colour.

ACRYLIC DISTEMPER
Distempering with 1st quality acrylic distemper (ready mixed) having VOC content less than

50 gram/litre, of approved manufacturer and of required shade and colour all complete to achieve even shade and colour:

EPOXY PAINT
Finishing with Epoxy paint (two or more coats) at all locations prepared and applied as per manufacturer's specifications including appropriate priming coat, preparation of surface, etc. complete.

OIL BOUND WASHABLE DISTEMPER
Distempering with oil bound washable distemper of approved brand and manufacture to give an even shade. New work (Two or more coats applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm

The specifications in respect of scaffolding, protective measures, measurements and rate shall be as described under 13.14.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 14 : STRUCTURAL GLAZING

Providing and supplying aluminium extruded tubular and other aluminium sections as per the architectural drawings and approved shop drawings , the aluminium quality as per grade 6063 T5 or T6 as per BS 1474,including super durable powder coating of 60-80 microns conforming to AAMA 2604 of required colour and shade as approved by the Engineer-in-Charge. (The item includes cost of material such as cleats, sleeves, screws etc. necessary for fabrication of extruded aluminium frame work. Nothing extra shall be paid on this account). The weight of aluminium extruded section shall be taken for purpose of payment.

Designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing (with open joints) for linear as well as curvilinear portions of the building for all heights and all levels, including:

(a) Structural analysis & design and preparation of shop drawings for the specified design loads conforming to IS 875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminum sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, flashings, fire stop (barrier)-cum-smoke seals, microwave cured EPDM gaskets for water tightness, pressure equalisation & drainage and protection against fire hazard including:

(b) Fabricating and supplying serrated M.S. hot dip galvanised / Aluminium alloy of 6005 T5 brackets of required sizes, sections and profiles etc. to accommodate 3 Dimentional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon seperator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers.

(c) Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size in a clean and controlled factory / work shop environment, including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass.

(d) Providing and fixing in position flashings of solid aluminium sheet 1 mm thick and of sizes, shapes and profiles, as required as per the site conditions, to seal the gap between the building structure and all its interfaces with curtain glazing to make it watertight.

(e) Making provision for drainage of moisture/ water that enters the curtain glazing system to make it watertight, by incorporating principles of pressure equalization, providing suitable gutter profiles at bottom (if required), making necessary holes of required sizes and of required numbers etc. complete. This item includes cost of all inputs of designing, labour for fabricating and installation of aluminium grid, installation of glazed units, T&P, scaffolding and other incidental charges including wastages etc., enabling temporary structures and services, cranes or cradles etc. as described above and as specified. The item includes the cost of getting all the structural and functional design including shop drawings checked by a structural designer, dully approved by Engineer-in-charge. The item also includes the cost of all mock ups at site, cost of all samples of the individual components for testing in an approved laboratory, field tests on the assembled working structural glazing as specified, cleaning and protection till the handing over of the building for occupation. In the end, the Contractor shall provide a water tight structural glazing having all the performance

characteristics etc. all complete, as per item description, as specified

Note:- 1. The cost of providing extruded aluminium frames, shadow boxes, extruded aluminium section capping for fixing in the grooves of the curtain glazing and vermin proof stainless steel wire mesh shall be paid for separately under relevant items under this subhead. However, for the purpose of payment, only the actual area of structural glazing (including width of grooves) on the external face shall be measured in sqm. up to two decimal places.

Note:-2. The following performance test are to be conducted on structural glazing system if area of structural glazing exceeds 2500 Sqm from the certified laboratories accreditated by NABL(National Accreditation Board for Testing and Calibration Laboratories), Department of Science & Technologies, India.. The NIT approving authority will decide the necessity of testing on the basis of cost of the work, cost of the test and importance of the work. Performance Testing of Structural glazing system Tests to be conducted in the **NABL accredited lab or by any other accreditation body which operates in accordance with ISO / IEC 17011 and accredits labs as per ISO/ IEC 17025.**

1. Performance Laboratory Test for Air Leakage Test (-50pa to - 300pa) & (+50pa to +300pa) as per ASTM E-283-04 testing method for a range of testing limit 1 to 200 mVhr
2. Static Water Penetration Test. (50pa to 1500p) as per ASTME- 331-09 testing method for a range up to 2000 ml.
3. Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml
4. Structural Performance Deflection and deformation by static air pressure test (1.5 times design wind pressure without any failure) as per ASTME-330-10 testing method for a range upto 50 mm
5. Seismic Movement Test (upto 30 mm) as per AAMA 501.4- 09 testing method for Qualitative test, Tests to be conducted on site.
6. Onsite Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml

Providing, assembling and supplying vision glass panels (IGUs) comprising of hermetically-sealed 6-12- 6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6 mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthned clear float glass 6 mm thick, spacer tube 12 mm wide, dessicants, including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineerin- Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor (Payment for fixing of IGU Panels in the curtain glazing is included in cost of item No.25.2) (i) Coloured tinted float glass 6 mm thick substrate with reflective soft coating on face # 2, + 12 mm Airgap + 6 mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m2 degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement

Frameless Toughened Glass Door Shutter

Providing and fixing 12 mm thick frameless toughened glass door shutter of approved brand and manufacture, including providing and fixing top & bottom pivot & double acting hydraulic floor spring type fixing arrangement and making necessary holes etc. for fixing required door

fittings, all complete as per direction of Engineer-in-charge (Door handle, lock and stopper etc.to be paid separately).

Corner Patch Look
Providing and fixing Corner Patch Look with 6 levers without pair of handles of approved quality for aluminium door, with necessary screws etc complete as per direction of Engineer-in-charge.

Pull Handle H type
Providing and fixing , ISI Pull Handle H type 32 mm Dia 600 mm marked, anodised (anodic coating not less than grade AC 10 as per IS : 1868) transparent or dyed to required colour or shade, with necessary screws etc. complete :

OTHER SPECIFICATIONS
For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 15 :: CEILING

GI Metal Ceiling
Providing and fixing tiled false ceiling of specified materials of size 595x595 mm in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm, both side inclusive) consisting of main 'T runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross·r of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of approved texture in the grid including, required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main ~" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x1.6 mm fixed to ceiling with 12.5 mm dia and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T, bottom exposed width of 24 mm of all T-sections shall be pre-painted with polyester paint, all complete for all heights as per specifications, drawings and as directed by Engineer-in-charge.

GI Metal Ceiling Lay in plain Tegular edge Global white color tiles of size 595x595 mm, and 0.5 mm thick with 8 mm drop; made of G I sheet having galvanizing of 100 gms/sqm (both sides inclusive) and electro statically polyester powder coated of thickness 60 microns (minimum), including factory
painted after bending.

CEMENT CONCRETE GOLA

Cement Concrete
The specifications for concrete shall be the same as described in subhead 4.0 of concrete work.

Gola
A chase of 75 mm wide and 75 mm deep shall be cut in the parapet wall just above the junction of mud phuska or lime concrete with parapet wall and it shall be filled with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 10 mm and down gauge) the external face finish with a slope of 1 : 0.75 and the exposed surface of the gola shall be plastered with cement mortar 1 : 3 (1 cement : 3 fine sand). Expansion joint at every 3.5 to 4.5 metres shall be provided and filled with bitumen filler. The bitumen filler shall be prepared by mixing bitumen, cement and coarse sand in the ratio of 80 : 1 : 0.25 (80 kg of hot bitumen : 1 kg of cement and 0.25 cum of coarse sand).

Curing
The finished surface shall be cured for at least 7 days.

KHURRAS
The khurras shall be constructed before the brick masonry work in parapet wall is taken up and it shall be of size 45 cm x 45 cm unless otherwise specified in the description of the item and shall be made of cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) or other mix as stipulated in the description of the item.

Laying

A PVC sheet of size 1 m x 1 m x 400 micron (alternatively, aluminium foil of 32 SWG) shall be laid under the khurra and then cement concrete shall be laid over it to average thickness of 50 mm with its top surface lower than the level of adjoining roof surface by not less than 50 mm.

The concrete shall be laid to a size greater than the stipulated size of the khurra in such a way that the adjoining terracing shall overlap the concrete on its three edges by not less than 7.5 cm. The concrete will slope uniformly from the edges to the outlet, the slope being as much as possible and in no case less than 20 mm cement concrete at the outlet. The concrete shall be continued same slope through the width of the wall into the outlet opening to ensure a water tight joint.

The khurras and the sides of the outlet shall then be rendered with 12 mm coat of cement plaster 1:3 mix (1 cement : 3 coarse sand) or other mix as stipulated in the description of the item. This shall be done when the concrete is still green and shall be finished. The sides of the khurras and sides of the outlet opening shall be well rounded. The size of the finished outlet opening shall be 10 cm wide and by 20 cm high or as directed by the Engineer-in-Charge.

In cases where rain water is to be disposed off through rain water pipes, iron grating shall be provided at the outlet as a safeguard against choking, if so directed by the Engineer- in-Charge. Iron gratings, shall be of overall size 20 × 25 cm. with an outer frame of 15 × 3 mm M.S. flat to which 4 Nos M.S. bars of 10 mm dia shall be welded in a vertical direction keeping equal clear spacing of 2.5 cm. or as directed by the Engineer in Charge.

G.I. METAL TILES CEILING

Frame
The frame work shall consists of G.I spring tee of specified size fixed to main C carrier with the help of suspension Brackets. The frame work shall be executed in a manner so as to form a grid of 600 mm x 600 mm as specified in the item. The pre-painted steel ‘C’ wall angle of size 20x30x20 mm and 0.5mm thick shall be fixed along the periphery of the room with nylon sleeves and wooden screws at 300 mm center to center. The main ‘C’ carrier of size 10x38x10 mm made of G.I steel 0.7 mm thick shall be fixed with cleats of size 37x27x25x1.6 mm and rawl plugs of size 38x12 mm.

Ceiling tiles
Ceiling tiles shall be of G.I metal plain beveled of specified white color of size 600x600 mm and 0.5 mm thick with 25 mm height made of G.I. sheet having galvanizing of 100 gms/sqm and electro statically polyester powder coated of minimum 60 microns thickness including factory painted after bending with or without perforation.

Fixing of ceiling tiles
The ceiling tiles shall be placed over the G.I frame and clip-in with frame.

Measurements
Length & breadth of the finished ceiling shall be measured correct to a centimetre. The area shall be calculated in square metre correct to two decimal places. No deduction shall be made for making openings for electrical, air conditioning, fire fighting fixtures nor shall extra payment be made either for extra materials or labour involved in making such openings.

CALCIUM SILICATE FALSE CEILING (TEGULAR EDGED- FIXED TO EXISTING T-FRAME)

Materials

Tiles

Eco friendly light weight calcium silicate tiles shall be made from Non-cementitious hydrated wet moulded calcium silicate slurry/mixture, reinforced with fibers and natural fillers. Free from formaldehyde and other harmful materials. Does not contain any toxic ingredients. Shall have appropriate recycled material contents. The Ceiling Tiles shall be of appropriate class and of finished thickness as specified in the description of the item .Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595 mm in size and shall be 15 mm thick integral densified tegular edged type, light weight wet moulded calcium silicate.

Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the Engineer-in-charge and maintained uniformly throughout of the length/ width of room/ corridor. Calcium silicate tiles shall have the following properties:

(a) Surface: All tiles are prime coated on both sides. Standard finish in two coats white dispersion type, solvent free paint.

(b) Dimensions:
595mmx595mmx15mm thick tegular edged. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.

(c) Thickness: 10 mm thick in the center and 15mm thick all around on edge resting portion with integral densified edge.

(d) Density of material: 350 kg per cum in the central 10 mm thick portion and 450 kg cum on the edges, (Average 370 kg per cum as per ECBC Code 2007).

(e) Relative humidity: 100% RH resistant.

(f) Fire resistance: Non-combustible as per BS:476 Part-4. Fire performance: as per BS:476 (Part-6) for fire propagation and BS 476 (Part 7) for Surface spread of flame.

(g) Thermal conductivity: 0.048 W/m- K - 0.052 W/m- K as per ECBC Code 2007 and ASTM 518-1991.

(h) Recycled Content: Shall have 46-50% recycled content out of which 18-20% should be FLYASH.

(i) Acoustic control: Sound Attenuation 30-32dB
Noise reduction coefficient (NRC)
Plain & Designer tile: 0.10-0.15.
For Pin Hole/Texture pattern tiles: 0.20-0.30.
Pin hole/Texture fully perforated tile: 0.30-0.40.
For 5mm fully perforated 0.40-0.50.
For 5mm fully perforated with 50mm/48gsm glass wool 0.65-0.85.

(j) Light reflectance: >85%.

(k) Weight: 5 - 5.5Kg/m2.

Frame
Frame is already exists at site. The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing
The tiles shall be placed properly in the grids already exists at site, as per required pattern, texture and design/ drawing and as per directions of the Engineer-in-Charge/manufacturer guide line. If required. level of the false ceiling grid shall be checked after placing of calcium silicate tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing
Care should be taken while placing Light Weight calcium silicate tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers. (worker should preferably wear clean soft cotton gloves while placing tile).

Measurements
Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square meters. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

MTC: Manufacturers test certificate/ report of invoice to be submitted for every delivery challan by suppliers.

GLASS FIBRE REINFORCED GYPSUM (GRG) FALSE CEILING (SEMI PERFORATED MICRO TEGULAR EDGED)

Materials
Tiles
Glass fibre Reinforced Gypsum (GRG) false ceiling tiles shall be made of Gypsum plaster of 75 microns particle size mixed with short length glass fibre filament of 20 microns ± 5 microns diameter to give it high strength and shall be free from harmful or any toxic ingredients.

Tiles shall be appropriate class and of finished thickness as specified in the description of the item. Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595mm in size and of approved texture, design and patterns and patterns and shall be semi perforated 12mm thick micro tegular-edged type GRG tiles.

Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the Engineer-in-charge and maintained uniformly throughout of the length/ width of room/ corridor. GRG tiles shall have the following properties:

(a) Surface: The GRG false ceiling tiles shall be painted with white dispersion type solvent free paint.

(b) Dimensions: 595mm x 595mm Semi perforated 12mm thick micro tegular-edged type GRG tiles. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.

(c) Density of material: 700 to 850 kg per Cum.

(d) Relative humidity:99% RH resistant.

(e) Fire resistance: Non-combustible as per BS:476, Part-4: 1970 CPWD SPECIFICATIONS 2019 **1322**

(f) Moisture Content: < 2%

(g) Acoustic control: Noise reduction coefficient (NRC) = 0.50 to 0.75 as per IS: 8225-1981.

(h) Light reflectance:>85%

(i) Suspension system: Suspension system shall be made of interlocking metal T-grids of hot-dipped galvanized iron section.

Frame
Frame is made up of interlocking metal T-grids of hot dipped galvanized steel sections of 0.33mm thick(Galvanized @ 120 grams per sqm including both sides) comprising of main T runners of size 15 x 32mm of length 3000mm, cross T of size 15 x 32mm of length 1200mm and secondary intermediate cross T of size 15 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m2 including all sides) i.e. 50mm long, 8mm outer diameter M-6 dash fasteners, 6mmdia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 85 x 25 x 2mm. Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws. The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing
Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid. The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per required pattern, texture and design/ drawing and as per directions of the Engineer-in-Charge. If required, level of the false ceiling grid shall be checked after placing of semi perforated GRG tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing
Care should be taken while placing semi perforated GRG tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers.

Measurements
Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square metres. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

GLASS FIBRE REINFORCED GYPSUM (GRG) FALSE CEILING (FULLY PERFORATED MICRO TEGULAR EDGED)

Materials

Tiles
Glass fibre Reinforced Gypsum (GRG) false ceiling tiles shall be made of Gypsum plaster of 75 microns particle size mixed with short length glass fibre filament of 20 microns ± 5 microns diameter to give it high strength and shall be free from harmful or any toxic ingredients.

Tiles shall be appropriate class and of finished thickness as specified in the description of the item. Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595mm in size and of approved texture, design and patterns and patterns and shall be fully perforated 12mm thick micro tegular-edged type GRG tiles. Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall be maintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the Engineer-in-charge and maintained uniformly throughout of the length/ width of room/ corridor. GRG tiles shall have the following properties:

(a) Surface: The GRG false ceiling tiles shall be painted with white dispersion type solvent free paint. fully perforated GRG false ceiling tiles shall have a non-woven fabric of density minimum 30 grams per square meter pasted at the back.

(b) Dimensions: 595mm x 595mm Fully perforated 12mm thick micro tegular-edged type GRG tiles. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.

(c) Density of material: 700 to 850 kg per Cum.

(d) Relative humidity:99% RH resistant.

(e) Fire resistance: Non-combustible as per BS: 476, Part-4: 1970

(f) Moisture Content: < 2%

(g) Acoustic control: Noise reduction coefficient (NRC) = 0.50 to 0.75 as per IS: 8225-1981.

(h) Light reflectance:>85%

(i) Suspension system: Suspension system shall be made of interlocking metal T-grids of hot-dipped galvanized iron section.

Frame
Frame is made up of interlocking metal T-grids of hot dipped galvanized steel sections of 0.33mm thick (Galvanized @ 120 grams per sqm including both sides) comprising of main T runners of size 15 x 32mm of length 3000mm, cross T of size 15 x 32mm of length 1200mm and secondary intermediate cross T of size 15 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m2 including all sides) i.e. 50mm long, 8mm outer diameter M-6 dash fasteners, 6mm dia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 85 x 25 x 2mm. Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws. The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing
Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid.

The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per required pattern, texture and design/ drawing and as per directions of the Engineer-in-Charge. If required, level of the false ceiling grid shall be checked after placing of semi perforated GRG tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing
Care should be taken while placing semi perforated GRG tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers.

Measurements
Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square metres. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

MINERAL FIBRE FALSE CEILING (BEVELED TEGULAR MINERAL FIBRES)

Materials

Tiles
Mineral Fiber Ceiling Tiles shall be made of granulated high-density Mineral Wool as the main material and top production technique which gives it superior features of fire-proofing, sound absorption, heat insulation & sag resistance. They are cost effective and are mainly used for acoustics and decoration. Tiles shall be appropriate class and of finished thickness as specified in the description of the item. Only selected tiles of uniform width shall be used. Unless otherwise specified in the description of the item or shown in the drawings, the width of tiles selected for use shall not be less than 595 x 595mm in size and of approved texture,

design and patterns and patterns and shall be of 16mm/ 20mm thick Beveled Tegular edge type.Where width of room/ corridor is in multiple of standard width of tiles, same pattern shall bemaintained throughout the length. Where the width of rooms/ corridor is not in multiple of standard width of tiles, borders with appropriate width and material of boards shall be provided in design approved by the Engineer-in-charge and maintained uniformly throughout of the length/ width of room/ corridor. Mineral Fibre tiles shall have the following properties:

(a) Surface: Shall be of approved texture, design and pattern.

(b) Dimensions: 595mm x 595mm x 16mm (20mm) thick Beveled Tegular edge type. Size referred to are always module sizes. The nominal panel size may differ depending on the suspension system used.

(c) Relative humidity:99% RH resistant.

(d) Fire resistance: Fire performance as per BS:476 (Part-6 & 7)

(e) Thermal conductivity: 0.052 W/m–K – 0.057 W/m–K

(f) Acoustic control: Noise reduction coefficient (NRC) = 0.50 to 0.60

(g) Light reflectance:>85%.

(h) Weight: 3.10 Kg/m2 (for 16mm thick) & 5.29 Kg/m2 (for 20mm thick)

(i) Suspension system: Suspension system shall be made of interlocking metal T-grids of hot-dipped all round galvanized steel.

Frame

Frame is made up of interlocking metal T-grids of hot dipped all round galvanized steel sections of 0.33mm thick (Galvanized @ 120 grams per sqm including both sides) comprising of main T runners of size 15 x 32mm of length 3000mm, cross T of size 15 x 32mm of length 1200mm and secondary intermediate cross T of size 15 x 32mm of length 600mm to form grid modules of size 600 x 600mm. This grid shall be suspended from ceiling using galvanized mild steel members (Galvanized @ 80 gms/m2 including all sides) i.e. 50mm long, 8mm outer diameter M-6 dash fasteners, 6mmdia fully threaded hanger rod upto 1000 mm length and L-shaped level adjuster of size 85 x 25 x 2mm.

Frame also consist of galvanized iron perimeter wall angle of size 24 x 24 x 0.40mm of length 3000mm to be fixed on periphery wall/ partition with the help of plastic rawl plugs at 450mm centre to centre and 40mm long dry wall SS screws.

The bottom surface of the frame shall be checked and corrected to true plans and slopes.

Fixing

Outer wall angle shall be fixed accurately and truly at required height and level, parallel and close to the wall. Thereafter all the T members shall be placed and fixed carefully to form the grid.

The grid comprises of main T-runners at 1200mm centres securely fixed to the structural soffit by approved and adjustable hanger rods at 1200mm maximum centres and not more than 150mm from spliced joints of main T-runners. The last hanger at the end of each runner should not be greater than 600mm from the adjacent wall. Similarly, cross T-runners of 1200mm length shall be placed at 600mm centre to centre. 600x600mm modules to be

formed by fitting 600mm long flush fitting cross Tees (secondary cross T) centrally between 1200mm cross T-runners. The tiles shall then be placed properly in the grids as per required pattern, texture and design/ drawing and as per directions of the Engineer-in-Charge. If required, level of the false ceiling grid shall be checked after placing of calcium silicate tiles and necessary adjustment shall be made wherever required through level adjuster.

Finishing
Care should be taken while placing calcium silicate tiles into the grid so that there will be no displacement to grid and stains/ dirty marks put by the workers.

Measurements
Length and breadth shall be measured correct to a cm. Areas shall be worked out to nearest 0.01sqm. The superficial area of the finished work ceiling shall be measured in square metres. No deduction in measurements shall be made for openings of areas upto0.36 Sqm. Nothing extra shall be payable either for any extra material or labour involved in forming such openings. For openings exceeding 0.36 sqm in area, deductions in measurements for the full opening in multiple of area of each tile (0.36 Sqm) will be made.

MINERAL FIBRE FALSE CEILING (BEVELED TEGULAR MINERAL FIBRE ANTI-MICROBIAL)

Specification for the mineral fibre false ceiling using 16 mm Beveled Tegular Mineral Fibre Antimicrobial is same as 16 mm Beveled Tegular Mineral Fibres specified in above clause 26.22.

CHIPPING OF UNSOUND / WEAK CONCRETE:

Precaution, Preparation and procedure
The Chipping of unsound work / concrete / delaminated layer of gunniting etc. shall be done by chipping(after properly supporting the member with false works) , in regular shape, with sides parallel or normal to the direction of the reinforcement. The chipping shall be done minimum 50 mm beyond the perimeter of the spell. For a single spell, the repair area should have a minimum width of 100 mm in any direction. If a number of spells are closely located to each other, these should be included in a single area marked for repair. The cut shall be made normal to the surface of member. The minimum depth of cut should be 12 mm. Adequate care is to be taken not to cut the reinforcement steel and a cover metre could be used to estimate the depth of cover, for which nothing extra shall be paid. Chipping should be done upto the required depth as decided by the Engineer-in- Charge to produce sound concrete surface to a near uniform depth for the repair areas. Removal of concrete should begin at the interior of the repair areas and progress towards the boundaries. All edges and cavities shall be square shouldered.

Measurements
Dimensions of area chipped off for RCC slabs, beams, columns etc. shall be measured in centimeters after the chipping / dismantling operation is completed for different thicknesses as specified in the item separately. The area of the chipped / exposed RCC surface shall be measured in sq. m correct to second place of decimal for different thicknesses as specified in the item separately

Providing and fixing mineral fibre false ceiling tiles at all heights of size 595X595 mm of approved texture, design and pattern. The tiles should have Humidity Resistance (RH) of 99%, Light Reflectance ≥ 85%, Thermal Conductivity k = 0.052 - 0.057 w/m K, Fire Performance as per (BS 476 pt - 6 &7)in true horizontal level suspended on interlocking T-

Grid of hot dipped all round galvanized iron section of 0.33 mm thick (galvanized @120 gsm) comprising of main T runners of 15x32 mm of length 3000 mm, cross T of size 15x32 mm of length 1200 mm and secondary intermediate cross T of size 15x32 mm of length 600 mm to form grid module of size 600x600 mm suspended from ceiling using galvanized mild steel item (galvanised@80gsm) 50 mm long 8 mm outer diameter M-6 dash fasteners, 6 mm diameter fully threaded hanger rod up to 1000 mm length and L-shape level adjuster of size 85x25x2 mm, spaced at 1200 mm centre to centre along main 'T'. The system should rest on periphery walls /partitions with the help of GI perimeter wall angle of size24x24X3000 mm made of 0.40 mm thick sheet, to be fixed to the wall with help of plastic rawl plug at 450 mm centre to centre & 40 mm long dry wall S.S. screws. The exposed bottom portion of all T-sections used in false ceiling support system shall be pre-painted with polyester baked paint, for all heights. The work shall be carried out as per specifications, drawings and as per directions of the engineer-in-charge. With 20 mm thick beveled tegular mineral fibre false ceiling tile (NRC 0.7)

Providing and fixing false ceiling at all heights including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fiXed to the ceiling with dash fastener 12.5 mm dia x 50 mm long with 6 mm dia bolts, other flange of cleat fixed to the angle hangers of 25x1 Ox0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G. I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fiXed to wall/partition with the help of rawl plugs at 450 mm centre, with 25 mm long dry wall screws@ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c:Jc, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound , jointing tapes, finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge but excluding the cost of painting with : 12.5 mm thick tapered edge gypsum moisture resistant board

Mineral Fiber False Ceiling

Providing and fixing Wall angle of 19 mmx19mm x 0.40 mm shall be screw fixed to brick wall/partition with the help of approved screws at 600mm centers. Then suspending Main T grid of 15mm x 38 x 0.3 mm of length 3600mm is hung with adjustable level clips 80x30x0.6mm & 4mm diameter GI rod which are connected to Soffit Cleat 27x37x1.6mm with approved 8mm dia 40mm long dash Fasteners @1200mm centers or as approved from RCC Slab. The Cross T of 15mm x 38mm x 0.3 mm of 1200mm length shall be interlocked between main T Grid at 600mm centers to form 1200 x 600mm modules. 600 x 600mm modules to be formed by click fitting donn Cross T of 15mm x 38mm x 0.3 mm of 600mm length centrally between the 1200mm cross T's. Then 19mm thick Sonata Healthcare tile or equivalent made of Mineral Fiber tile substrate manufactured in wet felted technology and finished with painted fiber glass scrim of size 595 X 595 mm of FLB edge confirming to ISO 4 according to the norm ISO 14644-1 : 2015, ceiling panel

shall be placed into the above grid of size 600x600mm. This ceiling panel confirms to ASTM E84 surface burning characteristics. (Class A, Flame Spread: 25 & Smoke developed: 70) Reaction to Fire: Euroclass A2-s1,d0 in accordance with EN-13501-1. The Ceiling panel provides NRC 0.70, CAC minimum: 37 Light Reflectance: 0.89, Recycled Content [up to 83%] and can withstand Relative Humidity up to RH 99%. Mold Prevention application as per ASTM D3273-1, Rate 10 as per D3274. Washability / Scrubbability exceeds 1000 Wash/Scrub Cycles without surface break or the extent of abrasion as per ASTM D4828 & D2486.



Gypsum Board False Ceiling

Providing and fixing false ceiling at all height including providing and fixing of frame work made of special sections, power pressed from M.S. sheets and galvanized with zinc coating of 120 gms/sqm (both side inclusive) as per IS : 277 and consisting of angle cleats of size 25 mm wide x 1.6 mm thick with flanges of 27 mm and 37mm, at 1200 mm centre to centre, one flange fixed to the ceiling with dash fastener 12.5 mm dia x 50mm long with 6mm dia bolts, other flange of cleat fixed to the angle hangers of 25x10x0.50 mm of required length with nuts & bolts of required size and other end of angle hanger fixed with intermediate G.I. channels 45x15x0.9 mm running at the spacing of 1200 mm centre to centre, to which the ceiling section 0.5 mm thick bottom wedge of 80 mm with tapered flanges of 26 mm each having lips of 10.5 mm, at 450 mm centre to centre, shall be fixed in a direction perpendicular to G.I. intermediate channel with connecting clips made out of 2.64 mm dia x 230 mm long G.I. wire at every junction, including fixing perimeter channels 0.5 mm thick 27 mm high having flanges of 20 mm and 30 mm long, the perimeter of ceiling fixed to wall/partition with the help of rawl plugs at 450 mm centre, with 25mm long dry wall screws @ 230 mm interval, including fixing of gypsum board to ceiling section and perimeter channel with the help of dry wall screws of size 3.5 x 25 mm at 230 mm c/c, including jointing and finishing to a flush finish of tapered and square edges of the board with recommended jointing compound, jointing tapes, finishing with jointing compound in 3 layers covering upto 150 mm on both sides of joint and two coats of primer suitable for board, all as per manufacturer's specification and also including the cost of making openings for light fittings, grills, diffusers, cutouts made with

frame of perimeter channels suitably fixed, all complete as per drawings, specification and direction of the Engineer in Charge but excluding the cost of painting with : 12.5 mm thick tapered edge gypsum plain board conforming to IS: 2095- (Part I) : 2011 (Board with BIS certification marks).



OTHER SPECIFICATIONS

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 16 : ALUMINIUM WORKS

Aluminium Sections

Aluminium sections used for fixed/openable windows, ventilators, partitions, frame work & doors etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-In-Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304.

The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/ operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-In-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-In-Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in- Charge.

Powder Coating

Material: The powder used for powder coating shall be Epoxy/polyester powder of make approved by the Engineer-In-Charge. The contractor shall give detailed programme for powder coating in advance, to facilitate the inspection by Engineer-In-Charge or his authorized representative.

Pre-treatment*:* Each aluminium alloy extrusion or performed section shall be thoroughly cleaned by alkaline or acidic solutions under the conditions specified by chemical conversion coating supplier and then rinsed. A chemical conversion coating shall be applied by treatment with a solution containing essentially chromate ions or chromate and phosphate ions as the active components as applicable. The amount of the conversion coating deposited depends on the type used by the conversion coating chemical supplier. The conversion coating shall be thoroughly rinsed either with the solution specified by the conversion coating chemical supplier or with de-mineralized water and then dried at the temperature for the time specified by the conversion coating chemical supplier. The contractor shall submit the detail specifications and application procedure for application of conversion coating for approval of Engineer-In-Charge. The metal surface after the conversion coating pretreatment and prior to the application of the coating shall be free from dust or powdery deposits.

Process: The polyester powder shall be applied by electrostatic powder spray method. Before start of powder coating the contractor shall submit detail specification for application of polyester powder from manufacturer of the polyester powder for approval of Engineer-In-Charge. The powder coating shall be applied as per the specification approved by Engineer-In-Charge.

Thickness: The thickness of the finished polyester powder coating measured by micron meter shall not be less than 50 micron nor more than 120 micron at any point.

Performance Requirements for the Finish

(i) **Surface appearance:** The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.

(ii) **Adhesion:** When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coating so that metal surface is visible) and a piece of adhesive tape, approximately 25 mm x 150 mm approved by the Engineer-In-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

Protection of Powder Coated / Anodizing Finish: It is mandatory that all aluminium members shallbe wrapped with self-adhesive non-staining PVC tape, approved by Engineer- In-Charge.

Aluminium Frame:- Providing and fixing aluminium work for doors, windows, ventilators and partitions with extruded built up standard tubular sections/ appropriate Z sections and other sections of approved make conforming to IS: 733 and IS: 1285, fixing with dash fasteners of required dia and size, including necessary filling up the gaps at junctions, i.e. at top, bottom and sides with required EPDM rubber/ neoprene gasket etc. Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically wherever required including cleat angle, Aluminium snap beading for glazing / paneling, C.P. brass / stainless steel screws, all complete as per architectural drawings and the directions of Engineer-in-charge. (Glazing, paneling and dash fasteners to be paid for separately) Powder coated aluminium (minimum thickness of powder coating 50 micron)

Shutters
For shutters of doors, windows & ventilators including providing and fixing hinges/ pivots and making provision for fixing of fittings wherever required including the cost of EPDM rubber / neoprene gasket required

Glazing In Aluminium
Providing and fixing glazing in aluminium door, window, ventilator shutters and partitions etc. with EPDM rubber / neoprene gasket etc. complete as per the architectural drawings and the directions of engineer-in-charge . (Cost of aluminium snap beading shall be paid in basic item)

Filling the gap in between aluminium/ stone/ wood frame and adjacent RCC/ Brick/ Stone/ wood/ Ceramic/ Gypsum work by providing weather/structural non sag elastomeric PU sealant over backer rod of approved quality as per architectural drawings and direction of Engineer-in-charge complete, complying to ASTM C920, DIN 18540-F & ISO 11600

OTHER SPECIFICATIONS
For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 17 :: CLADDING WORKS

CERAMIC TILES IN SKIRTING AND DADO

The tiles shall be of approved make and shall generally conform to IS 15622. The tiles shall be pressed ceramic covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze on more than 5% of the area in order that the tile may adhere properly to the base. The edges of the tiles shall be free from glaze, however, any glaze if unavoidable shall be permissible on only up to 50 per cent of the surface area of edges.

The glaze shall be free from welts, chips, craze, specks, crawling or other imperfections detracting from the appearance when viewed from a distance of one meter. The glaze shall be either glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be specified by the Engineer-In-Charge. There may be more than one colour on a tile.

Dimensions and Tolerances

Glazed pressed ceramic tiles shall be made square or rectangular in sizes Table 1, 3, 5 & 7 of IS 15622 give the modular sizes and table 2, 4, 6 & 8 of IS 15622 gives the sizes of non-modular tiles. The tiles shall conform to IS 15622 for dimensional tolerance, physical and chemical properties.

Half tiles for use as full tiles shall have dimensions which shall be such as to make the half tiles when jointed together (with 1 mm joint) match with dimensions of full tiles. Tiles may be manufactured in sizes other than those specified above.

The thickness of the tiles shall be 5 mm or 6 mm or as specified.

The dimensions of fittings associated with the glazed tiles namely cover base, round edge tile, angles corner cups, ridge and legs, cornices and capping beads shall be of the shape and dimensions as required and the thickness of fittings shall be the same as the thickness of tiles given above.

Preparation of Surfaces

The joints shall be raked out to a depth of at least 15 mm in masonry walls.

In case of concrete walls, the surface shall be hacked and roughened with wire brushes. The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

Laying

12 mm thick plaster of cement mortar 1:3 (1 cement: 3 coarse sand) mix of as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals.

The tiles should be soaked in water, washed clean, and a coat of cement slurry applied liberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped and corrected to proper plane and lines. The tiles shall be set in the required pattern and jointed.

The joints shall be as fine as possible. Top of skirting or dado shall be truly horizontal and joints truly vertical except where otherwise indicated. Odd size/cut size of tile shall be adjusted at bottom to take care of slope of the flooring.

Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot be fixed these shall be cut (sawn) to the required size and their edges rubbed smooth. Skirting /dado shall not project from the finished “surface of wall” by more than the tile thickness, undulations if any shall be adjusted in wall.

Curing and Finishing
The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to a depth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles. The work shall then be kept wet for 7 days.
After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

GRANITE TILES IN SKIRTING AND DADO
The granite shall be provided and installed for use in counters, window sills, skirting, and lift facias, ensuring precise measurements, high-quality finishes, and a durable, aesthetically pleasing result in accordance with the approved color, texture, and design specifications.

Providing and fixing 18 mm thick gang saw cut, mirror polished, premoulded and prepolished, machine cut for kitchen platforms, vanity counters, window sills, facias and similar locations of required size, approved shade, colour and texture laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc. complete at

Providing edge moulding to 18 mm thick marble stone counters, Vanities etc., including machine polishing to edge to give high gloss finish etc. complete as per design approved by Engineer-in-Charge. fixing marble /granite stone, over and above corresponding basic item, in facia and drops of width upto 150 mm with epoxy resin based adhesive, including cleaning etc. complete. Extra for providing opening of required size & shape for wash basin/ kitchen sink in kitchen platform, vanity counter and similar location in marble/ Granite/ stone work, including necessary holes for pillar taps etc. including moulding, rubbing and polishing of cut edges etc. complete.

1. **Preparation and Procurement**:
    - **Granite Selection**: Choose the 18 mm thick granite slabs based on the approved color, shade, and texture as per the design requirements. Ensure the granite is gang saw cut, mirror polished, premoulded, and prepolished.
    - **Site Measurement**: Accurately measure the required sizes and dimensions for the kitchen platforms, vanity counters, window sills, facias, and similar locations.
2. **Surface Preparation**:
    - **Cleaning the Substrate**: Ensure the surface where the granite will be fixed (such as the base slab, wall, or counter) is clean, dry, and free from any debris, dust, or grease.
    - **Preparing the Cement Mortar**: Prepare a 20 mm thick base cement mortar mix with a ratio of 1 part cement to 4 parts coarse sand. Mix thoroughly to ensure an even consistency.
3. **Laying of Cement Mortar**:
    - **Application**: Spread the prepared cement mortar uniformly on the surface

where the granite will be fixed. Ensure the mortar layer is level and smooth.
    - **Positioning the Granite**: Carefully position the granite slabs over the mortar base, ensuring proper alignment and spacing between slabs for joints.
4. **Granite Fixing**:
    - **Pressing and Securing**: Gently press the granite slabs into the mortar bed, ensuring that they adhere firmly without any voids. Use a rubber mallet to tap the slabs into place and ensure good contact with the mortar.
    - **Joint Treatment**: After placing the granite, the joints between the slabs should be treated with white cement mixed with a matching pigment to blend with the granite color. This helps ensure a seamless and aesthetically pleasing joint appearance.
5. **Finishing the Edges**:
    - **Edge Moulding**: Mould the edges of the granite slabs to the desired shape and finish. The edges should be smooth and uniform.
    - **Polishing the Edges**: Polish the edges of the granite to a smooth, high-gloss finish, ensuring they are free from any sharpness or roughness.
6. **Epoxy Touch-Ups**:
    - **Touch-Up Application**: Any minor surface imperfections or joint gaps should be filled with an epoxy-based filler for a smooth and flawless surface. After filling, allow it to cure as per the manufacturer's instructions.
    - **Polishing After Touch-Ups**: Once the epoxy is fully cured, the surface should be rubbed and polished to a high-gloss finish, matching the existing granite surface.
7. **Curing**:
    - **Curing the Mortar**: Allow the mortar base to cure for at least 24-48 hours before further work is carried out to ensure the mortar has hardened and bonded properly with the granite.
8. **Final Polishing**:
    - **Final Touch**: After the mortar and epoxy curing process, the entire surface of the granite should be polished once more to achieve a high-gloss, mirror-like finish.
    - **Cleaning**: Clean the entire area to remove any dust, debris, or excess cement. Ensure the granite is completely dry and spotless.
9. **Inspection and Handover**:
    - **Quality Check**: Perform a thorough inspection to ensure that all granite surfaces are properly fixed, polished, and finished. Check for uniformity in color, texture, and overall appearance.
    - **Final Approval**: Once the installation is complete and all standards are met, hand over the project for final approval. Ensure that all surfaces are aesthetically pleasing and structurally sound.

This methodology ensures that the granite is properly fixed and finished with a high-quality, durable result, suitable for kitchen platforms, vanity counters, window sills, facias, and similar applications

WPC (Wood Polymer Composite) Solid Plain White Colour Board Jali

1. **Material Procurement and Verification**:
    - **WPC Board Selection**: Procure factory-made 18 mm thick single extruded WPC boards of solid plain white color, ensuring they meet the approved design and specifications provided by the Engineer-in-charge. The WPC boards should consist of virgin polymer with a K value of 58-60, calcium carbonate, natural fibers (such as wood powder, rice husk, or wheat husk), and non-toxic additives with a maximum toxicity index of 12 for 100 grams.
    - **Board Properties**: Confirm the WPC boards have the following properties:

- Minimum density of 650 kg/cum
- Screw withdrawal strength of 1800 N (face)
- Minimum compressive strength of 50 N/mm²
- Modulus of elasticity of 850 N/mm²
- Fire retardant with Class A category resistance to the spread of flame
- Termite and borer proof, water and moisture resistant.

2. **Design and CNC Routing**:
    - **Design Approval**: The approved design for the CNC routing shall be finalized by the Engineer-in-charge before proceeding with the cutting.
    - **CNC Routing**: Use Computer Numeric Control (CNC) machines to route the WPC boards according to the approved design. Ensure the precision of the cuts and patterns, maintaining consistent quality throughout.
3. **Preparation of M.S Frame**:
    - **M.S Frame Fabrication**: Fabricate the mild steel (M.S) frame from 25 x 25 x 1.5 mm square hollow box section, ensuring the frame is square, level, and aligned.
    - **Priming of M.S Frame**: Apply an approved primer coat to the M.S frame to prevent rust and ensure proper adhesion of the fasteners. The priming process should be uniform and thoroughly cured before the next step.
4. **Fixing the WPC Board Jali**:
    - **Grid Placement**: Establish a grid layout at 1.0 x 1.0 m or as per the site requirements to ensure accurate placement of the WPC board jali panels.
    - **Fixing the Jali Panels**: Carefully place the routed WPC panels onto the prepared M.S frame. Ensure the panels are positioned precisely according to the grid layout.
    - **Attachment**: Secure the WPC panels to the M.S frame using stainless steel (SS) fasteners and screws, ensuring a tight and secure fit. Use SS screws to avoid corrosion and maintain the durability of the structure.
5. **Quality Checks**:
    - **Alignment and Aesthetics**: Check the alignment of the WPC panels and the overall aesthetic appeal to ensure uniformity and high-quality finish.
    - **Structural Integrity**: Ensure all fasteners are tightly secured, and the frame is stable, with the WPC jali properly fixed to the M.S structure.
6. **Completion and Handover**:
    - **Final Inspection**: The completed installation should undergo a final inspection by the Engineer-in-charge to ensure compliance with design, material specifications, and quality standards.
    - **Cleaning**: Clean the surface of the WPC jali and surrounding areas to remove any dust, debris, or construction residues.
    - **Handover**: Once the installation is complete and all inspections are passed, hand over the project to the client as per the Engineer-in-charge's approval.

EXPANSION JOINT

Materials

Premoulded Joint Filler in Expansion Joint

It shall conform to IS 1838 (Pt. I). the thickness shall be 25 mm with tolerance 1.5 mm. and shall be of the maximum available standard length not less than one lane width. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within tolerance of + 10 mm from the intended line of the joint. The depth of board shall be 25 mm less than thickness of slab within a tolerance of ± 3mm so that the top of the board shall be below the surface or will not impede the passage of the finishing straight edge

or oscillating beam of the paving machine.

Sealing Compound

The joint sealing compound shall be fuel and heat resistant type complying to grade B of IS 1834. It shall be capable of adhering to the concrete without cracking, spalling and disintegration.

Construction Procedure

Expansion joints shall be provided as shown in the drawing and as per directions of Engineer-In- Charge. All joints shall be constructed true to line with their faces perpendicular to the surface. The joint shall be 20 mm wide. The depth of the non-extruding filler pad shall be 25 mm less than the depth of the concrete slab.

Before the provision of expansion joint, the face of the already laid concrete slab shall be painted with primer at the rate of 2.6 liters per 10 square meters. The expansion pad shall be properly cut to shape and shall then be placed in position abutting the painted face of the already laid concretes lab. The adjacent slab shall then be concreted. The face of the pad against which the new concrete slab is to be laid shall also be painted with primer before laying the concrete, while concreting a neat groove of size 20 mm x 25 mm as per drawing shall be formed on top of the pad taking care that the edges are absolutely straight and that the groove so made does not get filled with any material like concrete, mortar and other rubbish. Before the curing process is started, the top of expansion joint shall be filled with bitumen sand mixture in order to ensure that no foreign material used in curing enters into the joint. This filling shall be removed before filling the joints with sealing compound.

The treatment of expansion joint system related with floor location as per drawings and direction of Engineer-In-Charge. The joints system will be of extruded aluminum base members, self-aligning / self-centering arrangement and support plates etc. as per ASTM B221-02. The system shall be such that it provides floor to floor /floor to wall expansion control system for various vertical locations in load application areas that accommodates multi directional seismic movement without stress to its components. System shall consist of metal profiles with a universal aluminum base member designed to accommodate various project conditions and finish floor treatments. The cover plate shall be designed of width and thickness required to satisfy projects movement and loading requirements and secured to base members by utilizing manufacturer’s pre-engineered self-centering arrangement that freely rotates / moves in all directions. The Self - centering arrangement shall exhibit circular sphere ends that lock and slide inside the corresponding aluminum extrusion cavity to allow freedom of movement and flexure in all directions including vertical displacement. Provision of Moisture Barrier Membrane in the Joint System to have watertight joint is mandatory requirement all as per the manufactures design and as approved by Engineer -in- Charge. (Material shall conform to ASTM 6063).

Floor / Roof Joint of 50 mm gap

Application Procedure

Provide continuous frame on each side of the joint, designed to support gasket and center plate where required. After installing the frames at both sides, place the center plate in between the two frames and finally flush the gasket on the top of the frames.

Fixing of the joint after proper assembly of the components should be through the proper stainless steel counter skunked screws, which should be drilled to the base concrete slab beams with a bonding agent.

UG Tank/ OHT Tank

Bore Packing

- The surface of the pvc pipe and concrete surface will be made rough and sand will be sprinkled with polymer bonding agent.
- The borehole gaps between concrete surface and pvc pipe of various dia upto the neck level shall be filled with non-shrink free flow grout
- The Free flow grout must have dual shrinkage compensation property.
- The Free flow grout must have compressive strength of minimum 50 Mpa when tested at 07 days as per ASTM C 109:99
- The Free flow grout must have 0% bleeding as per ASTM C 940
- The Free flow grout should have 28 day Tensile Strength of 5 Mpa as per ASTM C 307

Crystalline Admixture:

- The Crystalline admixture should be Hydrophilic in Nature.
- Crystalline admixture shall be compatible with all workability admixtures confirming to ASTM D 494 and IS 9103.
- Crystalline admixture for concrete exposed to Hydrostatic condition (PRAH) - Quartz Crystalline Admix must confirm to ACI-212-3R 2010 guidelines
- Crystalline admixture recommended dosage rate of 0.75% by wt of cementitious mix
- Crystalline admixture capable of reducing coefficient of Permeability of concrete by more than 90% and resistant to 16 bar hydrostatic pressure when tested as per DIN 1048 part 5 conforming by CBRI, Roorkee
- The Crystalline admixture must be Nontoxic in nature.
- The Crystalline admixture must be certified from CFTRI for potable water.
- crystalline admixture shall be capable of self-healing of cracks up to a width of 0.4mm.
- Crystalline Admixture shall have low risk of corrosion when tested as per ASTM C876 for minimum 180 days.
- The manufacturer shall not be blacklisted from any of the government organizations
- Crystalline Admixture shall possess the inhouse R&D lab equipped with all necessary equipment such as SEM having 10000xtimes zoom

2 component Elastomeric cementitious waterproofing coating

- The coating must have having 80 % elongation as per ASTM D412,
- The elastomeric cementitious coating must resist 5 bars hyrostatic pressure as per DIN 1048
- The elastomeric cementitious coating should do the reduction to rapid chloride shall be 70 as per DIN 1048 The elastomeric cementitious coating must have crack bridging upto 1.2mm as per ASTM 4548.5.
- The coating shall have food grade certificate from laboratories like CFTRI.
- The mixing ratio of the coating shall be 2 parts of powder & 1 part of liquid without any water addition in the mixing.

Protective Coat only for Potable Water tank - over plaster

- Epoxy coating to be applied on pre-dampened plastered surface @ 2.60 sqm/kg in 02 coats.
- Coating shall be certified by CFTRI as per 21CFR-175-300 of USFDA,
- The coating must have adhesion strength 3 MPa as per ASTM D 4541:02.
- The coating shall be able to withstand positive hydrostatic pressure of 4 bars as per DIN

1048.

OTHER SPECIFICATIONS:

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 18 : ROAD/PARKING WORKS

ROAD WORKS
LIST OF MANDATORY TESTS

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
1) Coarse Aggregate	16.1.1 of CPWD specifications 2019 volume-2	Los Angeles Abrasion Value or Aggregate Impact Value	Laboratory	IS 2386 (Part 4)	Per 200 m3
		Specific gravity, Water absorption & Density	Laboratory	IS 2386 (Part 3)	
	16.1.1 Table 16.2 of CPWD specifications 2019 volume-2	Combined Flakiness and Elongation Indices	Laboratory		
			Field	IS 2386 (Part 1)	Per 100 m3
		Size and grading of aggregate	Field	IS 2386 (Part 1)	Per 100 m3
2) Fine Aggregate	16.1.2 of CPWD specifications 2019 volume-2	Deleterious materials	Field	IS 2386 (Part 2)	As required by the Engineer-in- Charge.
		Specific gravity, Water absorption & Density	Laboratory	IS 2386 (Part 3)	
		Size and grading of aggregate	Field	IS 2386 (Part 1)	
3) Bitumen	16.1.5 of CPWD specifications 2019 volume-2	As prescribed in IS 73 or IRC:SP:53, IS:15462	Laboratory	As prescribed in IS 73	As required by the Engineer-in- Charge.
4) Embankment under (O.M.C. conditions)	16.3.1 of CPWD specifications 2019 volume-2	Moisture content Density	Laboratory Field	IS 2720 (Part 2) IS 2720 (Part 28)	250 m3 250 m3
	16.3.4.4 of CPWD specifications 2019 volume-	c) Control test on borrow pits.			

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
	2				
		(i) Gradation	Laboratory	IS 2720 (Part 4)	One to two tests per 8000 m3
		(ii) Plasticity	Laboratory	IS 2720 (Part 5)	-do-
		(iii) Proctor Test	Laboratory	IS 2720 (Part 8)	-do-
		(iv) Deleterious content	Laboratory	IS 2386 (Part 2)	As required by the Engineer-in- Charge
		(v) Moisture contents	Laboratory	IS 2720 (Part 2)	250 m3
5) Prime Coat / Tack Coat / Fog Spray		(i) Quality of Binder	Laboratory	IS:73	Number of samples per lot and tests as per IS:73, IS:217 and IS:8887 as applicable
		(ii) Binder temperature for application	Field		At regular close intervals
		(iii) Rate of spread of Binder	Field		Three tests per day
6) Seal Coat / Surface Dressing		(i) Quality of binder	Laboratory	IS:73	Same as mentioned under Serial No. 5
		(ii) Aggregate Impact Value or Los Angeles Abrasion Value	Laboratory	IS:2386 (Part 4)	One test per 200 cum of each source and whenever there is change in the quality of aggregate
		(iii) Combined Flakiness Index and Elongation Indices	Field	IS:2386 (Part 1)	One test per 100 cum of aggregate for each source and whenever there is change in the

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
					quality of aggregate
		(iv) Stripping value of aggregates (Immersion Tray Test)	Laboratory	IS:6241	One test of each source and whenever there is change in the quality of aggregate
		(v) Water absorption of aggregates	Laboratory	IS:2386 (Part 3)	-- do --
		(vi) Grading of aggregates	Field	IS:2386 (Part 1)	Two tests per day
		(vii) Soundness test (Magnesium and Sodium Sulphate)	Laboratory	IS:2386 (Part 5)	One test for each source and whenever there is change in the quality of aggregate
		(viii) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	Field		At regular intervals
		(ix) Rate of spread of materials	Field		Same as mentioned under Serial No. 5
		(x) Percentage of fractured faces (When gravel is used)	Field		One test per 100 cum of aggregate
7) Bitumen Macadam	16.32 & 16.47 of CPWD specifications 2019 volume-2	(i) Quality of binder	Field	IS 73	Same as mentioned under Serial No. 5
		(ii) Aggregate Impact Value/ Los Angeles	Laboratory	IS 2386 (Part 4)	Same as mentioned under Serial

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
		Abrasion Value			No. 6
		(iii) Combined Flakiness Index and Elongation Indices	Laboratory	IS 2386 (Part 1)	One test per 350 cum for each source
		(iv) Stripping value of aggregates	Laboratory	IS 6241	Same as mentioned under Serial No. 6
		(v) Water absorption of aggregates	Field or Laboratory	IS 2386 (Part 3)	Same as mentioned under Serial No. 6
		(vi) Deleterious material	Field	IS:2386 (Part 2)	Once in the month
		(vii) Grading of aggregates	Field	IS 2386 (Part 1)	Same as mentioned under Serial No. 6
		(viii) Soundness test (Magnesium and Sodium Sulphate)	Laboratory	IS:2386 (Part 5)	Same as mentioned under Serial No. 6
		(ix) Binder content	Laboratory		Two test per day per plant
		(x) Control of temperature of binder and aggregate for mix and of the mix at the time of laying and rolling	Field		Same as mentioned under Serial No. 6
		(xi) Density of Comp layer	Laboratory	IS 2386 (Part 3)	One test per 700 sqm area
8) Dense Bituminous Macadam / Bituminous Concrete		(i) Quality of binder	Laboratory	IS:73	Number of samples per lot and tests as per IS:73 or IRC:SP:53, IS:15462

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
		(ii) Aggregate Impact Value / Los Angeles Abrasion Value	Laboratory	IS:2386 (Part 4)	One test per 350 cum of aggregate for each sour and whenever there is change in the quality of aggregate
		(iii) Flakiness and Elongation Indices	Laboratory	IS:2386 (Part 1)	One test per 350 cum of aggregate for each source and whenever there is change in the quality of aggregate
		(iv) Soundness test (Sodium or Magnesium Sulphate test)	Laboratory	IS:2386 (Part 5)	One test for each source and whenever there is change in the quality of aggregate
		(v) Water absorption of aggregates	Laboratory	IS:2386 (Part 3)	One test for each source and whenever there is change in the quality of aggregate
		(vi) Plasticity Index	Laboratory	IS:2386 (Part 5)	One test for each source and whenever there is change in the quality of aggregate
		(vii) Mix grading	Laboratory		One set for individual constituent and mixed aggregate from dryer for each 400 tons of mix subject to minimum of two tests per day per plant

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
		(viii) Stability and voids analysis of mix including theoretical maximum specific of loose mix	Laboratory		Three tests for stability, flow value, density and void contents for each 400 tons of mix subject to minimum of two tests per day per plant.
		(ix) Moisture Susceptibility of mix (AASHTO T283)	Laboratory		One test for each mix type whenever there is change in the quality or source of coarse of fine aggregate
		(x) Temperature of binder in boiler, aggregate in dryer and mix at the time of laying and compaction	Field		At regular intervals
		(xii) Binder content	Laboratory		One set for each 400 tons of mix subject to minimum of two tests per day per plant
10) Mastic asphalt		(i) Quality of binder	Laboratory		Same as mentioned under serial No. 8
		(ii) Aggregate Impact Value or Los Angeles Abrasion Value	Laboratory	IS:2386 (Part 4)	Same as mentioned under serial No. 8
		(iii) Combined Flakiness and Elongation Indices	Field	IS:2386 (Part 1)	Same as mentioned under serial No. 8
		(iv) Stripping value	Laboratory	IS:6241	Same as mentioned under serial

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
					No. 6
		(v) Deleterious material	Field	IS:2386 (Part 2)	One in a month
		(vi) Grading of aggregates	Field	IS:2386 (Part 1)	Two tests per day per plant on the individual constituent and mixed aggregates from the dryer
		(vii) Water absorption of aggregates	Laboratory	IS:2386 (Part 3)	Same as mentioned under serial No. 8
		(viii) Soundness test (Magnesium Sulphate / Sodium Sulphate)	Laboratory	IS:2386 (Part 5)	Same as mentioned under serial No. 8
		(ix) Binder content	Laboratory		Two test per day per plant
		(x) Control of temperature of binder and aggregate for mixing and of the mix at the time of laying and rolling	Field		At regular close intervals
		(xi) Rate of Spread of Mixed Material	Field		Regular control through check of layer thickness
		(xii) Hardness number	Laboratory		Minimum two tests per day
11) Recycled Material		Grading of aggregate	Field	IS:2386 (Part 1)	Two tests per day
12) Cold Mixes			Laboratory		All tests as per S. No. 8

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
13) Quality of Modified Binder			Laboratory		Number of samples per lot and tests as per IS:15462
14) Geo textiles			Laboratory		The requirements of Section 700 of MORTH Specification shall apply
15) Granular Sub Base (GSB)		(i) Gradation	Field	IS:2386 (Part 1)	One test per 400 cum.
		(ii) Atterberg limits	Laboratory	IS:2720 (Part 5)	One test per 400 cum.
		(iii) Water absorption	Laboratory		One test per 400 cum.
		(iv) Density of compacted layer	Laboratory		One test per 1000 cum.
		(v) Deleterious constituents	Field	IS:2386 (Part 2)	As required
		(vi) Soundness test	Field	IS:2386 (Part 5)	Same as mentioned under serial No. 8
		(vii) CBR	Laboratory		As required
16) Lime / Cement Stabilised Soil Sub-base		(i) Quality of lime / Cement	Laboratory		One test for each consignment subject to a minimum of one test per 5 tons
		(ii) Lime / Cement content	Laboratory		Regularly, through procedural checks
		(iii) Degree of pulverization	Laboratory		Periodically as considered necessary
		(iv) CBR or Unconfined Compressive Strength Test	Laboratory		As required

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
		on a set of 3 specimens			
		(v) Moisture content prior to compaction	Laboratory		One set of two tests per 500 sqm.
		(vi) Density of compacted layer	Laboratory		One set of two tests per 500 sqm.
		(vii) Deleterious constituents	Field		As required
17) Water Bound Macadam		(i) Aggregate Impact Value	Laboratory	IS:2386 (Part 4)	One tests per 1000 cum of aggregate
		(ii) Grading of aggregate	Field	IS:2386 (Part 1)	One test per 250 cum
		(iii) Combined Flakiness and Elongation Indices	Laboratory	IS:2386 (Part 1)	One tests per 500 cum of aggregate
		(iv) Atterberg limits of binding material	Laboratory	IS:2386 (Part 4)	One test per 50 cum of binding material
		(v) Atterberg limits of screenings	Laboratory	IS:2720 (Part 5)	One tests per 100 cum of aggregate
		(vi) Water absorption of aggregate	Laboratory	IS:2386 (Part 3)	Once in a month
		(vii) Deleterious material	Field	IS:2386 (Part 2)	As required, once in a month
18) Wet Mix Macadam		(i) Aggregate Impact Value or Los Angeles Abrasion value	Laboratory	IS:2386 (Part 4)	One tests per 1000 cum of aggregate
		(ii) Grading of aggregate	Field	IS:2386 (Part 1)	One tests per 200 cum of aggregate
		(iii) Combined Flakiness and Elongation Indices	Laboratory	IS:2386 (Part 1)	One tests per 500 cum of aggregate

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
		(iv) Atterberg limits of portion of aggregate passing 425 micron sieve	Laboratory	IS:2720 (Part 5)	One tests per 200 cum of aggregate
		(v) Density of compacted layer	Field		One set of three tests per 1000 sq.m.
		(vi) Water absorption of aggregate	Laboratory	IS:2386 (Part 3)	Once in a month
		(vii) Deleterious material	Field	IS:2386 (Part 2)	As required, once in a month
19) Cement concrete pavement under controlled conditions	16.37.19 of CPWD specifications 2019 volume-2	Coarse aggregate 1. Flakiness Index	Laboratory	IS 2386 (Part 1)	Before approval of the quarry and every sub-sequent change in the source of supply and one test per 100 cum.
		2. Impact Value	-do-	IS 2386 (Part 4)	-do-
		3. Loss Angles abrasion Value	-do-	-do-	-do-
		4. Deleterious material	-do-	IS 2386 (Part 2)	Before approval of the quarry and at every subsequent Change in the source of supply
		5. Moisture content	-do-	IS 2386 (Part 3)	Regularly as required subject to a minimum of one test per day
		Fine Aggregate			

Material/ work	Clause / Para No.	Test	Field/ Laboratory	Test Procedure	Frequency of Testing
		1. Silt content	Field	As per CPWD specification Vol. I.	One test per 15 cum.
		2. Gradation of sand	-do-	IS 2386 (Part 2)	-do-
		3. Deleterious material	-do-	IS 2386 (Part 2)	Before approval of the quarry and at every subsequent change in the source of supply
		4. Moisture content	-do-	IS 2386 (Part 3)	Regularly as required subject to a minimum of two tests per day
		5. Mix Aggregate	Field	IS 2386 (Part 1)	One test per 15 cum of concrete
		6. Flextural strength	Laboratory	IS 526	One test consisting of 8 specimen for 30 cum. of concrete

LIST OF BUREAU OF INDIAN STANDARDS CODES AND IRC STANDARDS

S. No.	BIS. No.	Subject
1.	IS 73	Specification for paving bitumen
2.	IS 164	Ready mixed paint for road marking
3.	IS 217	Specification for cut back bitumen
4.	IS 8112	Specification for 43 grade ordinary Portland Cement
5.	IS 278	Specification for galvanized steel barbed wire for fencing
6.	IS 334	Glossary of terms relating to bitumen and tar
7.	IS 383	Specification for coarse and fine aggregate from natural sources for concrete
8.	IS 460	Specification for test sieves
9.	IS 516	Method of test for strength of concrete
10.	IS 702	Specification for industrial bitumen
11.	IS 712	Specification for building limes
12.	IS 1195	Specification for bitumen mastic for flooring
13.	IS 1199	Methods of sampling and analysis of concrete
14.	IS 1203	Method of testing tar and bituminous material, determination of penetration
15.	IS 1205	Method of testing tar and bituminous material determination of

S. No.	BIS. No.	Subject
		softening paint
16.	IS 1208	Method of testing tar and bituminous material determination of ductility
17.	IS 1212	Method of testing tar and bituminous material determination of loss of heating
18.	IS 1216	Method of testing tar and bituminous material determination of solubility in carbon-di-sulphide, trichloroethylene
19.	IS 1834	Specification for hot applied sealing compound for joint in concrete
20.	IS 1838 (Pt. 1)	Specification for performed fillers for expansion joint in concrete pavements and structures (non extruding and resilient type/ bitumen impregnated fibre)
21.	IS 2386 (Pt. 1)	Method of test for aggregate for concrete particle size and shape
22.	IS 2386 (Pt. 2) 1963	Method of test for aggregate for concrete estimation of deleterious materials and organic impurities
23.	IS 2386 (Pt. 3)	Method of test for aggregate for concrete specific gravity, density, voids, absorption and bulking
24.	IS 2386 (Pt. 4)	Method of test for aggregate for concrete mechanical properties
25.	IS 2720 (Pt.V)	Method of test for soil: Determination of liquid and plastic limit.
26.	IS 2720 (Pt. VII)	Methods of test for soils: part VII determination of water content dry density relation using light compaction
27.	IS 2720 (Pt. XXVIII)	Method of test for soil: determination of dry density of soils in place, by sand replacement method
28.	IS 3812	Specification for fly ash for use as pozzolana and admixture
29.	IS 5317	Specification for bitumen mastic for bridges decking and roads
30.	IS 5640	Method of test for determining aggregate impact value of soft coarse aggregates
31.	IS 6241	Method of test for determination of stripping value of road aggregates

IRC STANDARDS:

1.	IRC 10	Recommended practice for borrow pits for road embankments constructed by manual operation
2.	IRC 29	Specification for bituminous concrete for road pavements
3.	IRC 36	Recommended practice for construction of earth embankments for road works
4.	IRC 60	Tentative guidelines for the use of lime flyash concrete as pavement base of sub base
5.	IRC 88	Recommended practice for lime flyash stabilized soil base/ sub base in pavement construction
6.	IRC 107	Tentative specification for bitumen mastic wearing courses

CEMENT CONCRETE PAVEMENT (UNDER ORDINARY CONDITIONS)

Specifications of item 16.37 of CPWD specifications 2019 volume-2 to be followed except that cement concrete of grade 1:2:4 or specified otherwise to be prepared and compacted.

CEMENT CONCRETE PAVEMENT UNDER CONTROLLED CONDITIONS

Materials

Cement
Cement used on work shall be as per sub head cement concrete of CPWD specifications-2019 (Vol. – I).

Water : Water used on work shall conform to SH: cement concrete of CPWD, Specification 2019- Vol. I.

Coarse Aggregate : These shall be crushed or broken from hard stones obtained from approved quarry. These shall be clean strong, durable of fairly cubical shape and free from soft, friable, thin elongated and laminated disintegrated pieces. These shall also be free from dirt, organic deleterious and any other foreign matter and adherent coatings and shall satisfy the physical requirements laid down in para 16.37.19 of CPWD specifications 2019 volume-2 under quality control.

Fine Aggregate : This shall be coarse sand conforming to CPWD Specification 2019 Vol. I.

Grading of Mixed Aggregates : The grading of all aggregates (coarse and fine aggregates) to be used in the work shall be determined in the laboratory. The coarse and fine aggregates shall be mixed in suitable proportions so that the grading of the mixed aggregates shall be in the range indicated in Table 16.32 of CPWD specifications 2019 volume-2.

TABLE

I.S. Sieve Size (IS 460)	% age passing by weight
45 mm	100
22.4 mm	55 - 60
11.2 mm	45 - 50
5.6 mm	35 - 40
2.8 mm	30 - 35
1.4 mm	20 - 25
710 microns	15 - 20
355 microns	10 - 14
180 microns	2 - 5

Mix Design
The mix shall be approved by Engineer-in- Charge so as to obtain the following mean trength that exceeds the minimum specified flexural strength by 1.64 times the designed standard deviation.

Minimum works beam

flexural strength at 28 days	=	300 kg/sqm. for M-30 or specified in item
Designed standard deviation	=	60 kg/sqm. for M-30 or for specified grade(s)
Design flexural strength at 28 days	=	300+60x1.64
Water cement ratio by weight	=	398.4 kg/sqm. (f + 1.64 s) says 400 kg.

Water cement ratio by weight Minimum slump not more than 25 mm	=	0.5

For the purpose of tendering the contractor shall base his rate on the assumption that the quantity of cement used for one cum. of finished concrete shall be as per approved mixed design of M-30 grade.

Statistical Field Check
Samples of concrete shall be taken at the mixer and works beams, made, cured and tested in accordance with IS 1199 and IS 516.

When a mix is used for the first time, it is important to get a large number of results, as soon as possible, in order to establish the level of control and then suitability of the mix proportions. A sample of concrete shall be taken at random on eight separate occasions during each of the first five days of using that mix. From each sample two beams shall be made one for test at 7 days and the other for test at 28 days.

The work beam results shall be examined both individually and in consecutive (but not overlapping) sets of four, for which the average and the range of each set is calculated. The mix proportions shall be modified to increase the strength, if in the first ten consecutive (but not overlapping) sets any of the following conditions are not satisfied.

Each sample has a test strength not less than the minimum specified strength i.e. 30 kg/sq. cm. (or otherwise specified in item).

OR

(a) Not more than two individual results (Not more than one of first twenty) of the 40 beams tests shall fall below the minimum work beam strength but they shall not be less than 80% of the specified beam strength of 30 kg./sq. cm (or otherwise specified in item) or the minimum specified strength minus 1.35 times the standard deviation whichever is greater.

No value of the range in any set shall exceed 3 times the designed standard deviation.

The average for all samples (10 sets) shall not be less than the minimum specified strength i.e. 30 kg/sq. cm (or otherwise specified in item) plus 1.64 times the designed standard deviation 60 kg./sq.cm M-30.

If either of these conditions (16.37.3.3 I or 16.37.3.3 II) are not satisfied, the mix shall be modified and the procedure described above shall be repeated till results satisfying the above criterias are obtained.

Subsequently samples shall be taken at the rate of one for every 30 cubic metre of concrete laid. Eight beam specimen shall constitute one sample. A set of 4 specimen shall be tested after 7 days and another set of 4 specimen shall be tested after 28 days. These test results shall be checked individually and in sets of four as the work progresses. If at any stage it is found that either of conditions 16.43.4.3,I or 16.4.3,II are not satisfied, the overall average and the standard deviation of the previous consecutive 40 beam test results including the non-complying set shall be calculated.

If the overall average strength minus 1.64 times the standard deviation is more than the specified beam strength (30 kgm/sq.cm) (or otherwise specified in item) the concrete shall

be accepted. But if it is less than the concrete work corresponding to these 40 beams tests shall be rejected and the mix proportion shall be modified forth with for further work. The rejected work shall be replaced by the contractor immediately at his own cost and expense.

The statistical field checks described in 16.37.3.1 to 16.37.3.2 are meant to control the quality of concrete. The standard of acceptance of concrete shall be governed by the provision of para 16.37.3.3 to 16.37.3.5.

Slump Test

The test shall be carried out as per IS 1199. A slump test shall be carried out at each mixer at least one in fifty batches mixed or more frequently if directed by the Engineer- in-Charge. Any batch from which slump test is being made shall not be transferred to the place of laying till the slump test has been completed. Not only the batch which gives a slumps in excess of that specified shall be rejected but the concrete already laid immediately preceding the batch tested upto the nearest last transverse joint may be rejected by the Engineer-in-Charge or his subordinate, if he is satisfied that such preceding batches were substandard in this respect. The decision of the Engineer-in-Charge in this respect shall be final and binding on the contractor. Such rejected concrete shall be removed by the contractor immediately and replaced with proper slump concrete at his cost and expense.

Steel Forms

All side forms shall be of mild steel. The steel forms shall be of M.S. Channel sections and their depth shall be equal to the thickness of the pavement.

The side forms shall have a length of at least 3.0 metres except on curves of less than 4.5 metres radius where shorter lengths may be used. When set to grade and stacked in place the maximum deviation of the top surface of any section from a straight line shall not exceed 3 mm. The method of connection between sections shall be such that the joint formed shall be free from play or movement in any direction. The use of bent, twisted or worn out forms shall not be permitted. At least three stake pockets for bracing pins or stakes shall be provided for each 3.0 M length of forms. Bracing and supports must be ample to prevent the springing of forms under pressure of concrete or weight or thrust of the machinery (like screed vibrator) operating on the forms. Support to the forms shall be sufficiently rigid to hold them in position during the entire operation of laying and compacting and finishing and that they shall not at any time deviate more than 3 mm from straight edge 3 metres in length. Forms which show a variation from the required rigidity of the alignment and levels shown on the plans shall be reset or removed as directed. The length and number or pins or stakes shall be such as to maintain the forms at the correct line and grade.

The supply of forms shall be sufficient to permit their remaining in place for at least 12 hrs. after the concrete has been placed or longer, if in the opinion of the Engineer-in-Charge, it is necessary.

The top line of the forms is not to vary from the correct level or alignment and the levels and alignment of the forms are to be checked and corrected as necessary immediately prior to the placing of concrete. The top edges and faces of the forms are to be carefully cleaned and maintained in clean condition.

While removing the steel forms, care shall be taken to withdraw them gradually, any damage to the bull nosed edges shall be made good while the concrete is still green.

Setting of Forms

Setting of forms shall be according to the slab plan subject to the approval of Engineer-in-Charge and concreting shall not commence until the setting of forms is approved.

Forms shall be set for at least 50 metres in advance of the point where the concrete is being laid and shall not be removed until at least 12 hrs. of placing of the concrete or longer if in the opinion of Engineer-in-Charge is necessary.
After setting, the working faces shall be thoroughly oiled by using approved oil before concrete is placed against them.

The pavement joints of overlay layer would overlap with the joints of underlay cement concrete.

Batching and Mixing
As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2019.

Placing of Concrete
As detailed in SH: 5 of reinforced cement concrete work of CPWD specifications 2019.

Compaction of Concrete
Compaction shall be carried out by electrically (or) diesel operated needle and screed vibrators as stipulated hereafter. Needle vibrator should be used all over the area for obtaining initial compaction of concrete. These should be of diameter not less than 4.5 cm. If the vibrator are pneumatic the pressure must not be below 4 kg/sq.cm. If electrically operated, they should have a minimum frequency of 3500 impulses per minute.

There should be at least three needle vibrators working in any bay. A vibrating screed consisting of a steel or timber section weighing not less than 15 kg. per metre with a tamping edge of not less than 7 cm width and having a vibrator mounted thereon shall follow needle vibrators to obtain full compaction. The face of the wooden tamping edge of the screed shall be lined with M.S. Plate rigidly fixed by means of counter sunk screw. Where screed vibrators are used for compaction, a standby unit shall always be maintained ready for use, should the other one go out of order. Where electrically driven vibrators are employed, a standby diesel pneumatic unit shall be kept ready for use in case of power failure. At the discretion of the Engineer-in-Charge, for compaction at edges and joints, vibrators may be supplemented by hand tamping and rodding for securing satisfactory results. Under no circumstances, honey combing of concrete at joints or elsewhere shall be permitted.

When using screed vibrator for compaction it should not be dragged over the concrete. During the initial passes it shall be lifted to the adjacent forward position in short steps, subsequently, it shall be slowly slided over the surface with its axis slightly tilted away from the direction of sliding and the operation repeated until a close, dense surface is obtained.

Concreting shall be carried out in one operation between the expansion joints and construction joints without any break at the dummy joints.

Concrete shall be deposited on the base as near the joints as possible without touching them. It shall then be shoveled against the sides, maintaining equal pressure and deposited approx. 50 mm higher than the depth of the joints, care being taken that it is worked well around the joints. The concrete shall not be dumped from the bucket directly upon or against the joints.

Workmen shall not be allowed to walk on freshly laid concrete and proper cat walk shall be provided with independent supports beyond concreting bays.

Finishing of Concrete
During compaction, any low or high spots shall be made up by adding or removing concrete. After longitudinal floating has been completed but while concrete is still plastic, the slab

surface shall be tested for trueness with a 3 m straight edge. Any depressions or high spots showing departure from the true surface shall be immediately rectified. High spots shall be cut down and refinished. Depressions shall be enlarged to about 8-10 cm and filled up with fresh concrete, compacted and finished.

The straight edge testing the refloating is to continue until the entire surface: is free from observable departure from the straight edge, conforms to the required levels and across section, and shall conform to the specified surface when the concrete has hardened.

The foregoing work is to be carried out while the concrete is still plastic and workable.

Belting

Just before concrete becomes non-plastic, the surface shall be belted with a two ply canvas belt not less than 20 cm wide and at least 1 metre longer than the width of the slab. Hand belts shall have suitable handles to permit controlled uniform manipulation. The belt shall be operated with short strokes transversed to the centre line of the pavement and with rapid advance parallel to the centre line.

Brooming

After belting and as soon as the surplus water, if any, has risen to the surface, the pavement shall be given a broom finish with an approved steel or fiber broom not less than 45 cm wide. The broom shall be pulled gently over the surface of the pavement from edge to edge. Adjacent strokes shall be slightly overlapped. Brooming shall be perpendicular to the centre line of the pavement and so executed that the corrugations formed shall be uniform in character and width and not more than 1.5 mm deep.

Brooming shall be completed before the concrete reaches such a stage that the surface is likely to be torn or unduly roughened by the operation. The broomed surface shall be free from porous or rough spots, irregularities, depressions, and small pockets such as may be caused by accidental disturbing of particles of coarse aggregates embodied near the surface. The brooming shall be of uniform pattern all through.

Edging : After belting/brooming has been completed but before the initial setting of concrete, the edges of the slab shall be carefully finished with an edger of 6 mm radius, and the pavement edges shall be left smooth and true to line.

Honey Combing

The side forms shall not be removed until 12 hours or such longer period as the Engineer-in-Charge may decide after the laying of concrete.

As soon as the side forms are removed, any minor honey combed area shall be filled with mortar composed of one part of cement and two parts of fine aggregate. Major honey combing areas or segregated concrete or other defective work or areas damaged by removal of the forms or concrete damaged by rain or due to any other reason whatsoever shall be considered as defective work and shall be removed and replaced by the contractor at his own expense. The total area of honey combed surface shall not exceed 4 per cent of the area of the slab side. However, no individual honeycomb patch shall exceed 0.1 sqm. Engineer-in-Charge’s decision as to whether the concrete is defective or not shall be final and binding.

Surface Accuracy

After the concrete has sufficiently hardened after about 12 hours and not later than 24 hours, the surface shall be tested again for high spots. All high spots shall be marked and those

exceeding 3 mm shall be ground down immediately. Care shall be taken to see that the grinding does not in any way damage the concrete surface.

The final surface finish is to be such that when tested with a profilograh/roughness indicator/or a 3 metre long straight edge or an equivalent mechanical unevenness indicator placed anywhere within the same or adjoining slab in any direction on the surface, there shall be no variation greater than 3 mm.

If the surface irregularity exceeding 3 mm still remains despite grinding as per para. The concrete shall be removed to its full depth. The area of concrete to be removed shall be complete slab between the nearest joints, where the defective slab is less than 4.5 metres from the expansion joint, the whole area upto the expansion joint shall be removed to the full depth. The concrete so removed shall not be reused in the work. Fresh concrete shall be laid in the manner already de-scribed in above paras and shall again be subject to test for surface accuracy and other quality control measures. Nothing extra shall be paid on this account.

Every slab shall bear an impression not exceeding 3 mm in depth comprising the number allotted to the slab and the date on which it is laid. This impression shall be formed by the contractor when the concrete is green so as to leave permanent mark on setting.

Initial Curing

Immediately after completion of the finishing operations, the surface of the pavement shall be entirely covered with wetted burlap, cotton or jute mats. The mats used shall be of such length (or width) that as laid they shall extend at least 45 cm beyond the edges of the slab. The mats shall be placed so that the entire surface and both edges of the slab are completely covered. This covering shall be placed as soon as, in the judgment of the Engineer- in-Charge the concrete has set sufficiently to prevent damage to the surface prior to being placed, the mats shall be thoroughly saturated with water and shall be placed with the wettest side down. The mats shall be so placed and weighed down as to cause them to remain in intimate contact with the surface covered, and the covering shall be maintained full wetted and in position for 24 hours after the concrete has been placed or until the concrete is sufficiently hard to be walked on without suffering damage. Water shall be gently sprayed so as to avoid damage to the fresh concrete. If it becomes necessary to remove a mat for any reason, the concrete slab shall not be exposed for a period of more than half an hour.

Worn burlap or burlap with holes shall not be permitted. Burlap reclaimed from previous use other than curing concrete shall be thoroughly washed prior to use for curing purposes. If burlap is obtained in strips, shall be laid to overlap by at least 150 mm.

Burlap shall be placed from suitable bridges. Walking on freshly laid concrete to facilitate placing burlap shall not be permitted.

Final Curing

Upon the removal of the burlaps, the slab shall be thoroughly wetted and then cured as follows:

All joints shall be filled with filler in order to prevent the edges of joints from getting damaged and entry of clay materials into the joints during final curing. Exposed edges of the slab shall be banked with a substantial berm of earth. Upon the slab shall then be laid a system of transverse and longitudinal dykes of clay about 50 mm high immediately covered with a blanket of sandy soil free from stones to prevent the drying up and cracking of clay. The rest of slab shall then be covered with sufficient sandy soil so as to produce a blanket of earth not less than 40 mm deep after wetting. The earth covering shall be thoroughly wetted while it is

being placed on the surface and against the sides of the slab and kept thoroughly saturated with water for 21 days and thoroughly wetted down during the morning of the 22nd day and shall thereafter remain in place until the concrete has attained the required strength and permission is given by the Engineer-in-Charge. Thereafter the covering shall be removed and the pavement cleaned and swept. If the earth covering becomes displaced during the curing period, it shall be replaced to the original depth and resaturated.

Contractor shall appoint chowkidars at his expense to prevent workmen, cattle, etc., straying on the pavement concrete.

Concrete shall not be subjected to any load or weight of any plant until at least 28 days after laying.

Construction Joints

Construction joints shall be provided as shown in the drawing and also at places where concreting is stopped due to unforeseen circumstances. The joints shall be straight and vertical through the full thickness of the slab. While concrete in adjacent bay is still green, flats of suitable size shall be drawn along the edge and a groove of size 4 mm × 40 mm deep shall be neatly formed and finished. The edges of the groove shall be full nosed. After curing of concrete is complete, this groove shall be thoroughly cleaned of all sand dust and shall be perfectly dried and filled with poly sulphide/bitumastic sealant in the joints. Before filling with sealing compound the faces of concrete of the joint shall be coated with primer of approved brand to a depth of 25 mm at the rate of 2.6 liters per 10 square meters. Bitumen emulsion shall not be used as primer.

Dummy Joints

The joints shall be 10 mm wide and shall extend vertically from the surface of the slab to a depth equal to 1/3rd of the thickness of the slab but not less than 4 cm in any case. The joint may be formed by depressing into the soft but compacted concrete a high tensile M.S. or other approved Tee of flat bar of depth not less than required depth of the joint plus 25 mm. The bar used for forming the groove shall be coated with soft soap or other suitable lubricant to facilitate its removal when the steel Tee or flat is removed joints shall be neatly formed with proper tools and mortar/fine material from the slab itself. No additional cement mortar (rich or otherwise) shall be used.

Cutting or sawing by a saw mounted on a movable frame and driven mechanically shall also be permitted as a method for making the joint. In this case the width may be reduced to 6 mm. any other method for making joints can be followed with the prior approval of the Engineer-in-Charge.

In all cases, except where cutting is done with saw, the joint edges shall be bullnosed. Care should be taken to see that the edges of the grooves are not damaged.

The grooves shall be filled with hot poured sealing compound conforming to Grade B of IS:1834. Prior to filling with sealing compound, the joints shall be cleaned by compressed air and primed with Shalijet primer or equivalent at the rate specified in Para 16.37.16.1

All joints shall be sealed as soon as practicable after 28 days of casting of cc pavement. Joints shall be sealed flush with the adjacent pavement surface in summer and 3-4 mm below finished concrete surface in winter. The pavement shall be opened to traffic only after joint sealing over the entire pavement. To prevent tackiness or pickup under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by Engineer-in-Charge, for which nothing extra shall be paid to the contractor.

In case of sudden rain or storm, the work can be concluded at the dummy joints but these will then be formed as construction joints.

Before sealing of joints, it may be ensured that the groove extends fully across the bay between consecutive longitudinal joints, in the case of transverse joints and is continuous in the case of longitudinal joints. Any concrete or other foreign matter must be removed from the groove.

Providing and Laying Cement Concrete (NP-3) Pipes 250 mm Dia at,across the Cement Concrete Road at Start , Intermediate & End part of Each Road Segment and if Length of Road Exceed 30 m than additional 1 intermediate Pipe at equidistance Including Brick Chamber at both Ends of Pipe as per requirement & Design approved by Engineer-in-charge.

Note:- The quoted rate is all inclusive for laying the rigid pavement consisting of Compacted sub-grade, Sub base with GSB, Base layer with DLC and Surface layer with vacuum dewatered Cement concrete, CC Pipe, Chamber etc complete and nothing extra shall be paid.(Details as per Annexure B-1)

Concreting during Rains

To prevent damage to freshly laid concrete during monsoon, or sudden rains, the contractor shall provide an adequate supply of tarpaulins or other water proof covering material. Any concrete damaged by rain shall be removed and replaced by the contractor at his own cost as directed by the Engineer-in-Charge.

Quality Control

The following quality control tests shall be carried out at frequencies specified against each as in Table as below.

TABLE

S.No	Test	Test Method	Frequency	Acceptance Criteria
1	2	3	4	5
(i)	**COARSE AGGREGATE**			
(a)	Flakiness index	IS 2386 (Pt.1)	Before approval of the quarry and at every subsequent change in the source of supply and one test per 100 cum of aggregates	Not more than 15%
(b)	Impact value	IS 2386 (Pt.4)	-do-	Not more than 30%
(c)	Los angles abrasion	IS 2386 (Pt.4)	-do-	Not more than 40%
(d)	Deleterious materials.	IS 2386 (Pt.2)	Before approval of the quarry and at every subsequent change in the source of supply	As per table 1 of IS 383
(e)	Moisture content.	IS 2386 (Pt.3)	Regularly as required subject to a min. one test per day	-do-
(ii)	**FINE AGGREGATES**			
(a)	Silt content.	CPWD specifications 2019, Vol. I, SH: CC	One test per 15 cum	Not more than 8%
(b)	Gradation of sand	IS 2386 (Pt.1)	-do-	Fineness modulus
(c)	Deleteri us materials.	IS 2386 (Pt.2)	Before approval of the quarry and at every subsequent change in the source of supply	As per table 1 of IS 383
(d)	Moisture content.	IS 2386 (Pt.3)	Regularly as required subject to a min. 2 test/day	-do-

(iii)	**MIXED AGGREGATES**			
(a)	Grading	IS 2386 (Pt. 1)	1 test per 15 cum	As per para 16.37.1.5
(iv)	Slump test of concrete	IS 1199	At least once in 50 batches at each mixer or more frequently if directed by the Engineer-in-Charge	Not more than 25 mm

(v)	Flexural strength	IS 516	One test of sample consisting of eight specimen for every 30 cum of concrete	As per para 16.37.3.5.
(vi)	Surface accuracy	As prescribed	Regularly	As per para 16.37.13

Equipments

Equipments as per list at Appendix C shall be provided by the contractor in the field testing laboratory. Nothing extra shall be paid to him on this account. Records as required shall be maintained at site. All tests details in support of mix design shall be maintained as part of records of the contract and shall be signed both by the contractor and the Engineer-in-Charge. The contractor shall provide all labour, materials and equipment required for all tests to be carried out at his own cost.

The Engineer-in-Charge reserves the right to test any part of concrete laid regarding quality soundness, compactness, thickness, strength and finish of the concrete, at any time before the expiry of the “Defect liability period” not withstanding that necessary tests had been carried out and found satisfactory at the time of execution.

All defective unsound sub-standard work and concrete of sub-standard strength and quality etc. as established vide paras 16.37.3 shall be rejected and shall be replaced by the contractor at his own expense in the manner as detailed in para 16.37.3. Where due to operational or any other reason such replacement does not become possible (decision of Engineer-in-Charge in this respect being final and binding on the contractor), the cost of removal and replacement of such rejected work shall be recovered from the contractor whether such rejected work is subsequently replaced by the Government or not.

Defects Liability Period

This period shall be reckoned in the case of this work as one year from the date of completion of work and it shall be the liability of the contractor to repair, strengthen or reconstruct any portion of the work which has shown damage or any defect, arising out of any bad workmanship or defective material used in the work during this period. In the case of this rectification not being commenced by the contractor within 7 days from the date of notice from the Engineer-in-Charge and completed expeditiously the Engineer-in-Charge reserves the right to get the repair work executed at the risk and cost of the contractor.

Measurements

For the purpose of ascertaining the quantity of concrete in the pavement, thickness shall be measured by means of a scale correct to the nearest 2 mm. The thickness of the concrete pavement slabs shall be taken on either side of the pavement at each dummy joint at four corners of the slab immediately after removal of the side forms. In case the average thickness of the slab exceeds the specified thickness, payment shall be restricted to the specified thickness.

The dimensions of each slab of pavement shall be measured as follows to the nearest 5 mm. Length Between the end of a pavement to the centre line of the expansion joints. Between the centre lines of consecutive expansion joints. Width Between the edge of a pavement and the centre line of the construction joints. Between the centre lines of construction joints and expansion joints. Between the centre lines of consecutive construction joints.

Note : The quantity of concrete in the pavement slab shall be worked out by multiplying the area of the slab and its average thickness or specified thickness whichever is less. No deduction shall be made for any joints in the concrete slab.

Measurements of concrete slabs shall be recorded jointly by the Engineer-in-Charge or his authorised subordinate and the contractor or his authorised agent.

Rate

The rate of the item for concrete in pavement shall include the cost of all materials and labour including charges for machinery tools & plants required in all the operations described above. The rate also includes all cost of setting up the laboratory at site and carrying out the quality control measures/tests enumerated above by the contractor at his own cost in the presence of Engineer-in- Charge or his authorized representative and submission of test results on completion of tests to the Engineer-in-Charge thereof.

HARD CRETE

Hard crete of approved quality and brand to be used. It shall be mixed in ratio and method as recommended by manufacturer and approved by Engineer-in-charge in cement concrete for laying in paramount. Quantity shall be measured in litre used in cement concrete. Hardcrete to be brought in sealed container and proper record of quantity be maintained. Empty containers of hardcrete shall not be removed from site with but prior permission of Engineer-in-Charge.

EXPANSION JOINT

Materials

Premoulded Joint Filler in Expansion Joint : It shall conform to IS 1838 (Pt. I). The thickness shall be as site requirement with tolerance 1.5 mm. and shall be of the maximum available standard length not less than one lane width. The filler board shall be positioned vertically with the prefabricated joint assemblies along the line of the joint within tolerance of + 10 mm from the intended line of the joint. The depth of board shall be 25 mm less than thickness of slab within a tolerance of ± 3mm so that the top of the board shall be below the surface or will not impead the passage of the finishing straight edge or oscillating beam of the paving machine.

Bitumine Hot Sealing Compound : The joint sealing compound shall be fuel and heat resistant type complying to grade B of IS 1834. It shall be capable of adhering to the concrete without cracking, spalling and disintegration.

CONSTRUCTION PROCEDURE

Expansion joints shall be provided as shown in the drawing and as per directions of Engineer- in-Charge. All joints shall be constructed true to line with their faces perpendicular to the surface of the pavement. The joint shall be 20 mm wide. The depth of the non-extruding filler pad shall be 25 mm less than the depth of the concrete slab.

Before the provision of expansion joint, the face of the already laid concrete slab shall be painted with primer at the rate of 2.6 liters per 10 square metres. The expansion pad shall be properly cut to shape and shall then be placed in position abutting the painted face of the already laid concrete slab. The adjacent slab shall then be concreted. The face of the pad against which the new concrete slab is to be laid shall also be painted with primer before laying the concrete, while concreting a neat groove of size 20 mm x 25 mm as per drawing shall be formed on top of the pad taking care that the edges are absolutely straight and that the groove so made does not get filled with any material like concrete, mortar and other rubbish.

Before the curing process is started, the top of expansion joint shall be filled with bitumen sand mixture in order to ensure that no foreign material used in curing enters into the joint.

This filling shall be removed before filling the joints with sealing compound.

For sealing the joints following operations shall be carried out :

- The joints are cleared of any foreign matter to the full depth upto the top of expansion pad with steel spatula.
- The joints are blown with compressed air.
- Cleaning is done with Kerosene oil.
- Priming is done with spray gun @ 2.6 liters per 10 sqm of the surface to be primed.
- The primer is allowed to dry completely before pouring the sealing compound.
- The sealing compound grade 'A' is heated to the required temperature ranging between 155 deg. C to 165 deg. C or to the temperature range specified by the manufacturer. Over heating shall be avoided. Pouring shall be done from vessel with spout in such a manner that the material will not get spilled on the exposed surface of the concrete, any excess filler on the surface of the pavement shall be removed immediately and the pavement surface cleaned.
- The filling shall be worked into the joints with hot flats to ensure escape of trapped air.
- The filling is then ironed with hot iron. It is recommended that while in summer the joints may be sealed flush with the adjacent pavement surface, in winter the sealing compound may be filled to a depth 3-4 mm below the surface.
- The edges of the joints are then cut and trimmed to ensure neat and straight line finish.
- To prevent tackiness or pick up under traffic, the exposed surfaces of the sealing compound shall be dusted with hydrated lime, if directed by Engineer-in-Charge (Nothing extra shall be paid for the same).

PAINTING ROAD/ RUNWAYS MARKINGS

Materials

Special Road marking paint of approved brand and manufacture shall be used. The paint shall conform to IS 164. Ready mixed paint as received from the manufacturer shall be used without adding any admixture.

During work, if the consistency of the paint gets thick and thinning becomes necessary it shall be done by use of thinner of the approved brand of paint recommended by the manufacturer and with the approval of the Engineer-in-Charge.

The paint shall be brought to the site of work by the contractor in original sealed containers. The material shall be brought in one lot in adequate quantity to suffice for the entire work. The material shall be kept in the joint custody of the contractor and the Engineer-in-Charge. The empty container shall not be removed from the site of work, till the work has been completed and permission obtained from the Engineer-in-Charge.

Preparation of Surface

The surface shall be thoroughly cleaned and free from dust. All the dirt, scales, oil and grease shall be thoroughly removed before painting is started. The prepared surface shall be inspected and approved by the Engineer-in-Charge before painting is commenced.

Application

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in its original container. The paint shall be continuously stirred in the smaller container while applying to runway surface so that its consistency is kept uniform.

The painting shall be applied evenly and smoothly by means of crossing and laying off. The crossing and laying off consists of covering the area over with paint, brushing the surface

hard for the first time over and then brushing alternatively in opposite direction, two or three times and then finally brushing lightly in a direction at right angle to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

Each coat shall be allowed to dry out thoroughly before the next coat is applied.

Earlier applied coat shall be cleaned off dust before the next coat is laid.

No left over paint shall be put back into the stock tins. When not in use, the containers shall be kept properly closed.

No hair marks from the brush or clogging of paint puddles shall be left on the work.

The surface shall ordinarily not be painted until it has dried up completely. Trial patches of paint shall be laid at intervals to check if drying is satisfactory.

The runway marking shall be done in accordance with the drawing unless otherwise instructed by the Engineer-in-Charge.

Brushes and Containers
After work, the brushes shall be completely cleaned of paint by rinsing with turpentine. A brush in which paint has dried up is spoiled and shall on no account be reused for painting work. On no account kerosene oil shall be used for washing the brush.

When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth so that they are clean, and can be used again.

PAINTING ROAD SURFACE (WITH READY MIXED ROAD MARKING PAINT)
Specifications of item no. 16.41 to be followed except that road surface to be painted with ready mixed road marking paint of approved brand instead of paint of superior make.

RETRO REFLECTIVE SIGN BOARD
General

The colour, configuration, size and location of all the traffic signs for highways other than Express ways shall be in accordance with the code of practice for road signs, IRC:67 or as shown on the drawings. For expressways, the size of the signage, letters and their placement shall be as specified in the contract drawings and relevant specifications or as directed by the Engineer-in-Charge.

Materials

Concrete
Concrete shall be of M-30,35,40 grade as per Structure Drawings.

Reinforcing steel
Reinforcing steel shall confirm to the requirement of IS 1786 unless otherwise specified.

Bolts Nuts and Washers
High strength bolts shall confirm to IS 1367 whereas precision bolts, nuts etc. shall confirm to IS 1364.

Plates and Supports
Plates and support sections for the sign posts shall confirm to IS 226 and IS 2062 or any other stated IS specification.

Substrata
The substrate shall be either aluminium sheeting or aluminium composite material (ACM) confirming to following sub-sections.

Aluminium
Aluminium sheets used for sign boards shall be of smooth, hard and corrosion resistant aluminium alloy confirming to IS 736 material designation 24345 or 1900.

Aluminium composite materials
The Aluminum Composite Material (ACM), used as the substrate for signage application shall have a thickness of at least 4.0mm (excluding coating thickness).

The ACM shall be composed of thermoplastic core of “Low Density Polyethylene’ (LDPE) of 3.0mm thickness sandwiched between two thick sheets of aluminium, of 3003 grade and H-18 temper and minimum thickness of 0.5mm each. The retro reflection sheeting must be applied on the top surface with aluminium surface with recommended surface preparation from sheeting manufactures.

A fluorocarbon coating may be applied over the exposed surface of aluminum to ensure corrosion resistance and weather proof and thus shall confirm to relevant ASTM.

The ACM shall have a high-surface energy coating on the top surface, over which the retro reflective sheeting shall be applied.

When measured after 24 hrs after application, the 90 peel-adhesion strength of the top surface of ACM with the retro reflective sheeting applied on it using a 2kg roller as per ASTM D3330 shall be at least 1.5 kg-f.

The front surface shall have no other coating other than the high-surface energy coating and shall be protected with a self-adhesive peel-off film. The retro refletive sheeting shall be applied only on the top surface with high-surface energy coating.
On the back surface, it shall have a polyester based service coating preferably grey in color to protect against possible corrosion and to avoid undesired glare from the rear side of the sign.

The mechanical properties of 4mm ACM and that of its aluminium skim shall confirm to the requirement given in table below. When tested accordance with the test methods mentioned against each of them.

Specification for Aluminium Composite Material (ACM)

S. No.	Description	Specification for 4mm	
		Standard Test	Acceptable Value/Results
A	Physical Tests for ACM		
1	Over all thickness of ACM	Measurement	4mm (Tolerance + 0.2mm)
2	Aluminium Skin thickness (each side)	Measurement	0.5mm (Tolerance +/- 0.03mm)

S. No.	Description	Specification for 4mm	
		Standard Test	**Acceptable Value/Results**
	Panel weight (ACM)	Measurement	5.5 Kg/m2 (+ 5%)
B	Mechanical Properties of ACM		
1	Peel off strength with retro reflective sheeting. (Drum Peel Test)	ASTM D903	Min. 4 N/mm
2	Tensile strength	ASTM E638	Min. 40 N/mm2
3	0.2% Proof Stress	ASTM E638	Min. 34 N/mm2
4	Elongation	ASTM E638	Min. 6%
5	Flexural strength	ASTM C393	Min. 130 N/mm2
5	Shear strength with punch shear test	ASSTM D732	Min. 18 N/mm2
C	Properties of Aluminium skin		
1	Tensile strength (Rm)	ASTM E8	Min. 150 N/mm2
2	Modules of elasticity	ASTM E8	Min 70000 N/mm2
3	Elongation	ASTM E8	Min. 2%
4	0.2% proof stress	ASTM E8	Min. 110 N/mm2
D	Properties of High surface energy coating		–
1	(90deg) Peel adhesion strength of Retroreflective sheeting on ACM surface with high-surface energy coating	ASTM D330	Min. of 1.5 kgf i.e. Equal to or more than that with surface prepared aluminium

Performance Certificate

Requisite performance certificate from the manufacturer of the ACM stating compliance with ACM technical specification as per above Table shall be submitted by the contractor to the Engineer- in-Charge.

Retro- Reflective Sheeting (Type-XI Prismatic Grade sheeting):

(AS per IRC 67-2012 Clause 6.7)

The retro reflective sheeting used on the signs shall consist of white or coloured sheeting having a smooth outer surface which has the property of retro reflection over its entire surface. It shall be weather resistant and exhibit colour fastness. It shall be new and unused and show no evidence of cracking, scaling, and pitting, blistering, edge lifting or curling and shall have negligible shrinkage or expansion. A certificate of having the sheeting tested for coefficient of retro reflection, daytime colour

and luminance, shrinkage, flexibility, liner removal, adhesion, impact resistance, specular gloss and fungus resistance, 3 years outdoor weathering and its having passed these tests shall be obtained from International / Government Laboratory / Institute by the manufacturer of the sheeting and in case the certificate is obtained from international agency, it should also be obtained from Indian agency within 3 years of launching of product by the manufacture in abroad. Alternatively, a certificate conforming to ASTM Specification (D 4956-09) on artificial accelerated weathering requirements from a reputed laboratory in India can be accepted provisionally. In such a situation, the Employer/ Client, if so desires, could seek for a performance guarantee which would be released after receipt of certificate

meeting the requirement of three years outdoor weathering of the sheeting.

Retro-reflective sheeting is typically manufactured as a cube corner. The reflective sheeting shall be retro-reflective sheeting made of micro prismatic retro-reflective material. The retro-reflecting surface after cleaning with soap and water and in dry condition shall have minimum co-efficient of retro reflection (determined in accordance with ASTM D4956-09) confirming to IRC:67 Table 6.9.

When totally wet, the sheeting shall not show less than 90 per cent of the values of retro-reflection. At the end of 10 years the sheeting shall return at least 80 per cent of its original retro-reflectance.

Adhesives : The sheeting shall have a pressure-sensitive adhesive of the aggressive- tack type requiring no heat, solvent or other preparation for adhesion to a smooth clean surface, in a manner recommended by the sheeting manufacturer and approved by Engineer-in-Charge. The adhesive shall be protected by an easily removable liner (removable by peeling without soaking in water or other solvent) and shall be suitable for the type of material of the base plate used for the sign. The Adhesive shall form a durable bond to smooth, corrosion and weather resistant surface of the base plate such that it shall not be possible to remove the sheeting from the sign base in one piece by use of sharp instrument. The sheeting shall be applied in accordance with the manufacturers specifications.

Installation

Surface to be reflectorised shall be effectively prepared to receive the retro- reflective sheeting. The Aluminium / ACP sheeting shall be de-greased either by acid or hot alkaline etching and all scale/dust removed to obtain a smooth plain surface before the application of retro-reflective sheeting. Complete sheet of the material shall be used on the signs except where it is unavoidable. Sheeting with heat-activated adhesives may be spliced with an overlap not less than 5 mm or butted with a gap not exceeding 0.75 mm. The material shall cover the sign surface evenly and shall be free from twists, cracks and folds.

Sign posts, their foundations and sign mountings shall be so constructed as to hold these in a proper and permanent position against the normal storm wind load or displacement by vandalism. Normally, sign with an area upto 0.9 sq.m shall be mounted on a single post and for greater area two or more supports shall be provided. Sign supports shall be as specified in item or as per directions of Engineer-in-Charge. The work of foundation shall conform to relevant specification as specified.

Backside of aluminium sheet portion shall be painted with two coats of epoxy paint. Any part and support frame with two or more coats of synthetic enamel paint.

Performance Certificate

Requisite performance certificate from the manufacturer of the ACM stating compliance with ACM technical specification as per Table 16.44 above shall be submitted by the contractor to the Engineer- in-Charge.

Warranty and Durability

The Contractor shall obtain from the manufacturer a ten year warranty as per IRC:67 for satisfactory performance including stipulated retro-reflectance of the retro-reflective sheeting, the screen printed areas and cut out sheeting and cut out durable transparent overlay film and submit the same to the Engineer-in-Charge.

Processed and applied in accordance with recommended procedures, the reflective material

shall be weather resistant and following cleaning, shall show no appreciable discoloration, cracking, blistering or dimensional change and shall not have less than 50 percent of the specified minimum reflective intensity values when subjected to accelerated weathering of 1000 hours, using type E or EH Weather meter (AASHTO Designation M 268).

RETRO REFLECTIVE OVERHEAD SIGNAGE

General
Overhead signs may be used in lieu of, or as an adjunct to, ground signs where the situation so warrants for proper information and guidance of the road user.

The support system should be properly designed based on sound engineering principles, to safety sustain the dead load, live load and wind load on the completed sign system. For this purpose, the overhead signs shall be designed to withstand a wind loading of 150 kg/m2 normal to the face of the sign and 30 kg/m2 transverse to the face of the sign. In addition to the dead load of the structure, walkway loading of 250kg concentrated live load shall also be considered for the design of the overhead sign structure.

Height
Overhead signs shall provide a vertical clearance of not less than 5.5 m over the entire width of the pavement and shoulders except where a lesser vertical clearance is used for the design of other structures. The vertical clearance to overhead sign structures or supports need not to be greater than 300 mm in excess of the minimum design clearance of other structures.

Lateral Clearance
The minimum clearance outside the usable roadway shoulder for expressway sign mounted at the road side or for overhead sign supports either to the right or left side of the roadways shall be 1.80 m. This minimum clearance of 1.80 m shall also apply outside of an unmountable kerb. Where practicable, a sign should not be less than 3 m from the edge of the nearest traffic lane.

Where a median is 3.6 m or less in width, consideration should be given to spanning over both roadways without a central support. Where overhead sign supports cannot be placed at a safe distance away from the line of traffic or in an otherwise protected site, they should either be so designed as to minimize the impact forces or protect motorists adequately by a physical barrier or guard rail of suitable design.

Number of Signs at an Overhead Installation
In no case should there be more than three signs displayed at any one location, including regulatory or warning signs, either on the overhead structure or on its support.

Materials for Overhead Sign and Support Structures

Aluminium alloy or galvanized steel to be used as truss design supports shall conform to relevant IS. These shall be of sections and type as per structural design requirements as shown on the plans.

Plates and support sections for sign posts shall conform to IS 226 and IS 2062.

The overhead signs shall be reflectorised with high intensity retro-reflective sheeting of encapsulated lens type.

16.50.5 Size, Locations, etc of Signs 16.50.5.1 The size of the signs, letter and their

placement shall be as specified in the Contract drawings and specifications as per direction of Engineer-in-Charge.

Installation

The supporting structure and signs shall be fabricated and erected as per details given in the plans.

Sign posts, their foundations and sign mountings shall be so constructed as to hold sign in a proper and permanent position to adequately resist swaying in the wind or displacement by vandalism.

The work of construction of foundation for sign supports including excavation and backfill, forms, steel reinforcement, concrete and its placement shall conform to the relevant specifications given in this specification.

The structures shall be erected with the specified camber and in such a manner as to prevent excessive stresses, injury and defacement.

Brackets shall be provided for mounting signs of the type to be supported by the structure. For better visibility, they shall be adjustable to permit mounting the sign faces at any angle between a truly vertical position and three degree from vertical. This angle shall be obtained by rotating the front lower edge of the sign forward. All brackets shall be of a length equal to the heights of the signs being supported.

Before erecting support structures, the bottom of each base plate shall be protected with an approved material which will adequately prevent any harmful reaction between the plate and the concrete.

The end supports shall be plumbed by the use of levelling nuts and the space between the foundation and base plate shall be completely filled with an anti-shrink grout.

Anchor bolts for sign supports shall be set to proper locations and elevation with templates and carefully checked after construction of the sign foundation and before the concrete has set.

All nuts on aluminium trusses, except those used on the flanges, shall be tightened only until they are snug. This includes the nuts on the anchor bolts. A thread lubricant shall be used with each aluminium nut.

All nuts on galvanized steel trusses, with the exception of high strength bolt connections, shall be tightened only to a snug condition.

Field welding shall not be permitted.

After installation of signs is completed; the sign shall be inspected by the Engineer. If specular reflection is apparent on any sign, its positioning shall be adjusted by the Contractor to eliminate or minimize this condition.

ROAD MARKINGS STRIPS

The colour width and layout of road makings shall be in accordance with the Code of Practice for Road Markings with paints, IRC : 35, and as specified in the drawings or as directed by the Engineer- in-Charge.

Materials
Road markings shall be of ordinary road marking paint (retro-reflective), hot applied thermoplastic compound as specified in the item.

Hot Applied Thermoplastic Road Marking

General
The thermoplastic material shall be homogenously composed of aggregate, pigment, resins and glass reflectorizing beads.

The thermoplastic compound shall be screeded/extruded on to the pavement surface in a molten state by suitable machine capable of controlled preparation and laying with surface application of glass beads at a specific rate. Upon cooling to ambient pavement temperature, it shall produce an adherent pavement marking of specified thickness and width and capable of resisting deformation by traffic.

The thermoplastic material shall conform to ASTM D36/BS-3262-(Part I).
The material shall meet the requirements of these specifications for a period of one year. The thermoplastic material must also melt uniformly with no evidence of skins or unmelted particles for the one year storage period. Any material not meeting the above requirements shall be replaced by the manufacturer/supplier/Contractor.
Marking : Each container of the thermoplastic material shall be clearly and indelibly marked with the following information:

The name, trade mark or other means of identification of manufacturer.

- Batch number
- Date of manufacture
- Colour (White or yellow)

Maximum application temperature and maximum safe heating temperature.
Sampling and Testing : The thermoplastic material shall be sampled and tested in accordance with the appropriate ASTM/BS method. The Contractor shall furnish to the Engineer-in-Charge a copy of certified test reports from the manufacturers of the thermoplastic material showing results of all tests specified herein and shall certify that the material meets all requirements of this Specification.

Preparation
The material shall be melted in accordance with the manufacturer's instructions in a heater fitted with a mechanical stirrer to give a smooth consistency to the thermoplastic material to avoid local overheating. The temperature of the mass shall be within the range specified by the manufacturer, and shall on no account be allowed to exceed the maximum temperature stated by the manufacturer. The molten material should be used as expeditiously as possible and for thermoplastic material which has natural binders or is otherwise sensitive to prolonged healing, the material shall not be maintained in a molten condition for more than 4 hours.

After transfer to the laying equipment, the material shall be maintained within the temperature range specified by the manufacturer for achieving the desired consistency for laying.

Properties of Finished Road Marking
The stripe shall not be slippery when wet.

The marking shall not lift from the pavement in freezing weather.
After application and proper drying, the stripe shall show no appreciable deformation or discolouration under traffic and under road temperatures upto 60oC.
The marking shall not deteriorate by contact with sodium chloride, calcium chloride or oil drippings from traffic.The stripe or marking shall maintain its original dimensions and position. Cold ductility of the material shall be such as to permit normal movment with the road surface without chopping or cracking.
The colour of yellow marking shall conform to IS Colour No. 356 as given in IS 164.

Application
Marking shall be done by fully /semi automatic paint applicator machine fitted with profile shoe, glass beads dispenser, propane tank heater and profile shoe heater, driven by experienced operator as specified in item. For locations where painting cannot be done by machine, approved manual methods shall be used with prior approval of the Engineer-in-charge. The Contractor shall maintain control over traffic while painting operations are in progress so as to cause minimum inconvenience to traffic compatible with protecting the workmen.

The thermoplastic material shall be applied hot either by screeding or extrusion process. After transfer to the laying apparatus, the material shall be laid at a temperature within the range specified by the manufacturer or otherwise directed by the Engineer-in-Charge for the particular method of laying being used. The paint shall be applied using a screed or extrusion machine.

The pavement temperature shall not be less than 10oC during application. All surfaces to be marked shall be thoroughly cleaned of all dust, dirt, grease, oil and all other foreign matter before application of the paint.

Thermoplastic paint shall be applied in intermittent or continuous lines of uniform thickness of at least 2.5 mm unless specified otherwise. Where arrows or letters are to be provided, thermoplastic compound may be hand-sprayed.

The minimum thickness specified is exclusive of surface applied glass beads.
The finished lines shall be free from ruggedness on sides and ends and be parallel to the general alignment of the carriageway. The upper surface of the lines shall be level, uniform and free from streaks.

KERB CHANNEL OF CEMENT CONCRETE
Base : The base of the channel to be of the 75 mm compacted thick dry brick ballast 40 mm nominal size well rammed and consolidated and grouted with fine sand.
Kerb channel shall be provided in cement concrete of specified grade. These shall be cast in-situ of specified size as given in the item. Top surface of channel to be finished smooth.

COMPACTED BED OF DRY BRICK BALLAST

Collection of Material
Before the start of work brick aggregate 40 mm nominal size unless specified otherwise, shall be stacked for the entire work and record measurements done as per para 16.4.

Preparation of Sub Grade
The formation for a width equal to that of the area shall be cut to the depth below the proposed finish level, equal to the thickness of the course of brick aggregate (due allowance being made for consolidation) and dress off in level to the finished profile. In case of made up soil, copious water shall be poured so that earth settles down as much as possible and

the same rolled up with 3 tonnes or light power roller, as directed by the Engineer-in-Charge.

Laying and Packing Brick Aggregate
Brick aggregate shall be racked off the stack with the racks so as to leave behind mud and dust. It shall be spread evenly over the prepared surface to the required depth with a finishing material to avoid segregation. Brick aggregate shall be carefully laid and packed, bigger size being placed at the bottom to 7.5 cm. depth unless specified otherwise. After that the area shall be grouted with fine sand.

Consolidation
The bricks aggregate shall be consolidated by dry rolling with 3 tonne or light weight power roller as directed by the Engineer-in-Charge.

POST DELINEATORS
The role of delineators is to provide visual assistance to drivers about alignment of the road ahead, especially at night. Delineators are particularly effective in the case of complex locations involving changes in horizontal / vertical geometry and doing severe weather condition such as heavy rain, fog or snow. Normally reflectors are used on the delineators for better night time visibility. Road delineators may have a circular, rectangular or triangular cross-section, however the side facing the traffic should not be less than 10 cm wide.

In board sense, Delineators stands for any device or treatment whose aim is to outline the road way.

Material
The design, materials to be used and the location of the road delineators shall conform to recommended practice for road delineators, IRC:79, and to relevant drawings and as directed by the Engineer-in-charge.

The delineators are to be made of Acrylonitrite Butadiene Styrene (ABS) body fitted with 2 No. 100 mm dia of highly reflective reflectors are mounted on M.S. pipe of 65 mm dia or of size specified otherwise, duly powder coated of minimum 40 microns thickness anti-rust and anti-theft, installed as per direction of Engineer-in-charge. Road delineators may have a circular, rectangular or triangular cross-section, however the side facing the traffic should not be less than 10 cm wide.

Dimensions
Height of the delineator should be not less than 800 mm above ground. Width not less than 100 mm. Not more than 300 mm below the ground while being installed.

Placement and spacing
As a general rule, delineators posts should be erected at the edge of the usable shoulders, and in the case of kerbed sections at a distance of 0.6 to 1.5 m from the kerb face. On hill roads they may be placed either on the parapet or at the edge of the shoulders.

The delineator should be so positioned that the reflectorised face is perpendicular to the direction of travel.

Warranty
The contractor shall obtain a two years warranty for satisfactory performance including stipulated retro-reflectance of the retro-reflective sheeting and submit the same to the Engineer-in-charge.

EXCAVATING HOLES UPTO 0.10 CUM

The specifications of sub head earth work of CPWD specifications 2019 Vol-I to be followed for this item.

FACTORY MADE RCC PAVEMENT SLAB

Precast RCC slab casted with the cement concrete of M-30 or specified otherwise grade of size specified in item made of approved brand and manufacturer to be used.

Specification of cement concrete base, bed cement mortar and RCC to be of the sub head cement concrete, mortar and RCC of the CPWD specification- 2019 Vol- I to be followed.

FACTORY MADE CEMENT CONCRETE INTERLOCKING PAVER BLOCK

Base

Interlocking paver block to be fixed on the bed 50 mm or specified otherwise thick of coarse sand of approved specification and filling the joints with the sand of approved type and quality or as specified and as directed by Engineer-in-charge.

Interlocking Paver Block

Factory made 80mm thick reflectiveprecast paver block of M-30 or otherwise specified grade to be used. Paver blocks to be of approved brand and manufacturer and of approved quality. Minimum strength as prescribed by manufacturer and as per direction of Engineer-in-Charge for the grade specified to be tested as per method mentioned in specification of subhead cement concrete of CPWD Specification 2019 Vol. I.

Measurement & Rates

Area provided with paver block to be measured in sqm. correct upto two places of decimal. The rate include the cost of the material, labour, tools etc. required in all the operations described above.

KERB STONE (PRECAST)

Laying

Trenches shall first be made along the edge of the wearing course of the road to receive the kerb stones of cement concrete of specified grade. The bed of the trenches shall be compacted manually with steel rammers to a firm and even surface and then the stones shall be set in cement mortar of specified proportion.

The kerb stones of M-25, with top 15 cm. wide shall be laid with their length running parallel to the road edge, true in line and gradient at a distance of 30 cm. from the road edge to allow for the channel and shall project about 12.5 cm. above the latter. The channel stones with top 30 cm. wide shall be laid in position in chamber with finished road surface and with sufficient slope towards the road gully chamber. The joints of kerb and channel stones shall be staggered and shall be not more than 10 mm. Wherever specified all joints shall be filled with mortar 1:3 (1 cement : 3 coarse sand) and pointed with mortar 1:2 (1 cement: 2 fine sand) which shall be cured for 7 days.

The necessary drainage openings of specified sizes shall be made through the kerb as per drawings or as directed by the Engineer-in-Charge for connecting to storm water drains.

Finishing

Berms and road edges shall be restored and all surplus earth including rubbish etc. disposed off as directed by the Engineer-in-charge. Nothing extra shall be paid for this.

VACUUM DEWATERED CEMENT CONCRETE PAVEMENT

Cement concrete to be compacted by screed board vibrator of the type approved by Engineer- in-Charge and by vaccum dewatering process complete as per directions of Engineer-in-charge.

GRANULAR SUB–BASE

Scope

This work shall consist of laying and compacting well-graded material on prepared subgrade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer-in-charge.

Materials

The material to be used for the work shall be natural sand, crushed gravel, crushed stone, crushed slag or combination thereof depending upon the grading required. Use of materials like brick metal, Kankar and crushed concrete shall be permitted in the lower sub-base. The material shall be free from organic or other deleterious constituents and shall conform to the grading given in Table 16.44 and physical requirement given in Table 16.45 Gradings III and IV shall preferably be used in lower sub-base. Grading V and VI shall be used as a sub-base-cum-drainage layer. The grading to be adopted for a project shall be as specified in the Contract. Where the sub-base is laid in two layers as upper sub-base and lower sub-base, the thickness of each layer shall not be less than 150 mm.

16.62.2.2 If the water absorption of the aggregate determined as per IS : 2386 (Part 3); if this value is greater than 2 per cent, the aggregate shall be tested for Wet Aggregate Impact Value (AIV) (IS: 5640). Soft aggregates like Kankar, Brick ballast and laterite shall also be tested for Wet AIV (IS: 5640).

TABLE
GRADING FOR GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Percent by Weight Passing the IS Sieve					
	Grading I	Grading II	Grading III	Grading IV	Grading V	Grading VI
75.0 mm	100	--	--	--	100	--
53.0 mm	80-100	100	100	100	80-100	100
26.5 mm	55-90	70-100	55-75	50-80	55-90	75-100
9.50 mm	35-65	50-80	--	--	35-65	55-75
4.75 mm	25-55	40-65	10-30	15-35	25-50	30-55
2.36 mm	20-40	30-50	--	--	10-20	10-25
0.85 mm	--	--	--	--	2-10	--
0.425 mm	10-15	10-15	--	--	0-5	0-8
0.075 mm	<5	<5	<5	<5	--	0-3

TABLE
PHYSICAL REQUIREMENTS FOR MATERIALS FOR GRANULAR SUB-BASE

Aggregate Impact Value (AIV)	IS:2386 (Part 4) or IS:5640	40 Maximum
Liquid Limit	IS:2720 (Part 5)	Maximum 25
Plasticity Index	IS:2720 (Part 5)	Maximum 6
CBR at 98% dry density (at IS:2720-Part 8)	IS:2720 (Part 5)	Minimum 30 unless otherwise specified in the Contract

Construction Operations

Preparation of Sub-Grade:
The surface of the sub grade to receive the Granular Sub-base shall be prepared to the specified lines and crossfall (Camber) as necessary and made free of dust and other extraneous materials. Any ruts or soft yielding places shall be corrected in an approved manner and rolled with 80 – 100 kN smooth wheeled roller until firm surface is obtained if necessary by sprinkling water. Weak places shall be strengthened, corrugations removed and depressions and pot holes made good with suitable materials, before spreading the aggregate for GSB.

Where the existing surface over which the sub base of GSB is to be laid is black topped, to ensure effective internal drainage, furrows 50 mm x 50 mm (depth of furrows increased to reach bottom of bituminous layer where necessary) at one metre intervals shall be cut in the existing bituminous surface at 45 degrees to the central line of the carriageway at one metre intervals in the existing road before the GSB is laid.

Spreading and compacting:
The sub-base material of grading specified in the Contract and water shall be mixed mechanically by a suitable mixer equipped with provision for controlled addition of water and mechanical mixing. So as to ensure homogenous and uniform mix. The required water content shall be determined in accordance with IS:2720 (Part 8). The mix shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation, or other means as approved by the Engineer-in-charge.
Moisture content of the mix shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted so that, at the time of compaction, it is from 1 to 2 per cent below the optimum moisture content (OMC).

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 kN weight may be used. For a compacted single layer upto 200 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional crossfall or on super elevation. For carriageway having crossfall on both sides, rolling shall commence at the edges and progress towards the crown.

Each pass of the roller shall uniformly overlap not less than one third of the track made in the preceding pass. During rolling, the grade and crossfall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS : 2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

REFLECTIVE PAVEMENT MARKERS (RPM) OR ROAD STUDS

Scope

The work shall cover the providing and fixing of reflective pavement marker (RPM) or road stud, a device which is bonded to or anchored within the road surface, for lane marking and delineation for night-time visibility, as specified in the Contract.

Material
Plastic body of RPM/road stud shall be moulded from ASA (Acrylic Styrene Acrylonitrite) or HIPS (Hi-impact Polystyrene) or Acrylonitrite Butadiene Styrene (ABS) or any other suitable material approved by the Engineer. The markers shall support a load of 13.635 kg tested in accordance with ASTM D 4280.

Reflective panels shall consist of number of lenses containing single or dual prismatic cubes capable of providing total internal reflection of the light entering the lens face. Lenses shall be moulded of merthyl methecrylate conforming to ASTM D 786 or equivalent.

Design
The slope or retro-reflecting surface shall preferably be 35 ± 5º to base and the area of each retro- reflecting surface shall not be less than 13.0 sq.cm.

Optical Performance

Unidirectional and Bi-directional Studs.
Each reflector or combination of reflectors on each face of the stud shall have a Coefficient of Luminous Intensity (C.I.L.), as specified in Table.

TABLE
Minimum C.I.L. values for Road Studs

Entrance Angle	Observation Angle	C.I.L. in mcd/lx		
		White	Amber	Red
0º U 5º L&R	0.3º	220	110	44
0º U 5º L&R	0.5º	120	60	24

Tests
Co-efficient of luminance intensity can be measured by procedure described in ASTM E 809 “Practice for Measuring Photometric Characteristics” or as recommended in BS:873-Part 4 : 1973.

Fixing of Reflective Markers or Road Studs or Cats Eyes.

Requirements
The enveloping profile of the head of the stud shall be smooth and the studs shall not present any sharp edges to traffic. The reflecting portions of the studs shall be free from crevices or ledges where dirt might accumulate. Marker height shall not be less than 10 mm and shall not exceed 20 mm, and its width shall not exceed 130 mm. The base of the marker shall be flat within 1.3 mm. If the bottom of the marker is configured, the outermost faces of the configurations shall not deviate more than 1.3 mm from a flat surface. All road studs shall be legibly marked with the name, trade mark or other means of identification of the manufacturer.

Placement
The reflective marker shall be fixed to the road surface using the adhesives and the procedure recommended by the manufacturer. No nails shall be used to affix the marker so that they do not pose safety hazard on the roads. Regardless of the type of adhesive used, the markers shall not be fixed if the pavement is not surface dry and on new asphalt

concrete surfacing until the surfacing has been opened to traffic for a period of not less than 14 hours. The portions of the highway surface, to which the marker is to be bonded by the adhesive, shall be free of dirt, curing compound, grease, oils, moisture, loose or unsound layers, paint and any other material which would adversely affect the bond of the adhesive.

The adhesive shall be placed uniformly on the cleaned pavement surface or on the bottom of the of the marker in a quantity sufficient to result in complete coverage of the area of contract of the marker with no voids present and with a slight excess after the marker has been lightly pressed in place. For epoxy installations, excess adhesive around the edge of the marker, excess adhesive on the pavement and adhesive on the exposed surfaces of the markers shall be immediately removed.

Warranty and Durability

The contractor shall submit a two year warranty for satisfactory field performance including stipulated retro-reflectance of the reflecting panel, to the Engineer-in-charge. In addition, a two year warranty for satisfactory infield performance of the finished road marker shall also be given by the contractor who carries out the work of fixing of reflective road markers. In case the markers are displaced, damaged, get worn out or lose their reflectivity compared to stipulated standards, the contractor would be required to replace all such markers within 15 days of the intimation from the Engineer-in-charge, at his own cost.

APPENDIX C

LIST OF MINIMUM EQUIPMENT TO BE PROVIDED IN THE FIELD TESTING LABORATORY BY THE CONTRACTOR AT HIS OWN COST.

Concrete Section
Sieve Analysis of stone ballast
Sets of I.S. Sieves of sizes 63 mm, 45 mm, 22.4 mm, 11.2 mm, 5.60 mm. etc.
Sieve analysis of sand
Sets of I.S. sieves of sizes 2.36 mm, 1.18 mm, 600 micron, 355 micron and 180 micron.

Silt content of sand
Graduated glass cylinders 500 C.C. capacity.

Bulkage of sand
Graduated glass cylinders 500 C.C. capacity.

Slump test.
Slump cones.
Slump rods 3/8" dia. 24" long bullet pointed.
Steel plates 24” x 24”
Steel scales.

For making beam specimens for flexural strength.
Beam moulds.
Tamping rods.

Testing flexural strength of concrete:-
100 ton capacity compressive strength testing i/c hand operated in two numbers with flexure test attachment.

Other miscellaneous items.
Physical balance with set of weights.
Pan balances.
Spring balances.
Glass measuring jar.
Beakers.
Towels, glass plates etc.

APPENDIX D

GENERAL GUIDELINES ISSUED BY NDMC

I. Roads/Foot Paths/and Storm Water Drains.

RESIDENTIAL

S.No	Specifications applicable prior to 26.9.79	Specifications applicable after 27.9.79 (Modified)	Remarks
(1)	(2)	(3)	(4)
1.	15 ft wide right of way service lanes: Metal width not less than 8'-0" 4-1/2" soling 4-1/2" metal two coats of bitumen painting	4.577tres (15ft) right of way service lane: Metalled width not less than 2.44 metres (8 ft.) 0.1143 metres (4-1/2") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.1143 metre (4-1/2") thick stone aggregate base-course W.B.M. as per IRC specifications. 2 cm (3/4") thick pre-mix carpet with seal coat of premixed stone dust. 0.2286 metre (9") wide brick-on- edge edging on either side. CC (M-150) channel 8 cm thick and 30 cm wide with gola of 8 cm radius laid over a bed layer of 8 cm thick 1:5:10 c.c. top surface finished with a floating coat of neat cement. The space between brick edging and c.c. channel on both sides shall have brick on-edge flooring.	
2.	20 ft. wide right of way service lanes: Metalled width 10 ft. plus 9" brick-on-edge on either side. 4-1/2" soling 4- 1/2" metal ¾" bitumen carpet.	6.098 metres (20 ft.) right of way service lane: Metalled width 3.48 metres (10 ft.) 0.1143 metre (4-1/2") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.1143 metre (4-1/2") thick stone aggregate base-course of W.B.M. as per IRC specifications. 2 cm (3/4") thick pre-mix carpet with seal coat of premixed stone. 0.2286 metre (9") wide brick on edge edging on either side.C C (M-150) channel 8cm thick and 30 cm wide with gola of 8 cm radius laid over a bed layer of 8 cm thick 1:5:10 cement concrete top surface finished with a floating coat of neat cement.	

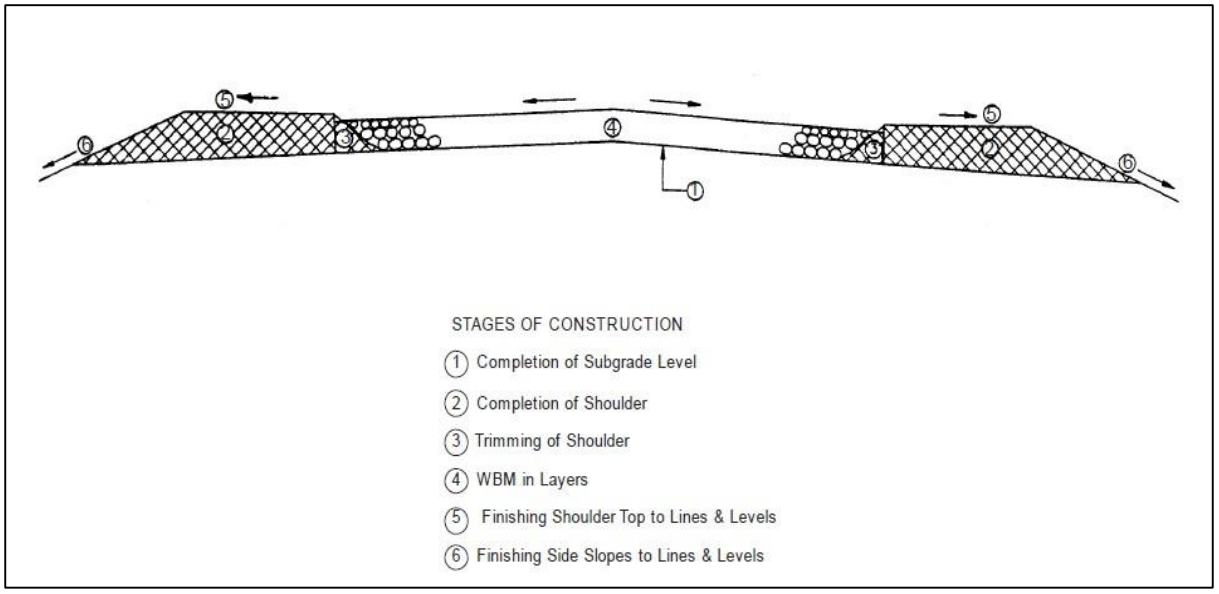
S.No	Specifications applicable prior to 26.9.79	Specifications applicable after 27.9.79 (Modified)	Remarks
(1)	(2)	(3)	(4)
		The space between brick edging & CC channel on both side brick on edge flooring.	
3.	Roads with right of way 30 feet: 12 ft. Metalled width plus 9" thick edging on either side. 6" soling 6" metal (water bound 3" thick each layer) 3/4" carpet	9.14 metre (30 ft.) right way roads: (i) metres (12 ft.) mettalled width with 0.2286 metre (9") wide brickon- edge-edging on either side 0.1016 metre (4") thick stone aggregate base-course of W.B.M. as per IRC specifications. 0.2032 metre (8") thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in two layers).2 cm (3/4") thick pre mix carpet with seal coat of premixed stone dust.	
4.	Service roads with right of way 40 ft. 18 ft. metalled width plus 9" thick edging on either side. 6" soling 7-1/2" metal (water bound 4-1/2" & 3" thick separately) 1" carpet.	12.19 mtrs. (40 ft.) and less than 13.71 mtrs. (45 ft.) right of way roads: 7.32 m. (24 ft.) metalled width with 0.2286 m (9") wide brick-on-edge edging on either side. 0.1524 m (6") stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.2032 m (7-1/2") stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in two layers) 2.5 cm (1") thick pre-mix carpet with seal coat of premixed stone dust.	The change in metalled width is to adopt two lane width since 18 ft. width is not standard width.
5.	Service roads with right of way 60 ft. 22 ft. metalled width plus 9" brickon-edge on both sides. 6" soling. 7-1/2" metal. 1-1/2" thick asphaltic concrete.	13.71 mtrs. (45 ft.) and less than 18.29 mtrs.(60 ft.) right of way road: 7.32 mtrs. (24 ft.) metalled with 0.2284 m (9") wide brick-on-edge on either side. 0.1524 m (6") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.2032 m (71/2”) thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in two layers). 5 cm (2”) thick Bituminous Macadam (B.M.) with seal coat of premixed stone dust.	The change in metalled width from 22 ft. to 24 ft. is to adopt standard two lane width.
6.	Roads with right of way above 60 ft. and upto 79 ft. 22 ft. metalled width 9" brick-on- edge on either side. 9" soling 7-	18.29 mtrs. (60 ft.) and less than 24.38 mtrs. (80 ft.) right of way road 7.32 mtrs. (24 ft.) metalled with 0.2286 mtrs. (9”) wide brick-on-edge edging. 0.1524 m (6”) thick stone aggregate sub-base of W.B.M. as per IRC	The change in metalled width from 22 ft. to 24 ft. is to adopt

S.No	Specifications applicable prior to 26.9.79	Specifications applicable after 27.9.79 (Modified)	Remarks
(1)	(2)	(3)	(4)
	1/2" metal (W.B.M. 4-1/2" & 3" thick separately). 1-1/2" thick asphaltic concrete	specifications. 0.2667 m (10-1/2") thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in three layers). 5 cm (2") thick Bituminous Macadam (BM) with seal coat of premixed stone dust.	standard two lane width.
7.	Roads with right of way 80 ft. and above 9" soling. Metalled width 24 ft. soling 9" 7- 1/2" metal. 1" carpet.	24.38 mtrs. (80 ft.) and above right of way road. (i) 14.64 mtrs. (48 ft.) metalled width. 0.1524 m (6") thick stone aggregate sub-base course of W.B.M. as per IRC specifications. 0.2667 m (10-1/2") thick stone aggregate base-course of W.B.M. as per IRC specifications (to be laid in three layers). 5 cms. (2") thick Bituminous Macadam (BM) with seal coat of premixed stone dust. 3.048 mtrs. (10 ft.) wide raised foot path on both sides of the carriageway as per specifications given hereinafter.	The change in metal width is to adopt standard X section for 80 ft. wide roads. Such roads normally carry heavy amount of traffic which needs a metalled width of 48 ft. for easy flow of traffic.
8.	Service lanes/ walkways having right of way less than 15 ft. Nil	Service lanes/walkways having right of way less than 4.57 mtrs.(15 ft.) 0.1143 mtrs. (4-1/2") thick cement concrete (M-150) over 0.1143 (4-1/2") dry brick ballast in complete width with c.c. (M-150) channel 8 cms. thick and 30 cm wide with gola of 8 cm radius laid over a bed layer of 8 cms. Thick 1:5:10 cement concrete top surface finished with floating coat of neat cement.	

Notes : Roads with right of way 80 ft. and above passing through residential colony should have raised foot paths on either sides.

Where raised footpaths are not provided, berms shall be properly dressed to slope towards the side drains.

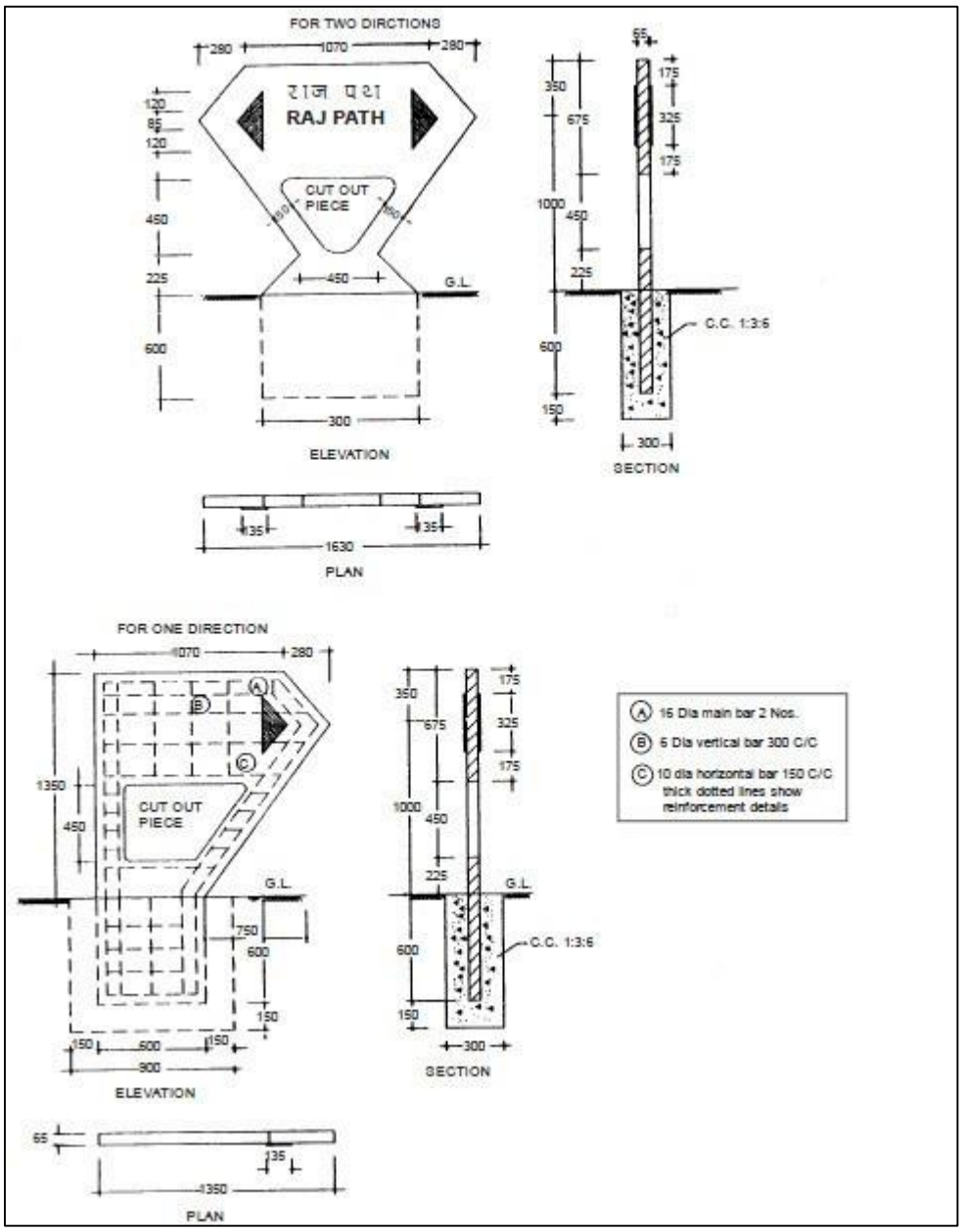
PROVISION FOR LATERAL CONFINEMENT OF AGGREGATES
Sub Head : Road Work Clause



Drawing not to Scale
All dimensions are in mm

Fig.: Provision for Lateral Confinement of Aggregates

R.C.C. NAME BOARD WITHOUT POST
Sub Head : Road Work



Drawing not to Scale
All dimensions are in mm

Fig.: R.C.C. Name Board without Post

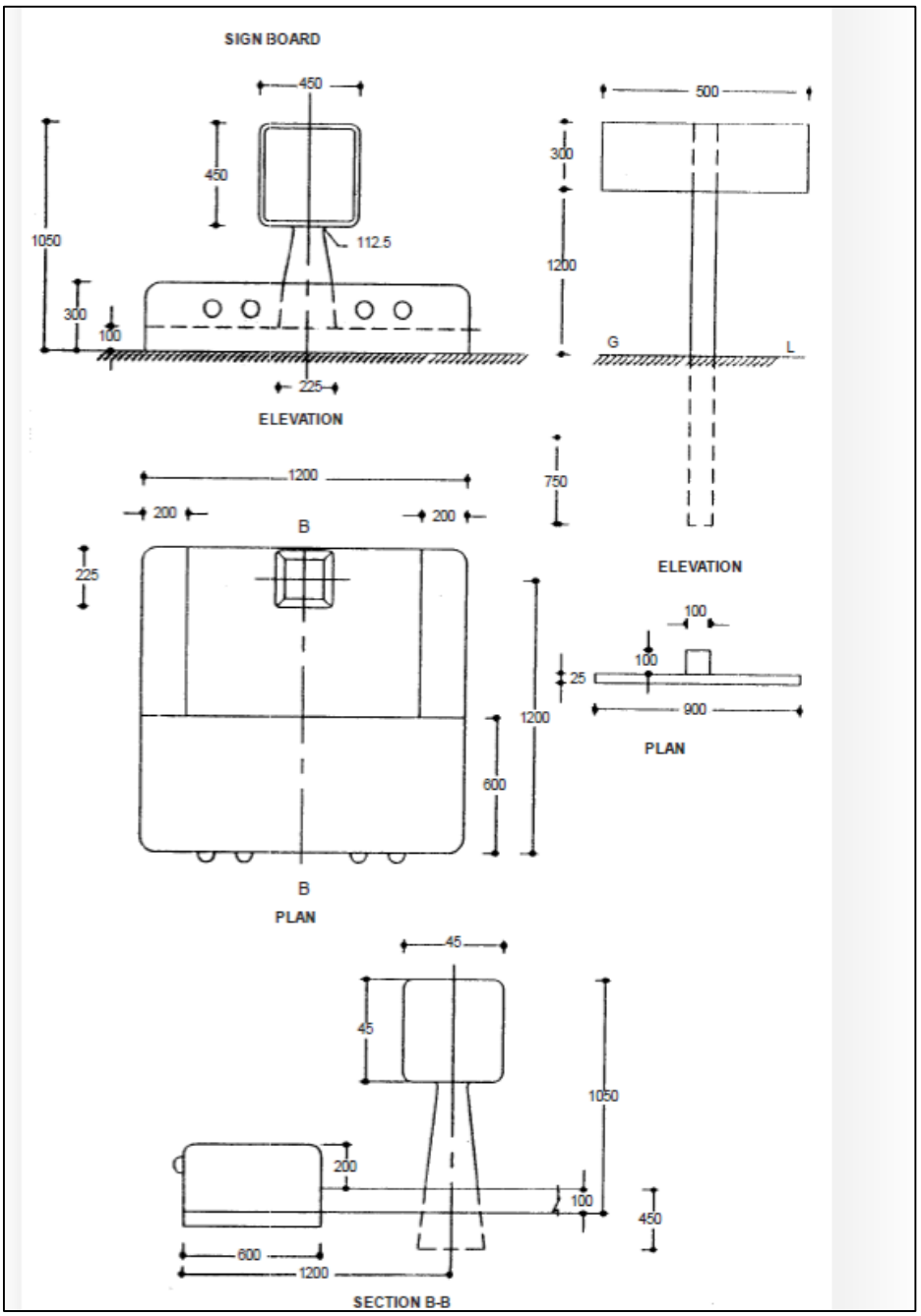
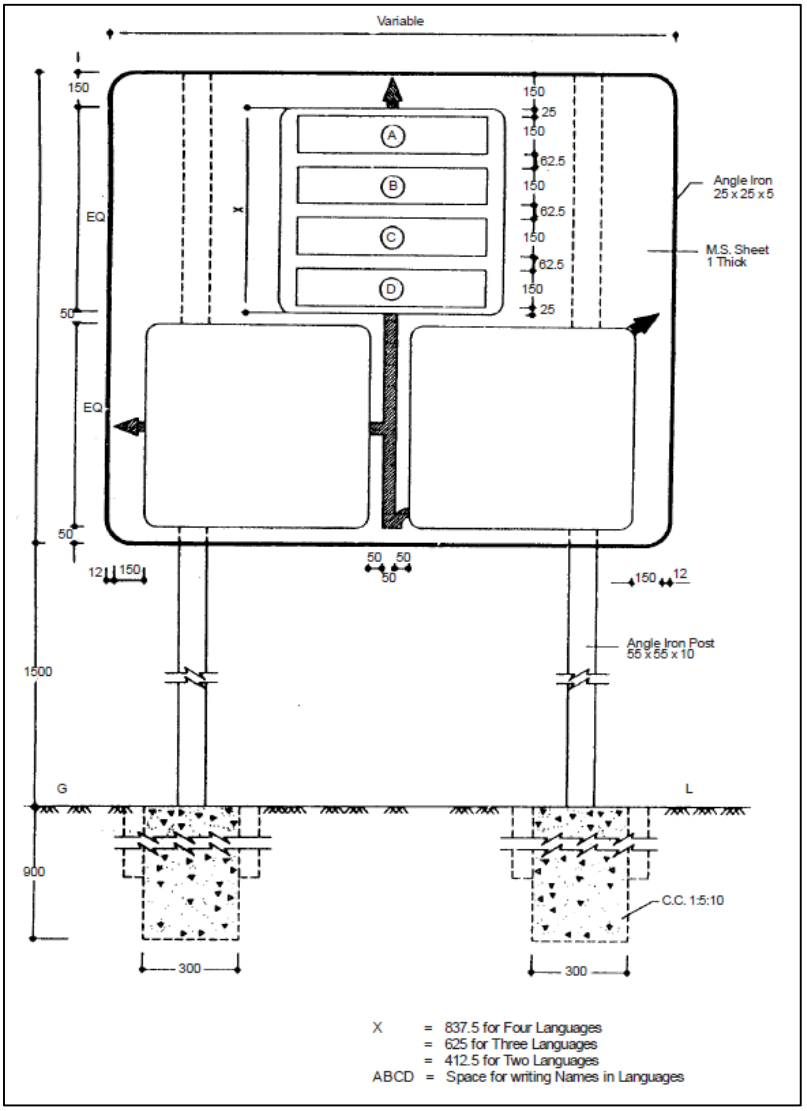


Fig. : Sign/Name Board

INFORMATORY SIGN BOARD
Sub Head : Road Work
Clause : 16.49



Drawing not to Scale
All dimensions are in mm

Fig.: Informatory Sign Board

LOCATION OF INFORMATORY SIGN BOARDS

Sub Head : Road Work
Clause : 16.49

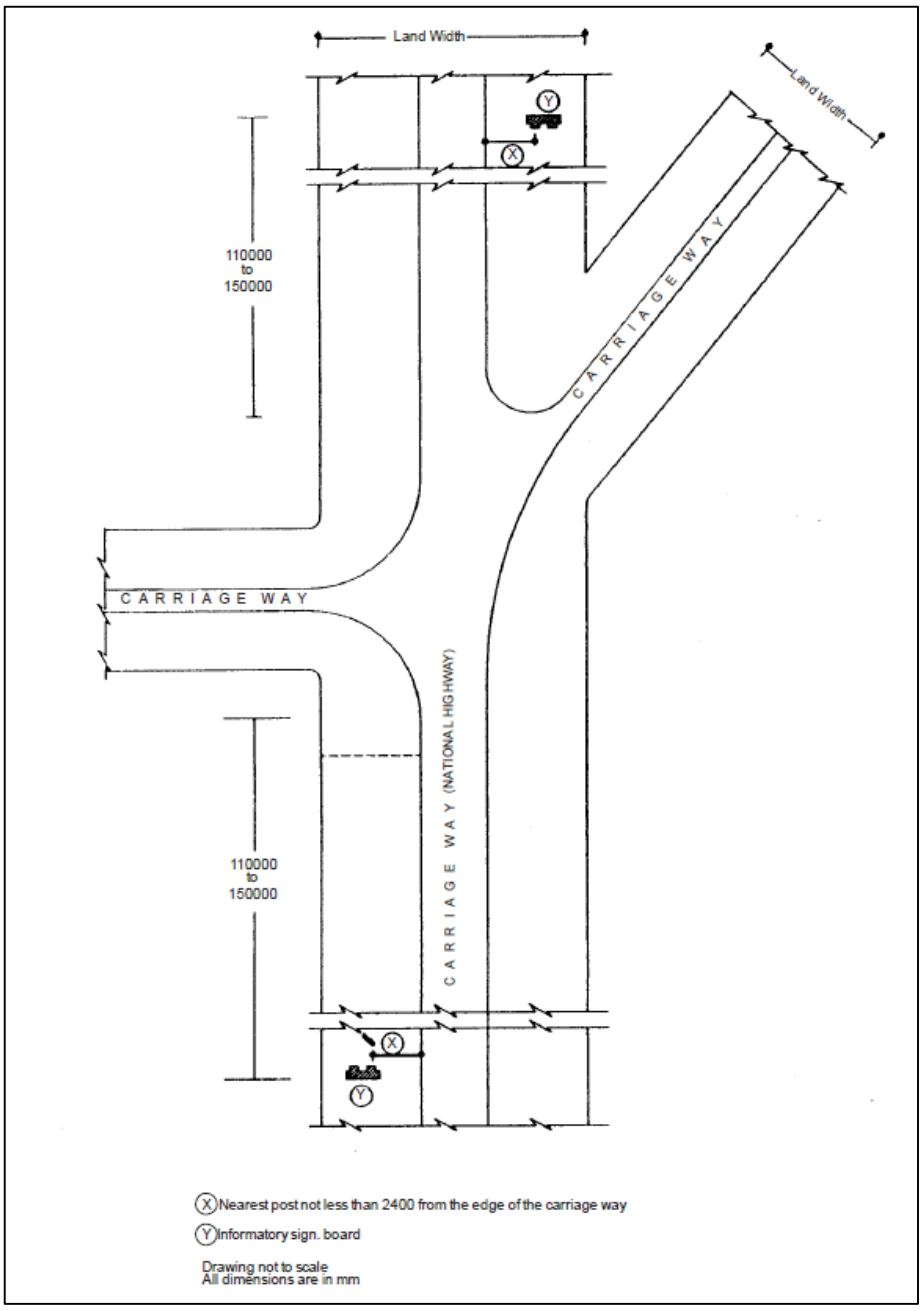
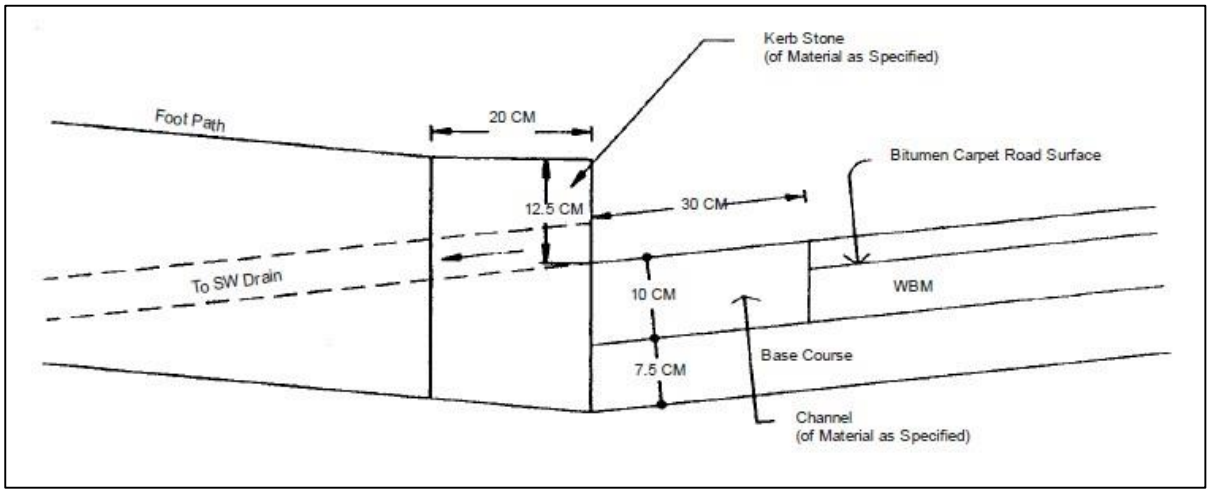


Fig.: Location of Informatory Sign Boards

KERB & CHANNEL STONES

Sub Head : Road Work
Clause : 16.1.20



Drawing not to Scale
All dimensions are in mm

OTHER SPECIFICATIONS

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 19 : HORTICULTURE WORKS

SPECIFICATIONS FOR HORTICULTURE WORKS

HORTICULTURE WORK

Horticultural operations shall be started on ground previously levelled and dressed to required formation levels and slopes. In case where unsuitable soil is met with, it shall be either removed or, replaced or it shall be covered over to a thickness decided by the Engineer-in-charge with good earth. In the course of excavation or trenching during horticultural operations, any walls, foundations, etc. met with shall not be dismantled without pre-measurement and prior to the written permission of the Engineer-in-charge.

TRENCHING IN ORDINARY SOIL

Trenching is done in order to loosen the soil, turn over the top layer containing weeds etc. and to bring up the lower layer of good earth to form a proper medium for grassing, regrassing, hedging and shrubbery. Trenching shall be done to the depth ordered by the Engineer-incharge. The depth is generally 30 cm for grassing and 60 cm for regrassing in good soil.

The trenched ground shall, after rough dress, be flooded with water by making small kiaries to enable the soil to settle down. Any local depression unevenness etc. shall be made good by dressing and/or filling with good soil.

Weeds or other vegetation which appear on the ground are then uprooted and removed and disposed off and paid.

Trenching

Trenching shall consist of the following operations:

1. The whole plot shall be divided into narrow rectangular strips of about 1.5 m width or as directed by the Engineer-in-Charge.
2. These strips shall be sub-divided lengthwise into about 1 m long sections. Such sections shall be excavated serially and excavated soil deposited in the adjacent section preceding it.
3. In excavating and depositing care shall be taken that the top soil with all previous plant growth including roots, get buried in the bottom layer of trenched area, the dead plants so buried incidentally being formed into humus.
4. The excavated soil shall be straight away dumped into the adjoining sections so that double handling otherwise involved in dumping the excavated stuff outside and in back filling in the trenches with leads is practically eliminated.

Measurements

Length and breadth of the plot shall be taken correct to 0.1 m and depths correct to cm. Cubical contents shall be calculated in cubic meters, correct to two places of decimal. No deduction shall be made nor extra paid for removing stones, brick bats and other foreign matter met with during excavation upto initial lead of 50 m and stacking the same.

Rate

The rate shall include the cost of all labour and material involved in the operations described above, including cost of all precautionary measures to be taken for protections and supporting all services etc.met with during trenching. It does not include the cost of mixing of earth, sludge/manure.

GOOD EARTH

The earth shall be stacked at site in stacks not less than 50 cm high and of volume not less than 3.0 cum.

Measurements: Length, breadth and height of stacks shall be measured correct to a cm. The volume of the stacks shall be reduced by 20% for voids before payment, unless otherwise described.

Rate: The rate shall include the cost of excavating the earth from areas lying at distance not exceeding one km. from the site, transporting the same at site breaking of clods and stacking at places indicated. The rate shall also include royalty if payable.

OIL CAKE

Neem/Castor: The cake shall be free from grit and any other foreign matter. It should be undecorticated and pulverized. The material shall be packed in old serviceable gunny bags of 50 kgs capacity approximately. The weight of gunny bag shall be deducted @1 kg per bag and payment shall be made for net quantity. The quality of cake should be got approved by the Engineer-in-charge before supply.

Measurements

The arrangement for weighing shall be made at site of work by the department. The gunny bags shall be the property of the government.

Rate: The rate shall include the cost of labour and material involved in all operations described above, including carriage up to site of work with all lead and lifts, weighing etc.

SUPPLY AND STACKING OF SLUDGE

It shall be transported to the site in lorries with efficient arrangement to prevent spilling enroute. It shall be stacked at site. Each stack shall not be less than 50 cm height and volume not less than 3 cum.

Measurements

Length, breadth and depth of stacks shall be measured correct to a cm. The volume of the stack shall be reduced by 8% for looseness in stacking and to arrive at the net quantity for payment.

Rate

The rate shall include the cost of labour and material involved in all operations described above, including carriage up to one km. The rate shall also include royalty if payable.

ROUGH DRESSING OF THE TRENCHED GROUND

Rough dressing of the area shall include making kiaries for flooding.

The trenched ground shall be levelled and rough dressed and if there are any hollows and depressions resulting from subsidence which cannot be so levelled, these shall be filled properly with earth brought from outside to bring the depressed surface to the level of the adjoining land and to remove discontinuity of slope and then rough dressed again. In rough dressing, the soil at the surface and for 75 mm depth below shall be broken down to particle

size not more than 10 mm in any direction.

Measurements
Length, breadth of superficial area shall be measured correct to 0.1 metre. The area shall be calculated in sqm. correct to two places of decimal.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

UPROOTING WEEDS FROM TRENCHED AREAS
After 10 days and within 15 days of flooding the rough dressed trenched ground with water, the weeds appearing on the ground shall be rooted out carefully and the rubbish disposed off as directed by the Engineer-in-charge.

Measurements
Length, breadth of superficial area shall be measured correct to 0.1 meters. Superficial area of the weeded ground shall be measured for purpose of payments.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

FINE DRESSING THE GROUND
Slight unevenness, ups, and downs and shallow depressions resulting from the settlement of the flooded ground, in drying and from the subsequent weeding operations, shall be removed by fine dressing the surface to the formation levels of the adjoining land as directed by the Engineer-in-charge, and by adding suitable quantities of good earth brought from outside, if necessary.

Measurements
Length, breadth and depth of stacks shall be measured correct to a cm. The area shall be calculated in sqm. correct to two places of decimal.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

SPREADING GOOD EARTH
Good earth shall be removed from stacks by head load and spread evenly over the surface to the thickness ordered by the Engineer-in-charge. It shall be spread with a twisting motion to avoid segregation and to ensure that spreading is uniform over the entire area.

Measurements: The quantity of good earth spread shall be determined by the difference in the volume of good earth in stacks before and after spreading duly reduced for looseness in stacking by 20% of good earth.

Rate: The rate shall include of all the labour and material involved in all the operations described above, but does not include the cost of the good.

SPREADING SLUDGE/MANURE
Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer-in-Charge. The mixing shall be spread

as described in 1.8.1 to the thickness ordered by the Engineer-in-Charge.

Measurements
The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth and sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.

Rate
The rate shall include of all the labour and material involved in all the operations described above.

MIXING OF GOOD EARTH AND SLUDGE/MANURE
The stacked earth shall, before mixing be broken down top particle of sizes not exceeding 6 mm in any direction. Good earth shall be thoroughly mixed with sludge or manure in specified proportion as described in the item or as directed by the Engineer-in-charge.

Measurements The quantity of good earth and sludge or manure mixed shall be determined by the difference in the volume of good earth, sludge or manure in stack, before and after spreading duly accounted for voids and looseness in stack.

Rate
The rate shall include the cost of all labour and materials involved in all the operations described above.

GRASSING WITH SELECT GRASS NO. 1
The area from where the grass roots are to be obtained shall be specified by the Engineerin-Charge at the time of execution of the work and no royalty shall be charged on this account from the contractor. Grass is to be arranged by contractor.

The soil shall be suitably moistened and then the operation of planting grass shall be commenced. The grass shall be dibbled at 10 cm, 7.5 cm, 5 cm apart in any direction or other spacing as described in the item. Dead grass and weeded shall not be planted. The contractor shall be responsible for watering and maintenance of levels and the lawn for 30 days or till the grass forms a thick lawn free from weeded and fit for moving whichever is later. Generally planting in other direction at 15 cm, 10 cm, spacing is done in the case of large open spaces, at 7.5 cm spacing in residential lawn and at 5cm spacing for Tennis Court and sports ground lawn. Rates are including cost of labour.

During the maintenance period, any irregularities arising in ground levels due to watering or due to trampling by labour, or due to cattle straying thereon, shall be constantly made up to the proper levels with earth as available or brought from outside as necessary, Constant watch shall be maintained to ensure that dead patches are replanted and weeds are removed.

Measurements
Length, breadth of the lawn grassed shall be measured correct to 0.1 meter and the area shall be calculated in sqm. correct to two places of decimal.

Rate
The rate shall include of all the labour and material involved in all the operations described above, excluding supply of the requisite quantity of good earth and grass so needed for properly maintaining the levels of the lawns.

RENOVATION OF LAWNS

The area shall be first weeded out of all undesirable growth. The entire grass shall be scrapped (cheeled) without damaging roots and level of the grounds. Slight irregularities in surface shall be levelled off and the area shall then be forked so as to aerate the roots of the grass without, however uprooting them.

Specified quantity of sludge or manure shall than be spread uniformly with wooden straight edge (phatti) as directed by the Engineer-in-charge. The area shall then be slightly sprinkled with water so as to facilitate proper integration of the manure or sludge with the soil and later flooded. The contractor shall be responsible for watering, proper maintenance and tending of the lawn for 30 days or till the grass forms a lawn fit for mowing, whichever is later. During the above operations, all undesirable growths shall be constantly weeded out and all rubbish removed and disposed off as directed by the Engineer-in-Charge.

MEASUREMENTS
Length, breadth of the lawn renovated shall be measured correct to 0.1 meter and the area shall be calculated in sqm. correct to two places of decimal.

Rate
The rate shall include of all the labour and T&P (excluding RH pipe/grass) involved in all the operations described above, excluding the supply of the requisite quantity of good earth if so needed for proper maintenance of the levels of the lawns. The cost of the sludge or manure shall be measured, unless its supply is specifically included in the description of the item.

UPROOTING RANK VEGETATION AND WEEDS AND PREPARING THE GROUND FOR PLANTING 'SELECT GRASS NO. 1'

1.11.1 Initially the area shall be dug up to a depth of 30 cm. and weeds and rank vegetarian with roots removed thereon by repeated forking. The whole area then shall be retrenched to a depth of 60 cm in the same manner as described in 2.1. Clods of excavated earth shall then be broken upto the size not more than 75 mm in any direction. The area shall then be flooded with water and after 10 days and within 15 days of flooding, weeds shall be uprooted carefully. The rubbish arising from the above operations shall be removed and disposed off in a manner directed by the Engineer-in-charge, away from the site. The earth shall then be rough dressed and fine dressed as described in 2.6 & 2.8.

Measurements
Length, breadth of uprooted area shall be measured correct to 0.1 meter and the area shall be calculated in sqm. correct to two places of decimal.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

EXCAVATION AND TRENCHING FOR PREPARATION OF BEDS FOR HEDGE AND SHRUBBERY

Beds for hedges and shrubbery are generally prepared to width of 60 cm. to 125 cm. and 2 to 4 meters respectively.

Beds for hedges and shrubbery shall be prepared in the following manner. The beds shall first be excavated to a depth of 60 cm. and the excavated soil shall be stacked on the sides of the beds. The surface of the excavated bed shall then be trenched to a further depth of 30 cm, in order to loosen the soil, in the manner described in 2.1. No flooding will be done at this stage but the top surface shall be rough dressed and levelled. The excavated soil from

the top 60 cm depth of the bed stacked at the site shall then be thoroughly mixed with sludge over manner in the proportion 8:1 by ratio or other proportion described in the item. The mixed earth and manure shall be refilled over the trenched bed, levelled neatly and profusely flooded so that the water reaches even the bottom most layers of the trenched depth of the bed. The surface after full subsidence shall again be refilled with the earth and manure mixture, watered and allowed to settle and finally fine dressed to the level of 50 mm to 75 mm below the adjoining ground or as directed by the Engineer-in-Charge. Surplus earth if any, shall be disposed off as directed by the Engineer-in-charge. Any surplus earth if removed beyond initially lead. Stones, bricks bats and other foreign matter if met with during excavation or trenching shall be removed and stacked within initially lead & lift, such material as is declared unserviceable by the Engineer-in-charge shall be disposed by spreading and levelling at places ordered by him. If disposed outside the initial lead & lift, then the transport for the extra leads. If a large proportion of material unsuitable for the hedging and shrubbery operations is met with and earth from outsides is required to be brought in for mixing with manure and filling, the supply and stacking of such earth.

Measurements
Length, breadth and depth of the pit excavated and trenched shall be measured correct to a cm. The cubical contents shall be calculated in cubic meter correct to two places of decimal

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above. The rate shall not include the cost of supply & stacking of the manure unless the same is specifically included in the description of the item.

DIGGING HOLES FOR PLANTING TREES
In ordinary soil, including refilling earth after mixing with oil cake, manure and watering.

Holes of circular shape in ordinary soil shall be excavated to the dimensions described in the items and excavate soil broken to clods of size not exceeding 75 mm in any direction, shall be stacked outside the hole, stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth met with during excavation shall be separated out and unserviceable material removed from the size as directed. Useful material, if any, shall be stacked properly and separately. Good earth in quantities as required to replace such discarded stuff shall be brought and stacked at site by the contractor. The tree holes shall be manured with powdered Neam/castor oil cake at the specified rate along with farm yard manure over sludge shall be uniformly mixed with the excavated soil after the manure has been broken down to powder, (size of particle not be exceeded 6 mm in any direction) in the specified proportion, the mixture shall be filled in to the hole up to the level of adjoining ground and then profusely watered and enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level or as directed by the Engineer-in-charge.

Measurements : Holes shall be enumerated.

Rate: The rate shall include the cost of all the labour and material involved in all the operations described above, excluding the cost of supply and stacking the requisite quantity of manure/ sludge and oil cake.

In Soil other than Ordinary Soil

Where holes are dug in (a) Hard soil (b) Ordinary rock or (c) Hard rock, the above soils occurring independently over in conjunction with each other and /or ordinary soil in any hole, the different excavated soil shall be stacked separately. Excavation in hard rock shall be

carried out by chiseling only.

The stack measurement of ordinary rock and hard rock shall be reduced by 50% and of soil by 20% to arrive at the excavated volume. This excavation shall bfor holes dug in ordinary soil above, at rate appropriate to particular soil concerned.

Sufficient quantity of good soil to replace the solid volume of stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth, ordinary and hard stacks shall be brought and stacked at site.

The useless excavated stuff shall be disposed off by spreading at places as ordered by the Engineer-in-charge. If such places are outside initially leads, carriaged.
The ordinary soil excavated from the hole and the earth brought from outside shall then be mixed with manure screened through sieve of IS designation 16 mm in the proportion specified in the description of the item and filled with the pit and the same watered and finally dressed.

Measurements: The pit shall be enumerated. The volume of excavation in soil and other than a ordinary soil shall be determined by reducing the stack volume of the relevant soil with respective percentage for voids specified in 2.14.2.2.

Rate: The rate shall include the cost of all the labour and material involved in all the operations described above, including mixing refilling, watering, dressing etc. but shall not include

(a) cost of manure over sludge
(b) cost of supplying and stacking of good earth for replacement and
(c) the cost of carriage beyond initial lead for disposing off useless materials. The excavation other than that of ordinary soil.

M.S. FLAT IRON TREE GUARD

M.S. Iron Riveted Tree Guard

The tree guard shall be 600 mm in diameter and 2 meter high above ground level and 25 cm in below ground level.

The tree guard shall be framed of 4 nos. 25 x 6 m M.S. flat 2 meter long excluding displayed outward at lower and upto an extent 10 cm and 8 nos. 25 x 3 mm vertical M.S. Flat Rivetted to 3 Nos. 25 x 6 mm Flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. bolts and nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.

Measurement
The tree guard shall be enumerated.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

M.S. Flat Iron Welded Tree Guard

The tree guard shall be 600 mm in diameter and 2 meter high above ground level and 25 cm in below ground level.

The tree guard shall be framed of 4 nos. 25 x 6 mm MS. Flat 2 metres long excluding displayed outward at lower and upto an extent 10 cm and 8 Nos. 25 x 3 mm vertical M.S. Flat Riveted to 3 nos. 25 x 6 mm flat iron rings in two halves, bolted together 8 mm dia and 30 mm long M.S. Bolts & nuts. The entire tree guard shall be given two coats of synthetic enamel paint of approved brand and manufacturer of required shade brand and manufacturer of required shade over a priming coat of ready mixed steel primer of approved brand and manufacturer. The design of tree guards shall be shown in the drawing.

Measurement
The tree guard shall be enumerated.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

FILLING MIXTURE OF EARTH & SLUDGE OVER MANURE

The separately specified earth and sludge shall be broken down to particles of size not exceeding 6 mm in any directions before mixing. Good earth shall be thoroughly mixed with sludge over manure in specified proportions as directed by Officer-in-Charge. During the process of preparing the mixture as above, trenches shall be flooded with water and levelled.

Measurements
Measurement shall be made in (Length, breadth and height of stacks) cubic meter. The cubical contents shall be worked out to the nearest two places of decimal in cubic meter.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above, but do not include the good earth, sludge or manure.

EXCAVATION OF DUMPED STONE OR MALBA

Excavation operations shall include excavation and getting out water if required. During the excavation stone, brick bats and other foreign material if met shall be removed and stacked within 50meter leads and lifts. Such material as is declared unserviceable by the Engineer - in- Charge be disposed within 50 m. The excavated surface shall be neatly dressed and levelled.

Measurements
Measurement shall be made in (Length, breadth and height of stacks) cubic meter. The cubical contents shall be worked out to the nearest two places of decimal in cubic meter.

Rate
The rate shall include the cost of all the labour and material involve in all the operations Described above.

EXCAVATION IN BAJRI PATH

All excavated operations shall include excavation and stacking of serviceable and unserviceable material. Excavated surface of Bajri path shall be removed and stacked upto

50 meter lead and disposed material neatly dressed.

EXCAVATION OF WATER BOUND MACADAM

All excavated operations shall include excavation, stacking of serviceable and unserviceable material. Excavation shall be straight and uniform in width. Soling stone and aggregate obtained from excavation of W.B.M. shall be stacked separately and unserviceable material disposed off with lead upto 50 meter and lift upto 1.50 meter and neatly dressed.

Measurements
Measurement shall be made in (Length, breadth and height of stacks) cubic meter. The cubical contents shall be worked out to the nearest two places of decimal in cubic meter.

Rate
The rate shall include the cost of all the labour and material involved in all the operations described above.

FLOODING THE GROUND WITH WATER AND MAKING KIARIES

The water for flooding shall be of soft water and free from chemical and good for growing the trees and shrubs etc. Before flooding the kiaries shall be made in required size and shape as per directions of Officer-in-charge. After uprooting weeds from the trenched area and uprooting vegetation, kiaries shall be dismantled.

Measurements
Measurement shall be made in sqm. of area.

Rate
The rate shall be for 100 sqm of area and include the cost of all the labour and material involved in all the operations described above.

CLEANING AND SWEEPING OF LAWN

The Cleaning of Garden shall cover to proper sweeping work including removing litter, debries, picking of leaves, papers, plastic bottles etc. & disposal of collected waste in dustbin/designated place as decided by officer in charge.

Measurements
Measurement shall be made in sqm. of area.

RATE

The rate shall be for per sqm of area and include the cost of all the labour and material involved in all the operations described above.

REMOVAL OF GARDEN WASTE

Removal of garden waste by TATA 407 or equivalent including loading/unloading and carriage up to 1 km lead, complete disposal at designated place decided by officer in charge.

Measurements
Measurement shall be made per Trip.

RATE

The rate shall be for per Trip basic and include the cost of all the labour and material & TATA 407 or Equivalent involved in all the operations described above.

PRUNING, TRIMMING, SHAPING OF TREES

Pruning, trimming, shaping of trees/shrubs (ht 15 feet and above) i/c removal of cut materials up to 50mt. lead and as per direction of officer in charge.(i/c necessary T&P shall be arranged by the contractor. Pruning, trimming, shaping of trees/ shrubs shall be done as per direction of officer incharge.

Measurements
Measurement shall be madeper tree/shrub in proper manner.

RATE
The rate shall be for per Tree/shrub basic and include the cost of all the labour and materials &equipments involved in all the operations described above.

SPECIFICATIONS OF PLANTS

The plants included under Sub Head 3 to 10 should be as per following specification.

1. The plants should be full of fresh and healthy foliage.
2. The plants should be free from insect, pest and diseases.
3. Plant should be well developed and healthy.
2. The height of the plants will be measured from top of the pots.
3. The plants should be well settled and should not be newly shifted/Transplanted.
4. The plants should be true to the variety and Variety name should be tagged.
5. Moss stick used should be made on plastic pipe.
6. Moss stick should be straight and properly fixed in the pot.
7. The rejected plants materials should be removed from the site immediately.
8. Moss stick should be covered with the plants in case of plants supplied with moss stick.
9. The Plant should be well stablished and should have good foliage.
10. Good earth and manure used for filling the pot/poly bag should be free from any inert materialand mixed to proper ratio.
11. Pot/ Poly bag used for filling the plants should be of proper size.
12. There should be proper drainage in pots for plants.
13. The flowering plants should also have proper flowering and should be true to the variety.
14. All plant should have the tendency of growth and should not be stunted or deshaped.
15. There should be no stagnation of water in the pots.
16. Plant should not have any physiological disorder.
17. Tips of the Plants should have intact, there should not be any damages etc.
18. In case of flowering pots flower should be on bud stage/semi bloom stage.
19. In case of potted plant pots should have uniformity/same size and quality.
20. Plants of bigger height should be properly supported/stacked by bamboo stick.
21. Pots/Polybags soil should not be infectious and plant should have free from all kind of diseases.
22. Bulbs, seeds, seedling, suckers should properly treated with fungicides before supply.

All Horticulture works including materials shall be done in accordance with the provisions of CPWD/NBC of relevant codes.

Pre-construction measures of prevention of soil erosion, management of storm water, preservation of existing vegetation, top soil removal and preservation of utilizing its rich organic content by stripping the top soil to a depth of 200 mm from area proposed to be

occupied by buildings roads, pavement etc. shall be taken.

In the case the soil is unsuitable for horticulture the same shall be substituted or covered over to the required level with suitable soil.

OTHER SPECIFICATIONS

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 20 : HUMEPIPE WORKS

A. Earth work in excavation by mechanical means (Hydraulic excavator) I manual means in foundation trenches or drains (not exceeding 1.5 m in width or 10 sqm on plan), including dressing of sides and ramming of bottoms, for all lift, including getting out the excavated soil and disposal of surplus excavated soil as directed, within a lead of 50 m.

B. Filling available excavated earth (excluding rock) in trenches, plinth, sides of foundations etc. in layers not exceeding 20cm in depth, consolidating each deposited layer by ramming and watering, lead up to 50 m and for all lift.

C. Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work upto plinth level. 1:5:10 (1 Cement : 5 coarse sand (zone-III): 10 graded stone aggregate 40 mm nominal size)

D. Providing and laying non-pressure NP2 /NP-3class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement : 2 fine sand) including testing of joints etc. complete : 1000 mm dia. R.C.C. pipe or above as per engineer in charge

NON PRESSURE NP-3 CLASS (MEDIUM DUTY)/ NP-4 CLASS (HEAVY DUTY) R.C.C. PIPES

The pipes shall be with reinforcement as required and shall be of class not lesser than NP2. These shall conform to IS 458 and shall be capable of withstanding a test pressure of 0.07 MPa (7 m head). The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process or vibrated casting process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding. Concrete used for the manufacture of reinforced concrete pipes and collars shall be as per design mix. The concrete quality (concrete mix, maximum water-cement ratio, minimum cement content. etc) shall be as per IS 456 for at least very severe environment exposure condition with minimum cement content 260 kg/m^3. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm internal diameter. But for pipes of internal diameter 80 to 250 mm, the maximum size of aggregate should be 10mm. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight

Laying and Jointing Cement Concrete Pipes and Specials

Trenches

(i) Trenches shall be as described in 18.4.4. Where the pipes are to be bedded directly on soil, the bed shall be suitably rounded to fit the lower part of the pipe, the cost for this operation being included in the rate for laying the pipe itself.

(ii) Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain pulley block is recommended. All pipe sections and connections shall be inspected carefully before

being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipes shall proceed upgrade of a slope
.
(iii) If the pipes have spigot and socket joints, the socket ends shall face upstream. In the case of pipes with joints to be made with loose collars, the collars shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.
(iv) In case where foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed tracks manholes etc. the pipe shall be encased allaround in 15 cm thick cement concrete 1:5:10 (1 cement : 5 fine sand : 10 graded stone aggregate 40 mm nominal size) or compacted sand or gravel.

(v) In cases where the natural foundation is inadequate the pipes shall be laid either in concrete cradle supported on proper foundations or on any other suitably designed structure. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia of the pipe subject to the min. of 10 cm and a maximum of 30 cm. The concrete shall extend up the sides of the pipe at least to a distance of 1/4th of the outside diameter of pipes 300 mm and over in dia. The pipe shall be laid in this concrete bedding before the concrete has set. Pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from the backfill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

(vi) When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalising bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

(vii) The method of bedding and laying the pipes under different conditions are illustrated in
(viii) When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on rigid foundations at intervals. Suitable arrangements shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe. The distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joints come in the centre of the span. Care shall be taken to see that super imposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted. Suitably designed anchor blocks at change of direction and grades for pressure lines shall be provided where required.

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Jointing
Joints are generally of rigid type. Where specified flexible type joints may also be provided.

a). Rigid Spigot and Socket Joint (Fig. 19.10): The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The opening of the joint shall be filled with stiff mixture of cement mortar in the proportion of 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

b). Rigid Collar Joint (Fig. 19.10): The two adjoining pipes shall be butted against each

other and adjusted in correct position. The collar shall then be slipped over the joint, covering equally both the pipes. The annular space shall be filled with stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) which shall be rammed with caulking fool. After a day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

c). Semi Flexible Spigot and Socket Joint (Fig. 19.10): The joint is composed of specially shaped spigot and socket ends on the concrete pipes. A rubber ring shall be placed on the spigot which shall be forced into the socket of the pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and the socket, stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work any extraneous materials shall be removed from the inside of the pipe and the newly made joint shall be cured.

d). Semi Flexible Collar Joint: This is made up of a loose collar which covers two specially shaped pipe ends as shown in the Fig. 19.10. Each end shall be fitted with a rubber ring which when compressed between the spigot and the collar, seal the joint. Stiff mixture of cement mortar 1:2 (1 cement: 2 fine sand), shall then be filled into the remaining annular space and rammed with a caulking tool. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

e). Internal Flush Joint (Fig. 19.10): This joint is generally used for culvert pipe of 60 cm dia and over.

f). The ends of the pipe are specially shaped to form a self centering joint with an internal jointing space 1.3 cm wide the finished joint is flush with both inside and outside with the pipe wall as shown in Fig. 19.10. The jointing space is filled with cement mortar 1:2 (1 cement: 2 fine sand) mixed sufficiently dry to remain in position when forced with a trowel or rammer. After day's work, any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

g). External Flush Joint : This joint is suitable for pipes which are too small for jointing from inside. This joint is composed of specially shaped pipe ends as shown in Fig. 19.10. Each end shall be butted against each other and adjusted in correct position. The jointing space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) sufficiently dry and finished off flush. Great care shall be taken to ensure that the projecting ends are not damaged as no repairs can be readily affected from inside the pipe.

In all pressure pipe lines the recess at the end of the pipe line shall be filled with jute braiding dipped in hot bitumen or other suitable approved compound. Pipes shall be so jointed that the bitumen ring of one pipe shall set into the recess of the next pipe. The ring shall be thoroughly compressed by jacking or by any other suitable method. The number of pipes that shall be jacked together at a time shall depend on the diameter of the pipes and the bearing capacity of the soil, for small pipes up to 25 cm diameter, six pipes can be jacked together at a time. The quantity of jute and bitumen in the ring shall be just sufficient to fill the recess in the pipe when pressed hard by jacking or by any other suitable method. Before and during jacking care shall be taken to see that there is no offset at the joint.

SUB HEAD: DRAINAGE

Testing: For pressure pipes, the completed pipeline shall be tested for pressure (Known as site test pressure) which shall not be less than the maximum pipeline operating pressure plus the calculated surge pressure, but in no case shall it exceed the hydrostatic test pressure. For non pressure pipes the joints shall be tested as per procedure laid down under Para 19.2.1.2 (iv).

Refilling of Trenches:
The specification described in 19.2.1.2 (v) shall apply. In case where pipes are not bedded on concrete special care shall be taken in refilling, trenches to prevent the displacement and subsequent settlement at the surface resulting in uneven street surfaces and dangers to foundations etc. The backfilling materials shall be packed by hand under and around the pipe and rammed with a shovel and light tamper. This method of filling will be continued up to the top of pipe. The refilling shall rise evenly on both sides of the pipe and continued up to 60 cm above the top of pipe so as not to disturb the pipe. No tamping shall be done within 15 cm of the top of pipe. The tamping shall become progressively heavier as the depth of the backfill increases.

Measurements
The lengths of pipes shall be measured in running metres nearest to a cm as laid or fixed, from inside of one manhole to the inside of the other manhole. The length shall be taken along the centre line of the pipes over all fittings such as bends, collars, junctions, etc. which shall not be measured separately. Excavation, refilling, shoring and timbering in trenches, and cement concreting wherever required shall be measured separately under relevant items of work.

Haunching Of Pipes
Providing and laying cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate 40 mm nominal size) up to haunches of NP-2 pipes including bed concrete as per standard design : Concrete bedding with additional concrete at the sides of the pipe.

SECTION - 21 : BOUNDARY WALL

Earth work in excavation by mechanical means (Hydraulic excavator)/ manual means over areas (exceeding 30 cm in depth, 1.5 m in width as well as 10 sqm on plan) including getting out and disposal of excavated earth lead upto 50 m and lift upto 1.5 m, as directed by Engineer-incharge.

All kinds of soil

Providing and laying in position cement concrete of specified grade excluding the cost of centering and shuttering - All work up to plinth level 1:4:8 (1 Cement : 4 coarse sand (zone-III) derived from natural sources : 8 graded stone aggregate 40 mm nominal size derived from natural sources

Brick work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in: Cement mortar 1:4 (1 cement : 4 coarse sand)

Brick work with non modular fly ash bricks conforming to IS:12894, class designation 10 average compressive strength in super structure above plinth level up to floor V level in Cement mortar 1:4 (1 cement : 4 coarse sand)

Centering and shuttering including strutting, propping etc. and removal of form for all heights : Foundations, footings, bases of columns etc. for mass concrete. Lintels, beams, plinth beams, girders, bressumers and cantilevers. Columns, Pillars, Piers, Abutments, Posts and Struts.

Providing and laying in position ready mixed or site batched design mix cement concrete for reinforced cement concrete work; using coarse aggregate and fine aggregate derived from natural sources, Portland Pozzolana / Ordinary Portland /Portland Slag cement, admixtures in recommended proportions as per IS: 9103 to accelerate / retard setting of concrete, to improve durability and workability without impairing strength; including pumping of concrete to site of laying, curing, carriage for all leads; but excluding the cost of centering, shuttering, finishing and reinforcement as per direction of the engineer-in-charge; for the following grades of concrete. Note: Extra cement up to 10% of the minimum specified cement content in design mix shall be payable separately. In case the cement content in design mix is more than 1.10 times of the specified minimum cement content, the contractor shall have discretion to either re-design the mix or bear the cost of extra cement. Concrete of M30 grade with minimum cement content of 350 kg /cum

Steel Reinforcement for R.C.C. work including straightening, cutting, bending, placing in position and binding all complete.Upto & Above plinth level Thermo-Mechanically Treated bars of grade Fe-500D or more.

Steel work welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required. In gratings, frames, guard bar, ladder, railings, brackets,gates and similar works

12mm cement plaster of mix : 1:6 (1 cement: 6 coarse sand)

15mm cement plaster on rough side of single or half brick wall of mix: 1:6 (1 cement: 6 coarse sand)

Finishing walls with textured exterior paint of required shade : New work (Two or more coats

applied @ 3.28 ltr/10 sqm) over and including priming coat of exterior primer applied @ 2.20kg/10 sqm

Finishing with Deluxe Multi surface paint system for interiors and exteriors using Primer as per manufacturers specifications : Painting Steel work with Deluxe Multi Surface Paint to give an even shade. Two or more coat applied @ 0.90 ltr/10 sqm over an under coat of primer applied @ 0.80 ltr/10 sqm of approved
brand and manufacture.

Providing and fixing sheet covering over expansion joints with iron screws Aluminium fluted strips 3.15 mm thick. 150 mm wide

Working 'as per drawing & engineer-in-charge' refers to the practice of performing tasks, construction, or fabrication activities strictly according to the technical drawings, specifications, and instructions provided, under the supervision of the engineer-in-charge. This means that the work must adhere to the detailed plans and design guidelines, ensuring accuracy and compliance with the intended structure or system. Additionally, the engineer-in-charge oversees the work process, ensuring that it meets the required quality standards, safety regulations, and project objectives. This approach ensures that the work is executed correctly, efficiently, and safely, with proper oversight to address any technical or design-related issues.

OTHER SPECIFICATIONS

For specifications of items not included above and other related miscellaneous items, specifications shall be taken from latest relevant CPWD specifications.

SECTION - 22 : OTHER SPECIFICATIONS

Providing and fixing Glass Reinforced Concrete (G.R.C) Screens casted with 'Spray Mix' concrete design in approved size, pattern, thickness of 50mm on the outer Border & 25-30mm for Internal member or overall thickness of 40mm and shade. The Screens should be made from '53 grade' Portland Cement , White Quartz fine graded sieve Silica Sand, Alkali Resistant Glass Fibre , Super Plasticizers, Polymers and U.V resistant Synthetic inorganic pigments should be used for pigmentation. The Screens casting shall take place with layering methodology using- Direct Power Spray machines. The GRC Screens flexural strength average L.O.P should be above or equivalent to 7 N/mm² & M.O.R should be above or equivalent to 18 N/mm² and Water Absorption Levels should be less than 11% for tests done on 28 days cured samples.

The fixing of Elements should be done using 'Dry fixing' method onto structural support members i.e. R.C.C, Brick work or Red Oxide Primer -paint or Epoxy primer -paint treated mild steel. The fixtures, fasteners and self-tapping screws to be used for dry fixing , MS Clamps of 40x40x40x3mm to be used. The quantity of fasteners or self-tapping screws shall be calculated in accordance to the weight of Elements and actual site fixing conditions. Welding Electrodes to be Joints to be left open for any expansion & contraction due to changes in temperature. If at all there is a requirement of Joint filling, then Elastomeric exterior grade paintable PU Sealant to be used. For final finishing of Element one weather shield exterior grade water based diluted paint coat will be done if required. Vendors shall submit shop drawings of the same, the drawings to be duly approved by the Engineer in charge at site.

Supply & Installation of roof with co-extruded, UV protected, multi-layered / multi-cell connectible modular polycarbonate panel system. The system is consisting of 25 mm thick standing seam panel with X-cell truss bracing design structure for better strength and flexibility in seven layers with all fixing accessories to ensure best performance for wind uplift, vibration, oil canning and visual appearance. Panels shall be fixed on Purlins of MS / aluminum structure (to be paid Separately) with wide trapezoidal SS fastener/cleat/Aluminium Special Profile with top holding of 80mm on standing seam, fixed with purlins with 3 numbers of self-drilling screws to ensure a pull-out load of min. 7000 N (7KN) tested as per ISO 6892:1998 and IS 1608: 2005. The entire fixing mechanism shall be covered with a continuous U/2, interlocking connectible connectors with grip lock anti pop double tooth locking mechanism running lengthwise at both sides of the panel. Each panel shall be solo opaque type with opaque and clear combination of louvers inside the single panel i.e. with transparent body and opaque layers in between the layers creating 'Light Duct' for better ambience & increased shading. U value of such panel shall not be more than 1.6 Watt/m2K as per EN ISO 10077-2:2018 and respective third-Party test certificate shall be produced before procurement. Opaque Layers shall form a "V Shape" in top layer, "rhombus shape" in the middle and an "inverted V" in the bottom layer to create angular daylighting duct. The width of the panels shall not be less than 1220 mm. Panels must satisfy Dart drop impact test as per IS 14443-97 shall show no sign of breakage on Polycarbonate sheets which have been exposed to UV for a min. of 500 Hours as per ASTM G 155. Panels shall not have Yellowness Index as per ASTM D2244 (standard D65 illuminant, CIELAB) not more than 1 unit when tested on a sample exposed to UV/weathering test for 5000 Hours as per ASTM D4329. The panel shall be with additional sealing / breathing tape, Aluminum U profile for ends, screws etc. as per standard accessories as required. Panel shall be fixed conforming to the detailed methodology & guideline as per the manufacturer. Trained and factory authorized labor shall be used with supervision to complete the entire panel installation as per drawing and direction of the engineering in charge. Color: As per

approval.

CPWD specifications and guidelines to be followed for any item not mentioned in the given document but specified in the drawings and schedules.

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PLUMBING WORKS

TECHNICAL SPECIFICATIONS

GENERAL SPECIFICATINS

This General Specification are to be read in conjunction with other documents issued along with tender. In case of any discrepancy between Design drawings, General conditions or Bill of quantity, more stringent of the same shall be applicable.

The contractor shall refer the following drawings while bidding and will read them in conjunction with specifications as well as bill of quantity. A part list of applicable codes & standards is mentioned as Annexure – the compliance and I will be ensured.

WORK DESCRIPTION

The work shall be strictly carried out as per the scope listed in this document and in accordance with the specifications. The equipment & material supplied at site will also be selected out of the approved makes. Bill of quantity provided with the document is for contractor guidance. It is expected that after award of work, contractor shall prepare shop drawings for approval by the Consultant &PMC's representative and submit Technical documentation duly identifying shortlisted make of material/equipment along with its data sheets. Actual ordering shall be based on approved shop drawings & documents.

The work at site shall comply with the approved shop drawings and will meet the satisfaction of PMC's representative. The contractor shall be required to demonstrate satisfactory operation of entire system (including client supplied equipment installed by contractor) and furnish the required labour, material & tools to install & commission the system.

The broad scope of work for proposed plumbing and firefighting system covered under this contract shall include supply, installation, testing &commissioning of the following:

- Sanitary fixtures and accessories.
- C.P. bathroom fittings and accessories.
- Soil, waste and vent pipes with fittings
- Rain water disposal pipes with fittings
- Water supply pipes with fittings
- External sewerage system
- External Drainage system
- External water supply system
- Connection to and from municipal mains in case of water, sewer and drain connection including coordination with all other agencies
- Fire pumping system, Fire Hydrant including fire extinguishers. The scope also includes electrical panel as applicable.
- Other Miscellaneous Items.
- Wiring & earthing from MCC panels to various firefighting system, control wiring & interlocking.
- Any chasing/chipping/civil masonry.
- Balancing, testing & commissioning of the entire plumbing system.

Besides above, contractor shall also be required to undertake following:

- Obtain approval from Local Authorities prior & post installation for operation of

system.
- All civil works which include making openings in walls & slabs and making good of the same.
- Commissioning of the plant including test reports to demonstrate satisfactory working prior to handing over.
- Provide as-built drawings and handing over document Test reports, list of recommended spares, operation & maintenance manual for the entire plumbing system.
- Training of Client's staff.

SITE MANAGEMENT

The Contractor shall be required to provide following staffing for the project:
- Design Engineer who will work with Consultant for getting shop drawings, technical submittal and variation in quantity statement approved.
- Procurement team at per tender document.
- Full time dedicated Engineer& supervisor posted at site as per tender document.
- The contractor shall submit organization chart and CV prior to starting work at site.
- The Contractor shall have required stores, tools & plant, security and facility to transport materials to place of installation for speedy execution of work.

REGULATIONS& PERMITS

Prior to starting work at site, the contractor shall obtain required permits/ licenses required for satisfactory execution and operation of the installation.

The executed work shall strictly confirm to applicable laws, regulations and Indian Standards which become applicable. In case the specifications and drawings contained in this document call for higher standard than those required by prevailing regulations, then these specifications & drawings shall become applicable. However, in case of any conflict or violation between the document/drawings and prevailing laws, then the applicable laws & regulations shall be governing & binding.

SHOP DRAWINGS

A set of design drawings listed in this document are available at Consultant office and may be issued with the tender document. These design drawings are for reference of the contractor and indicate proposed arrangement and the extent of work covered in the contract. The data given in the drawings and specifications is as exact as could be procured, but its accuracy is not guaranteed. The contractor cannot execute work or scale these drawings for reference.

Following shall be the procedure followed by contractor while preparation of shop drawings:

- The contractor shall refer the design drawings for understanding the scope and proposed routes to be followed during execution.
- Collate latest architectural backgrounds from the PMC's representative/Architect/Consultant.
- Examine all related services drawings but not limited to structural, plumbing, electrical, HVAC, Interior, landscape and others including as-built works before

starting the work. Any discrepancy must be report to the PMC's site representative in writing and obtain approval for go-ahead.

- Within one week of award of work, the Contractor shall prepare a list of shop drawing along with submission schedule for approval of PMC's representative/Consultant. The list of drawings must include layouts for Plant room, Pump room, Typical drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.
- Maximum headroom shall be maintained at all points and in case the same is inadequate, then written approval from PMC's representative must be obtained prior to execution at site.
- These shop drawings shall depict information required to complete the Project as per specifications and as required by the Consultant/PMC's representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.
- Where the work under this contract is proposed to be installed in close proximity or is interfering with other trades, then based on PMC's representative/consultant directions, the contractor shall prepare all services coordinated working drawings and sections at a suitable scale (not less than 1:50), clearly showing proposed installed in relation to the work of other trades.
- The contractor shall thereafter furnish six sets of detailed shop drawings to PMC's representative/Consultant for obtaining comments/approval. The Contractor will make unlimited number of re-submissions of shop drawings unless PMC's representative/Consultant/Architect approval is obtained.
- The Contractor will thereafter submit six sets of final shop drawings to the PMC's representative for their exclusive use and all other agencies.
- No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.
- In case installation is carried out without following above process or obtaining a waiver to follow the procedure from PMC's representative, the work shall be rejected and contractor shall rectify the same at their own cost.
- Shop drawings shall be submitted for approval minimum four weeks in advance of planned delivery and installation of any material to allow PMC's representative/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

TECHNICAL DOCUMENTATION

The contractor prior to supplying material at site, will submit the following documentation

to Consultant/PMC's representative for approval:

- Manufacturers drawings, catalogues, pamphlets and other documents in triplicate. Each item shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.
- Samples of all materials shall be submitted to the PMC's site representative prior to procurement. These will be submitted in two sets for approval and retention by PMC's representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed, a mockup or sample installation shall be carried out for approval before proceeding for further installation.
- Where the contractor proposes to use an alternate make or model of equipment other than that specified, all new drawings and detailing required thereafter shall be prepared by the contractor at his own expense including any re-design required for other discipline/trade. Any delay on such account shall also be at the cost of and consequence of the Contractor.

Contractor to get the makes & materials approved by Engineer-in-charge for this project.

QUALITY ASSURANCE

The contractor to ensure that all materials and equipment supplied shall be new and of best available quality conforming to the relevant Indian Standard Specifications and to these specifications. Makes shall be strictly in conformity with approved manufacturers. PMC reserve the right to reject any item which in their assessment is second hand

Any deviations from above shall be clearly highlighted prior to supply and shall be brought to the notice of the PMC's representative/Consultant for further instructions in the matter.

Prior to starting execution work at site, the Contractor shall verify the sufficiency of the size of the shaft openings, clearances and ceiling spaces for proper installation. Failure to communicate insufficiency of any of the above, shall constitute Contractor acceptance of the same. The Contractor shall locate all equipment in fully accessible locations which can be easily serviced, operated or maintained. Valve or other devices requiring attendance shall be finalized and communicated in sufficient time. Failing this, the Contractor shall make all the necessary repairs and changes at own expense. Access panel shall be marked.

INTEGRATION WITH BUILDING AUTOMATION SYSTEM

The scope of Plumbing and Firefighting Contractor shall include the following for the interface to Building Automation System and no additional cost shall be paid for providing the interface feasibility.

- Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for those equipment whose start / stop is controlled by Building Automation System.
- Potential free 'NO' contacts for monitoring 'Run' status of equipment wherever required.

- Necessary contactor with potential free contacts and Stop/Manual/ Auto switches to be provided for all equipment wherever the starter is not provided and which requires starting / stopping through Building Automation System.
- Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.
- The space provision in all the equipment panel (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing and Firefighting contractor. Separate current transformers shall be provided by Plumbing and Firefighting contractor for monitoring current / KWH (wherever required) through BAS.
- The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing and Firefighting contractor. All transducers shall be supplied by BAS contractor.

- The low voltage BAS Cables shall be brought upto the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing and Firefighting contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Plumbing and Firefighting system, lies solely with the contractor.
- All necessary Hardware/ Software shall be made available by the Plumbing and Firefighting Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS

TESTING, ADJUSTING ANDBALANCING

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner’s site representative. All tests shall be carried out in the presence of the representatives of the Architect / Consultant and Owner’s site representative.

COMPLETION CERTIFICATE

On completion of the installation, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire installation duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

AS-BUILT DRAWINGS

Contractor shall submit following as-built drawings as and when work is completed:

- Six set of hard copies of all as-built drawings duly corrected and incorporating any modifications during execution.
- Two set of pen drive containing the drawings.
- Position of all sanitary fixtures.
- Runs of all water lines with diameters on all floors and vertical risers / drops.
- Runs of all soil, waste, vent & rain water piping with diameters on all floors and vertical stacks.
- Position and sizes of all type of control valves and all other plant and equipment.
- Position of cleaning eye / access doors and opening panels in soil/waste disposal system.
- Original installation and Maintenance manual of all types of equipment.
- Location of all mechanical equipment with layout and piping connections.

MAINTENANCE MANUAL

Upon completion and commissioning of works, the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and PMC's site representative and two for Clients Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment. The manuals shall include

- Description of the work carried out / installed.
- Operating instructions.
- Maintenance instructions including procedures for preventive maintenance.
- Manufacturers catalogues.
- Spare parts list.
- Trouble shooting charts.
- Drawings
- Type and routine test certificates of major items.

Details of all the bought out item should be part of this maintenance manual.

ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for such periods so as to enable the Client's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Client's personnel in the operation, adjustment and maintenance of all equipment installed.

DEFECTS LIABILITY PERIOD

Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Client.

UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall and no reimbursement shall be made for the extended period.

PART LIST OF CODES & STANDARDS

LIST OF BUREAU OF INDIAN STANDARDS AND OTHER INTERNATIONAL CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below. All equipment and material being supplied by the contractor shall meet the requirements of IS and other specified.

Tariff advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1.	**Pipes and Fittings**	
	IS 15905	Centrifugally Cast Iron Hub less pipes & fittings.
	IS:13592	PVC Pipes
	IS:15778	c-PVC SDR 11 Internal Water Supply pipe
	IS 8329 & IS 9523	Ductile iron K-7 & K-9 for External water supply
	IS:458:2003	NP3 Pipe
	IS:4736	Gi pipe
2.	**Valves**	
	IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
	IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
	IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
	IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
	IS : 3950	Specification for surface boxes for sluice valves.
	IS : 5312 (Part 1)	Specification for swing check type reflux (non-return) valves: part 2 Multi door pattern.
	IS : 5312 (Part 2)	Specification for swing check type reflux (non-

		return) valves: part 2 Multi door pattern.
	IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
	IS : 13095	Butterfly valves for general purposes.
3.	**Sanitary Fittings**	
	IS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.
	IS : 774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)
	IS : 775	Specification for cast iron brackets and supports for wash basins and sinks
	IS : 781	Specification for cast copper alloy screw down bib taps and stops valves for water services.
	IS : 1700	Specification for drinking fountains.
	IS : 2548 (Part 2)	Specification for plastic seats and covers for water closets: Part 1 Thermo set seats and covers.
	IS : 2556 (Part 1)	Specification for vitreous sanitary appliances (Vitreous china) : Part 1 General requirement.
	IS : 2556 (Part 2)	Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water closets.
	IS : 2556 (Part 3)	Specification for vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pans.
	IS : 2556 (Part 4)	Specification for vitreous sanitary appliances (vitreous china): part 4 specific requirements of wash basins.
	IS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china): part 6 Specific requirements of urinals, section 2 half stall urinals.
	IS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china): Part 6 specific requirements of urinals, section 4 partition slabs.
	IS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 5 waste fittings.
	IS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
	IS : 2556 (Part 7)	Specification for vitreous sanitary appliances (vitreous china): Part 7 Specific requirements of half round channels.
	IS : 2556 (Part 8)	Specification for vitreous sanitary appliances (vitreous china): Part 8 Specific requirements of siphoning wash down water closets.
	IS : 2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china): Part 11 Specific requirements for shower rose.
	IS : 2556 (Part 12)	Specification for vitreous sanitary appliances

		(vitreous china): Part 12 Specific requirements of floor traps.
	IS : 2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china) : Part
		15 Specific requirements of universal water closets.
	IS : 2692	Specification for ferrule for water services
	IS : 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
	IS : 2963	Specifications for waste plug and its accessories for sinks and wash basins.
	IS : 3311	Specification for waste plug and its accessories for sinks and wash basins.
	IS : 5961	Specification for cast iron gratings for drainage purposes.
	IS : 6249	Specification for gel-coated glass fiber reinforced polyester resin bath tubs.
	IS : 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubes.
	IS : 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
	IS : 9758	Specification for flush valves and fitting for water closets and urinals.
4.	**Water Quality To lerance**	
	IS : 3025 (Parts 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water.
	IS : 4764	Tolerance limits for sewage effluents discharged into inland surface waters.
	IS : 10500	Drinking Water
5.	**Pumps & Vessels**	
	IS : 1520	Specification for horizontal centrifugal pumps for clear cold fresh water.
	IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers.
	IS : 2825	Code for unfired pressure vessels.
	IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1: Rubber lining.
	IS : 5600	Specification for sewage and drainage pumps
	IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
	IS : 8418	Specification for horizontal centrifugal self-priming pumps.
6.	**General**	
	National Building Code of India 2005 Part IV and Part IX	
	Uniform Plumbing Code of India 2008	
	SP : 6 (1)	Structural Steel Sections
	IS : 325	Three Phase Induction Motors

	IS: 456	Code of practice for plain and reinforced concrete (3rd rev.) (Amendment 2)
	IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
	IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
	IS : 779	Specification for water meters (domestic type).
	IS : 782	Specification for caulking load.
	IS : 800	Code of practice for general construction in steel
	IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
	IS : 1172	Code of Basic requirements for water supply drainage and sanitation
	IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.
	IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
	IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables : Part 1 for working voltages up to and including 1100 V.
	IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV up to and including 11 KV.
	IS : 1726	Specification for cast iron manhole covers and frames.
	IS : 1742	Code of practice for building drainage.
	IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
	IS : 2065	Code of practice for water supply in buildings.
	IS : 2104	Specification for water meter for boxes (domestic type)
	IS : 2373	Specification for eater meter (bulk type)
	IS : 2379	Color code for identification of pipe lines.
	IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
	IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
	IS : 3114	Code of practice for laying of cast iron pipes
	IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system: Part 1 manholes.
	IS : 4127	Code of practice for laying glazed stoneware pipes.
	IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
	IS : 5455	Cast iron steps for manholes.
	IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
	IS : 7558	Code of practice for domestic hot water installations.
	IS : 8321	Glossary of terms applicable to plumbing work.
	IS : 8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filtration medium sand and gravel.
	IS : 8419 (Part 2)	Requirements for water filtration equipment: Part 2

		under drainage system.
	IS : 9668	Code of practice for provision and maintenance of water supplies and firefighting.
	IS : 9842	Preformed fibrous pipe insulation.
	IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
	IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
	IS : 10446	Glossary of terms relating to water supply and sanitation.
	IS : 11149	Rubber Gaskets
	IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
	IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings: Part 1 water supply.
	IS : 12251	Code of practice for drainage of building basements.
	IS : 5572	Code of practice for sanitary pipe work.
	BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
	BS : 8301	Code of practice for building drainage.
	BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.

SUMMARY OF PLUMBING SPECIFICATIONS

S NO.	ITEMS OF WORK	SPECIFICATIONS
1	Water supply &Sanitary Installation for attached Toilets	1 a) White vitreous china, 580x440 mm Orissa pattern Indian WC
		1 b) EWC with twin flush of capacity 10 litre low level Vitreous china flushing cistern of approved quality as approved make and model.
		2. White vitreous china flat back wash basin with pedestal of basin size 550x410 with single 15mm CP brass long neck pillar tap or equivalent quality as per approved make and model.
		3. CP brass fittings for faucets (low flow), angle valve, concealed valve, pillar cock, waste coupling, bottle trap CP/PVC, CP brass soap dish holder, shower rose / arm as per the Architectural drawings/approved services drawings.
		4. Necessary provision for Gyser with two angle valves.
		5. CP brass towel rail of 600 mm long as per approved make.
		6. CP Brass single lever diverter of bath spout, shower rose and hand shower all .
		7. Corner Glass Shelf for shampoo bottles, Looking mirror of minimum size 750x450mm with Decorative rigid PVC molded beadings and CP brass towel ring near wash basin as per the Architectural drawings/ approved services drawings.
		8. Health faucets as per approved make and model
		9. CP brass/ Stainless steel toilet paper holder with CP flange,
2	Kitchen Fixtures	10) SS Kitchen Sink with drain board of 304 grade of size not less than 510x1040, minimum 250mm bowl depth with drain board as per architectural drawings.
3	Internal Water supply pipes	Chlorinated Polyvinyl Chloride (CPVC sdr 11 IS: 15778) pipes, having thermal stability for cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing all as per the approved services drawings. CPVC sdr 11 IS: 15778 pipes for hot water supply diameter od pipe is as per design and specifications as per

S NO.	ITEMS OF WORK	SPECIFICATIONS
		CPWD specifications 2019.
	Internal Water supply pipes	Pipes Exposed: diameter as per approved design and specification. Galvanised Iron & Ductile iron pipes as per approved plumbing drawing as per CPWD Specifications/approved services drawings.
4	Soil & waste pipes and fittings	Soil waste and vent Hubless Centrifugally Cast (Spun) Iron Pipes and Fittings soil, waste and ventilating pipes, fittings and accessories shall conform to IS 15905. including testing of joints as per approved design and as per the Architectural drawings/approved services drawings.
5	Manhole	Brick masonry in cement mortar 1:4 with common burnt clay FPS (Non-modular) Brick confirming to IS: 12894 of class designation 7.5 with SFRC light duty cover at top at required locations as per approved services drawings.
6	Pipe between building manhole& service manhole	Np3 pipe of required size or as approved by Engineer- in- charge along with providing gully trap – as per CPWD Specifications/approved services drawings.
7	Drainage	Diameter as per approved design NP3 class RCC pipes and brick masonry manholes for disposal of sewage including testing of joints as per approved design and as per the Architectural drawings/ approved services drawings
8	Overhead terrace tank	RCC Water storage tank for domestic usage / drinking /flushing tank capacity as per consultant drawing and separate firefighting tank capacity 20kl having suitable size as per NBC 2016 to be provided on terrace. Gun metal Control valve – each tank. Tanks to have CI Doors on top for access to tanks. Betonies based expandable water bar of size 15mmx20mm shall be provided at every construction joint. Water proofing inside the tanks with Brush bond RFX of M/s FOSROC of thickness not less than 1.5mm followed by 12mm plaster of CM 1:3 neat cement finished. Application of Anti- Fungal paints: Food Grade Epoxy paint over a coat of compatible primer on the finished inner surfaces of the tank to avoid fungal growth on walls.
		Brick masonry Manholes & Gully trap of required dia. as per depth in cement mortar 1:4 (1 cement: 4 with foundation concrete 1:3:6 (1 cement: 3 coarse sand: 6 aggregate 20 mm nominal size stone aggregate) with inside plaster 1:4 (1 cement: 4 coarse sand) with

S NO.	ITEMS OF WORK	SPECIFICATIONS
9	Manholes & Gully trap	floating coat of neat cement, outside cement plaster 1:4 (1 cement: 4 coarse sand) with SFRC cover 30 ton load capacity at top. In sub-soil or adverse soil conditions, manholes & Gully trap shall be as per approved structural design (to be given by the contactor) to avoid sinking and settlement of lines/manholes. The channels to require shape, size and slope in cement concrete 1:1.5:3 finished with neat cement punning shall also be provided inside the manhole. Manholes, Gully trap pipe line connected to nearest external seaware line/ STP as per direction of Engineer-in- Charge/approved services drawings
10	Foot rest	Orange color safety foot rest of minimum 16mm thick plastic encapsulated complete as per IS: 10910 at required spacing as per CPWD specifications to be provided in UG sump, terrace water tanks, Deep Manholes.
11	Storm water drains	RCC Grade M-30 storm water drains of size as per design and covered with perforated RCC cover slabs (with angle iron edge protection) to withstand the traffic load) as per the services drawings to be submitted by contractor and approved by Engineer-in-charge.

BASIS OF DESIGN

The Plumbing, External Drainage and water supply System for the project is designed keeping in view the following:

Requirement of adequate and equal pressure availability of hot and cold water lines in Toilets, Kitchen and other identified areas.

Adequate storage of water in underground + overhead water tanks.

Levels of roads / pavements and other services in the area.

Landscape layout.

The execution of works and materials used shall be as per the latest relevant I.S. specifications. Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

CONCEPT OF THE SYSTEM

The following services are envisaged for the complex:

It is understood that supply of water to this complex is potable as per IS:10500.

Domestic/Flushing water supply through Hydro pneumatic system.

Sewage and Silage collection system based on IS:1742 and applicable standards fordomestic drainage and connected to existing sump.

Storm / Rain water drainage system from various levels of the building and disposal to Rain Water Harvesting System / storm water drain and connected to existing drain.

WATER STORAGE & DISTRIBUTION SYSTEM

Water Requirement
The water requirement for this project is proposed to be as per the provisions in IS : 1172 andprevalent practices.

Source of Water

It is expected that part of the daily domestic water requirement shall be through central mainssupply.

Following components shall be included in the water supply system for efficient functioning:

i. Automatic air vent
ii. Pressure Gauge.
iii. Water Hammer arrestors.

WORKMANSHIP

The workmanship shall be best of its kind and shall confirm to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the engineer-in-charge. All materials and/or workmanship which in the opinion of the engineer-in-charge are defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

MATERIALS

All materials shall be best of their kind and shall confirm to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the engineer-in- charge. As and when required by the engineer-in-charge, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If aftertests any materials, work or portions or work are found defective or unsound by the engineer-in- charge, the contractor shall remove the defective material from the site, pull down and re-executethe works at his own cost to the satisfaction of the engineer-in-charge. To prove that the materialsused are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

GENERAL INSTRUCTIONS

Scope of Work

The form of Contract shall be according to the “Conditions of Contract”. The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in specification or shown on the Plumbing Drawings.

Without restricting to the generally of the foregoing, the sanitary installations shall include the following:

a) Plumbing Works
b) Sanitary ware Installation
c) Water Supply System (Hot & Cold).
d) Ro plant
e) Solar water heater
f) Hydro pneumatic pump
g) Sewerage & Storm water drainage system.
h) STP. & ETP.
i) Garden Irrigation System.
j) High side works.

Services rendered under this section shall be done without any extra charge.

Specifications

Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with up to date amendments as applicable in the contract and or as per the instruction of the engineer-in-charge.

Works not covered shall be carried out as per relevant Indian Standards and in case of its absence as per Code of Practice.

Execution of Work

The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural and Other specialized services drawings.

The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in

advance to prevent hold up of progress of the construction schedule.

On award of the work, Contractor shall submit a schedule of construction in the form of a PERT Chart or BAR Chart for approval of the engineer-in-charge. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

Drawings

Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

Contractor shall verify all dimensions at site and bring to the notice of the engineer-in-charge all discrepancies or deviations noticed. Decision of the E.IN.C. shall be final.

Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

All drawings issued by the EPC Contractor for the work are the property of the EPC Contractor and shall not be lent, reproduced or used on any works other than intended without the written permission of the EPC Contractor.

Inspection and Testing of Materials

Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

a) Theodolite, Steel tapes
b) Dumpy level
c) Weighing machine
d) Plumb bobs, Spirit levels, Hammers
e) Micrometers, Tachometers
f) Thermometers, Stoves
g) Hydraulic test machine
h) Smoke test machine

All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.

All Testing Equipment shall be preferably located in a special room meant for the purpose.

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the engineer-in-charge or kept at site in a sample room. Any materials declared defective by engineer-in-charge shall be removed from the site within 48 hours.

Metric Conversion
All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

Reference Points
Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

Reference Drawings
The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All-important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled. And one set of drawing should be laminated kept in custody contractor.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the E.IN C.or Architects.

Shop Drawings

The Contractor shall submit to the engineer-in-charge three copies of the shop drawings.

Shop drawings shall be submitted under following conditions:-

(a) Showing any changes in layout in the plumbing drawings
(b) Equipment layout, piping and wiring diagram.
(c) Manufacturer's or Contractor's fabrication drawings for any materials or equipmentsupplied by him.

The Contractor shall submit two copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the engineer-in-charge.

Completion Drawings
On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the E.IN.C. Which were taken from contractor these drawings shall have the following information.

a). Run of all piping, diameters on all floors, vertical stacks and location of external services.

b). Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.

c). Run of all water supply lines with diameters, locations of control valves, access panels.

d). Location of all mechanical equipment with layout and piping connections.

Completion certificate shall not be issued until and unless the above drawings are submitted.

Contractor shall provide two sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

All "Warranty Cards" given by the manufacturers shall be handed over to the engineer-in-charge.

Contractors Rates

Rates quoted in this tender shall be inclusive of cost of materials, labour, supervision, erection, tools, plant, scaffolding, service connections, transport to site, taxes, octree and levies, breakage, wastage and all such expenses as may be necessary and required to completely do all the items of work and put them in a working condition.

Rates quoted are for all heights and depths and in all positions as may be required for this work.

All rates quoted must be for complete items inclusive of all such accessories, Fixtures

and fixing arrangements, nuts, bolts, hangers as are a standard part of the particular item exceptwhere specially mentioned otherwise.

All rates quoted are inclusive of cutting holes and chases in walls and floors and making good the same with cement mortar/concrete/water proofing of appropriate mix and strength as directed by Project Manager. Contractor shall provide holes, sleeves and recesses in the concrete and masonry work as the work proceeds.

The Contractor shall furnish the engineer-in-charge with vouchers and test certificates, on request, to prove that the materials as specified and to indicate that the rates at which the materials are purchased in order to work out the rate analysis of non tendered items which he may be called upon to be carried out.

Testing

Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications

Field tests shall be performed in the presence of the engineer-in-charge.

All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

Contractor shall provide all labour, equipment and materials for the performance of the

tests.

Site Clearance and Cleanup
The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

License Permits and Authorities
Contractor must keep constant liaison with the Municipal/statutory authority and obtain all approval of all drainage, water supply and other works carried out by him.

Cutting of Water Proofing Membrane
No walls, terraces shall be cut for making and opening after water proofing has been done withoutwritten approval of engineer-in-charge. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by engineer-in-charge.

Materials
Unless otherwise specified and expressly approved in writing by the engineer-in-charge, only materials of makes and specifications approved by Engineer-in-Charge with the specifications shall be used.

If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the E.INC. and returned to the Contractor at the appropriate time.

SANITARY FIXTURES
Work under this section shall consist of furnishing all material and labour as necessary and required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings.

Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.

Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

GENERAL REQUIREMENTS
All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned, specifications, drawings or not.

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural/interior designers requirements. Wherever necessary the fittings shall centered to dimensions and pattern desired.

Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of engineer-in-charge.

All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at contractors cost.

When directed, contractor shall install fixtures and accessories in a mock-up room for the approval of the Architect. Sample room fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

INDIAN W.C.

Indian W.C. pan shall be Orissa pattern of size as specified in the schedule of quantities. Each W.C. shall be provided with a 100mm dia cast iron or porcelain long arm P or S trap with or without vent horn.

W.C. shall be flushed by means of a low level cistern of polyethylene body complete with accessories on an exposed or concealed type flush valve or as specified in bill of quantities.

The W.C. shall be fixed in level in a neat workmanlike manner. The W.C. and trap shall be set in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). Joints between W.C. and flush pipe shall be made with lead and linseed oil and caulked well or with an approved rubber joint.

WASH BASIN

Built-in basin, oval, size Oval shape 450x350 mm (outer dimensions), glazed inside and outside, white, without tap hole, with overflow, including fixing set and overflow set. Auto self-closing pillar cock for Wash Basin.

Accessories

Bottle trap:	As per approved design
Drain valve :	As per approved design
Tap fitting information:- optimum	Tap fittings with a vertical outlet and aerator provide the flow of water onto the surface below (angle of impact: 90°). Optimum point of impact approx. 100 – 125mm from rear edge of basin.

EUROPEAN W.C.

European W.C. shall be wash down, single or double siphonic type, floor or wall mounted set, flushed by means of porcelain low level flushing cistern, or an exposed or concealed type flush valve, as specified in schedule of quantities. Flush pipe/bend shall be connected to the W.C. by means of suitable rubber adapter. Wall hung w.c. shall be

supported by C.I. floor mounted chair.

Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

URINALS

Urinals shall be lipid type half shall white glazed vitreous China of approx. size 630x420x380mm size or as specified in bill of quantities.

Half stall Urinals shall be provided with 15mm dia C.P. spreader, 32mm dia C.P domical waste and C.P. cast brass bottle trap with pipe and wall flange, and shall be fixed to wall by one C.I. bracket and two C.I. wall clips as recommended by manufacturers complete as directed by E.IN C.

Half stall urinals shall be fixed with C.P. brass screws and shall be provided with 32mm dia domical waste leading to urinals trap.

Urinals shall be flushed by means of automatic porcelain flushing cistern or exposed or concealed type urinal flush valve, as specified in schedule of quantities.

Flushing cistern for urinals shall be automatic type vitreous china as given in the schedule of quantities. Each flushing cistern shall have a copper siphon and inlet noose cock to control the flow. Flushing cistern shall be fixed to wall with R.S. or C.I. brackets. Cast iron cistern and brackets shall be painted with two coats of white enamel paint. Cistern may be concealed in pipe shafts or false ceilings where required as directed by E.IN C.

Flush pipes of flushing cistern with sizes of main and branch flush pipes shall be as follows:

No. of Urinals	Capacity of cistern			Size of main flush	branch	Size of Connection to urnial
in range		litres	pipe		flush pipe	
One		5		--	--	15
Two		10		20	--	15
Three		10		25	--	15

Alternatively, urinals may be flush with flush valves, exposed or concealed type.

Waste pipes for urinals shall be any one of the following:

Rigid P.V.C.

Lead pipes.

Waste pipes may be exposed on wall or concealed in chase as directed by the engineer-in- charge. Specifications for waste pipes shall be same as given in sub-section 8.0 to 10.0 section-II of Volume-II.

LAVATORY BASIN

Lavatory basins shall be white glazed vitreous chine or poly marble of size, shape and

type specified in the drawing or as decided by engineer-in-charge with pillar cock.

Each basin shall be provided with R.S. or C.I. brackets and clips and the basin securely fixed to wall. Placing of basins over the brackets without secure fixing shall not be accepted.

Each basin shall be provided with 32mm dia C.P. waste with overflow, pop-up waste or rubber plug and chain as given in the bill of quantities, 32mm dia C.P. Brass bottle trap with C.P. pipe to wall and flange.

Each basin shall be provided with fittings or mixing fitting as specified in the bill of quantities.

Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms above the floor or as directed by E IN C.

SINKS
Sinks shall be of precast Terrazzo marble, or white glazed fireclay or vitreous china or stainless steel or any other material as specified in the schedule of quantities with pillar cock.

Each sink shall be provided with R.S. or C.I. brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 40mm dia C.P. waste with chain and plug or P.V.C. waste. Fixing shall be done as directed by Architect. Supply fittings for sinks shall be mixing fittings or C.P. taps as specified in the bill of quantities.

MIRRORS
Mirrors shall be electro coated copper 5.5mm thick of guaranteed reputed make. The size shall be as specified in the quantities or shown on the drawings. The image shall be clear and without waviness at all angles of vision.

Mirrors shall be provided with backing of 12mm thick marine plywood sheet fixed with C.P. brass semi-round headed screws and cup washers or C.P. brass clamps as specified or instructed by E.IN.C.

SHOWER SET
Shower set shall comprise of one/two C.P. Brass concealed stop cocks with two long body brass/C.P. brass bib cock, or bath spout or as given in the bill of quantities.

Each shower set shall also be provided with C.P. Shower arm with wall flange and shower head of approved quality as specified in the bill of quantities.

Concealed stop cocks shall be so fixed as to keep the wall flange clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

ACCESSORIES
Contractor shall install all chromium plated and porcelain accessories as shown on the drawings or directed by E. IN C.

All C.P. accessories shall be fixed with C.P. brass half round head screws and cup

washers in wall with raw plugs or nylon sleeves and shall include cutting and making good as required or directed by E.IN.C..

Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work.

URINAL PARTITIONS

Urinal partitions shall be white glazed vitreous china or granite of size as per approved drawing or as decided by engineer-in-charge.

HUBLESS CENTRIFUGALLY CAST (SPUN) IRON PIPES AND FITTINGSSOIL, WASTE, VENT PIPES & FITTINGS

Hubless Centrifugally Cast (Spun) Iron Pipes and Fittings soil, waste and ventilating pipes, fittings and accessories shall conform to IS 1590

The hubless centrifugally cast (spun) iron pipes shall have plain both ends (spigot type), without sockets. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and shall be free from cracks, taps, pinholes and other imperfections and shall be neatly dressed and carefully fettled. All pipes and fittings shall emit a clear ringing sound when struck with a light hand hammer.

The ends of pipes and fittings shall be reasonably square to their axis. The hubless centrifugally cast iron pipes shall be 3.0 metre or more in length.

All pipes and fittings shall be coated internally and externally with the epoxy coating material at the factory, the fitting being preheated prior to total immersion in a bath containing a uniformly heated composition. The coating material shall have good adherence and shall not scale off.

The tolerance in diameter of pipes shall be as prescribed in Table

Table
External Diameters and Tolerances

Sl. No.	Nominal size DN (in mm)	External Diameter DE (in mm)	Tolerance on External diameter DE (in mm)
(1)	(2)	(3)	(4)
1	50	58	+2 -2
2	75	83	+2 -2
3	100	110	+2 -2
4	150	160	+2 -2
5	200	210	+2.5 -2.5

The thickness of fittings and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The nominal & minimum thicknesses of pipes & fittings shall be as per Table-2.

Table
Nominal & Minimum Thickness of Pipes & Fittings

Sl. No.	Nominal size DN (in mm)	Thickness 'e' mm Pipe			
		Pipe		Fittings	
		Nominal	Minimum	Nominal	Minimum
(1)	(2)	(3)	(4)	(5)	(6)
i	50	3.5	3.0	4.2	3.0
ii	75	3.5	3.0	4.2	3.0
iii	100	3.5	3.0	4.2	3.0
iv	150	4.0	3.5	5.3	3.5
v	200	5.0	4.0	6.0	4.0

The access door fittings shall have no dead spaces in which filth may accumulate. Doors shall be provided with 3 mm rubber insertion packing and when closed and bolted, these shall be watertight.

Joints
The pipes and fittings may assembled using various types of joints, The joints are intrinsic components of the drainage, whose characteristics and tolerances shall be specified in the manufactures catalogues.

Taking into account the different applications of cast iron pipe work systems, various joint designs arepermitted provided that they satisfy the requirement to this standard. The joints shall incorporate one or more EPDM rubber gasket(s) to ensure leak tightness and prevent direct contact between the ends of pipes, fittings and accessories.

Materials for coupling of clamping components shall usually be made from:

(a) Ductile iron of grade 500/7 as per IS 1865,

or

(b) Stainless steels in accordance with IS 1570 (Part 5) in order to ensure resistance to corrosion and a stabilization against the austenitic stainless steel with at least 17 percent chrome and 9 percent nickel of equivalent, or from material of comparable resistance.

(c) Ductile iron couplings of clamping components shall be coated internally and externally.

(d) All parts of the joints shall free from defects likely to compromise their suitability for

use.

Floor Traps & Urinal Traps
Floor traps shall be PVC, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 Cement: 2 Coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor levels. Contractor shall provide all necessary shuttering and centering for the block. Size of the block shall be 30 x 30 cms of the required depth.

Waste Pipe from Appliances
Waste pipe from appliances e.g. washbasins, sinks, urinals shall be of galvanized steel in toilets, kitchens, pantries and service areas where so required, and as given in the Schedule of Quantities or as shown on the drawings.

All pipes shall be fixed in gradient towards the connection to stack or drains. Pipes inside all toilets room shall be in chase unless otherwise shown on drawings. Where so required and shown on drawings or directed by the engineer-in-charge.

(a) UPVC Pipes (Where specified or required at site for sump drainage only)
Pipes shall UPVC Pipes SWR grade conforming to IS:13592 and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, Plugs. All UPVC. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

Rain water Pipes
All open terraces shall be drained by rain water down takes. Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground storm water drainage system of the campus. Rainwater in open courtyards shall be collected in catch basins and connected to the storm water drains. Any dry weather flow from waste appliances e.g. AHU’s, parking and Drainage Sumps shall connected to the Storm Water Network will be connected to the rain water harvesting pits.

Upvc Rain water Fittings
Pipes shall be uPVC confirming to IS: 4985-2000 (quick fit type) and quality certificates shall be furnished as required. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, and Plugs. All waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

Rain Drainage under floor/above floor (service floors, basement ceiling etc.)

All rain water drainage lines passing under building, in exposed position above ground e.g. service floors, basement ceiling etc. shall be Multilayered as per details given in sub-clause 3.10 shall be as per details given below. Position of such pipes shall generally be shown on the drawings.

CUTTING HOLES IN WALL UPTO 30 × 30 CM
Square holes of size as specified or as directed by the Engineer-in-Charge shall be cut

in the masonry. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-in-Charge. All dismantled material shall be removed from the site..

Masonry Work
Brick work etc. shall be made good by using the same class of brick, tile or stone masonry as was cut during the execution of work. The mortar to be used shall be cement mortar 1:4 (1 cement: 4 fine sand) or as directed by the Engineer-in-Charge.

Finishing
Cement mortar in 1:4 mix (1 cement: 4 sand) shall be used for plastering or pointing, as may be required. Sand shall be fine or coarse, as used in the original work. The surface shall be finished with two or more coats of white wash, colour wash, distemper or painting as required but where the surface is not to be white washed, colour washed, distempered or painted; it shall be finished smooth with a floating coat of neat cement or as required to match with the surrounding surfaces.

CUTTING HOLES IN R.C.C. FLOORS (UPTO 15 × 15 CM)
Square holes of size as specified shall be cut in R.C.C. floor and roofs for passing drain pipe etc. Any damage to the adjoining portion or to any other item shall be made good as directed by the Engineer-in-Charge. All the dismantled material shall be removed from the site.

Cement Concrete
After insertion of drain pipe etc. the hole shall be repaired with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) and the surface finished to match with the existing surface. The top and bottom shall be finished properly to make the joint leak proof. The specifications for cement concrete work and finishing etc. shall be the same as detailed under relevant sub-heads.

WATER SUPPLY SYSTEM

Scope of Work
Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

Without restricting to the generality of the foregoing, the water supply system shall include the following:-

- Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
- Cold water supply lines from tube-wells and city water connections to fire and underground water tanks.
- Municipal water and Bore-well connections to U.G. water tanks.
- Garden Irrigation system
- Excavation and refilling of pipes trenches.
- Pipe protection and painting.
- Control valves, masonry chambers and other appurtenances.
- Connections to all plumbing fixtures, tanks, appliances and Municipal mains
- Inserts for RCC tank.

General Requirements
All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

Short or Long bends shall be used on all main pipe lines as far as possible. Use of Elbows shall be restricted for short connections.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.

Valves and other appurtenances shall be so located as to provide easy accessibility for

Operations, maintenance and repairs
Contractor should study the site plan and water supply system diagram for an overview of the system.
Source Water supply will be acquired from water mains to a service connection within the site and collected in water storage tanks located in basement.

Ball Valve (Brass)
The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 he ball valve shall be of following two classes:

High Pressure:
High pressure float valves are indicated by the abbreviation ‘HP’ and are designed for use on mains having pressure of 0.175 MPa or above.

Low Pressure
Low Pressure float valves are indicated by the abbreviation ‘LP’ and are designed for use on mains having a pressure up to. 0.175 MPa.

Bib Taps and Stop Valve
A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clock wise direction.

Gate Valve - Gun Metal
These shall be of the gun metal fitted with wheel and shall be of gate valve type opening full way and of the size as specified. These shall generally conform to IS 778

Butterfly Valves – Slim Seal Type
Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle. Butterfly valve shall be of best quality conforming to IS: 13095.

Non Return Valve (Dual Slim Type)
Where specified, non return valve shall be provided through which flow shall occur in one direction only. Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of nuts, bolts and washers of correct length.

Water Meter
Water meters shall be selected according to flow to be measured and not necessarily to suit a certain size of main. The following points shall govern the selection of meters:

a. The maximum flow shall not exceed the nominal capacity of the meter.
b. The continuous flow shall be not greater than the continuous running capacity rating.
c. The minimum flow to be measured shall be within minimum starting flows.

Inferential water meter has the same accuracy as the semi -positive type at higher flows; it passes unfiltered water better than a semi-positive meter and is lower in cost.

Special care is necessary in selecting the most suitable meter where large rates of flow may exist for short periods. The normal working flow shall be well within the continuous running capacity specified in IS 779, as high rates of flow over short period may cause excessive wear if the meter chosen is too small for the duty

Owing to the fine clearances in the working parts of meters, they are not suitable for measuring water containing sand or similar foreign matter, and in such cases a filter or dirt box of adequate effective area shall be fitted on the upstream side of the meter. It shall be noted that the normal strainer fitted inside a meter is not a filter and does not prevent the entry of small particles, such as sand

Water meters and their parts, especially parts coming in continuous contact with water shall be made of materials resistant to corrosion and shall be non -toxic and non-training. Use of dissimilar metals in contact under water shall be avoided as for possible in order to minimise electrolytic corrosion.

Strainers
Strainers shall be provided at pump room section pipe. Strainers shall be of a material which is not susceptible to electrolytic corrosion. They shall be of plastics or other corrosion-resistant materials for both Type A and Type B meters. They shall be rigid, easy to remove and clean, and shall be fitted on the inlet side of the water meter. It shall be possible to remove and clean the strainer in such a way as not to permit disturbing the registration box or tampering with it. The strainer shall have a total area of holes not

less than twice the area of the nominal inlet bore of the pipe to which the meter is connected however, in the case of meters provided with internal strainer involving opening
of the registration box for cleaning, an additional external strainer shall be fitted on the inlet side satisfying the above requirements.

Hydrostatic Tests

After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests:

a. Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.
b. Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for duration of two hours.

CP BRASS BIB COCK
The CP brass bib cock shall be conforming to IS : 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the bib cocks are normally fitted. The dimensions of body for Bib Cock shall be as per table given to IS : 8931. Each bib cock shall be legibly marked with the Manufacture's name and trade mark.

CP BRASS LONG NOSE BIB COCK
The CP brass long nose bib cock shall be conforming to IS standards. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the bib cocks are normally fitted. The weight of long nose Bib Cock shall be less than 810 grams. Each bib cock shall be legibly marked with the Manufacture's name and trade mark.

CP BRASS LONG BODY BIB COCK
The CP brass long body bib cock shall be conforming to IS standards. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the long body bib cocks are normally fitted. The weight of long body Bib Cock shall be less than 690 grams. Each bib cock shall be legibly marked with the Manufacture's name and trade mark.

CP BRASS STOP COCK (CONCEALED)
The CP brass stop cock shall be conforming to IS : 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the stop cocks are normally fitted. The dimensions of body for stop Cock shall be as per table given to IS : 8931. Each stop cock shall be legibly marked with the Manufacture's name and trade mark.

CP BRASS ANGLE VALVE
A valve with the inlet and outlet at right angles to each other and is intended to facilitate servicing of water fittings or appliances. The CP brass angle valve shall be conforming

to IS: 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the angle valves are normally fitted. The dimensions of body for angle valve shall be as per table given to IS: 8931. Each angle valve shall be legibly marked with the Manufacture's name and trade mark.

CP BRASS EXTENSION NIPPLE

The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The size of CP brass extension nipple shall be 15mm x 50mm.

CHROME PLATED BRASS BATTERY BASED INFRARED SENSOR OPERATED PILLAR COCK

The chrome plated brass battery based infrared sensor operated pillar cock shall be of chromium plated copper alloy and external and internal surface shall be clean, smooth and free from sand. The 15 mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the chrome plated brass battery based infrared sensor operated pillar cock are normally fitted. Each chrome plated brass battery based infrared sensor operated pillar cock shall be legibly marked with the manufacture's name and trade mark. Chrome plated brass battery based infrared sensor operated pillar cock shall be enumerated and rate shall include the cost of material and labour involved in fixing the same.

CPVC WATER SUPPLY PIPE

Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply pipe use for internal and external water supply below 80 mm dia

INSTALLATION

A. Visually inspect pipe ends before making the joint. Use of a chamfering tool will help identify and crakes, as it will catch on to any crack
B. Pipe may be cut quickly and efficiently by several methods. Wheel type plastic tubing cutters are preferred. Ratchet type cutter or fine tooth saw are another options. However, when using the ratchet cutter be certain to score the exterior wall by rotating the cutter blade in circular motion around the pipe. Do this before applying significant downward pressure to finalize the cut. This step leads to a square cut. In addition, make sure ratchet cutter blades are sharp. Cutting tubing as squarely as possible provides optimal bonding area within a joint.
C. Burrs and filings can prevent proper contact between the tube and fittings during the assembly, and should be removed from the outside and inside of the tube. A chamfering tool is preferred, but a pocket knife or file is also suitable for this purpose.
D. Use only CPVC cement jointing. Use CPVC cement, which is fully recommended by the manufacturer.
E. When using adhesive solution/solvent cement be certain of proper ventilation.
F. When making a join, apply a heavy, even coat of cement to the pipe end. Use the same
applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged waterways. Do not allow excess cement to puddle in the fitting and pipe assembly. This could result in a weakening of the

pipe wall and possible pipe failure when the system is pressurized.

G. Rotate pipe one-quarter to one-half turn while inserting it into the fitting socket and remove the excess adhesive solution/solvent cement from the joint with clean rag.
H. When making a transition connection to metal threads, use a special transition fitting or CPVC male threaded adapter whenever possible. Do not over-torque plastic threaded connections. Hand tight plus one-half turn should be adequate.
I. Hang or strap CPVC systems loosely to allow for thermal expansion. Do not use metal straps with sharp edges that might damage the tubing.
J. CPVC stub outs for lavatories, closets and sinks are appropriate. However, on areas where there is a likelihood that movement or impact abuse will occur, metal pipe nipples may be a more appropriate stub-out material. Showerheads, tub spouts and outside still cocks are examples.
K. When connected to a gas water heater, CPVC tubing should not be located within 50 cm of the flue. For water heaters lacking reliable temperature control, this distance may be increased up to 1 m a metal nipple or flexible appliance connector should be utilized. This measure eliminates the potential for damage to plastic piping that might result from excessive radiant heat from the flue.

Galvanized Iron pipe

The pipes (tubes) shall be galvanized mild steel hot finished seamless (HFS) or welded (ERW) HRIW or HFW screwed and socketed conforming to the requirements of IS 1239 Part-I for medium grade. They shall be of the diameter (nominal bore) specified in the description of the item, the sockets shall be designated by the respective nominal bores of the pipes for which they are intended.

Galvanizing shall conform

The zinc coating shall be uniform adherent, reasonably smooth and free from such imperfections as flux, ash and dross inclusions, bare batches, black spots, pimples, lumping runs, rust stains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanized in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the tube.

The dimensions and weights of pipes and sockets and tolerances shall be as prescribed in Appendix ‘C’.

All screwed tubes and sockets shall have pipe threads conforming to the requirements of IS 554. Screwed tubes shall have taper threads while the sockets shall have parallel threads.

All tubes shall withstand a test pressure of 50 Kg/sq.cm without showing defects of any kind.

Fittings: The fittings shall be of mild steel tubular or wrought steel fittings conforming to IS 1239 (Part-2) or as specified. The fittings shall be designated by the respective nominal bores of the pipes for which they are intended.

Nominal bore	Dimension of pipes			Weight of pipe	
	Out diameter		Thickness	Plain end	Screwed end socket
mm	max	min			

	mm	**mm**			
(mm)	(mm)	(mm)	(mm)	(kg/m)	(kg/m)
6	10.6	9.8	2.0	0.404	0.407
8	14.0	13.2	2.3	0.641	0.645
10	17.5	16.7	2.3	0.839	0.845
15	21.8	21.0	2.6	1.21	1.22
20	27.3	26.5	2.6	1.56	1.57
25	34.2	33.3	3.2	2.41	2.43
32	42.9	42.0	3.2	3.10	3.13
40	48.8	47.9	3.2	3.56	3.60
50	60.8	59.7	3.6	5.03	5.10
65	76.6	75.3	3.6	6.42	6.54
80	89.5	88.0	4.0	8.36	8.53
100	115.0	113.1	4.5	12.2	12.50
125	140.8	138.5	4.8	15.90	16.40
150	166.5	163.9	4.8	18.90	19.50

LAYING AND JOINTING OF G.I. PIPES (EXTERNAL WORK)

The specifications described in 18.4 shall apply, as far as applicable.

Trenches

The galvanised iron pipes and fittings shall be laid in trenches. The widths and depths of the trenches for different diameters of the pipes shall be as in Table 18.11.

TABLE

Dia of pipe (mm)	**Width of trench (cm)**	**Depth of trench (cm)**
15 to 50	30	60
65 to 100	45	75

At joints the trench width shall be widened where necessary. The work of excavation and refilling shall be done true to line and gradient in accordance with general specifications for earth work intrenches.

When excavation is done in rock, it shall be cut deep enough to permit the pipes to be laid on a cushion of sand minimum 7.5 cm deep.

Cutting and Threading

Where the pipes have to be out or rethreaded, the ends shall be carefully filed out so that no obstruction to bore is offered. The end of the pipes shall then be carefully threaded conforming to the requirements of IS 554 with pipe dies and tapes in such a manner as will not result in slackness of joints when the two pieces are screwed together. The taps and dies shall be used only for straightening screw threads which have become bent or damaged and shall not be used for turning of the threads so as to make them slack, as the later procedure may not result in a water tight joint. The screw threads of pipes and fitting shall be protected from damage until they are fitted.

Jointing

the pipes shall be cleaned and cleared of all foreign matter before being laid. In jointing the pipes, the inside of the socket and the screwed end of the pipes shall be oiled and

rubbed over. Teflon Tape should be used on threads instead of 'Dhaaga/ Safeda'. The end shall then be screwed in the socket, Tee etc. with the pipe wrench. Care shall be taken that all pipes and fittings are properly jointed so as to make the joints completely water tight and pipes are kept at all times free from dust and dirt during fixing. Burr from the joint shall be removed after screwing. After laying, the open ends of the pipes shall be temporarily plugged to prevent access of water, soil or any other foreign matter.

Thrust Blocks
In case of bigger diameter pipes where the pressure is very high, thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) of adequate size and shape shall be provided on all bends to transmit the hydraulic thrust to the ground, spreading it over a sufficient areas, depending upon the type of soil met with.

Painting
The pipes shall be painted with two coats of anticorrosive bitumastic paint of approved quality.

DI WATER SUPPLY PIPE
Ductile iron pipe is pipe made of ductile cast iron commonly used for domestic water transmission and distribution

Push-on joints
The Contractor shall source the push-on-joint gaskets only from the pipe manufactures. In turn the pipe manufacturer shall supply at least 10% additional quantity of gaskets over and above the requirement to the Contractor at no extra cost. The gasket used for joints shall be suitable for natural and purified water conveyance. In jointing DI pipes and fittings, the Contractor shall take into account the manufacturer's recommendations as to the methods and equipments to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that once the rubber ring is correctly positioned before the joint is made, does not get damaged by friction or sharp edges of the spigot Chamfer. The rubber rings and the recommend lubricant shall be obtained only through the pipe manufacturer. Rubber ring bundles form every lot shall carry with them manufacturers test certificate for the following mechanical properties.

1. Hardne ss
2. Tensile strength
3. Compression set
2. Accelerated again test
3. Water absorption test
4. Stress relaxation test

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacturer's name and trade mark, the month and year of manufacture and the shelf life.

TESTING OF PIPE
The main test among others to be conducted shall be as per IS: 8329-2000 or with its latest revision/amendments.

Mechanical Tests
Mechanical tests shall be carried out during manufacture of pipes as specified in the Standards. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS 11606-1986. The test results so obtained for all the pipes and fittings of different sizes shall be submitted to Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS; 8329/EN 545 for pipes and IS: 9523/EN 545 for fittings.

Brunel Hardness Test
For checking the Brielle hardness the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS:1500. The test shall comply with the requirements specified in IS: 1500/ISO 6506.

Re-tests
If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements the lot shall be accepted. Should either of these additional test pieces fall to pass the test, the lot shall be liable for rejection.

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in the standard for a period of minimum 15 seconds during which the pipes shall be struck moderately with a 700 g hammer for confirmation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

QUALITY ASSURANCE
The manufacturer shall have a laid down Quality Assurance Plan for the manufacture of the products offered which shall be submitted along with the tenders.

MODE OF MEASUREMENT AND PAYMENTS:
The payment shall be made as mentioned in price bid. The measurement shall be taken in running meter of the pipes. The payment shall be made on running meter base. Item includes all taxes, octroi, insurance, transportation, freight charges, loading, unloading, conveyance to site, staking etc. including necessary testing charges.

DI Specials
DI Specials with all types of diameters suitable of K9 grade pipes with inner cement mortal lining the necessary DI Specials required during the lowering & lying of Ductile Iron Pipe shall be supplied by the agency and shall be as per standard specification. And per IS specification It shall be of best quality as per requirement Rate shall be including loading, unloading, carting, insurance and Labor charge etc

Painting
All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard color code given in this document or specified by Project Manager.

Storage tanks Underground & Overhead Tank. (Accessories & Connections)

Storage tanks for water supply shall be in reinforced cement concrete built by the building contractor.

Each tank shall be provided with a 560mm Dia Heavy Duty Cast Iron manhole frame and cover.

Storage Tanks
Underground storage tanks for water supply shall be reinforced cement concrete built by the building contractor.
Each tank shall be provided with a 560mm Dia Heavy Duty Cast Iron manhole frame and cover or as approved by local municipal authority.

Outlets and overflow
All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities, further connections and accessories shall be provided under this contract.

Testing
All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm whichever is higher. Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor (s) and Project Manager.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes' or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves, which do not effectively operate, shall be replaced by new ones at no extra cost and the same shall be tested as above.

Hot water pipes chased into the walls shall be provided with a 6mm thick insulation with elastic flexible material having hermetic closed cell structure of expanded synthetic material rated for 60ºC hot water supply.

Measurement
The quoted cost shall be inclusive of all the operation stated above and nothing extra shall be paidin any account.

DRAINAGE WORK

Scope of Work
Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the drainage system as required by the drawings, specified here in after and given in the Schedule of Quantities.

General Requirements

a. In designing a drainage system for building(s), the aim shall be to provide a self-

cleansing conduit for the conveyance of soil, waste, surface or sub-surface waters and for the removal of such wastes speedily and efficiently to a sewer or other outlet, without risk of nuisance and hazard to health.

b. The discharge of water through a domestic drain is intermittent and limited in quantity and therefore, small accumulations of solid matter are liable to form in the drains between the building and the public sewer. There is usually a gradual shifting of these deposits as discharges take place. Gradients shall be sufficient to prevent these temporary accumulations building up and blocking the drains.
c. Normally, the sewer shall be designed for discharging three times the dry weather flow flowing half-full with a minimum self-cleansing velocity of 0.75 metre per second. The approximate gradients which give this velocity for the sizes of pipes likely to be used in building drainage and the corresponding discharges when flowing half-full are given in Table. The sizes and slopes shall conform to Local Municipal Bye-laws.
d. In cases, where it is practically not possible to conform to the minimum gradients, a flatter gradient may be used but the minimum velocity in such cases shall on no account be less than 0.61 metres per second.
e. On the other hand, it is undesirable to employ gradients giving velocity of flow greater than 2.4 metres per second. Where it is unavoidable, cast iron pipes shall be used. The approximate gradients which give a velocity of 2.4 metres per second for the various sizes of pipes and the corresponding discharge when flowing half-full are given in Table

Gradients for table

Diameter mm	Minimum gradient		Maximum gradient	
	Gradients	Discharge cum/min	Gradients	Discharge cum/min
100	1 in 57	0.18	1 in 5.6	0.59
150	1 in 100	0.42	1 in 9.7	1.32
200	1 in 145	0.73	1 in 14	2.4
230	1 in 175	0.93	1 in 17	2.98
250	1 in 195	1.10	1 in 19	3.60
300	1 in 250	1.70	1 in 24.5	5.30

Glazed Stone Ware **Pipes and Fittings**

All pipes with spigot and socket ends and fittings shall conform to class SP1 of IS 651. These shall be sound, free from visible defects such as fire cracks or hair cracks. The glaze of the pipes shall be free from crazing. The pipes shall give a sharp clear tone when struck with a light hammer. There shall be no broken blisters.

S.W. Gully Trap

Gully traps shall conform to IS 651. These shall be sound, free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free form crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 Kg and the frame not less than 2.70 Kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

EXCAVATION
The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the PMC's Engineer in-charge.

FIXING
The gully trap be fixed over cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) foundation 650 mm square and 100 mm thick. The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes as described above.

BRICK MASONRY CHAMBER
After fixing and testing gully and branch drain, a brick masonry chamber 300 mm x 300 mm (in side) with bricks in cement mortar 1:5 (1 cement : 5 fine sand) shall be built with a 100 mm brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the trap shall be filled with cement concrete 1:5:10 (1 cement: 5 fine sand : 10 graded stone aggregate 10 nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered in side with cement mortar 1:3 (1 cement : 3 sand), finished with a floating coat of neat cement. The corners and bottoms of the chamber shall be rounded off so as to slop towards grating.

C.I. cover with frame 300 mm x 300 mm (inside) size small then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) 40 mm thick and rendered smooth. The finish top of the cover shall be left about 40 mm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

MANHOLES

GENERAL
Manholes of different types and sizes specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawing or as directed by the PMC's engineer in-charge. The size specified shall indicate the inside dimensions (between wall faces) of the manholes. The branch sewer should deliver sewage in the manhole in direction of main flow and the junction must be made with case so that flow in the main is not impeded.

No drain from house fitting i.e. gully taps or soil pipes etc. to manholes shall normally exceed a length of 6 meter unless it is unavoidable.

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 45 m for up to 300 mm dia, 75 meter for 350 to 500 mm dia and 90 meter for 600 mm dia and above.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber.

Manholes shall be built to the following specifications:-

Bed concrete
The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement : 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) The thickness of Bed Concrete shall be 150 mm upto 0.90 meter depth, 200 mm thick for manholes from 0.90 meter to2.25 meter depth and 30 mm for manholes of above 2.25 meter depth.

Walls
The walls of the manholes shall be of brick masonry. The brick masonry shall be with bricks in cement mortar 1:4 (1 cement: 4 coarse sand) of brick work shall be carefully built in English bond. The jointing face of each brick being well buttered with cement mortar before laying so as to ensure a full joint. The thickness of wall shall not be less than 230mm upto 2.25 meter in depth, 345 mm thick for depth 2.25 to 3.0 meter, 460 mm thick for depths 3.0 m to 5.0 meter and 575 mm thick for 5.0 to 8.0 meter depth. For greater depths and for subsoil water conditions the exact thickness of wall shall be governed by the structural design & site conditions.

Plaster
The inside of wall shall be plastered by 12 mm thick with cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement. All angle shall be rounded to 7.5 cm. radius and all rendered internal surfaces shall have impervious finish obtained by using a steel trowel.

Where the saturated soil is met with, also the external surface of the walls of the manhole shall be plastered with 12 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished smooth upto 30 cm above the highest sub-soil water level with the approval of the PMC's Engineer in-charge. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications

Channels and benching
Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with themainchannel on appropriate shall suitably rounded off in the direction of flow in the main channel shall be given.

The channels and benching shall be done in cement concrete 1:2:4 (1cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) rising at a slope of 1 in 6 from the edges of channel. The channels of the bottom of the chamber shall be finished with the floating coat of neat cement.

Foot Rests
All manholes deeper than 0.8 m shall be provided with C. I. foot rests. These shall be embedded 20 cm deep in 20 x 20 x 10 cm blocks of cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size). The concrete block with C.I. foot rest placed in its center shall be cast in situ along with the masonry and surface finished with 12 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished smooth.

Foot rests which shall be of 20 x 20 sq. C.I. bars shall be fixed 30 cm apart vertically and staggered laterally and shall project 10 cm beyond the surface of the wall. The top

foot rest shall be 45 cm below the manhole cover.

Foot rests shall be painted with coal tar, the portion embedded in the cement concrete block being painted with thick cement slurry before fixing.

Cover slabs
These shall be of R.C.C. 1:1.5:3 (1 cement: 1.5 coarse sand: 3 graded stone aggregate 20 mm nominal size) 15 cm thick with surface and edge finished fair. Full bearing equal to the width of the wall shall be given to the slab on all sides. The frame of the man hole cover shall be embedded firmly in the R.C.C. slab so that the top of the frame remains flush with the top of the R.C.C. slab. Where the opening of manhole is only 560 mm dia, the MH cover shall be fixed in 150 mm thick PCC (1:2:4).

TESTING
Manholes shall be tested by filling with water to a depth not exceeding 1.2 meter as directed by the PMC's Engineer in-charge.

After completion of the work manhole covers shall be sealed by means of thick grease.

CONNECTION TO EXISTING SEWER
The connection to an existing sewer shall, as far as possible, be done at the manholes. Where it is unavoidable to make connection in between two manholes, the work of breaking into the existing sewer and forming the connection shall be carried out under the supervision Administrative Authority.

Breaking of sewer shall be effected by the cautions enlargement of sewer hole and every precaution shall be taken to prevent any material from entering the sewer. No connection shall be former in such a way so as to constitute a projection into the sewer or to cause any diminutions in its effective size.

DROP CONNECTIONS
Where it is uneconomic or impracticable to arrange the connection within 600 mm height above the invert of the manhole, the connection shall be made by constructing a vertical shaft outside the manholes chamber. If the difference in the levels between the incoming drain and the sewer does not exceed 600 mm and there is sufficient room in the manhole, the connection pipe may be directly brought through the manhole wall and the fall accommodated by constructing a ramp in the benching of the manhole.

RECAST CONCETE MANHOLE COVERS & FRAMES
Precast reinforced cement concrete manhole covers intended for use in sewerage, drainage and water works shall generally conform to IS : 12592 - 2002. Detailed specification are as under :

GRADES : TYPES & USES
Manhole covers and frames shall be of the following four grades and types :

Grades	Grade Designation	Type / shape of cover
Light Duty	LD – 2.5	Rectangular, Square, Circular
Medium Duty	MD – 10	Rectangular, Circular
Heavy Duty	HD – 20	Circular-Square, Rectangular,
Extra Heavy Duty	EHD – 35	Circular, Square, Rectangular,

The different grades and types of manhole covers may be used as follows :

LD – 2.5 Rectangular, Square or Circular types :
These are suitable for use within residential and institutional complexes / areas with pedestrian but occasional LMV traffic. These covers may also be used for inspection chambers.

MD – 10 :
These are suitable for use in service lanes / roads, car parking areas etc.

MD – 20 :
Suitable for use in institutional/commercial areas / carriage ways with heavy duty vehicular traffic like buses, trucks, etc. for a wheel load between 50 to 100 KN.

EHD – 35 : Circular, square, or rectangular (scrapper manhole) types -
These are suitable for use on carriage way in commercial industrial / port areas / near warehouses / godowns where frequent loading and unloading of trucks / trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads upto 115 KN, irrespective of the location of the manhole chambers.

MATERIALS

Cement
cement used for the manufacture of precast concrete manhole covers shall conform to IS : 269 or 455 or 1489 or 6909 or IS : 8041 or IS : 8043 or IS : 8112.

Aggregates:
The aggregates used shall be clean and free from deleterious matter and shall conform to the requirements of IS: 383–1970.The aggregates shall be well graded and the nominal maximum size of coarse aggregate shall not exceed 20 mm.

Concrete:
The mix proportions of concrete shall be determined by the manufacturer and shall be such as will produce a dense concrete without voids, honey combing etc. (IS : 456) The minimum cement content in the concrete shall be 360 kg/m3 with a maximum water cement ratio of 0.45. Concrete weaker than grade M-30 (design mix) shall not be used. Compaction of concrete shall be done by machine vibration.

Reinforcement:

- The reinforcement steel shall conform to Grade A of IS : 2062 or IS 432 (Part I) or IS : 432 (Part 2) or IS : 1786 as appropriate.

- Reinforcement shall be clean and free from loose mills scale, loose rust, and mud, oil, grease or any other coating which may reduce or destroy the bond between the concrete and steel. A light film of rust may not be regarded as harmful but steel shall not be visibly pitted by rust.

- Fibers steel : In association with in the main steel bars reinforcement steel fibers of appropriate types and forms may also be used as secondary reinforcement (upto 0.5% by volume).

SHAPES AND DIMENSIONS:

Shapes :

The shapes of precast concrete manhole covers shall be square, rectangular or circular as specified.

Dimensions :

Dimensions of precast concrete manhole covers shall be as given in Table below, the minimum clearance at top between the frame and cover shall be 5 mm.

S. No.	Description	Heavy / Extra Heavy duty HD / EHD	Medium duty M.D.	Light duty L.D.
1.	Clear opening matching the top opening of manhole	560 mm dia or 600 mm dia or square or 560 mm	450 mm dia. 480 mm dia. 500 mm dia. dia or square	600 x 450 mm (rectangular) 450 mm dia or 350 mm dia or square
2.	Precast slab with integral frame (D/T)	900 mm dia x 180 mm or square corners cut 1000 mm dia x 200 mm or square corner cut	800 mm. dia x 130 mm 800 mm dia x 150 mm	850mmx700mmx100mm 625mm dia x 100 mm or 575 mm dia x 100 mm or square
3.	Thickness of cover depth of frame (T1)	100 mm or 110 / 120 mm	70 / 80 mm	50 mm
4.	Matching Manhole Cover (B)	685 / 660 mm or 735 / 710 mm dia or square	585 mm dia or 645 mm dia or square	685 x 535 mm 515 mm dia or square 435 mm dia or square
5.	Edge protection of covers/lifting facility	Precast manhole covers are designed and provided with MS rims of 2.5 mm thickness welded around with provision of two lifting hooks welded at appropriate locations.		
6.	Chequered pattern on operative surface	The MS rims along with the edges of precast manhole covers and their operative surface are suitably coated/finished using corrosion resistant paint.		
7.	Marking on the covers	Precast manhole covers/precast slabs are suitably marked on the operative surface with the following letters, unless specified otherwise Name of the Department/Sewer or SWD/Grade/Date of MFR/Trade Name etc.		
8.	Performance requirements Test load	When tested for ULTIMATE breaking load using 300 mm dia block as per the method described in IS : 12592 (Part I) manhole covers shall be within the following range : Light duty - 2.5 tones (L.D. – 2.5) Heavy duty – 20 tones (HD – 20) Medium duty - 10 tones (MD – 10) Extra heavy duty - 35 tones (EHD – 35).		

LIFTING DEVICE

The minimum diameter of mild steel rod used as lifting device shall be 10 mm for light and 12 mm for medium duty covers and 16 mm for heavy and extra heavy duty covers. The lifting device shall be protected from corrosion by not galvanizing or epoxy coating

or any other suitable.

FINISHING AND COATING

To prevent any possible damage from corrosion of steel the underside of the covers shall be treated with anticorrosive paint. The top surface of the covers shall be given a chequered finish.

In order to protect the edges of the covers from possible damage at the time of lifting and handling it is necessary that the manhole covers shall be cast with a protective mild steel sheet of minimum 2.5 mm thickness around the periphery of the covers. Exposed surface of mild steel sheet shall be given suitable treatment with anticorrosive paint or coating.

PHYSICAL REQUIREMENTS

General

All units shall be sound and free from cracks and other defects which interface with the proper placing of the unit or impair the strength or performance of the units. Minor chipping at the edge / surface resulting from the customary methods of handling during delivery shall not be deemed for rejecting.

Load test

The breaking load of individual units when tested in accordance with the method described in IS: 12592 shall be not less than the values specified in Table below.

TABLE

Grade of cover	Type	Load in Tones	Diameter of Blocks in mm
EHD – 35	Circular, Square or Rectangular	35	300
HD – 20	Circular, Square or Rectangular	20	300
MD – 10	Circular, or Rectangular	10	300
LD – 2.5	Rectangular, Square or Circular	2.5	300

FIXING

The frames of manhole shall be firmly embedded to correct alignment and level in RCC slab or plain concrete as the case may be on the top of masonry which shall be paid as extra unless specified otherwise

ROAD GULLY CHAMBER WITH GRATING

The chamber shall be of brick masonry of specified class and shall have a C.I. grating with frame fixed in 15 cm thick cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) at the top. The size of the chamber shall be taken as the clear internal dimensions of the C.I. frame. The chamber shall have a connection pipe, the length of which in metre between the road gully chamber and the manhole of the drain shall not be less than one by forty (1/40) times the nominal diameter of pipe in mm (i.e. for 150 mm connection pipe, length shall not be less than

3.7 m and for 250 mm connection pipe length shall not be less than 6.25 m). The chamber shall be built at the location fixed by the Engineer-in-Charge. Generally the spacing of the chambers shall be 18 to 36 m depending upon the grading of the road channel and the area of the drainage. R.C.C. gully grating shall be fixed in cement mortar 1:2 (1 cement: 2 coarse sand)

INSPECTION CHAMBER

At every change of alignment, gradient or diameter of drain, their shall be a inspection chamber. Bends and junctions in the drain shall be group together in inspection chamber as far as possible. The maximum distance between chambers shall be 30m.

Inspection chambers of different types and sizes as specified shall be constructed in the drainage line at such places and to such levels and dimensions as shown in the drawings or as directed by the Engineer-in Charge. The size specified shall indicate the inside dimensions between brick faces of the inspection chamber.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the inspection chamber. In exceptional cases and where unavoidable, the crown of the branch drainage may be fixed at lower level but in such cases the peak flow level of the two drainage shall be kept the same.

Drainage of unequal sectional area shall not be joined at the same invert in a inspection chamber. The invert of the smaller drainage at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch drainage shall deliver drainage in the inspection chamber in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

Inspection chamber of 455 ×610 mm and 45 cm deep for single pipe line, 500 × 700 mm and 45 cm deep for one or two inlets and 600 × 850 mm and 45 cm deep for three or more inlets are generally constructed for drainage line.

Excavation

The excavation for inspection chamber shall be true to dimensions and levels shown on the plans or as directed by the Engineer-in-Charge.

Bed Concrete

The inspection chambers shall be built on a bed of cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) unless required by local authorities. The thickness of the bed concrete shall be 15 cm unless otherwise specified or directed by the Engineerin-Charge and 40 mm thick cement concrete 1:2:4 (1 cement: 4 coarse sand: 4 grade stone aggregate 40 mm nominal size).

Brick Work

The brick work shall be with class 75 bricks in one brick thickness in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof.

Plaster and Pointing

The walls of the inspection chambers shall be plastered inside including bed with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth. For earth work excavation, bed concrete, brick work, plaster and pointing, R.C.C. work and refilling of

earth, respective specifications shall be followed.

Inspection Chamber Covers and Frames
The frame of inspection chambers shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, inspection chambers covers shall be sealed by means of thick grease.

Measurements
Inspection chambers shall be enumerated under relevant items. The depth of the inspection chambers shall be reckoned from the top level of C.I. cover to the invert level. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

Rate
The rate shall include the cost of materials and labour involved in all the operations described above but excludes the cost of (i) excavation, (ii) 12 mm thick cement plaster with water proofing material applied at the external surface of the inspection chambers if required (iii) 40 mm thick cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 grade stone aggregate 40 mm nominal size). These items shall be paid for separately under relevant items of work. Payment for extra depths of inspection chambers shall be made separately under relevant items of work.

NON PRESSURE NP-3 CLASS (MEDIUM DUTY R.C.C. PIPES)

All NP2 / NP3 RCC pipes shall be spigot and socket end pipes. The ends shall be suitable for rubber ring joints. The pipes shall be ISI marked as per IS:458:2003. The rubber rings shall confirm to IS 5382.

MATERIAL

General - The pipes shall be with reinforcement and shall be of the specified class. These shall conform to IS : 458 amended up to date. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete – The concrete quality shall be as per IS: 456 for at least very severe environmental exposure condition. Concrete used for the manufacture of reinforced concrete pipes shall have minimum cement content of 450 kg/cum and a compressive strength not less than 35N/sq.mm at 28 days.

Aggregates – The aggregate shall confirm to 3 of IS : 383. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm dia and 10 mm size for pipe dia from 80 to 250 mm.

Reinforcement - The reinforcement shall confirm to mild steel grade 1 or medium tensile steel bars confirming to IS:432 (part 1) or hard drawn steel wire confirming to IS : 432 (part 2) or structural steel (standard quality) bars confirming to IS : 2062. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand

the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

CLASS NP3 – REINFORCED CONCRETE MEDIUM DUTY, NON PRESSURE PIPES

Internal Diameter of Pipes (mm)	Barrel Wall Thickness (mm)
150	25
200	30
225	30
250	30
300	40
350	75
400	75
450	75
500	75
600	85
700	85
800	95
900	100
1000	115
1100	115
1200	120
1400	135
1600	140

TRENCHES

1. The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

2. Cover shall be measured from top of pipe to the surface of the ground.

3. The width of the trench shall be D+400 mm with a minimum of 750 mm. (D= External diameter of pipe). Note: The width should not be more than the mentioned for structural safety of the pipes.

4. The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layer.

5. If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe.

6. After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient

depth to ensure that the barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

7. Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed.

8. The excavated materials shall not be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling that may be re-laid and compacted in the same order to the satisfaction of the PMC's Engineer in-charge.

9. The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after rewatering the trenches.

10. Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water main, cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the PMC's Engineer in-charge.

LAYING

Pipes shall be lowered into the trench carefully. Mechanical appliances may be used, where necessary, pipes shall be laid in straight lines or with easy curves and true to line and gradient as specified. Laying of pipes shall proceed upgrade of a slope. In the pipes spigot end socket joints, the socket ends shall have face up stream. In the case of pipes with joints to be made with loose collars the collars shall be slipped on before the next pipe is laid.

The Cement Concrete bedding shall be provided below RCC pipes as per tender and drawings.

When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

JOINTING

SPIGOT AND SOCKET JOINT

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The jointing of pipe shall be done by rubber ring method. The rubber rings shall confirm to IS : 5382.

A rubber ring shall be placed on the spigot which shall be forced into the socket of pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar 1:2 (1 cement : 2 fine sand) shall then be filled into the remaining annular space and

rammed with a caulking tool. After days work any extraneous material shall then be removed from inside of the pipe and the newly made joint shall be cured,

TESTING OF JOINTS

HYDRAULIC TEST

The pipes shall be subjected to a pressure of at least 2.5meter head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the low end of the drain and the ends of the connection, if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head; or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fix suitably for observation.

Subsidence of the test water may be done to one or the more of the following causes Absorption by pipes and joints;

Sweating of pipes or joints;
Leakage at joints or from defective pipes and
Trapped air.

Allowance shall be made for (i) above by adding water until absorption has ceased after which the proper test should commence if any leakage is visible the defective part of the work should be made good. A slight amount of sweating which is uniform may be over looked but excessive sweating from a particular pipe or joint shall be watched for as taken as indicating a defect to be made good

RECTIFICATION OF FAULTY JOINTS:

Any joint leaking or sweating shall be rectified or embedded into into 150mm layer of cement concrete (1:2:4) 300mm in length and the section retested.

RAIN WATER HARVESTING

1. Rainwater harvesting is the collection of rainfall. In most cases, a roof is used for this purpose. The rainwater then flows through the gutters, into a collection tank. The collected water can be used for small scale irrigation (of vegetable gardens etc.), clothes washing, bathing and after treatment also for drinking and food preparation.

2. Rainwater offers advantages in water quality for both irrigation and domestic use. Rainwater is naturally soft (unlike well water), contains almost no dissolved minerals or salts, is free of chemical treatment, and is a relatively reliable source of water for households.

3. A rooftop rainwater harvesting system consists the following elements:

    a. Collection area.
    b. Conveyance / pipe system.
    c. Filtration / treatment
    d. Storage
    e. Usage/ Recharge

4. The collection area in most cases is the roof of a house or a building. The effective roof area and the material used in constructing the roof influence the efficiency of

collection and the water quality.

5. A conveyance system usually consists of gutters or pipes that deliver rainwater falling on the rooftop to manholes or other storage vessels. Both drainpipes and roof surfaces should be constructed of chemically inert materials such as wood, plastic, aluminum, or fiberglass, clay tiles etc in order to avoid adverse effects on water quality.

6. The water ultimately is stored in a storage tank, which should also be constructed of an inert material. Reinforced concrete, Brick masonry, fiberglass, or stainless steel are suitable materials. Storage tanks may be constructed as part of the building, or may be built as a separate unit located some distance away from the building.

7. Water can also be stored in 100% recycled polypropylene modular tank system (non-plate and non-hyperboloid design) engineered for underground applications. The system shall be based on mat raft foundation with a column base structure and unidirectional assembly of modular units. Each module measures 600 mm × 600 mm × 250 mm and offers an effective water holding capacity of 85 litres, with a void ratio of 94.5% for maximum runoff storage. The design allows tool-free stacking up to 6 meters, making it ideal for deep cavity installations. Made from high-quality recycled PPCP, the structure is resistant to chemicals and high temperatures and offers a minimum service life of 20 years. It is designed to withstand vehicular loads up to SLW 60 (HGV class) with appropriate backfilling and features a double-lock connection mechanism for enhanced stability. The vertical column structure is engineered to distribute loads evenly, with column spacing not exceeding 75–80 mm and a minimum column density of 75–80 columns per square meter. Systems using more than four components per module shall not be permitted.

8. Design of various component of systems for Rain Water Harvesting are covered in the CPWD Rain Water Harvesting and conservation Manual.

9. The specifications of various types of piping systems used in RWH, manholes, manhole covers, Open surface drains, road gully chamber, Dispersion trenches, soak pits are provided in the CPWD specifications Sub Head: Drainage.

10. The Specifications for Storage tanks/Underground sumps shall be followed as per IS 2470: 1986 (Part I & II)

11. The recharge wells/pits are provided with the bore wells to recharge the ground water table directly draining rainwater through filter media to the aquifer.

12. The recharge wells/pits are also used for drawing water from the aquifer by making deep tub well in the or near the recharge pit.

13. The specifications for tube well for the withdrawal of underground water are also provided in this chapter.

    Tube wells are generally constructed in alluvial formations comprising a casing pipe, a housing pipe (if need be) and an intake section either screen or slotted pipe with or without gravel packing. These wells may be either under water table conditions or under artesian conditions.

DESIGN AND LOWERING OF PIPE ASSEMBLY

1. The length and diameter of the casing pipe is selected on basis of static water level, the draw down, the discharge expected from the well and the size of pump to be installed. The size and length of slotted/strainer pipes are selected according to the actual requirement according to the strata met with the expected discharge end the depth of tubewell, the casing pipes shall generally conform to IS 4270: 1983, the slotted/strainer pipes shall conform to -IS 8110 : 1985 and the u-PVC casing pipes and screen shall conform to IS 12818 : 2010.
2. The entry of water in the tube well shall be either through screens or slotted pipes. Following are the various types of well screens and slotted pipes used in water wells depending upon the type and size of well:

   a. Plain slotted pipe.
   b. U-pvc pipe

   The design, selection and type of screen or slotted pipe size and distribution of slots shall be as specified in IS 8110: 1985.

   GRAVEL PACKING
   All gravel to be used as pack in tube well construction for water supply shall be as specified in IS 4097: 1967. The thickness of the gravel shroud around the screen shall generally be not less than 10 cm.

   The gravel selected for packing tube wells shall consist of hard quartz (about 96 percent SiO2) or other suitable material, with an average specific gravity of not less than 2.5. Not more than 10 percent by weight of the material shall have a specific gravity of less than 2.25. The gravel shall contain not more than two percent by weight of thin flat or elongated pieces. In the case of such pieces, the larger dimensions shall not be more than 3 times the smallest dimensions. The quartz shall be of sub-rounded to rounded grains with minimum angular features.

   The gravel for use as pack shall be free from impurities, such as shale, mica, feldspar, clay, sand, dirt, loam, and hematite and organic materials.

   The porosity of the gravel when laid as a pack shall not be less than 25 percent.

   Gravel Sizes:- The gravel conforming to this standard as per IS 4097 : 1967 shall be of the following grades:

Sl.NO.	Grade	Pack	Particle Size Range mm	IS Sieves (see IS: 460-1962
1	A	Fine Gravel	Over 2.0 to 3.35	2.0 , 3.35
2	B	Fine Gravel	Over 3.35 to 4.75	3.35 , 4.75
3	C	Medium Gravel	Over 4.75 to 6.3	4.75 , 6.3
4	D	Medium Gravel	Over 6.30 to 8.0	6.3 , 8.0
5	E	Coarse Gravel	Over 8.0 to 12.5	8.0 , 12.5

The particle size distribution of gravel shall be determined by screening through standard sieves in accordance with IS: 460-1985. The percentage distribution of the sizes shall be determined from a graph in which the percentage of material passing

through each sieve is plotted against the standard aperture of that sieve. Any size, say D20, will thus indicate that the cumulative weight of all the grains smaller than this size is 20 percent of the total weight of the test sample. The uniformity coefficient of the gravel, that is, the ratio of its D20to D10sizes shall not exceed 2. A material with uniformity coefficient less than 2 shall be classified as uniform and if greater than 2 it shall be taken as non-uniform. The limiting sizes given in above table are the minima and maxima, and the stacks containing smaller or bigger sizes as shown by sieve analysis shall be rejected.

The gravel shall have a hardness of not less than 5 in Moh's scale.

The pack aquifer ratio (P/A ratio) is defined as the ratio of 50 percent size (D30) of the gravel pack to the 50 percent size of the aquifer. The size of gravel when used as pack in tube wells shall be decided in accordance with the size of the aquifer material proposed to be tapped. The gravel size shall be limited as below:

(a) Uniform aquifer with uniform gravel pack
Pack aquifer ratio — 9 to 12.5
(b) Non-uniform aquifer with uniform gravel pack.
Pack aquifer ratio — 11 to 15.5

The thickness of gravel pack shall be limited to 13 to 18 cm

However, artificial gravel pack may not be necessary if the effective size (D10) of the aquifer is greater than 0.3 mm and its uniformity coefficient is greater than 5. For artificial gravel pack

For sampling and packing, corresponding provisions of IS 4097:1967 may be referred.

1. In percussion method of drilling, .gravel is fed into the annular space between the casing pipe and the assembly pipe up to 3 m above the bottom of the slotted pipe. The well is developed using compressed air or by bailers and as the water becomes clear, surging or backwashing is done to make the development more perfect. More gravel is fed, if necessary, and when the water becomes free from sand, the casing pipe is jacked up to some height, and the process is repeated until all the aquifers are gravel packed.
2. In rotary method, the pipe -assembly is lowered into position and gravel packing may be done up to a suitable depth below the bottom of the housing pipe in the first instance. There after the gravel packing up to the required depth is completed after keeping the housing pipe vertical within limits. To achieve uniform gravel packing around the pipe assembly inverted cones should be used.
3. A provision for a well base to eliminate the possibilities of subsidence of the well structure may be incorporated. If the bottom of the well is in a soft formation, the well should be provided with an artificial base for the casing and screen by over drilling the hole about 1 to 2 m and filling the extra depth with concrete or gravel.

Modules:

Supply and installation of a 100% recycled polypropylene modular tank system (non-plate and non- hyperboloid design) engineered for underground applications. The system shall be based on a mat raft foundation with a single-column base structure and unidirectional assembly of modular units. Each module measures 600 mm × 600 mm × 250 mm and offers

an effective water holding capacity of 85 litres, with a void ratio of 94.5% for maximum runoff storage. The design allows tool-free stacking up to 6 meters, making it ideal for deep cavity installations. Made from high-quality recycled PPCP, the structure is resistant to chemicals and high temperatures and offers a minimum service life of 20 years. It is designed to withstand vehicle loads up to SLW 60 (HGV class) with appropriate backfilling and features a double-lock connection mechanism for enhanced stability. The vertical column structure is engineered to distribute loads evenly, with column spacing not exceeding 75–80 mm and a minimum column density of 75–80 columns per square meter. Systems using more than four components per module shall not be permitted.

Geotextile:
Supply and installation of high-strength, non-woven polypropylene (PP) geotextile fabric, minimum 400 GSM, used for wrapping modular tanks to enhance filtration and prevent silt ingress.

- Tear Strength: ≥ 250 N (ASTM D4533)
- Width-wise Strength: ≥ 215 N (ASTM D4533)
- Puncture Resistance: ≥ 1550 N (ASTM D6241)
- Elongation at Break: ≥ 57% (ASTM D4595)

Fabric is needle-punched, heat-welded, and made from long synthetic fibers ensuring high porosity, effective filtration, and seamless percolation. Includes all necessary activities such as cutting, sizing, seaming, and wrapping around tank modules.
Application: Essential for proper tank functioning, sediment control, and structural reinforcement.

Filtration Unit:
Supply and installation of FRP-based Rainwater Harvesting Microfilter with 750mm diameter and 1000mm height, equipped with dual 6” inlet and outlet ports. The filter includes an internal SS 304 mesh for effective primary filtration.

- Flow Rate Capacity: Minimum 40–45 KL/hr
- Constructed from UV-resistant, corrosion-proof FRP body for long life
- Suitable for rooftop and stormwater collection
- Must be GRIHA and SVAGRIHA Certified (GRIHA Criteria 18 & 21, SVAGRIHA Criterion 9) with valid certification on date of installation
- Compatible with modular tank systems for both recharge and reuse applications

DEVELOPMENT OF TUBE WELL

1. Trial bore of 300 mm dia upto 200 mtr depth below ground level in any kind of soil strata including hard stone/boulder.
2. Trial bore of 300 mm dia exceeding 200 mtr depth below ground level and up to 400 RM in any kind of soil strata including hard stone / boulder.
3. Trial bore of 300 mm dia exceeding 400 mtr depth below ground level and up to 500 RM in any kind of soil strata including hard stone / boulder.

Development of trial bore well by reaming in the following steps-

4. Reaming up to 675 mm For 170 RM from ground level including casing pipe of 350 mm dia and thickness 8 mm and pea gravel.
5. Reaming upto 525 mm from depth exceeding 170 mtr to 300 mtr including casing pipe of 250 mm dia and thickness 8 mm and pea gravel

6. Reaming upto 525 mm from depth exceeding 300 mtr to 400 mtr including casing pipe of 250 mm dia and thickness 8 mm and pea gravel
7. Reaming upto 525 mm from depth exceeding 400 mtr to500 mtr including casing pipe of 250 mm dia and thickness 8 mm and pea gravel
8. slotted pipe of 250 mm dia in lieu of caseing pipe of 250 mm dia

- Cast Iron Air Valves with two air Outlets, bore and fixing Up in cast iron water supply mains
- Development of tube well with compressed air and after 25% extra capacity pump by pumping muddy water
- Yield test for the bore well by continuously pumping for for 16 hours to determine safe pump yield
- Submersible pump electric driven 415 Volt, TP suitable for 200/250 dia bore well (casing pipe size 200/250 mm supplied and installed complete upto suitable WHP. (Note : Actual capacity of submersible pump will be designed on the base of yeald available)
- MS reducer, bail plug, well cap, MS Strip for centering, MS iron clamps, electric logging and sample strata box
- Valve reflux, with bypass Arrangement, 100 mm(6") dia
- Strainer Y type conforming to IS
- Earthling of machinery/ equipment installed at power house/ substation using 32 x6 mm galvanized MS strip and MS galvanized plate of size 600 x600x6mm as earth electrode
- MS ERW flange pipe 150(6")dia for RM column pipe
- LT panel 415 Volt, 4 wire AC, 50 HZ factory made indoor type, panel CPRI approved, made out of MS sheet of size 2.0 mm thick duly with powder coated & mounted on an angle iron frame made out of 50 x 50 x 6 mm angle iron frame, 90 cm high, duly fixed with PCC etc. complete with following accessories(Pump house bldg)

a. 4 Nos Al bus bars of rating 200 Amp mounted on heavy duty rubberized porcelain support-01 set
b. MCCB 125 Amp rating, 25 KA, four pole Adjustable type(for incoming)-01No
c. ©Space for starter for submersible pump suitable HP-01 No
d. MCCB 100 Amp 25 KA, 4 pole Adjustable type for outgoing-02 Nos(One no spare) for panel No.2
e. MCCB 40 Amp, 25 KA, 3 pole adjustable type for outgoing-01Nos. For submersible pump
f. MCB SPN 40 Amp, 10 KA, outgoing-01 no. for pump house building
g. Ammeter (0 to 150), Digital type with selector switch and CT's-01 set
h. Voltmeter (0to 500V) Digital type with selector switch-01 set
i. Indicator lamp LED Cluster type(set of 3)-1 set
j. S/F time switches 250 V, Single phase of 20 Amp rating with contactor fitted inside steel enclosure-01 Nos
k. Ammeter(0 to 150), Digital type with selector switch and CT's-01 Set
l. Voltmeter (0 to 500V) Digital type with selector switch-01 Set
m. Indicator Lamp LED Type(Set of 3)-1 set
n. MCB SPN 20 Amp, 230 Volt-01 No
o. Labour, Installation/ Connecting/ transportation etc

- Pipes Galvanized, " Medium class" supplied and laid complete including fittings in trenches/ on walls/ on floors etc as required for following sizes all as specified

& directed
a. 40 mm bore
b. 50 mm bore

- Colum pipe & valve

a. Ductile iron, S/S pipe including special class "K-9" 100 mm (4") dia
b. Ductile iron, S/S including special class "K-9" 150 mm (6") dia
c. Sluice valve both ends flanged of class 1.6 PN of size 100 mm bore
d. Sluice valve both ends flanged of class 1.6 PN of size 150 mm bore

- Brick masonry valve pit chamber of following sizes(internal dimensions) with MS sheet cover 6 mm thick and angle iron 40x 40x 6 mm frame duly painted with two coat of synthetic enamel over one coat of red oxide primer including locking arrangement, necessary earth work etc complete of following sizes:-

a. Size 1050x 1050x1050 mm
b. Size 900x 900x 900 mm

- M & L for cutting of existing CI/DI for inserting new TEE/ Connected items of following sizes

a. 100 mm bore

- Valves, sluice, flanged of class 1.6 PN supplied and installed complete ISI marked with high tensile brass spindle etc complete, of following sizes:-

a. 150 mm bore
b. 100 mm bore

- Valve, stop, screwed, supplied and installed complete, ISI marked for pipe of following complete all as specified and directed

a. 40 mm bore
b. 50 mm bore

- DI Fitting bend tapers tee pieces single & double branch any type and angle/ radius and straight connecting piece but all end flanged up to 150 mm

HYDRO- PNEUMATIC PUMP SYSTEM FOR WATER SUPPLY

Scope (Item Description)

The item includes the Pumps (Vertical/Horizontal centrifugal type), Pressure vessels, pressure switches, gauges, pressure transmitter on delivery manifold, pump suction & delivery piping, manifolds & valves, flexible bellows, Fixed speed/ variable frequency drive, control panels, Microprocessor based operation) and all accessories including installation, testing & commissioning.

Pump –Motor Set Design & Construction Features

Two types of pumps i.e. inline vertical multistage or horizontal type centrifugal pump shall be provided. Variable frequency drive shall be provided with one of the installed pump – if specified in Schedule of quantity.

The pump motor set and shall be suitable for 3 Ph., 415 V, 50 Hz. AC power supply. The pump shall be installed with isolation gate/ butterfly valve, non-return valve, etc. The detailed specification for pump & motor is as below.

The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

The pump shall be capable of developing required total head at rated capacity. Impeller shall be closed type and shall be dynamically balanced. The pump shall have non overloading characteristics.

The casing shall be of rigid construction and shall have side suction and side delivery in case of vertical multistage pump and side suction and central delivery in case of horizontal centrifugal pump.

The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss.

Impeller shall be of one piece and shall be of SS CF8 M.

The shaft shall be of S.S. and its surface shall be properly finished. Shaft sleeves shall be provided to protect shaft from any damage Bearing shall be ball or roller type.

Mechanical seal shall be provided to avoid any leakage.

Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on an anti vibration pad.

All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be hot dip galvanized or of stainless steel construction.

Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. Shut off head shall be 120% of duty point head.

All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

Leakage from pump gland shall be drained to the nearest floor waste.

Pump shall be driven by directly coupled squirrel cage induction motor having TEFC enclosure, IP 55 protection & shall be of Class F insulation.

Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor.

Inspection & Testing

The pump shall be offered for visual inspection before dispatch.
Material test certificates for the various pump components shall be furnished for purchaser’s approval.

System Description

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. When the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, if the system pressure be still below the pre-set value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate, similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/ standards.

The system shall be under the control of a microprocessor based control panel.

A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

The variable frequency drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Frequency Drive (VFD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VFD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand the reverse sequence to the above description shall apply. Alternatively pumping system shall be with fixed speed drive motor. By getting the signal from microprocessor based control panel through pressure transmitter, pumps will operate in sequence & vice a versa.

The frequency converter shall be linked to the motor of the duty pump for continuous speed

adjustment and ultimately the water delivery shall be maintained at constant pressure at the pre-set value.

Control Panel
The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions.

Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system pre-set delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps.

When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/ day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s).

In event of control failure, the pumps shall be able to be start/ stopped manually at the local panel by means of pressure switches.

The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

Automatically starting the pumps when the water level is back to normal.

In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

Functions to limit the no. of start/ stop of pumps per hour. The system control panel shall incorporate LCD Display.

Electrical Component
All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit breaker

Method of Starting
The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/ Delta, using Soft Starters

Pump Pressure Vessel
Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/ stop cycles of the pumps.

The vessel shall be constructed of steel plate built to ASME Standards for Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

Accessories
The system shall be provided with all accessories such as base plate, mounting pads, foundation bolts, foot valves, pressure gauge, pressure switches, pressure transmitter, level indicator, isolation valve for pressure vessel, etc. all accessories required for proper and safe operation shall be furnished with the pumps.

Suction & Delivery Pipe Fitting, Flange & Valves
All suction, delivery and header pipe shall be GI & shall conform to IS: 1239, medium/ heavy duty. Fittings shall be as per the pipe thickness. All pipes shall have flanges connection & pipe shall conform to BS 10, Table - D. All hardware shall be zinc plated. The system shall be equipped with suction & delivery valves flanged valves. On suction side ball/gate valve shall be provided while on delivery side ball/ butterfly valves shall be provided. Also, spring operated check valves shall be provided on delivery side of each pump & on delivery header. In case of negative suction foot valve shall be provided for each pump suction or suction header as specified in data sheet. Flexible bellows shall be provided on suction & delivery side of each pumps.

SPECIFICATION OF SOLAR WATER HEATING SYSTEM
This specification covers Design, Engineering, Manufacture, Assembly, Installation, Testing and Commissioning of Solar Water Heating System. However, the minimum, Solar Water Heating System of as per demand shall be provided for hospital building, Canteen and other utilities comprising of solar flat plate collector, collectors stand assembly, SS316 Stainless Steel insulated hot water storage tank with closed circuit heat exchanger and various other components.

Suitable Number of fat Plate should be installed for each Solar Water Heating system. Each Flat Plate collector should be of at least 100 LPD capacity. The outlet water temperature required at tap location shall be 60 degree C.

a) Solar Flat Plate Collector
Solar flat plate collector shall be with BIS approval and as per to IS: 12933 (Part-1 & 2) with up to date amendments and various components shall be as under:

b) Cover plate
Cover plate shall be tempered/ toughened glass and thickness of 4.0mrn (min) conforming to section-1 of IS: 12933 (Part-2)/2003. The solar transmittance of the cover plate shall be minimum 82 percent at near normal incidence. The glass shall be free from bubbles and rough surface.

c) Collector Box
Collector box shall be made of Aluminum sections only. Type grade, size, workmanship and finish of the material used shall be as per section 2 of IS. 12933 (Part-2)/2003. The minimum thickness of Aluminum shall be as under:
i) Channel section for sides: 1.6mm
ii) Support for glass retaining: 1.2mm
iii) Sheet for entire body: 1.0mm

d) Absorber
Absorber shall consist of riser, header and sheet for absorber. Type, grade, size, workmanship and finish of the material used shall be as per section-3 of IS: 12933 (Part-2) 2003. Sheet for absorber shall be made of copper only. Riser and header assembly designed for working pressure up to 2.5kg/ Square cm, shall be tested for leakage at a minimum hydraulic pressure of 5 kg/ Square cm.

e) Collector box insulation
Insulation shall be provided at back and sides. Thermal resistance (R) of insulation material shall be minimum 0,96 square meter. degree C/W for back insulation and minimum 0.48 square meter. degree C/W for side insulation. This shall be derived after determining thermal conductivity (K) value at 100 degree C mean temperature in accordance with IS: 3346. Collector box insulation shall conform to sec.4 of IS: 12933 (Part-2)/2003.Aluminium foil shall be used for covering the back as well as side installation. Aluminum foil shall be used for covering the back as well as side insulation.

f) Gaskets and Grommets
Gaskets and Grommets shall conform to sec.5 of IS: 12933 (Part-2)/2003.

INSULATED HOT WATER STORAGE TANK:

The thickness of the water storage tank shall be uniform.

a) Material
Insulated hot water storage tank shall be non-pressure type and made of SS 316 grade stainless steel of IS:1570 (Part-5)/1985) (Reaffirmed 2004), TIG/MIG welded, minimum sheet thickness shall be 16 SWG. The storage tank shall be well insulated and large enough to hold/store about two days supply of hot water.

b) Insulation
Solar water heating system shall be insulated with 100 mm thick Rock wool, 48 Kg/m3 density, 22 SWG Aluminum cladding. Alternatively, 50 mrn thick CFC free thermal grade PUF insulation, 32Kg/m3 or higher density may be used. PUF insulation could be pre-extruded type fitted with FRP exterior cladding or alternatively injection molded in a twin walled steel tank and PPE end cap.

c) Tank stand assembly & Collector stand assembly
Shall be made of MS angle of size (min) 40 rnm x 40 mm 5 mm duly pre-treated and stove enameled with black colour paint. Alternatively, tubular structure with powder coating could also be provided. The structure should be designed in such a way that it will take less space and will withstand wind load up to 200 kilometer/hour

System interconnection piping:

a). a)Providing and fixing Polyethylene-Aluminum-Polyethylene PE-ALPE Composite Pressure Pipes conforming to IS - 15450, U.V. stabilized with carbon black having thermal stability for hot & cold-water supply, capable to withstand temperature up to 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g., elbows, tees, reducers, couplers & connectors, accessories, fittings etc., for hot water piping at terrace and clamps at 1.00 meter spacing. This includes testing of joints complete as per direction of the Engineer-in-charge.
b). ISI marked, medium class GI pipes of IS:1239 of suitable size inclusive of all

accessories, fittings and necessary supports for connecting Cold water tank with Solar Water Heating System. ISI marked valves shall be of gun metal.

c). 6) Suitable capacity SS304 makeup water tank along with piping and valves as required shall be provided.

d). 7) Temperature Gauge: Dial type, duly calibrated and suitable for temperature range from 0 degree C to 120 degree C and shall be provided.

e). 8) Other component essential for completeness of the system as per tender specifications.

f). 9) Contractor shall submit general arrangement drawings within 15 days from the date of start. General arrangement drawing shall clearly show all the parts of the system (such as solar flat plate collectors, collectors stand assembly, internal and external piping, tank stand assembly, various valves, pressure gauges, temperature gauges, water meter etc.) and their fixing arrangements.

g). 10)The contractor shall supply two sets of instruction manual without any extra cost. Instruction manual shall contain the following details

h). Schematic diagram of the solar collector, Instruction manual and list of service centers.

i). 11)The supplier firm shall furnish complete and satisfactory type test reports for each size / type of solar flat plate collector as per contract specification from any govt. laboratory. Type test reports shall be complete with authenticated drawing giving complete details of the various component used in the solar flat plate collector. Type test reports shall include all the tests listed in IS. 12933 (Part-1) with amendment No. 1 (excluding test requirements as per clause 7.2.7 and 7.2.8 of IS) and also the tests included on various components of solar flat plate collector as per IS: 12933 (Part-2) I 2003 amended update. All leaks & defects in different joints noticed during the testing & commissioning shall be rectified to the satisfaction of the Engineer-in charge.

j). Civil work for foundation, grouting etc. of the system complete as required is in the scope this work. The foundation shall be carried out with 1:2:4 PCC. While erecting the equipment at terrace, contractor shall make sure no damage is done to water proofing and civil structure, location at which grouting is required shall be sealed with high quality water proofing compound. Installation shall be as per guideline issued by MN RE/Manufacturer's standards, whichever is stringent.

Warranty

All the solar water heating systems shall be warranted for a minimum period of 5 years from the date of installation and commissioning against any manufacturing and design defects. Consumables such as rubber parts etc. shall also be warranted for a minimum period of 5 years from the date of installation and commissioning.

SPECIFICATION OF RO PLANT SYSTEM

RO SYSTEM

- Tenderer must inspect the site and the quality of raw water. He shall be at liberty analyses the raw water characteristics from any Lab to his satisfaction and to examine and satisfying himself with the process and detail provided in tender document in obtaining treated water quality as specified in tender document no claim on whatsoever account regarding raw water characteristics and treated water parameters thereon shall be entertained.
- Contractor shall submit with the Tender, General Arrangement (GA) layout and hydraulic drawing of plant giving all major dimensions, design parameters, sizes of

units and equipment and pipes, H.P. of motors and all other pertinent information for assessment of the tender.

- Contractor shall submit with the Tender all the detailed specifications of proposed electromechanical part of work described herein.
- The contractor shall arrange all T&P, Manpower, and chemicals/ consumables like RO anticipant chemical, pH correction agent, chlorine, CEB & CIP chemicals, micro cartridge filters, reducing agents, POL etc. specified in the tender document for commissioning and maintaining the plant under warrantee period of 12 months for which nothing extra shall be paid. v. The raw water characteristics have been indicated from the sample which got tested however the values can be different. The tenderer shall consider his quote considering the quality of treated water which ultimately required by the department on satisfactory installation of plant, complete with the prescribed technology and treatment process.
- The main components in the scope of supplier shall be as under: RO System Components, Instrumentation & Controls.

RO System	To design with minimum recovery of 70% for all time from commissioning of plant.
(i) Inlet Pump	(ii) Pressure Gauges, Instrumentation & Controls
(iii) Anti Scalent Dosing System	(iv) Flow indicators
(v) Fully Automatic Ultra filtration Unit	(vi) Liquid level controllers in storage
(vii) High Pressure Pump	(viii) Ball valves at inlet and outlet piping
(ix) Pressure Vessel	(x) Timer for auto flash
(xi) Membrane	(xii) High pressure switch and low-pressure switch
(xiii) pH correction system	(xiv) Auto flushing system with solenoid valve
(xv) Ultra Violet System	(xvi) Electric control panel with " A" meter, Voltmeter indicators, on off switch
(xvii) Cleaning in place system	(xviii) Pressure Control Valve
(xix) Micron cartridge filter	(xx) Digital conductivity or TDS Meter
(xxi) 1000 Litres capacity treated water tank	(xxii) Piping from raw water tank to RO System and RO System to outlet pipe

Note: The R.O Plant should have control instrument i.e., flow meter for permeate and reject, pressure gauge so that the department may able to visualize the rejection percentage of water.

RO System Requirements

The capacity of the plant shall be the output water capacity of RO in litres per hour (LPH). The technical specifications of each component of RO system shall be for its output capacity of as per demand. The output water quality characteristics are given. However, the total dissolved solids (TDS) of output water obtained from RO plant shall range between 100 to 250 mg per litre in any case. The other chemical parameters of treated Water shall be within limits mentioned in this document. The contractor shall design the R.O keeping in view recovery of treated water minimum 70% and shall provide the required digitized gauge so as to ascertain the percentage of treated and rejected water. In any case the rejected water should not be more than 30%. In the event if it is noticed that during running and operating of R.O. Plant the treated water recovery and quality is not in terms of NIT in such case the department shall forfeit the

performance guarantee and can also claim damages on a/c of breach. The bidder shall analyse the water sample for parameters as per BIS norms at least once in a month from approved laboratory and maintain proper record as per the directions of Engineer-in-charge. In addition to this the bidder shall make available at plant site, all the times, a digital TDS meter for on-the-spot for testing of R.O. Water. The system should be able to adopt the variable feed water characteristics such as varying amount of fine particulate / silt etc. in the raw water and varying TDS levels throughout the design. The use of cleaning chemicals in the system should be minimal. The system should ensure prevention of fouling of the downstream RO membranes caused by the presence of organic and microbiological coolants in the raw water. The system should ensure prevention of a majority of physical foul ants from entering into RO membranes so as to ensure clean RO membranes delivering consistent performance. The system should generate minimal amount of effluents thus giving an environment- friendly solution. The dependence on operator for day-to-day functioning should be minimal. The Bidders should provide automated system so that manual monitoring is minimal.
Making connection for raw water: - The bidder shall be responsible for executing works for making connection for raw water from the source provided by the department including cost of all material and labour etc.

GENERAL REQUIREMENTS:
The bidder shall perform all routine maintenance to ensure proper operation. The bidder shall provide training to the system operator. The bidder shall ensure routine inspection of the equipment by the equipment supplier. The bidder shall provide trained manpower to maintain the equipment, change filters, and refill chemical storage tanks. Maintaining the required uptime of all the systems to ensure the provisions of quality services. The bidder shall be responsible for the supply of consumables and chemicals, and any other material required essentially to provide effective services. The bidder shall install the equipment at the locations specified by Engineer-in-charge.

OTHER REQUIREMENTS:
The record containing hours of operation and quality of water etc. shall be maintained by the bidder, The record should always be updated, legible and be produced for inspection as and when asked for. Frequency of replacement of membrane shall invariably be mentioned in the offer. The minimum guaranteed period of membrane should not be less than 6 years and in case if the water quality is deteriorating and membrane is required to be changed before 6 years it shall be replaced by the bidders at his own cost. Any deviation from the proposed design needs to be approved by the Department.

PACKING, FORWARDING AND TRANSPORTATION
All accessories which are likely to get damaged as an assembly/ unit during transit, shall be removed and adequately packed and shipped separately. All inlet and outlet flanges shall be blanked with thick bolted wooden planks. Packing shall be sturdy and adequate to protect all assemblies, components and accessories by damage, corrosion, dampness, heavy rains breakage and vibration encountered during transportation, handling and storage at the plant site.

TESTING AND INSPECTION

Pre dispatch inspection
All equipment covered under R.O. Plant may require pre dispatch inspection, if so, required by the department during the course of execution. The pre- dispatch inspection may be carried out by Department or its accredited agencies/third party as approved by the department. The charges for third party inspection, if any, would be borne by the

contractor wherever pre dispatch inspection is required, the bidder should produce all the documentary evidences having procured and used new and quality components which go into the total system. These documents including guarantee/ warrantee / test certificate of the component manufacturer will be verified and authenticated by the inspection agencies. Such authenticated document should form a part of the total document required for clearing the bill for payment as per the schedule of payment.

Site tests
After erection at site, all components, equipment as described shall be tested to prove satisfactory performance and /or fulfilment of functional requirements without showing any sign of defect as individual equipment and as well as a system. All rotating components of the system as applicable shall run at the rated speed for a period of 7 (Seven) Days. During this period, all the components shall function smoothly without any undue deflection; unbalance vibration, flutter, slipping or sticky motion, excessive play & overheating at bearing parts, sparking etc.

Tests for R.O. Plant system on commissioning
All equipment covered under R.O. Plant shall be subjected to inspection testing by Department on completion & commissioning.

ERECTION AND COMMISSIONING (E & C)
The Supplier shall be responsible for satisfying himself and the Department as to the correctness of the electrical and mechanical connections between all equipment in his supply

TREATMENT PROCESS

SCHEME OF TREATMENT

Sand Bed Filter
Outlet of Iron removal filter shall be passed through Sand Bed for removal of suspended solids to produce clear filtrate.

Activated Carbon Filter
Filtered water after removal of iron and suspended solids shall be passed through Activated carbon filter to remove colour, odour and residual oxidizing agent. Operation of all the filtration units (viz. iron removal, sand bed and activated carbon filter) shall be on automatic mode for service and regeneration. Raw water pumps will operate automatically as per the requirement of water level in tanks.

pH Correction unit
Perfect pH of Membrane feed water not only ensures better performance of membranes also reduce the dose of costly anti-scalant chemical. Suitable chemical shall be dosed to maintain the appropriate Langelier Saturation Index (LSI). pH shall be constantly checked and monitored.

Anti-scalant Dosing unit
To prevent scale formation and fouling of membranes, measured quantity of suitable chemical shall be dosed in membrane feed water. The dosing pump shall be electronic metering type having proper arrangement of level controller and alarm for accurate and consistent dosing.

Fine Filtration unit

After dosing of required chemicals, water is passed through micron cartridges filtration unit of rating 5 microns to avoid the possibility any residual carryover in membranes.

DESALINATION BY REVERSE OSMOSIS UNIT with post pH correction
Ultra-Filtered and properly conditioned water shall be pumped to membranes at high pressure over osmotic level to separate the concentrate and dilute water stream. The membranes selected shall be energy efficient, high rejection type and will be designed on safe flux rate 13 GFD to produce purified water having TDS below 100 mg/L and pH neutral (7.0 - 7.5) after correction. The vendor shall guarantee that the RO system produces rated output on 75 % recovery and specified parameters (TDS, Total hardness, Total alkalinity, chlorides etc) shall not exceed the limit as specified in treated water table. Besides, it will conform to IS - 10500:1991 protocol of drinking water specified by Bureau of Indian Standards

Treated water for Domestic, drinking and cooling
RO permeate water after pH correction shall be ideal/ suitable for domestic, drinking and cooling and major quantity of this water shall be utilized for such applications of following parameters.
Other parameters and E. Coli, coil forms shall confirm to the standard IS: 10500

Storage and pumping of water for domestic, drinking and cooling
Purified water of above specifications shall be collected in storage tank in pump house area.

General Design Data for R.O. Plant

1. Site Location:
   ESIC Hospital, Sheela agar, Visakhapatnam.
2 Ground Water:
   Inspect and verify site before tendering.
3 Soil Characteristics
   Inspect and verify site before tendering.
4 Influent Characteristics

Type of Feed Water: Feed water is from water softening plant which treats ground water. The water softening plant shall be provided by the main contractor.

Note: - The raw water characteristics has been indicated from the sample which got tested however the values can slightly be different. However, the tenderer shall consider his quote considering the treated water quality (output water from R.O. plant) Input Water, Treated Water Characteristics and Technical Specifications of Electrical & Mechanical Equipment.

Space Availability & Proposed Height
All the three plants shall be installed on the terrace of each block i.e., one plant for each block. Contractor shall require to plan and coordinate within the space only for which he shall require to get approve the exact space, location and area from the Department.

Scope of Work
1. Design and Drawings for complete plant.
   a. Preparation and submission of process and instrumentation drawings
   b. Preparation and submission general arrangement drawings

c. Preparation and submission of equipment/system layout drawings
d. Preparation and submission of civil construction drawings for foundation work/ raised platform to install pumps & motors. Civil work is also included in the scope of this contract for which nothing extra shall be paid.
e. Preparation and submission of detailed engineering drawings.
f. Preparation and submission of as built drawings

2. Making out/ linking proper drainage, so that any leaked water from joints, couplings etc. may not flow on floor of the service block.

3. Providing complete layout plan duly laminated with glass panel showing complete system flow and discharge also necessary guidelines for the operator for day-to-day running of plant, in case the plant is run in manual mode and regarding periodical service of plant.

4. Supplying, installation and commissioning of all electro-mechanical equipment's as per the approved specifications, design.

5. Providing and fixing of all interconnecting pipe works starting from inlet chamber to final delivery outlet pipe.

6. Testing and commissioning of plant to produce output of specified parameters as well as specified water quality and quantity.

The following routine tests which shall be required to carry out on day to day basis as per IS: 10500.

a. COLOUR
b. TURBIDITY
c. pH
d. TOTAL DISSOLVED SOLIDS
e. IRON
f. CHLORIDES
g. CARBONATES
h. BICARBONATES
i. TOTAL HARDNESS
j. CALCIUM HARDNESS
k. RESIDUAL CHLORINE
I. e-COLI
m. COLIFORM

Balance tests as per IS: 10500 shall be carried out from the outside NABL accredited Lab as approved by Engineer-in-charge. The contractor shall bear all incidental charges for cartage, storage and safe custody of materials brought to site.

PERIODICAL TESTING AND MAINTENANCE SCHEDULE

S.No.	System Component	Activity	Periodicity
1	Sand Filter	Back Wash	Daily
		Rinse	Daily
		Replacement (Filter + Filter Sand)	Once in a Year
2	Carbon Filter	Back Wash	Daily
		Rinse	Daily
		Replacement (Filter + Carbon)	Once in a Year

S.No.	System Component	Activity	Periodicity
3	Micron Filters		
3.1	Micron Filter	Replacement	Once in every month
3.2	Micron Filter	Replacement	Once in every month
4	Cleaning	Membrane Chemical Cleaning	Every Month
		SS Water Tank Cleaning	Every 15 Days
5	Dosing	Anti Scalant Dosing	During Operation of Plant
6	Anti Scalant Chemical	Adding	every month
7	Dosing	Anti Scalant Dosing	During Operation of Plant
8	Water Testing	Chemical Testing	Every Three Months
		Bacterial Test	Every Three Months

Note: - The Make and Model shall be got approved from the Engineer-in-charge before use on work. The decision of the Engineer-in-charge regarding the model and make shall be final and binding based on the prevailing models at the time of execution.

SEWAGE TREATMENT PLANT (STP)

Moving Bed Bio-film Reactor (MBBR) is an aerobic attached biological growth process. It does not require primary clarifier and sludge recirculation. Raw sewage, after screening and de gritting, is fed to the biological reactor. In the reactor, floating plastic media is provided which remains in suspension. Biological mass is generated on the surface of the media. Attached biological mass consumes organic matter for their metabolism. Excess biological mass leaves the surface of media and it is settled in clarifier. Usually a detention time of 5 to 12 h is provided in the reactors.

Sewage water from Toilets, Bathrooms, Canteen, Pantry, washrooms etc. is fed into the Sewage Treatment Plant.

The contractor shall set out the works in relation to original points, lines and levels of reference required for execution of work. The contractor shall be responsible for the correct positions of all parts of the works and shall rectify any error in the positions, levels, the dimensions, or alignment of works. Carrying out & confirming the detailed topographical survey along finalized Gravity main/Rising main alignment and treatment plant site, disposal of treated water and sludge and establishing benchmarks at least two locations within the site and one at pumping station site.

Supply, erection, testing & commissioning of all the piping, valves and specials etc. as per detailed technical specification.

Water tightness (seepage)/ testing of all the water retaining structures as required.

Trail Run: The contractor shall initially operate the STP for a period of one month, after completion of work, for start-up/stabilization and for satisfactory performance, by deploying experience staff in two shifts a day and the staff of the user department shall be trained for operation of plants for which nothing extra shall be paid.

The designs of Civil/ Electrical/ Mechanical portion shall be based on the latest relevant IS codes, CPWD specifications, PH Engg. Manual, Indian Electricity Rules. Norms of

pollution control board, Local By – laws and WHO standards with up-to-date amendments and correction slips and sound engineering practice. Each and every step of the design calculations should be self-explanatory. Wherever formulae are adopted, they may be printed clearly. Each factor/ parameter contained in the formula has to be stated in clear terms regarding what for they stand/ their representation in the formula. Side references along with calculations are to be given regarding adoption of references from books/ manuals/ IS codes etc., including their page numbers.

The characteristics given are indicative and subject to change. The Effluent treatment should be based on MBBR Technology. The treated effluent shall be subjected to tertiary treatment. Quality of effluent after tertiary treatment shall be in conformity with the standards laid down by Pollution Control Board for discharge in to a stream.

The tenderers are free to adopt the sizes to suit the design requirements for final approval from State Pollution Board/ Local authorities.

The Effluent treatment plant shall follow satisfy the following requirements.

Efficient
Low power consumption.
Minimum maintenance.
Minimum space requirement.
Self-operating system.

The scheme proposed shall be free from environmental hazard to the occupants and neighbouring tenants.

The tenderer shall obtain No-Objection Certificate from Pollution Control Board before and after execution of work.

Characteristics

Flow	200 m3/day
Discharge period	24 hrs
Peak Duration	3.0 hrs

Inlet parameters STP

Temperature 25°	25°c to 35°c
Color	Light yellowish & Blackish
Odor	Present
TSS	452
PH	5.5
Oil and grease	18
`BOD	326
COD	242

Total Nitrogen	14
Total Phosphorus	8
Total Coli forms	329

Outlet parameters STP
(As Per NGT Norms)

Temperature 25°	Not exceed 5°c above
Color	Colorless
Odor	Nil
TSS	<20mg/ltr
PH	6.5 to 9
Oil and grease	<10mg/ltr
`BOD	<10mg/ltr
COD	<50mg/ltr
Total Nitrogen	<10mg/ltr
Total Phosphorus	<1mg/ltr
Total Coli forms	100-230

To treat the Sewage, the following treatment philosophy is adopted:-

Bar Screen : To trap any free floating debris.
Oil & Grease removal tank : To trap free & floating oil if any.
Equalization tank : To equalize the sewage quantitatively & qualitatively.
MBBR-1 : Moving bed bioreactor tank 1
MBBR-1 : Moving bed bioreactor tank 2

Tube settler tank : For solids liquid separation.
Chlorine contact tank : For polishing & disinfection.
Filter Feed tank : For Feeding to Filters.
MGF, ACF, and SF : Polishing Units.
CWT : Clear water tank
UF : Ultra filtration plant
TWT : Treated water tank
Sludge Tank : For storage & digestion of Sludge.

PROCESS DESCRIPTION
Bar Screen:-
Raw sewage from the source is usually received into the bar screen chamber by gravity. Screen provided will remove all floating and big size matter, which may otherwise choke the pipeline and pumps.

Type -1	Manually cleaned with Handrake
Construction	In SS flats of size 25 x 5 not more than 10mm with necessary SS flat stiffeners. 1 No. hand rake shall also be provided with GI pip rod.
Type – 2	Mechanically cleaned automatic system.

Construction	In SS flats with opening not more than 4-5 mm with automatic cleaning system based on head loss.

Mechanical Oil Skimmer:

Material of Construction	CI
Type	Belt type of 2-4" belt width and belt length suitable for chamber depth below Liquid in O&G Tank. Skimmer shall be Motor driven type with suitable Motor and suitable speed reduction arrangement.

Equalization Tank

Usually, Sewage generation is more during peak hours. Visually no Sewage is generated during shift change hours. Any biological system needs constant feed for bacteria to work efficiently. Hence, it is important to put an equalization tank to collect the excess flow during peak hours and feed Sewage in lean hours. Equalization tank shall have a capacity of 8-12 hours of average flow rate. Provision of air grid shall be made for thoroughly mixing the sewage to make it of homogenous quality and to keep the suspended matter in suspension and to avoidseptic conditions. The well mixed sewage is then pumped into the Rotary FAB reactor with the help of pumps.

Raw Effluent Transfer Pump

Non-Clog, Self-Priming, raw Effluent transfer pump suitable capacity to pump Effluent from equalization tank to Aeration tank No.1 & 2(MBBR Tank 1 & 2) suitable for handling 25 mm to 30 mm solid particles and liquid discharge.

Air Blower

Twin lobe rotary type air blower capable of delivering suitable capacity of Air at designed pressure, driven through “V” belt or directly coupled/ through flexible coupled to a suitable TEFC motor with accessories. The pressurized air from blower shall be fed to Equalization tank, MBBR Tank-1, MBBR Tank-2.

MBBR Tank (Aeration tank)

The process at MBBR tanks under aerobic conditions is that the rising buoyancy of air bubbles generated during aeration and oxygenation can promote the flow of the filler and surrounding water. When the airflow passes through the water flow and the gap of the filler, it is blocked by the filler and divided into small bubbles. In this process, the filler is fully stirred and mixed with the water flow, and the air flow is fully divided into fine bubbles, which increases the contact and oxygen transfer efficiency of the biofilm with oxygen. Under anaerobic conditions, the water flow and the filler are fully fluidized under the action of a submersible mixer to achieve the purpose of full contact and degradation of biofilm and treated pollutants.

Polypropylene MBBR Media

MBBR media is one kind of new bioactive carrier as a house for attached growth bacteria in MBBR process. It works as carrier for the growth and attachment of microorganisms and are directly put into the MBBR system, the wastewater go through the suspended carriers in MBBR reactor, Kaldnes media adopt scientific formula and blend some micro-elements in the high polymer material, which microorganisms attach themselves to submerged moving biofilm carrier, forming a biofilm. Air is transferred into the water, mixing the media and water and providing oxygen to the bacteria. The MBBR media biofilm absorbs oxygen and reduces organic and inorganic material thus

providing treatment.

Tube Settler tank
The aerated mixture shall be transferred from MBBR tank to RCC Tube settler Tank. The aerated mixture shall be passed through tube settler media before it reaches to the bottom of the tube settler tank.

Flocculation–Diffusers &Tube Settler
Suitable size and quantity, Coarse & fine bubble disc type diffusers, with necessary accessories, of EPDM/Silicon with anti-fungal treatment, to provide clog free oxygen for aeration at Equalization tank, sludge holding tank, treated water tank and aeration tanks.

Suitably designed UV treated PVC tube deck settling media to be installed in Tube Settler Tank along with retainer plates and suitable sludge removal arrangement either by pumps or any other suitable arrangement.

Polyaluminium chloride (PAC) dosing & Polymer (PE) dosing shall be done at Tube settler media.

Sludge Holding Tank
The sludge from the Tube Settler tank is to be removed from bottom of tank and transferred to RCC Sludge Holding Tank (SHT). SHT shall have 6 days sludge holding capacity. The sludge collected at bottom of sludge holding tank shall be fed to filter press.

Filter Press
Filter press suitable for dewatering the sludge and making its cakes with moisture contents of 75% to 80% complete as required, Suitable for operation on 415 ± 10% volts, 3 phase, 50 cycles A/. Supply.

Clear water tank:
The sewage water from tube settler tank is transferred to RCC clear water tank of suitable capacity, for chlorination.

Disinfection
The clear sewage water is then added with chlorine using chlorination pump to kill the pathogens / E-Coli coliforms. The chlorinated sewage water becomes clear water and now it is substantially free from organic contamination, free from coliform bacteria.

Multi Grade Filters
Multi Grade Filters (MGF) are used in water treatment and waste water treatment to remove suspended solids, dust and dirt present in the water.

The raw water flows down from the filter inlet through the media bed. The media bed consists of multiple layers of sand, pebbles and gravels arranged according to size and density. As the raw water passes through different layers of the media, filtration takes place in each media layer. The media bed retains all the suspended solids, dust and dirt present in the water and the clear filtered water flows through the outlet of the filter.

Activated Carbon Filter
Activated Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption. Each particle/granule

of carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media. Granular activated carbon (GAC) is commonly used for removing organic constituents and residual disinfectants in water supplies. This not only improves taste and minimizes health hazards; it protects other water treatment units such as reverse osmosis membranes and ion exchange resins from possible damage due to oxidation or organic fouling.

An activated carbon filter (ACF) works on the principle of adsorption; filter medium adsorbs or reacts with a pollutant molecules then filtered water is drained out. Activated carbon which is used as medium to remove contaminants is natural material derived from coconut shell, lignite, bituminous coal etc. further, activated by chemical or steam under absence of oxygen with high temperature around 1000°C. Specific contaminants can be removed by employing blends of various carbons.

Softener Filter :
A water softener removes calcium and magnesium from water through a process called ion exchange. When the hard water enters into the mineral tank, it flows through a bed of spherical resin beads. These plastic beads, usually made from polystyrene, are charged with a sodium ion. The resin beads are anions, meaning they have a negative charge. The calcium and magnesium minerals have a positive charge, making them cations. Since opposite charges attract, the negative charge of the minerals is attracted to the positive charge of the resin beads. As the hard water passes through the resin, the beads grab ahold of the mineral ions and remove them from the water. When the bead seizes the mineral ion, the sodium ion is released. The column of resin strips all the hardness out of the water as it passes through the mineral tank, and softened water flows out

Clear water tank
The sewage water from tube settler tank is transferred to RCC clear water tank of suitable capacity, as per sld

Basket Filter
The main function of the **basket filter** is to install on the pipeline to effectively filter out the dirt, dust, pipe scale and other solid impurities in the gas and liquid. It will protect the metering, pressure regulating equipment and instruments in the pressure regulating station can work normally. Besides, it ensures the safe production. The basket filter has a larger dirt volume and a smaller resistance loss, which can extend the maintenance period.

The basket filter is mainly composed of a tube, a cylinder, a filter basket, a flange, a blind plate cover, and fasteners. The basket filter has high reliability and safety. The filter basket can be cleaned, which is convenient for maintenance. It shortens the equipment maintenance cycle and saves the high cost of replacement parts. The filter is a clamp-type quick start structure.

Basket filter working principle: when the liquid through the barrel into the filter basket, solid impurities particles are blocked in the filter basket, and clean fluid through the filter basket discharged from the filter outlet. When it needs to be clean, unscrew the bottom of the main screw plug, discharge fluid, remove the flange cover, and reload after cleaning.

Ultra filtration

Ultrafiltration (UF) is a membrane filtration process similar to Reverse Osmosis, using hydrostatic pressure to force water through a semi-permeable membrane. The pore size of the ultrafiltration membrane is usually 103 - 106 Daltons. Ultrafiltration (UF) is a pressure-driven barrier to suspended solids, bacteria, viruses, endotoxins and other pathogens to produce water with very high purity and low silt density.

Ultrafiltration (UF) is a variety of membrane filtration in which hydrostatic pressure forces a liquid against a semi permeable membrane. Suspended solids and solutes of high molecular weight are retained, while water and low molecular weight solutes pass through the membrane. Ultrafiltration is not fundamentally different from reverse osmosis, microfiltration or nanofiltration, except in terms of the size of the molecules it retains.

A membrane or, more properly, a semi permeable membrane, is a thin layer of material capable of separating substances when a driving force is applied across the membrane. Once considered a viable technology only for desalination, membrane processes are increasingly employed for removal of bacteria and other microorganisms, particulate material, and natural organic material, which can impart color, tastes, and odors to the water and react with disinfectants to form disinfection byproducts (DBP).

HCL Dosing System
HCL Dosing System are available in varied specification depending on several applications and features embedded. The HCL Dosing System is consisting of solution preparation tank with dosing tank. The compatible material is provided to transfer the Highly Corrosive/Concentrated fluid. It is energy efficient And ensures Good Performance.

CAUSTIC DOSING SYSTEM
Unique dosing system offers the best pump for caustic transfer requirement. Caustic Dosing System is available in various designs to meet client's requirement. This system is equipped with motor and water tank of various capacities and widely used in small, medium, and large industries for dosing of caustic

Ultraviolet (UV) Disinfection Unit:
Ultraviolet dis-infection unit shall have over 99.9 % bacterial reduction from inlet to outlet. The dis-infection chamber shall be constructed of SS 316L steel. The UV lamp shall be of low pressure mercury vapor type with hard glass enclosure, the sockets shall be water tight & vibration resistant. The lamp life shall be rated for 6000 hours.. The UV unit shall have reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lamp out alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV lamp shall be easily replaceable type. The lamps should be selected based upon the flow requirement of respective unit.

Treated water Tank:
The treated water from UV Disinfection unit shall be led to treated water tank before its disposal. The capacity of treated water tank shall be designed accordingly.

SCADA Systems
The beauty of modern plumbing is that when we turn on our faucet, we can reasonably expect freshwater to come pouring out. There are few places left in the country that are

untouched by the advancements and regulations of public water. So when the *Washington Post* published an article in 2016 about researchers finding unsafe levels of industrial chemicals in the drinking water of 6 million Americans, wastewater treatment plants and water management services took notice.

The report cited in the Post article found that “194 of 4,864 water supplies across nearly three dozen states had detectable levels of the chemicals.” Of those water supplies, 66 services had at least one sample that exceeded the EPA’s recommended safety limit for two types of chemicals. That ratio might not seem like a high number, but 66 water services affect six million Americans, so it’s clearly not a small issue.

Water treatment plants and water usage facilities can do their part by making sure their monitoring equipment is up-to-date and as accurate as possible. While SCADA (supervisory control and data acquisition) systems are more commonplace in modern operations, an updated version exists and is proving to a more reliable and better solution: a cloud-based SCADA system.

A cloud-based SCADA system allows water management plants to not only monitor levels of specific chemicals and toxins but to have precise records accessible from anywhere. No longer are digital read-outs only available at a fixed point on the SCADA unit. Instead, any manager or operator who needs data can access it from their own satellite- or WIFI-enabled device.

In the contaminated water study, the EPA sought to mitigate the ramifications until stricter guidelines could be drawn up. When it comes to healthy drinking water, Americans don’t want to waste time in the bureaucratic process of defining regulations.

Unfortunately, Congress mandates that before the EPA imposes new limitations on the nation’s water utilities, it has to prove that there is a meaningful opportunity to improve public health. It is a long, arduous process that takes years; officials have not successfully regulated any new contaminant in two decades because the process is complicated and contentious.

Another benefit of a cloud-based SCADA system is that data collected in real-time from the contaminated areas can be studied, compared, and shared with researchers in a faster, more efficient, digital manner. By comparing the data points, researchers can have the most accurate knowledge from which to draw, and that hopefully can lead to quicker results and faster action.

Because of our industrial advancements, the environment is changing faster than we can understand. However, because of our technological advancements, we can use the digital tools available, like a cloud-based SCADA solution, to monitor, record, and support research for improvements.

List of Civil works:

S.No.	Item	Qty.	Material of construction
1.	Bar screen pit	1 No.	RCC
2.	Oil & Grease Trap pit	1 No.	RCC

S.No.	Item	Qty.	Material of construction
3.	Equalization tank	1 No.	RCC
4.	MBBR tank	2 Nos.	RCC
5.	Tube settler tank	1 No.	RCC
6.	Sludge Tank (For 6 days storage)	1 No.	RCC
7.	Clear water tank	2 No.	RCC
8.	Treated water tank	1 No.	RCC
9.	Platforms for Dosing Tank and foundation for equipment.	1 Lot.	RCC

List of E & M Works:

S.No.	Item	Qty.	Material of construction
1.	Bar screener	1 No. Manual type 1No. Mechanical type	MS-EP
2.	Mechanical Oil Skimmer	2 Nos.(1 W + 1 S)	MS-EP
3.	Raw Effluent Transfer Pump:	2 Nos. (1W+1S)	Impeller – CI Body – CI
4.	Air Blower for EQT & FABX	2 Nos. (1W+1S)	CI
5.	MBBR media	1 Lot.	PP
6.	FABX-Air Distribution grid	1 Lot.	UPVC
7.	Sludge Transfer Pumps	2 Nos. (1W+1S)	Impeller – CI Body – CI
8.	Filter Feed Pump	2 Nos. (1w + 1s)	Impeller – CI Body – CI
9.	Screw pump for dewatering of sludge	2 Nos. (1W+1S)	Impeller – CI Body – CI
10.	Filter Press, Centrifuge type	2 Nos. (1W+1S)	Basket –SS304 Body - MS
11.	Air grid for Equalization Tank & SHT.	1 lot.	UPVC
12.	PAC Dosing Tank	1 No. (1w)	LDPE
13.	PAC Dosing Pump	1 No. (1w)	PP
14.	PE Dosing Tank	1 No. (1w)	LDPE
15.	PE Dosing Tank Agitator	1 No. (1w)	SS304
16.	PE Dosing Pump	1 No. (1w)	PP
17.	Tube Settler Media	1 Lot.	PVC
18.	Collection Trough	1 Lot.	MS-EP
19.	Sodium Hypochlorite Dosing Tank	1 No. (1w)	LDPE
20.	Sodium Hypochlorite Dosing Pump	1 No. (1w)	PP
21.	Chlorine Contact Tank	1 No.	MS-EP
22.	Dual Media Filter.	1 No. (1w)	MS - Bituminous
23.	Activated Carbon Filter.	1 No. (1w)	MS - Bituminous

24.	Air grid – Sludge tank Coarse Bubble aeration without Diffuser.	1 lot. (1w)	uPVC
25.	DWPE Dosing Tank	1 No.	LDPE
26.	DWPE Dosing Pump	1 No.	PP
27.	Agitator for DWPE Dosing Tank.	1 Lot.	SS304
28.	Interconnecting piping- Air blower line (B-Class - Confirming to IS1239)	1 Lot.	MS
29.	Interconnecting valves -- Air blower line	1 Lot.	CI
30.	Interconnecting piping -- Sewage line.	1 Lot.	uPVC
31.	Interconnecting Valves -- Sewage line	1 Lot.	PP
32	Ultra filtration plant	1 No.	

1.	Small Atm. Tanks Horizontal tanks	Good Engineering Practice.
2.	FABX tanks and Tube Settler	Design
3.	Piping (MS)	These shall be as per IS 1239 Pt I medium duty ERW up to 150 NB and IS 3589 ERW for 200 NB and above/ PVC/MS piping.
4.	Fittings (MS)	These shall be fabricated from the parent pipes.
5.	Flanges (MS)	These shall be plate type made from IS 2062 Grade A plates drilled to BS10TD SOFF
6.	UPVC Piping	These shall be of PN 10 class upto 110 mm OD, PN 6 class upto 219mm OD
7.	Fitting PVC Piping	Socket cemented joint with rating as per pipe.
8.	Flanges PVC Piping	BS10TD SOFF – Socket Cemented
9.	Fasteners	These shall be as per IS 1367 class 4.6.
10.	Valves	These shall be BUTTERFLY WAFER type MOC :-Body CI (FG200) Disc :- SG Iron with Nitrile / EPDM seating. For PVC piping PVC ball valves will be provided wherever provided.
11.	Check valves	These shall be CI/CIEL Wafer type /PVC.
12.	Instrument isolation	For 1/2 “ connection GM/SS 316 needle valve. For 1” connection CI/CIEL diaphragm valves shall be used.

Plumbing, Interconnecting Pipes and Valves

All the plumbing works including interconnecting pipelines, fittings and valves shall be done. The pipelines to be used shall be of HDPE / MS/ G.I/ /CPVC/UPVC material of construction based on the application.

Control Panel and Cabling

Separate Electrical control panels shall be provided for STP & ETP. Indoor control Panel shall be made out of 14 SWG CRCA sheet duly powder coated. The panel shall be having PVC heat shrinkable sleeved and 4 strip (3 phase + 1neutral) copper bus bar of suitable size and copper interconnections etc. complete as required along with suitable

rated MCCBs/ MCBs for incoming and outgoing, Starters, O-L relay, Single Phase Preventer, Dry run preventer, LED Indication Lamps, Digital Ammeters and Volt meters with selector switch. The Panel shall function in complete Auto Mode / Manual Mode.
Supplying and providing all inter-connecting cabling with XLPE insulated PVC sheathed unarmored copper conductor cables of 1.1 KV grade conforming to IS: 7098 with up to date amendments and of suitable sizes with ISI mark, including connections, lugging, testing, i/c laying UG cable along with earth wires from panel board to all the Equipment / Pumps of STP &ETP in suitable size GI pipes below ground/G. I. tray on surface including supply of suitable size of GI pipe/G. I tray.

Electrical supply shall be tapped from nearest feeder through XLPE insulated PVC sheathed Aluminum/ Copper conductor cable, 1.1 KV grade.

Motors
Motors shall be as per IS 325, TEFC squirrel cage induction motors. Degree of protection shall be IP55. Motors shall be suitable for supply voltage of 415 volts +/- 10%, 50 Hz, A.C. Supply. Insulation Class 'F' considering temperature Rise as Class 'B'. Efficiency Class IE2

Earthing
All the Panels, pumps and other current carrying items shall be properly earthed. Sizes of earth strips, wires shall be as per calculations and shall be of Copper only. All the copper earth strips, copper earth wires shall be connected to main earth grid at suitable points.

Water Treatment Plant (WTP)
It is proposed to provide Water Treatment Plant of suitable Capacity to meet the specified outlet parameters of water. The system shall consist of following components

Water supply /filter feed pumps/ MoC preferably should be -SS-304/C.I casing, SS-304 /Brass /Bronze impeller & SS shaft suitable for operation 400/440 volts, 3 phase, 50 Hz, 2900 rpm, TEFC electric motor with best efficiency class preferably IE-3 complete with all accessories like flexible rubber bellows, strainers, valves, pressure gauges etc. Suitable PCC/RCC foundation with plaster, MS channel plate with primer and two coats of paint, Anti-vibration arrangement of cushy foot mountings should be provided. Multi grade filter/dosing unit/activated carbon/ Softeners sized for optimum working pressure etc. Panels, Allied Equipment & Accessories (level controllers, probes, vibration eliminators, starters, valves, pressure gauges etc.)

All equipment shall be installed on suitable foundations underground pump house

Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.

Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.

The water treatment process shall be designed depending upon the quality of water. pH, TDS, Turbidity, Total Hardness & other biological factors shall conform to latest IS Codes/GRIHA Norms. Suitable nos. of Filters/Softeners shall be considered & sized taking into consideration the diameter, OBR, depth of filter media, backwash arrangement, interconnecting pipes of suitable material (GI/CPVC/UPVC/PVC) & grade,

instruments, valves etc. One standby pump shall be provided considered for each type

- Sufficient maintenance space shall be provided inside the water treatment plant room for accessibility of various pumps, panels etc. during repair & maintenance activities.
- Water Treatment Plant Room shall be suitably ventilated considering adequate ACPH as per NBC 2016 code.
- Water treatment Pump Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.

It is proposed to provide all sanitary engineering services and specification which are:

- High standards of materials and workmanship.
- Provide leak proof plumbing.
- Reliable and dependable engineering systems.
- Provide adequate safety and means to egress easily in case of fire.
- To plan the system in such a way as to minimize the energy requirements.
- To create minimum nuisance and disturbance to the environment

Sizing of Pumps

The Flow Rate of Pumps shall be suitably selected to meet building‘s water demand & of Sufficient Head depending upon Building Height , Pipe Friction losses, Bends etc. and other relevant Site Conditions. One Standby Pump to be considered in each & every variant. The Pumps shall be sized so as to ensure approximately 4 hours of operation time to fill the treated water tank

Multi grade filter (Pressure Sand Filter - Dual Media Filter)

the water treatment technology, a Multi Grade Filter consists of vertical or horizontal pressure sand filters that contain multiple layers of coarse and fine sand (pebbles and gravels) in a fixed proportion. It is a kind of a deep filter bed with adequate pore dimensions for retaining both large and small suspended solids and un-dissolved impurities like dust particles. As compared to conventional sand water filter, this multigrade filtration system works on higher specific flow rates. It is also a low cost pre-treatment system for ion exchangers (deionizer and softener) and membrane systems such as reverse osmosis etc. With high throughputs, high dirt-holding capacity and capacity to reduce turbidity and TSS (< 5ppm) from water, it protects ion-exchange resins and membranes from physical fouling due to suspended impurities present in the water.

The working principle of a multigrade filter is quite straight forward. In a multigrade filter or pressure sand filter, water is passed through multi layers of filter media consisting graded sand, pebbles and gravels layers. The contaminants in the water are captured in the media bed and filtered water passes into the discharge manifold at the bottom of the tanks. The next and last step is backwashing, a process of effectively removal of captured contaminants from the media bed. After back-washing the filter is rinsed with raw water and after the required quality of water is achieved the filter is put back into service.

Dosing unit

Chemical dosing unit processes are always used with physical operations and may also be used with biological treatment processes. Chemical processes use the addition of chemicals to the raw water to bring about changes in its quality.

Example: pH control, coagulation, chemical precipitation and oxidation.
Chemical coagulation and Flocculation:

Coagulation refers to collecting the minute solid particles dispersed in a liquid into a larger mass. Chemical coagulants like Al2 (SO4)3 {also called alum} or Fe2 (SO4)3 are added to raw water to improve the attraction among fine particles so that they come together and form larger particles called flocs.

A chemical flocculent (usually a polyelectrolyte) enhances the flocculation process by bringing together particles to form larger flocs , which settle out more quickly.
Flocculation is aided by gentle mixing which causes the particles to collide.

Activated Carbon Filter
Activated Carbon Filter is widely accepted system in water filtration techniques. The treated water is free from chloramines (chlorine and ammonia mixture) and organic compounds; therefore, best for discharge and production use. Activated Carbon Filter is also utilized in pre-treatment for ro water plant and dm plant as the treated water keeps these systems safe from oxidation or organic fouling.

An activated carbon filter (ACF) works on the principle of adsorption; filter medium adsorbs or reacts with a pollutant molecules then filtered water is drained out. Activated carbon which is used as medium to remove contaminants is natural material derived from coconut shell, lignite, bituminous coal etc

There are some limitations of activated carbon filters (ACF); uses are limited to wastes with low organic concentrations (< 5%) and very low inorganic concentrations (< 1%). Removing highly soluble organics or those with low molecular weights are also out of their capabilities. An activated carbon filtration system is unable to remove all of contaminants; such as, microbes, sodium, fluoride and hardness from water; however, special activated carbon water treatment is necessary for removing lead and other heavy metals. In addition, disposal process of contaminated carbon is complicated if not regenerated.

Water Softener with Brine tank
Water softeners work through a process called ion exchange which eliminates calcium and magnesium from the water. When the hard water enters into the mineral tank, it flows through a bed of spherical resin beads. These plastic beads, usually made from polystyrene, are charged with a sodium ion. The resin beads are anions, meaning they have a negative charge. The calcium and magnesium minerals have a positive charge, making them cations. Since opposite charges attract, the negative charge of the minerals is attracted to the positive charge of the resin beads. As the hard water passes through the resin, the beads grab a hold of the mineral ions and remove them from the water. When the bead seizes the mineral ion, the sodium ion is released. The column of resin strips all the hardness out of the water as it passes through the mineral tank, and softened water flows out into your treated water tank

A water softener is made up of three components: a control valve, a mineral tank, and a brine tank. These three work in conjunction to remove the minerals from hard water, monitor the flow of water, and periodically clean the system through a regeneration process.

Mineral tank

The mineral tank is the chamber where the hard water is softened. The water supply line feeds the hard water into the tank. The water seeps through the bed of resin beads, depositing the water-hardening calcium and magnesium ions. The water exits the tank soft and flows through your pipes and out to your household appliances.

Control valve

The control valve measures the amount of water passing through the mineral tank and into your house. The valve houses a meter that tracks the volume of water entering the mineral tank. As hard water flows through the mineral tank, the resin beads exchange their sodium ions for hardness ions. Over time, this depletes the capacity of the resin to continue to effectively soften water. Before the beads become too burdened with mineral content to continue removing calcium and magnesium ions, the control valve automatically initiates a regeneration cycle. This maximum capacity is pre-programmed into the control valve's onboard computer and is based on a range of factors, like the size of your house, the number of occupants, and the hardness of your water. Control valves are demand-initiated controllers, which allow water softening units to be extremely efficient.

Brine tank

The brine tank aids the water softening system in regeneration. It is a shorter tank that sits adjacent to the mineral tank. The brine tank holds a highly concentrated solution of salt (or sometimes potassium) to restore the resin beads' positive charge. Salt is manually added to the brine tank in the form of pellets or blocks. These dissolve in the water at the bottom of the tank. When the control valve registers the softening capacity of the resin is diminishing, the heavy brine solution is drawn out of the tank and flushed through the resin in the mineral tank. If the brine tank runs out of salt, the water passing through the unit will no longer be softened.

Regeneration cycles inundate the resin beads with a highly concentrated brine solution, washing off the hardness minerals and draining them out of the system. The resin beads are recharged and primed to again eliminate the hardness minerals. Resin beads are extremely durable and can effectively soften your water for twenty years or longer. Water softeners regenerate by one of two methods: co-current or counter-current regeneration (also referred to as downflow brining and upflow brining.

Expected Treated Water Characteristics after Filtration (Domestic Water Requirements for all Buildings)		
SL NO	**Parameters**	**Characteristics**
1	pH	6. 5 – 8.5
2	Total Dissolved Solids	Less than 500 ppm
3	Suspended solids	< 1 mg/ litre
4	Turbidity	Nil
5	Total Hardness	Less than 150 ppm

Expected Treated Water Characteristics after Filtration (Domestic Water Requirements for all Buildings)		
SL NO	**Parameters**	**Characteristics**
1	pH	6. 5 – 8.5
2	Total Dissolved Solids	Less than 500 ppm
3	Suspended solids	< 1 mg/ litre
4	Turbidity	Nil
5	Total Hardness	Less than 40 ppm

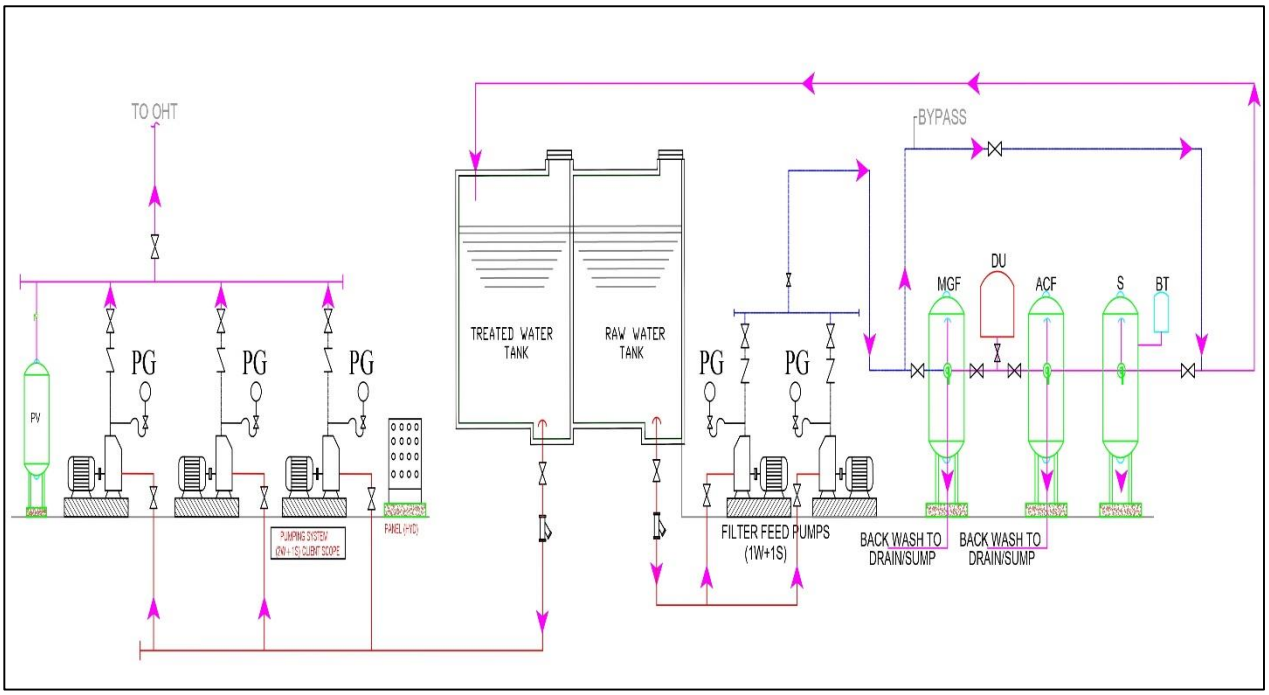
GENERAL REQUIREMENTS

All materials shall be new and of the best quality conforming to specifications and subject to the approval of Engineer.

1. All equipment shall be of best available make manufactured by reputed firms.
2. All equipment shall be installed on suitable foundations, true to level and in a neat work-man-like manner.
3. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
4. Piping within the pump houses shall be so done as to prevent any obstruction in the movement within the pump house.
5. Each pumping set shall be provided with a valve and a flap type non-return valve on the delivery side.

The contractor shall submit the following documents:

a. Process and hydraulic design calculations for all units.
b. Civil, Structural arrangement , design calculations if included in the scope of work.
c. Plant sld drawings
d. Process flow sheet
e. Design Philosophy
f. All technical brochures,
g. Operation and maintenance manuals and other details of the system offered.
h. Equipment’s listing & list of consumables.


TO OHT
PG
PG
PG
PV
TREATED WATER TANK
RAW WATER TANK
PG
PG
BYPASS
MGF
DU
ACF
S
BT
FILTER FEED PUMPS (1W+1S)
BACK WASH TO DRAIN/SUMP
BACK WASH TO DRAIN/SUMP

ELECTRICAL WORKS

TECHNICAL SPECIFICATIONS

C O N T E N T

I. SPECIFICATION FOR ELECTRICAL WORKS

1.0 GENERAL SCOPE OF WORK
2.0 INTERNAL ELECTRIFICATION OF BUILDINGS
3.0 LT PANELS & BUS DUCT
4.0 LOW VOLTAGE (L.V CABLES)
5.0 EARTHING
6.0 LIGHTNING PROTECTION
7.0 CAPACITOR PANEL
8.0 H.T SWITCH BOARDS
9.0 DISTRIBUTION TRANSFORMER
10.0 BATTERY & BATTERY CHARGER
11.0 HT CABLE(XLPE)
12.0 CABLE TRAY
13.0 EXTERNAL LIGHTING
14.0 DIESEL GENERATING SETS
15.0 INTELLIGENT ADDRESSABLE FIRE ALARM
16.0 VOICE NETWORKING
17.0 CCTV
18.0 1 & 3 PHASE ENERGY METER
19.0 UN-INTERRUPTED POWER SUPPLY SYSTEM (UPS)
20.0 ON GRID-TIED SOLAR PV POWER PLANT
21.0 LIFTS

II. SPECIAL CONDITION OF ELECTRICAL WORKS

III. TESTING OF INSTALLATION

1.0 GENERAL SCOPE OF WORK

1.1 Scope

The scope of work shall cover internal & external electrical works along with L.V. System works for the JUDICIAL OFFICERS FLATS AT SECTOR-19,DWARKA, DELHI. The scope covers supply, installation, testing and commissioning of all above System of the project including the following main items /systems

1. Internal Electrification Including Providing MCB Distribution Boards and MV Panels (MDB/SDBs) including sub-main wiring / cabling, T.V & Telephone cables etc.
2. Internal and External illumination with providing and fixing lighting fixtures.
3. Fire – Alarm, Public Address & Talk Back System.
4. Sub-station equipments like 11 VCB Panel, Distribution Transformer, Bus duct, Rising Mains, LT Panels, Capacitor Panels, Battery & Battery charger panel etc.
5. D.G. Set with AMF panel etc.
6. H.T & L.Ts control cabling and its end terminations, cable tray, Hume pipe etc.
7. Solar-PV power system.
8. Earthing and lightning protection of electrical installation complete in all respect.
9. Lifts.
10. CCTV
11. UPS System for common area light and It system
12. BOOM Barrier system
13. Fire Supression
14. EV Charger system
15. Testing and commissioning of all electrical/ digital electronic installations.
16. Obtaining approvals from Chief Electrical Inspectors, Local Electricity Supply Authority (State Electricity Boards), Telecom Department, Chief Controller of Explosives, Pollution Control Board (for DG set) and any other statutory authorities for the complete scope.

1.2 REGULATIONS AND STANDARDS

1.2.1 The installation shall conform in all respects to Indian Standard Code of Practice for Electrical Wiring Installations IS:732-1989. It shall also be in conformity with Indian Electricity Rules and the Regulations, National Electric Code, National Building Code, and requirements of the Local Electric Supply Authority. In general, all materials, equipment and workmanship shall conform to the Indian Standards, specifications and code. Some of the applicable codes/ standards are as under:

a)	Guide for marking of insulated conductors	IS 5578
b)	Guide for uniform system of marking and Identification of conductor and apparatus terminals	IS 11353
c)	Low voltage switchgear and control-gear assemblies	IS 8623 Part-1 to 3
d)	Degrees of protection provided by enclosures for low voltage switchgear and control-gear.	IS 2147
e)	Enclosed distribution boards and cutouts for voltages not exceeding 1000V AC and 1200 V DC	IS 2675
f)	Code of practice for selection, Installation and maintenance of switch gear and control gear.	IS10118 Part1-4
g)	Low-voltage fuses for voltages not exceeding 1000V AC or 1500V DC	IS13703 Part-1&2
h)	PVC insulated (heavy duty) electric cables	IS 1554
i)	PVC insulated cables for working voltages upto and including 1100V.	IS 694
j)	Conduit for electrical installations	IS 9537
k)	Accessories for rigid steel conduits for electrical wiring	IS 3837
l)	Boxes for the enclosure of electrical accessories	IS 5133
m)	General and safety requirements for luminaries	IS 1913
n)	Code of practice for earthing	IS 3043
o)	Electrical accessories – circuit breakers for Over current protection for household and Similar installations	IS 8828
p)	Low voltage switchgear and controlgear	IS 13947 Part 1-5
q)	Residual current operated circuit breakers	IS 12640
r)	Current Transformers	IS 2705
s)	Voltage Transformers	IS 3156
t)	Direct acting indicating analogue electrical Measuring instruments and their accessories	IS 1248 Part-1 to 9

U) CONTROL SWITCHES (SWITCHING DEVICE FOR CONTROL IS 6875 PART- 1 TO 3 AND AUXILIARY CIRCUITS INCLUDING CONTACTOR RELAYS) FOR VOLTAGES UPTO AND INCLUDING 1000V AC AND 1200V DC

v) Oil type power transformer IS 1180 Level-2

1.3 Fees, Permit and Tests

The contractor shall obtain all sanctions including (i.e. electrical load, approval of drawings) and permits required for the electrical installation including D.G. Sets, L.V. Systems etc. work from SEB/ Chief Electrical Inspector/ Local Authorities. All actual fee payable in this regards will be re-imbursed against receipt/documentary evidence. On completion of the work the contractor shall obtain N.O.C. from SEB & Chief Electrical inspector, Pollution Board etc a copy of the same shall be delivered to the Employer through consultant. The consultant shall have full powers regarding the materials or work got tested by Independent agency at the electrical contractor's expense in order to prove their soundness and adequacy. The contractor will rectify the defects/ suggestions pointed out by independent agency through employer/consultants at his own expense.

1.4 Rules & Regulations

The installation shall comply in all respects with the requirements of Indian Electricity Act 1910 as amended upto date, NEC Indian Electricity Rules 1956 amended upto date there under, and special requirements, if any of the State Electricity Boards etc. Local administration (such as the tenderer/contractor) is liable to furnish the list of authorised licensed persons/employed/deputed to carry out the works/perform the assigned duties to full fill the requirements of Rule No. 3 of IER-1956, as amended upto date. As regards power circuit. The outlets shall be provided according to the load designed for these circuits. In no case there shall be more than two to six (FCU's) outlets per circuit.

1.5 Shop Drawing

The contractor shall prepare detailed co-ordinated electrical shop drawing including all electrical equipments and cable system referring other services e.g. Architecture, AC, Plumbing, FA, Telephone etc. and submit to the consultant for his approval or the Engineer in charge before commencing the work. The shop drawings shall show all setting out details and physical dimensions of all components in the system i.e. conduit and cable routes location of mains and sub-distribution boards junction boxes, manhole trap and fixing details. These shall also indicate the number and size of wires in each section of conduit. All work shall be carried out on the approvals of these drawings. However, approvals of these drawings do not relieve the contractor of his responsibility to meet with the intent of the specifications.

Completion Drawings / As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the consultant 6 sets of "As-Built drawings" of the work along with original tracings & Soft copy. These drawings must provide.

a) Trenches, inspection and pull boxes.

b) Number and size of cable in each rack/Trenches.

c) Layouts and rating of Transformers & D.G. Sets HT/LT Panels etc.

d) Location and details of distribution board, main switches, switch gear and other particulars. (along with nomenclature)

e) A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system. In hard copy and AutoCAD.

f) Location of outlets of various services, junction boxes, light fixtures and

g) Location of all earthing stations(with nos) route and size of all earthing conductors and the values of the earth pits just after installation.

h) Instructions, maintenance and operation manuals for equipments supplied.

i) Layout and particulars of all cables.

1.6 Position of Lighting, Distribution Switchboards Panel

a) The recommended positions of the light points, control switches, distribution boards and switchgear as shown on the layout drawings will be adhered to as far as practicable. In case the location changes due to architectural requirements, no extra payment will be made to contractor on this account.

b) Should there be any discrepancy of incomplete description ambiguity or omission in the drawings or in other documents whether original or supplementary forming the contract, the tenderer shall immediately on discovering the same shall draw attention of the Architect.

c) Before commencement of work, the exact final position of all points, switch boxes and the distribution boards shall be ascertained by the contractor from the Architects. Contractor shall mark the location at site and got approved before execution of work.

1.7 Samples

The contractor shall submit samples of accessories and apparatus, he propose to use in the installation from approved make, at site for approval of employer as required. The employer & Consultant jointly will approve the sample. This specification shall not be departed without any written instructions from the Consultant. The verbal approval given by the Consultant to any exonerate the contractors from their liability to carry out the work in accordance with the terms of the contract.

1.8 Manufacturer's Instructions

Where manufacturers have furnished specific instructions, relating to the material/equipments to be used on this job, covering points not specifically mentioned in this document, manufacturers instructions shall be followed.

1.9 Materials and Equipments

All the materials and equipments shall be of the approved make and design. Unless otherwise called for, only the best quality materials and equipment shall be used.

1.10 Storage-Cum-Erection Insurance

All the equipments and materials being supplied by the contractor shall be completely insured at his own cost from the time of despatch from the manufacturer works upto the completion of erection, testing and commissioning at site and taking over by the client. It will be the responsibility of the contractor to settle all claims with the Insurance Company in case of any damage, loss, theft, pilferage or fire and the owner shall be kept informed about it. The losses, if any will have to be borne by the contractor, if the claims are not lodged and passed properly or in time or if the same are not settled by the Insurance Company.

1.11 Site Conditions & Design Criteria

All equipment shall be designed for an ambient temperature of 50 C and 100% Relative humidity. It is the responsibility of the contractor to survey the site and acquaint himself to prevailing site conditions before quoting.

ELECTRICAL DETAILS OF INCOMING SUPPLY

a)	Supply Voltage	11 KV
b)	Fault level (sym.) at supply of point (designed)	500 MVA (to be confirmed from State Electricity Board by Tenderer).
c)	Neutral	Grounded
d)	Voltage Regulation	± 10%
e)	Frequency Regulations	± 3%
f)	Combined	± 10%

L.T. POWER DISTRIBUTION SYSTEM

a)	Voltage	415 V
b)	Frequency	50 Hz
c)	Neutral	Grounded
d)	Short Circuit Fault withstand Capacity	25 - 100 KA (1 Sec.) as per B.O.Q. and specification.

CONTROL SUPPLY FOR ELECTRICAL SYSTEM

The various supply voltage to be used in the control panels for main equipments are:

a)	Spring Charge Motor	230 Volt AC
b)	Closing/Trip Coil	24V DC
c)	Alarm/Indication/Relay	24 V DC
d)	Heaters	230 V AC

PAINTING OF PANEL	Powder coating of approved shade as per Specification
PAINTING OF CABLE TRAY AND STRUCTURE STEEL	Powder coated of approved shade as per Specification

CABLE DETAILS

L.T. CONTROL CABLES	Copper conductor FRLS PVC/ XLPE insulated 1.1 KV grade.

POWER CABLES (L.T.)	Copper / Aluminium conductor FRLS PVC/ HRPVC / XLPE armoured.
1.1 KV & ABOVE	Aluminium conductor XLPE armoured.
GROUNDING CONDUCTOR	Copper/G.I. as per data sheet.
ACCURACY CLASS OF METERS	
a) Revenue Metres	Class-0.2 or as per SEB approved.
b) Ammeter Voltmeter and Other Instrument	Digital Type.

1.12 Prices

Prices shall remain firm and free from variation due to rise & fall in the cost of materials and labour during the stipulated period of execution and during extended period of completion of work.

Item rates shall remain valid for any variation in the estimated quantities given in schedule of quantities.

1.13 Measurements

All measurements shall be taken in accordance with the Indian Standard Code for Electrical Installation in building method of measurements IS:6980:1970 unless otherwise specified.

1.14 Painting of All Steel Work

The steel used for fabrication of electrical/mechanical equipment should be powder coated as per the detailed specifications given below:

a) Degreasing: All the steel components, to be painted, should be effectively cleaned by alkaline degreasing.

b) Pickling: Oxide scale rust formation are to be removed in a hot bath of sulphuric acid. Pitting of the surface is to be prevented by the use of pickling inhibitors.

c) Cold Rinsing: The parts are then to be washed with cold water to remove all traces of acidic solution.

d) Phosphating: In order to attain durable paint coating the metal surface is to be given phosphating treatment by development a phosphate layer on the surface. Preferably hot grenadine solution is to be used in the phosphating plant.

e) Passivating: This process is to be carried out by using diluted solution.

f) Drying: The treated parts should then be dried in a hot chamber in dust free atmosphere to ensure that they are absolutely clear and dry before the paint is applied.

g) Primer Coating: The treated and dried parts are to be sprayed with high corrosion resistance primer.

h) Stove Drying: The primer coating is to be backed in an electrically heated, air circulated area type storing oven.

i) Finishing Coat: The finishing paint coat is to be applied by spraying one coat of 60 micron thickness powder coated paint of approved shade.

2.0 INTERNAL ELECTRIFICATION OF BUILDING

2.1 GENERAL

The electrical Installation work shall be carried out in accordance with Indian Standard Code of Practice for Electrical Wiring Installation IS: 732-1989 and IS: 2274-1963. It shall also be in conformity with the current Indian Electricity rules and regulations and requirements of the Local Electricity Supply Authority and Fire Insurance regulations, so far as these become applicable to the installation.

Wherever this specification calls for a higher standard of material and or workmanship than those required by any of the above mentions regulations and specification then the specification here under shall take precedence over the said regulations and standards. In case of discrepancy/ambiguity in specifications the specifications given herewith will prevail.

2.2 DISTRIBUTION BOARDS

Distribution Board shall be of standard type with 16 SWG CRCA sheet steel, powder coated of approved shade. Distribution boards shall contain miniature circuit breakers of rating specified in BOQ/DB Schedule.

Miniature circuit breakers shall be quick make and quick break type with trip free mechanism. MCB shall have thermal and magnetic short circuit protection. All miniature circuit breakers shall be of 10 KA rated rupturing capacity unless otherwise specified.

Neutral busbars shall be provided with the same number of terminals, as there are single ways on the board, in addition to the terminals for incoming mains. An earth bar of similar size as the neutral bar shall also be provided. All live parts shall be screened from the front. Ample clearance shall be provided between all live metal and the earth case and adequate space for all incoming and outgoing cables. A circuit identification card in clear plastic cover shall be provided for each distribution board.

MCB's shall be provided on the phase of each circuit. The individual banks of MCB's shall be detachable. There shall be ample space behind the banks of MCB's to accommodate all the wiring. All the distribution boards shall be completely factory wired, ready for connections. All the terminals shall have adequate current rating and

size to suit individual feeder requirements. Each circuit shall be clearly numbered from left to right to correspond with wiring diagram. All the switches and circuits shall be distinctly marked with a small description of the service installed.

Earth Leakage Circuit Breaker shall be current operated type and of 100mA sensitivity unless otherwise specified. It shall also provide over-current and short circuit protection i.e. it shall be MCB-cum-RCCB (Residual Current Circuit Breaker). In case ELCB doesn't have inbuilt short circuit protection, same rating MCB have to be provided for short circuit protection along with ELCB. Cost of this MCB is deemed to be included in the cost of ELCB. ELCB shall be housed within the Distribution Board.

Before procurement of Distribution Boards, MCBs, ELCBs (incomer and outgoings switchgears) etc, the contractor has to make the DB Schedule of Each DB on the basis of the working drawings and take approval of the DB Schedule/Drawings of each DB from the Engineer-In-Charge. The whole unit i.e. Distribution Board, MCBs, ELCBs etc. shall come from the manufactures premises/ workshop. After inspection and clearance from the Engineer-In-Charge the same may be dispatched to site for installation. However if a single component (such as ELCB or MCB or DB) is required for any reason such as replacement, increase in no. of circuits in the DB, change in the load of existing circuit, change in the total load on a particular DB etc., the same may be ordered separately but after the approval of Engineer-In-Charge.

2.3 MS/PVC CONDUIT WIRING SYSTEM.

2.3.1 TYPE AND SIZE OF CONDUIT.

All conduit pipes shall be of approved gauge as per the dimensions & quality specified in IS. The maximum number of PVC insulated 650/1100 volts grade copper conductor cable that can be drawn in conduit of various sizes shall be as per IS Code. No conduit less than 20mm in diameter shall be used, and conduit laid exposed on surface must be MS conduit.

2.3.2 CONDUIT JOINTS.

Conduit pipes shall be joined as per the ISI code.

2.3.3 RECESS/CONCEALED CONDUIT.

The chase in the wall shall be neatly made and of sample dimensions to permit the conduit to be fixed in the manner desired. In the case of building under construction, conduit shall be buried in the wall before plastering and shall be finished neatly after erection of conduit. Incase of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work. Entire work of chasing the wall, fixing the conduit in chases, and burying the conduit in mortar before plastering shall form part of point wiring work.

The conduit pipe shall be fixed by means of staples or by means of saddles not more than 60cm apart or by any other approved means of fixing. Fixing of standard bends and elbows shall be avoided as far as practicable and all curves maintained by bending the conduit pipe itself with the long radius, which shall permit easy drawing in of conductors. All threaded joints of conduit pipe shall be treated with some approved preservative compound to secure protection against rust. Suitable inspection boxes to the barest minimum requirements shall be provided to permit

periodical inspection and to facilitate replacement of wires, if necessary. These shall be mounted flush with the wall. Suitable ventilating holes shall be provided in the inspection box covers. Wherever the length of conduit run is more than 10 meters, then suitable size junction box shall be provided. Cost of these junction boxes is deemed to be included in cost of conduiting.

Suitable size fish wire shall be provided in the conduit, at the time of conduit laying, to facilitate wiring.

2.3.4 METAL OUTLET BOXES & COVERS.

The switch box shall be made of modular metal boxes with suitable size modular cover plates. Modular metal box shall be made of mild steel on all sides except on the front. Modular metal boxes shall be of same make as that of the switches/sockets etc.

The metal box (other than modular type) shall be made of metal on all sides except on the front. Boxes shall be hot dip galvanized/ chrome plated mild steel Box. Metal boxes upto 20 x 30 cm size M.S. box shall have wall thickness of 18 SWG and MS boxes above 20 x 30 cm size shall be of 16 SWG. Clear depth of the box shall not be less than 60mm. The metal boxes shall have a provision to connect earthing wire.

2.3.5 ERECTION OF CONDUITS.

The conduiting for each circuit or section shall be completed before conductors (Wires/ Cables) are drawn in.

2.3.6 SWITCHES.

All 6 and 16 Amp switches shall be modular type of 240 volts A.C. grade. All switches shall be fixed on approved modular metal boxes. All 6 Amp socket shall be 5 pin type and 16 Amp socket shall be 6 pin type (unless otherwise specified) suitable for 16/6 Amp. All modular switches, sockets, telephone outlets, TV outlet etc. shall be in off white finish unless otherwise specified. The switches for controlling the lights or fans shall be connected to the phase wire of the circuit. Switch boards shall be located at 1050 mm above finished floor level unless otherwise indicated on drawings or directed by Engineer-In-Charge.

2.3.7 COVER PLATE.

All modular switches, sockets, telephone outlets etc. shall be fixed modular metal boxes with modular base plates and modular cover plates on top.

2.3.8 WALL SOCKET PLATE.

Each outlet shall have a switch located beside the socket preferably on the same cover plate/modular base. The earth terminal of the socket shall be connected to the earth wire.

2.3.9 WIRING.

All FRLS PVC insulated copper conductor wires shall conform to relevant IS Codes. All wires/cables shall be stranded type irrespective of its size. Cable conductor size

and material shall be specified in BOQ.

All internal wiring shall be carried out with FRLS PVC insulated wires of 650/1100 volts grade. The circuit wiring for points shall be carried out in looping in system and no joint shall be allowed in the length of the conductors. Circuit wiring shall be laid in separate conduit originating from distribution board to switch board for light/fan points. A switchboard may have more than one circuit but shall have to be of the same phase. Each circuit shall have a separate neutral. Neutral looping shall be carried out from one switchboard to the other or between light/fan points. Conduit for point wiring may be used for circuit wiring from first switchboard to subsequent switchboard(s). Cost of circuit wiring from first switchboard to subsequent switchboard(s) is deemed to be included in the cost of point wiring. A separate earth wire shall be provided along with circuit wiring for each circuit. For point wiring red/yellow/blue colour wire shall be used for phase and black colour wire for neutral. Circuit wiring shall be carried out with red, yellow or blue colour FRLS PVC insulated wire for RYB phase wire respectively and black colour FR PVC insulated wire for the neutral wires. FRLS PVC insulated copper wire shall be used as earth continuity conductor and shall be drawn alongwith other wires. No wire shall be drawn into any conduit until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires so that no damage occurs to the insulation of the wire.

Before the wires are drawn into the conduit, the conduits shall be thoroughly cleaned of moisture, dust and dirt. Drawing and jointing of copper conductor wires and cables shall be as per CPWD specifications.

Maximum number of FRLS PVC insulated 650/1100 V grade aluminium /copper conductor cable conforming to IS: 694 – 1990 should be as per specifications.

2.3.10 JOINTS

All joints in wiring shall be made at main switches, distribution board socket and switch boxes only. No joint in wiring shall be made inside the conduits or junction boxes. Conductors shall be continuous from outlet/switchboards to outlet or from MCB to outlets.

2.3.11 LOAD BALANCING

Balancing of circuits in three-phase installation shall be planned before the commencement of wiring and shall be strictly adhered to.

2.3.12 COLOUR CODE FOR CIRCUIT WIRING.

Colour code for circuit and sub main wiring installation shall be Red, Yellow, and Blue for three phases. Black for neutral and green for earth incase of insulated earth wire. In case of single-phase circuits either of Red, Yellow or Blue colour wires can be used.

2.4. CLASSIFICATION OF POINTS.

2.4.1 Point Wiring (Modular)

Defination of point wiring

A point (other than socket outlet point) shall include all work necessary in complete wiring to the light points/ fan/ exhaust fan/ call bell point from the controlling switch/MCB. The scope of wiring for a point shall, however, include the wiring work necessary in tapping from another point in the same distribution circuit i.e. from first switch board (wiring from distribution board to first switch box is covered in the circuit wiring and is in the scope of point wiring) to subsequent switch board(s) in the same distribution circuit. The point wiring includes all materials specified below including chasing the wall (in case of recessed wiring in wall), supply and fixing the conduit and making the wall good as it originally was. It also includes supply, drawing, testing and commissioning of wires. Classification of Group A, B, & C must be followed as per guidance of Delhi Shedule of rates along with CPWD General Pool of Residence.

2.4.2 Scope of point wiring

Following shall be deemed to be included in point wiring.

(a) Supply & fixing conduit & conduit accessories for the same and wiring cables (including supplying and drawing wires) between the switch box and the point outlet.
(b) All fixing accessories such as clips, nails, screws, Phil plug, Rawl plug etc. as required.
(c) Modular Metal boxes for control switches, electronic fan regulators, sockets etc. recessed or surface type, modular base plates and modular cover plates over the same.
(d) Outlet boxes, junction boxes, pull-through boxes etc. provided for the switchboards for loose wires/conduit terminations.
(e) In case of recessed wiring in wall the scope includes chasing of wall, fixing the conduit and making the wall good as it originally was.
(f) Control modular switch (5/6A) as specified in the BOQ.
(g) Ceiling rose or connector (in case of points for ceiling/exhaust fan point and prewired light fittings).
(h) Connections to ceiling rose, connector, socket outlet, lamp holder, switch etc.
(i) Interconnecting wiring between points on the same circuit, in the same switch box or from another. Interconnecting wiring from first switchboard to subsequent switch board(s).
(j) Protective (loop earthing) conductor (as specified in the BOQ) from one metallic switch box to another in the distribution circuits, and from switchboard to each point (light/fan/exhaust fan/call bell etc).
(k) Bushed conduit where wiring cables pass through wall etc.
(l) Ceiling rose (in the case of pendants except stiff pendants).
(m) Lamp holder (in the case of goose neck type wall bracket, batten holder and fittings which are not prewired).
(n) Back Plate (in the case of stiff pendants).
(o) MS Hexagonal fan boxes (Painted with 2 coats of red oxide & one coat of black bituminous paint)/ GI fan Boxes in case of Fan points.
(p) Circuit & sub-circuit wiring.

2.4.3 Measurement of Point Wiring (other than socket outlet points)

i) There shall be no linear measurement for point wiring for light points, fan points, exhaust fan points and call bell points. These shall be measured on unit basis by counting, irrespective of whether it is controlled by a switch or has been looped to another light/fan point.

ii) No separate measurement shall be made for interconnections between points in the same distribution circuit and for the circuit protective (loop earthing) conductors between metallic switch boxes.

2.4.4 Circuit and Submain Wiring

Circuit Wiring

Circuit wiring shall mean the wiring from the distribution board upto the tapping point for the nearest first point of that distribution circuit i.e. upto the nearest first switch board.

Submain Wiring

Submain wiring shall mean the wiring from one main/distribution switchboard to another.

Measurement of submain wiring

Submain wiring shall be measured on linear basis along the run of the wiring. The measurement shall include all lengths from end to end of conduit, exclusive of interconnections inside the switchboard etc. The increase on account of diversion or slackness shall not be included in the measurement.

2.4.5 Power Plug Wiring

(a) 6A Plug Wiring

Wiring for all 6 A Socket Outlets shall be done with 2X1.5 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing of Conduit with accessories) along with the earth wire as specified in the BOQ, from the switch board as the case may be.

(b) 16A Power Plug & Special Power Point Wiring

Wiring for all 16Amp Socket Outlets/Geyser point shall be done with 2X4 sqmm PVC insulated copper wire in suitable size MS Conduit (including supplying and fixing of Conduit with all accessories) along with the earth wire as specified in the BOQ/Drawings, directly from the MCB-Distribution Board or from one power point to another in case of computer power points. Looping shall not be done in general 16A power points (other than computer power points).

Measurement of all power points wiring shall be done on Linear Basis as per BOQ Item.

No extra payment shall be made on account of changes in location of power points (6A, 16A or 20A Power Points or computer power points) due to change in the architectural layout or change due to any other reason. Height of the power socket outlets shall be 300mm from the finished floor level or 300mm from the counter/working platform in case of points to be provided in kitchen area, lab areas etc. unless otherwise specified.

2.4.6 CONDUCTOR SIZE

Wiring shall be carried out with following sizes of FR PVC insulated stranded single core copper conductor wire/cable.

i. Light point. - 1.5Sq.mm / 4.0 sq.mm
ii. Ceiling /Cabin/Exhaust Fan Point - 1.5Sq.mm
iii. Plug Point (6 A Outlet) - 2.5Sq.mm
iv. Circuit Wiring - 2.5Sq.mm
v. General Power Point - 4Sq.mm
vi 25A/20A Industrial Socket Outlet with MCBfor AC and gyser – 6 Sqmm

3.0 LT PANELS & BUS-DUCT

Medium voltage switch boards, motor control centre or the combination of both these components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ compliment each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the drawing, specifications shall be construed as being required and nos. extra charges shall be payable on this account.

3.1 Codes & Standards

The design, manufacture and performance of equipment shall comply with all the currently applicable statues, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (B.S.), International Electro Technical Commission (IEC) Publication, Electro NEMA, IDE & DEMA standard as amended upto date.

a)	IS:13947-1993/IEC60947-1989	:	Air circuit breaker / moulded case circuit breaker.
b)	IS : 3156	:	Voltage Transformers.
c)	IS:2705 Part-I, II & III 1964	:	Current transformers for metering and protection with classification burden and insulation.
d)	IS: 9224	:	Low voltage fuse and protection.
e)	IS: 3231	:	Specification for electrical relays for power system protection.
f)	IS:8623	:	Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.
g)	IS:4237	:	▪ General requirements for switch gear and control gear for voltage not exceeding gear.
h)	IS:2147	:	▪ Degree of protection provided by enclosures for low voltage switch gear and control gear.
i)	IS:1018	:	Switchgear and control gear selection/installation and

			maintenance.
j)	IS:1248	:	Direct acting electrical indicating instruments.
k)	IS:375	:	▪ Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking. ▪
l)	IS:2959	:	AC contactors for voltage not exceeding 1000V.
m)	IS:5578	:	Guide for marking of insulated conductors.
n)	IS:11050	:	Guide for forming system of marking and identification of conductors & apparatus terminal.
o)	IS:1248	:	▪ Direct acting indicating analogue electrical measuring instruments and testing accessories.
p)	IS:6005	:	Code of practice for phosphating of iron & steel. ▪

The board shall be metal enclosed single front, indoor, floor mounted free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-54. However bus bar chamber shall have IP:42 degree of protection incase bus bar rating exceed 1600 Amps. IP-55, with weather proof enclosure for out door installation Keeping in view the operating height of the top switch 1750mm from finish floor. 200mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and 50mm height. The panel manufacturer shall have the valid CPRI test certificates of required rating/capacity as indicated in BOQ.

All cutouts and covers shall be provided with synthetic rubber gaskets (neoprene)

The panel shall be divided into distinct vertical sections each comprising of:

i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.
ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB etc.
iii) Compartment for power and control cables of at least 300mm width covering entire height provided.
iv) The panel shall have sufficient space at least 20% of outgoing feeders with wiring provision for future use.

The front of each compartment shall be provided with hinged single leaf door with locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and MCCB/ACBs and accessories shall be of fixed/drawout type as per BOQ.

Each feeder shall have compartmentalised or non-compartmentalised for MPCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate shall be provided) as required.

The panel shall be provided with three phase buses and neutral bus bars of high conductivity electrolytic Aluminium sections throughout the length of the panel and shall be adequately supported and braced to withstand the stressed due to the short circuit current of 20 to 100 KA rms. for 1 sec. as called for in BOQ. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C capacity of aluminium bus-bar shall be considered as 0.8 amp per sq.mm and 1.0 Amp per sq.mm for copper conductor.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be as per IS. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fibre glass moulded material.

All bus bars shall be colour coded as per IS:375.

G.I./Copper earth bus of suitable size minimum shall be provided at the bottom of the panel throughout the length. Similarly suitable size of aluminium strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel where MCCB is on position. Safety interlock with operating handle shall be provided. All MCCB shall be with vertical operator.

Contactors shall be electro magnetic type with interrupted duty as per IS:2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS:6875 (Part-II).

3.2 ACB (AIR CIRCUIT BREAKER)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IS:13947-1993 /IEC 60947-2 and switch disconnect as per IEC 60947-3 with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere The breaker shall be provided with variable microprocessor based releases for over load, short circuit and earth fault protection.

For the complete range of ACB, Ics=Icu=Icw for 1 sec with two-way communication feature in-built in the release. Thermal memory shall be a standard feature and shall be suitable for 50 degree ambient Temp without derating. Manufacturer should submit the derating Charts .ACB shall have common accessories(continuously rated). All EDO ACB shall be provided with “Ready to close” contact. ACB release should have Zone Selective Interlocking (ZSI). There shall be flexibility in terminal orientation by 90 degree to suit site condition. ACB shall be provided with full rated

neutral with setting at 50%, 100% and OFF. ACB shall have Dual core “Rogoskey type” CT. ACB shall have stainless steel filter to absorb ionized/ hot gases in case of higher short ckt condition.ACB shall be suitable for impulse voltage for 12 KV and shall have the in-built “Auto-protection” feature, so that high level short circuit can be cleared and I2t feature should be there to discriminate with upstream breaker.
Release Parameter:

ACB release shall be able to provide Restrickted Earth Fault (REF) and shall have making current release. LCD display shall be there with % loading graph for individual load. Release shall have both DIAL type potentiometer and navigation keys for setting the parameter. The release should be self powered and there should be LED for fault differentiation.

The breaker shall consist of a horizontal drawout pattern triple/four pole, fully interlocked, independent manual/motorised spring operated mechanism. The mechanism shall be such that the circuit breaker is at all times free to open immediately. The trip coil is energised. Current carrying parts shall be silver plated and suitable arcing contacts shall be provided to protect the main contact arc-chutes with Cover for each pole shall be provided and shall be lifted out for the inspection of main and arching contact.

Self aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct position - SERVICE/TEST/ISOLATED within the cubicle.

Breaker shall be provided with automatic safety shutters with locking arrangement to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

- Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.
- Interlock to prevent earth connection from being made by the earthing device except breaker is open.
- Interlock to prevent the breaker being closed unless it is fully raised.
- Interlock to prevent the breaker from being made alive without its rack in position.

3.3 MOULDED CASE CIRCUIT BREAKER (MCCB)

MCCB shall confirm to the latest IS13947-1993/IEC 60947-1989. The Service Short Circuit Breaking Capacity (ICS at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Double Make – Break switching mechanism are extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating moulded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with electronic releases. There should not be any derating upto 50 degree.

The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimise the let thru' energies and capable of achieving total discrimination upto the full short circuit capacity of downstream MCCB. It should be the responsibility of panel builder & OEM to submit the discrimination study at the time of drawing approval. The manufacturer shall provide both the discrimination tables and let thru' energy curves. The MCCB shall not be restricted to Line/Load connections. MCCB should have cross bolted termination to withstand higher short ckt. Fault levels.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts i.e. Positive Isolation as per IEC 60947-2. In case of 4 pole MCCB the neutral shall be defined and capable of offering protection. All accessories shall be rated for continuous operation and shall be common for entire range.

MCCB should be suitable for Class-II front face as per IS / IEC 61140. The general purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

MCCB shall be provided with microprocessor based trip unit (as per BOQ / Schedule of Quantities.

The switch shall be normally a fixed control box type heavy duty unit.

Indicating lamps shall be of the panel mounting, filament/LED type and shall have execution plates marked with its function wherever necessary. It should be possible to have fault differentiation against O/L, S/C and E/F.The colour of the lamp cover shall be red for 'ON' and green for 'OFF' indicating lamps shall be provided with series resistor.

3.4 NAME PLATES & LABLES

i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switch boards, similar panel and board identification labels shall be provided at the rear also.

ii) All name plates shall be of non-rusting metal or 3 ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to Owner's approval.

iii) Suitable stenticilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

3.5 PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade as per painting clause.

3.6 WIRING

Control and protective wiring shall be done with copper conductor PVC insulated

1100 volts grade multi-stranded flexible wire of 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS:375.

Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or splied between terminal points.

Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than one wire shall be connected to any terminal block. All door frame of L.T. switchboard shall be earthed with bare braided copper wire.

3.7 Testing & Inspection

After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by primary or secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2.5 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out alongwith copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switch boards.

3.8 DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general

constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducibles shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.
ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.
iii) A comprehensive spare parts catalogue.

TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switch board shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

LT BUS DUCT –Air Insulated

The Bus duct shall be of indoor type for connections between Equipment & Panels and Panels to panels. Bus Duct system shall be suitable for continuous current rating and shall have rupturing capacity of 35 MVA at 415 volts or as indicated in BoQ. The bus duct panel manufacturer shall have the valid CPRI test certificates of required rating/capacity as indicated in BOQ.

CONSTRUCTION

Bus duct shall consist of three phase and neutral busbars permanently positioned. Bus duct inside the Substation building shall conform to degree of enclosure protection IP 42 and IP55 weather proof for outdoor installation with upto date amendments. Minimum thickness of sheet steel enclosure shall be of 2mm, in case width does not exceed 270mm. For width more than 270mm up to 750mm, minimum thickness of sheet steel shall be 2.6mm. The busbars shall be of high conductivity electrolytic quality aluminium conforming to relevant Indian Standards and shall be of sufficient cross section. Current density of busbars shall be considered as 0.8 Amp/ sqmm. The cross section of neutral busbar shall be half of phase busbars. Entire length of busbars shall be provided with colour coded PVC sleeves. Bus duct shall be natural cooled with inspections covers at suitable intervals. Busbars shall be supported with 12mm thick non-hygroscopic insulating material at every 600mm but allowing busbar to expand on normal operation but restrict excessive movement under fault conditions. Expansion joints shall be provided in such a way that expansion and contraction does not have undue strain on the bus at the terminals at both ends.

The Bus duct arrangement shall have a common frame earth bar of sizes 2No. 75mm x 10mm of GI for entire length suitably loop earthing various section. Two numbers of each terminal shall be provided for earthing connections. Frame earthing of Bus duct system shall be connected to two earthing terminals at Main L.T. Panels and Transformer ends / D.G. ends.

Installation

Bus duct shall be suitable suspended/ supported from ceiling and/ or wall as required. In case of ceiling suspended Bus duct, supports shall be of 40mmx40mmx6mm angle iron. Horizontal distance between supports shall not exceed 1200mm. Bus duct supports shall be suspended from ceiling with suitable suspension device to the satisfaction and approval of PMC\ Consultant. Incase of Bus duct supported from wall, supports shall be provided at intervals not exceeding 1500mm. At bends, branches and vertical drops, supports shall be provided within 300mm of bends, branches & vertical drops. Supporting systems shall be of 40 x 40 x 6mm MS angle iron vertical suspending M.S. rods shall be of 12mm diameter.

TESTS

Following tests shall be carried out at site and test results recorded.

i. Insulation resistance test with 500 volts megger. The insulation resistance shall be not less than 100 mega ohms. The testing shall be done as per IS 8084 - 1976 with upto date amendments.
ii. Earth continuity test.
iii. Heat run test.

LT BUS DUCT –Sandwitch type

1.1.1 Scope:

The specification covers design, manufacturing, supply, installation, testing and commissioning of Sandwich type busbar trunking for use as feeder busbars for interconnection between separate electrical equipment / load centers, and for use as plug in busbar risers.

1.1.2 System details:

The busbar shall be suitable for operation in a 1000V system with insulation voltage of 1000V and frequency of 50 Hz having 100% neutral and 50% integral earth . The bus duct shall conform to seismic protection certification (Zone-4 as specified in NBC/CBC). Product and its manufacturing process should be in compliance with KEMA KEUR and ASTA DIAMOND certification.

Degree of ingress protection (IP rating) shall also be tested at any reputed independent laboratory. This test shall be for IP54 for indoor application and IP65 for outdoor application for sandwiched busbars.

1.1.3 Manufacturer

The manufacturer must have ISO 9001 certification for design, manufacture and testing of busbar systems. It should be noted that cast resin should not be considered for primary insulation as it is prohibited as per IEC 60364 chapter 5.523.6.

1.1.4 Design & Construction requirements – Sandwich busbars

General: The busbars shall be of sandwich construction, non-ventilated design. It shall be possible to mount the busbar system in any orientation, without affecting the current rating.

The bus duct shall consist of three phases and neutral bus bar permanently positioned dust and vermin proof and the degree of enclosure protection shall be IP54 for indoor installation and shall be IP-65 for outdoor installation as per schedule of quantities.

Busbars: The busbars shall of high conductivity Aluminum, as specified in the tender and should conform electrolyte grade of 91E. Where an earth conductor is required, it shall be a integral earth conductor, of the same high conductivity material and should be 50% as of phase conductors. Current density of bus bars shall be considered as 1.0 Amp/sq.mm

Insulation: The busbars shall be insulated throughout their length by Mylar. The insulation material used shall be of Class B (130 deg. C). The insulation must comply to UL 94 V-O.It shall be Halogen Free.

Housing: The housing shall be made of extruded Aluminum (1.5 mm thick) case duly enameled/ electro-galvanized sheet steel, with an epoxy powder coated paint finish. The housing shall be profiled, to provide higher strength and efficient heat dissipation. The temperature rise at any point of the busbar shall not exceed 55 degree C rise above ambient temperature (40 degreeC) when operation at rated current. The width of the housing shall preferably be the same for all ratings of busbars, in order to provide interchangeability of tap off boxes. The housing of busduct should conform to minimum IK 10 as per IEC62262.

1.1.5 Tap off units:

Vendor shall provide “Tap Off” Boxes at equal interval of 500 mm. Where specified, tap off locations shall be provided for insertion of plug in tap off units. The tap off locations shall be covered by hinged plates.

Tap off units safety features:

- Tap off units should be type tested as per IEC60439-2
- When the door cover is open, it should not be possible to turn the MCCB on. This should be by means of mechanical safety locking system and not by the rotary handle of the MCCB.
- The door shall be provided with a lock and keys.
- The tap off unit handle shall be flexible in the sense that the 'on/off' handle can be attached to the left or right side of the box, depending on the site situation.
- When the box is open the live conductors shall be safe guarded by a transparent insulator plate which allows for visible inspection but does not allow touching of the live conductors.
- The tap off boxes will be suitable for accommodating MCCBs or other accessories, as required.

Accessories: A full range of accessories like bends, End flanges (Cu), end feed units, and support brackets etc. shall be provided as per schedule of Quantities.

Installation: Bus ducts running along the wall shall be supported at intervals not exceeding 1.5 m. In case of branching, there shall be support on all branches at a distance of 300 mm from the point of branching, Support shall not be less than 40 x 40 x 6 mm MS angle secured in an approved manner. Supports may also be provided in the form of brackets fixed to walls where the duct runs along the wall. In case of ceiling suspended bus ducts, supports made out of 40x40x6 mm MS angle iron shall be provided. The horizontal distance between two such supports shall not be more than 1200 mm. The ducts supports shall be suspended from suitable approved suspension devices provided in the ceiling. Fire barrier shall be provided at each floor/wall crossing as per relevant IS code.

1000 hour salt test. Type Test should be as per IEC 60439-6.

TESTS

Following tests shall be carried out at site and test results recorded.

i. Insulation resistance test with 500 volts megger. The insulation resistance shall be not less than 100 mega ohms. The testing shall be done as per IS 8084 - 1976 with upto date amendments.

ii. Earth continuity test.

iii. Heat run test.

4.0 LOW VOLTAGE (L.V.) CABLES

A. Wires

The design manufacture, testing and supply of single core FRLS PVC insulated 1.1 KV grade stranded twisted wires under this specifications shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.
IS : 5831 HRPVC/PVC insulation and sheath of electric cables.

IS : 694 HRPVC/PVC insulated cables for working voltage upto and including 1100 volts.
IEC : 754(i) FRLS PVC/HFFR insulated cable.

Copper/Aluminium stranded twisted conductor HRPVC / FRLS PVC / PVC / XLPE insulated wires shall be used in conduit as per item of work. Aluminium for power cables and copper for control cables shall be used.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth.

Progressive automatic in line indelible, legible and sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of cable.

B. Cables

The design, manufacture, testing and supply of the cable under this specifications shall comply with latest edition of following standards:

IS : 8130	Conductors for insulated electric cables and flexible cords.
IS : 5831	HRPVC/PVC insulation and sheath of electric cables.
IS : 3975	Mild steel wires, strips and tapes for armouring cables.
IS : 3961	Current rating of cables.
IS : 694	HRPVC/PVC insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.
IS : 424-1475 (F-3)	Power cable-flammability test.
IS : 7098(I)	Specification for cross linked polyethylene insulated HRPVC/PVC sheathed cable for working voltage upto 1.1 KV.
IS : 1554	Specification for PVC insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.
IS : 10810	Testing method of cable.
IS : 6121	Cable glands.
ASTM-D : 2863	Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).
ASTM-D : 2843	Standard test method for measuring the density of smoke from the burning or decomposition.
IEEE : 383	Standard for type of test Class-IE, Electric cables, field splicers and connections for power generation station.
ASTME : 662IEC : 754 (A)	Standard test method for specific optical density of smoke generated by solid materials.
IS : 10418	Cable drums.

C. Technical Requirements

a) The cables shall be suitable for laying in racks, ducts, trenches conduits and under-ground buried installation with uncontrolled back fill and chances of flooding by water.

b) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

c) The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformally good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.

d) The cable should withstand 1 – 35 KA for 1 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration. Copper screen of each core shall be suitable for carrying full fault/earth current.

e) The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.

f) Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre 'FRLS' marking in case of 'FRLS' cables.

g) Strip/Wire armouring following method (b) mentioned in IS:3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.

h) Allowable tolerance on the overall diameter of the cables shall be + 2mm.

i) The normal current rating of all PVC insulated cables shall be as per IS:3961.

j) A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS:5831.

k) Outer sheath shall be provided by extrusion process as per IS:5031.

l) The breaking load of armour joint shall not be less than 95% of that armour wire. Zinc rich paint shall be applied on armoured joint surface.

m) In plant repairs to the cables shall not be accepted.

n) All the cables shall be supplied in non-returnable drums as per IS:10418.

o) XLPE insulated cables shall be rated for continuous operation. At maximum rating capacity, the conductor temperature shall not exceed 90 degree C under normal operating conditions and 250 degree C under Short Circuit.

D. In Case of FRLS Cables

i) The inner and outer sheath of cables shall have an oxygen index of not less than 29 as per ASTMD : 2863.

ii) The maximum acid gas generation by weight as per IEC:754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.

iii) The cables inner and outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ASTMD:2843). In case the test for light transmission is conducted as per ASTME: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTMD: 2843.

iv) The cable shall pass the fire resistance test as per SS:42, 41, 475 (I) and flammability test as per IEEE:383.

v) Smoke/light density rated shall be 40% (minimum) and 65% (maximum).

E. Inspection

All cables shall be inspected at manufacture place and on receipt of the same at site checked for any damage during transit.

F. Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilization and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, the location of such joints shall be got approved from the Owner/Consultant. The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction/drawings.

G. Joint Boxes For Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

H. Jointing of Cables

All cable joints shall be made in suitable, approved cable joints boxes, on the jointing of cables in the joint box and the filling in of compound shall be done in accordance with manufacturer's instructions and in an approved manner. All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS:8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhabitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.
The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison, no extra cost shall be incurred by the client.

I. Testing of Cables

Cables shall be tested at factory as per requirement of IS:1554 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to despatch of cables. All the testes will be witnessed by Employer / Consultant in accordance with testing procedure approved by Consultant at no extra cost to Employer. Besides that the following tests shall be carried out:

a) Insulation test between phases and phase to earth for each length of cable before and after jointing.
On completion of cable laying work, the following test shall be conducted in the presence of Architect/Owner.

b) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

c) Continuity test.

J. Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming kinks. At all changes in directions in horizontal & vertical places, the cable shall be bent with a radius of bend not less than 12 – 15 times diameter and 8 times only at places of space constraints.

The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable cur-vature shall be i.e. either 20 times the dia meter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3 meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming ‘Kinks’. The cable drum shall in-verbally conveyed on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. in total sand cushioning be provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion be provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tilesor bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

PVC pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment.

Nothing extra shall be paid on this account. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters & with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false-ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed &clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, shall be tested as per IS and the results submitted to Architects/Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

K. Fire Seal System

a) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.
b) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS:476 Part-B. The fire proof seal system shall have minimum one hour fire resistance rating.
c) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonry concrete members. The system shall be completely gas and smoke tight, antirodent and anti-termite.
d) The material used in fire proof seal system shall be non-toxic and harmless to the working personnel.
e) Type of fire proof seal system shall be foaming type or flamemastic type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 1 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for 15 minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of

removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed.

HV Cable (11 KV)	-	HV Cable (11 KV)	50 mm
ELV & LV 230 V/433 V	-	ELV & LV cable 230 V/433 V	50 mm
HV cables (11 KV)	-	ELV & LV cables 230 V/433 V	300 mm
LV cables 433 V	-	Telephone/Instrument cable	350 mm
All cables	-	All hot pipe work	600 mm

Tests :
Type and routine tests at factory as per relevant IS the bidder will submit testing procedure for.

Quality Assurance (Q.A.)
Quality Assurance shall follow the requirement of Client/ Consultant. Q.A. documents as applicable.
Q.A. involvement will commence at enquiry and follow through to composition and acceptable thus ensuring total conformity to purchaser's requirement.

Deviations

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.

5.0 EARTHING

1 GENERAL

All the non-current metal parts of electrical installation shall be earthed properly. All metal conduits trunking, switchgear, distribution boards, switch boxes, outlet boxes, and all other parts made of metal shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. Earthing work shall conform to IS General Specifications for Earthing work shall conform to Internal) - 1994 and Indian Electricity Rules 1956 amended upto date and in the regulations of the local Electricity Supply Authority.

2 EARTHING CONDUCTOR

- Earth continuity conductor along with submain wiring from Main/Sub Distribution boards to various distribution boards shall be of copper. Earth continuity conductor from distribution board onward upto outlet point shall also be of bare copper. Earth continuity conductor connecting Main & Sub Distribution boards to earth electrode shall be with galvanized MS strip.

3 SIZING OF EARTHING CONDUCTOR

Single phase distribution board shall have one earth continuity conductor while three phase distribution board shall be provided with two earth continuity conductors.

Earthing of main switch board and sub switch boards shall be earthed with two independent earth electrodes or as indicated elsewhere. Earth conductor laid in ground shall be protected for mechanical injury & corrosion by providing GI pipe.

4 SIZING OF EARTHING ELECTRODE

GI pipe shall be of medium class 40mm dia and 4.5 metre in length. Galvanising of the pipe shall conform to relevant Indian Standards. GI pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia drilled not less than 7.5cm from each other upto 2 metre of length from bottom. The electrode shall be buried in the ground vertical with its top not less than 20cm below ground level as per detail enclosed. Earth electrode shall not be situated less than 2metres from the building. The location of the earth electrode will be such that the soil has reasonable chance of remaining moist as far as possible. Masonry chamber of size 300 x 300 x 300mm shall be provided with water funnel arrangement a cast iron or MS frame & cover having locking arrangement at the top.

5 PLATE EARTH ELECTRODE

Earthing shall be provided with either GI plate electrode or copper plate electrode of following minimum dimensions.

i.	GI Plate Electrode	:	1200mm x 1200mm x 12mm thick
ii.	Copper Plate Electrode	:	1200mm x 1200mm x 6.3mm thick
iii.	GI Plate Electrode	:	600mm x 600mm x 6mm thick
iv.	Copper Plate Electrode	:	600mm x 600mm x 6.3mm thick
v.	Copper Plate Electrode	:	600mm x 600mm x 3mm thick

The electrode shall be buried in ground with its faces vertical and not less than 3 metres below ground level. 20mm dia medium class GI pipe shall be provided and attached to the electrode. A funnel with mesh shall be provided on the top of this pipe for watering and earth electrode. Earth electrode the watering funnel attachment shall be housed in masonry enclosure of not less than 300 x 300 x 300mm deep. A cash iron or MS frame with cover having locking arrangement shall be provided at top of metres from the building. Care shall be taken that the excavation for earth electrode may not affect the column footing or foundation of the building. In such cases electrode may be further away from the building.

6 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, then the soil resistivity immediately surrounding the earth electrodes shall be reduced by addition of sodium chloride calcium chloride, sodium carbonates copper sulphate, salt and soft coke or charcoal in suitable proportions.

7 RESISTANCE TO EARTH

The resistance of earthing system shall not exceed 1 ohm.

6.0 LIGHTNING PROTECTION SYSTEM

Lighting protection of various buildings and blocks shall be provided as per IS/ IEC-62305-1:2010 (latest as amended), NBC 2016 norms. The

mainandmosteffectivemeasureforprotectionofstructuresagainstphysicaldamageiscons idered to be the lightning protection system (LPS). An external LPS which consists of air-termination system, down-conductor system and earthing system is intended to:

a) Intercept a lightning flash to the structure (with an air-termination system),
b) Conductthelightningcurrentsafelytowardsearth(usingadown-conductorsystem),and,
c) Disperse the lightning current into the earth (using an earth-termination system).

Accordingly, a standard lighting protection system will be provided in all the buildings asper NBC 2016 Standards, using single prone finials, horizontal and down comer aluminumroundconductorofsuitablesize,terminatingintheG.IPlateEarthPits.AviationOb struction Light (AOL) shall be provided in various buildings as per Civil Aviation regulations, NBC norms &State PWD Specifications as applicable. All Aviation Obstruction Lights shall be fed with UPS supply only.

7.0 CAPACITORS & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964 IS-13340 and latest IEC specification. The capacitors shall be suitable for 3 phase 440 V at 50Hz frequency and shall be available in units of 25/50 KVAR size (heavy duty) with self heating property as per BOQ to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper bus bars of adequate current carrying capacity having S.C rating of 50 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminum conductor armored cables. Two separate earthing terminals shall be provided for each bank for earth connection.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use up to 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.
b) Current overload 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing.

Capacitors shall be of metallized polypropylene film (capacitor grade). Hermetically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnant. The capacitors shall withstand voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V AC is applied shall not be less than 50 mega ohms.

- Capacitor bank and switching equipment shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.
- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.
- Necessary discharge register shall be provided externally to reduce the terminal voltage to less then 50V in 60 seconds after disconnection from supply.
- Testing shall be done as per applicable standards for shunt capacitors.

7.1 CAPACITOR CONTROL PANEL

The capacitor control panel shall generally comprise of the following:

a) Automatic power factor correction relay. (APFCR)
b) Step controller with reversing motor.
c) Time delay and no-volt relays.
d) Protection MCCB with static O/C and S/C releases.
e) Contactor for individual capacitors of suitable rating.
f) Change over switch for either automatic or manual operation with push button control.
g) CTs with ammeter and selector switch.
h) Voltmeter with selector switch.
j) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, Digital Microprocessor based APFC relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, freestanding front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed dust tight, vermin proof and ventilation louvers with wire mesh inside. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

All sheet steel material used in the construction of capacitor control panel should be painted as per the painting clause with approved shade.

8.0 H.T. SWITCHBOARD

SCOPE
This specification covers the ‘General Requirements’ for the design, manufacture, performance, inspection, testing and commissioning including supply of indoor type high voltage switch boards upto 11 KV.

Specific requirements shall be in accordance with single line diagram/specification.

In case of conflicting requirement between the General Specification the former shall prevail.

STANDARDS

All equipment, material and components shall comply with the requirements of the latest editions of Indian Standards with updated amendments. Standards and Regulations applicable in the area where equipment is to be installed shall also be followed.

The equipment offered complying with other standards, these standards shall be equal to or superior to those specified and full details of the differences shall be furnished alongwith the tender.

Some of the relevant Indian and British Standards are listed below:

IS 13947	:	A.C.Circuit Breakers (Relevant Parts/SCC)
IS 3427	:	Metal enclosed Switchgear & Control Gear
BS 162	:	Safety Clearances
IS 2705	:	Current Transformers (Parts 1 to 4)
IS 3156	:	Voltage Transformers (Parts 1 to 4)
IS 3202	:	Code of Practice for climate proofing of electrical equipment
IS 375	:	Marking & Arrangement for Switchgear Bus Bars, main connections and auxiliary wiring.
IS 722	:	A.C. Electric Meters (digital).
IS 13779	:	Digital microprocessor based / static) electrical measuring instruments & testing accessories.
IS 3231	:	Electrical Relays for Power System Protection (digital).
IS 2544	:	Epoxy Cast Resin Insulators
IS 5082	:	Electrolytic Copper and Aluminium
IS 5792	:	High Voltage HRC fuses
IS 12729/ IEC 298, 694	:	M.V. switchgear

DETAIL OF DESIGN

CONSTRUCTION

The switch boards shall be cubicle type, suitable for indoor installation, floor mounting and free standing. The design shall be totally enclosed, dust - tight, damproof and verminproof offering degree of protection not less than IP-4X.

Separate segregated compartments shall be provided for circuit breakers, bus bars, cable box, voltage transformers, wireways, relays, instrument and control devices. Switchgear cubicles/ modules shall be provided with hinged doors in front with facility for padlocking door handles or as per manufacturer design.

Vent openings shall be covered with grills so arranged that hot gases cannot be discharged through them in a manner that can injure the operating personnel. These vent openings shall be verminproof.

All panels shall be of same height, width and depth. Panels shall be bolted together to form a continuous flush front switch board, suitable for front of board operation. The switch board shall be extensible on both sides.

The switchgear cubicles shall be rigid and robust in design and construction, fabricated out of CRCA sheet steel. Cubicles shall be made from rigid welded

structural frames made of structural steel sections or of pressed/formed sheet steel of not less than 3mm thickness. The frames shall be enclosed by sheet steel of at least 2mm thickness, smoothly finished, levelled and free from flaws. Stiffners shall be provided wherever necessary.

All doors, panels, removable covers shall be provided with non deteriorating (neoprene) gaskets all around the perimeter.

All doors shall be removable and supported by concealed type hinges. The hinges shall be strong and braced to ensure freedom from sagging, bending and general distortion of panel or hinged part.

Floor mounted cubicles shall be provided with a 50mm high channel base frame. The total height of the cubicle shall not exceed 2500mm.

BUSBARS & BUSBAR CHAMBER

Three phase (T.P.) bus bars shall be of high conductivity electrolytic copper/ aluminium as stated in SLD.

The bus bars shall be air insulated and housed in a separate compartment, segregated from all other compartments.

Bus bars shall be of uniform cross section throughout the entire length of the switch board and suitable for carrying rated current continuously and short circuit current for specified duration without overheating. The bus bars shall be adequately supported on insulators to withstand dynamic stresses due to short circuit current as specified. Normal operating temperature for bus bars shall be 45 Deg.C. + 40 Deg.C. (For Calculations Only).

All bus bar joints and bus tap joints shall be silver or tin plated. Joints shall be bolted clamp type and insulated. Spring/Lock washers shall be provided to ensure good contact of the joints.

Direct access to accidental contact with bus bars and primary connections shall be avoided by providing shrouds. All apertures and slots shall be protected by barriers to prevent accidental shorting of bus bars. To provide a tight seal between cubicles, bushings or insulating panels shall be provided for bus bars crossing from one cubicle into another.
All insulating materials used shall be non-hygroscopic and shall be treated for preventing fungus growth. Surface of insulators shall be highly glazed and treated with silicone compounds to minimise accumulation of dust, condensation and tracking.

CIRCUIT BREAKERS

The circuit breakers shall be vacuum type / SF6 type.

The circuit breakers shall be of horizontal drawout construction with or without vertical isolation. The circuit breaker including its operating mechanism shall be mounted on a wheeled carriage moving on guides, designed to align correctly and allow easy movement on the circuit breaker. There shall be three discrete positions viz. SERVICE, TEST and ISOLATED. Locking facility in all three positions shall be available. Position indicator shall be provided on the panel to indicate the position of

the circuit breaker. Test position shall offer testing of circuit breaker operation/interlocks without energising the power circuit.

Circuit breakers shall be manually as well as electrically operated.

The closing mechanism of the circuit breakers shall be the following types:

a) Motor wound, spring charged with a provision for manual charging (D.C. battery operated, battery sizing calculation will be submitted by bidder).

Solenoid operated, through battery/P.T in case A.C.

The operating mechanism device shall be mechanically/electrically trip free with anti-pumping device. Anti-pumping feature may be built in or separate anti-pumping relay may be provided. In case spring charged mechanism, spring charged indication shall be provided.

Local manual/remote trip device shall be provided on the operating mechanism. The trip device shall be suitable for front operation and positive mechanical 'ON-OFF' indication shall be provided.

Main contacts of circuit breaker shall have ample area and adequate contact pressure to carry the rated and short time current without excessive temperature rise. The contacts shall be adjustable for wear and easily replaceable. Main contacts shall open before and close after the arcing contacts when these are provided. Arcing contacts shall be easily accessible for inspection and replacement (or as per manufacturer design).

Each breaker shall normally be provided with auxiliary contacts of 6 NO+6NC directly operated from breaker operating mechanism. These contacts shall be in addition to these used in circuit breaker internal wiring. These contacts shall be rated for 10 Amps at 240V AC and 2 Amp (inductive breaking) at 220V D.C. If more breaker auxiliary contacts are required latching relay shall be used to multiply the contacts.

Shunt trip coil(s) as called for shall be provided for tripping the circuit breaker. The trip coil(s) shall operate satisfactorily between 70% - 110% of rated control voltage. Wattage of trip coils will be sufficiently high to prevent it from picking up or holding on with specified number of trip circuit supervisory indicating lamps wired in series.

Circuit breaker type, duty and rating shall be as per schedule of quantities and drawings

Circuit breakers of similar rating shall be interchangeable.

In case of failure of control supply, it shall be possible to trip the breaker.

CURRENT TRANSFORMERS (C.T.)

Current transformers shall be of ratio, burden (shall be worked out by panel supplier), class/accuracy specified in Single Line Diagram.

Current transformers shall conform to latest edition to relevant standards. Current transformers shall be epoxy resin cast with bar Primary or ring type.

The design and construction shall be sufficiently robust to withstand thermal and dynamic stresses due to the maximum short circuit current of the circuit.

The current transformer shall preferably be capable of being left open circuited on the secondary side with primary carrying rated full load current, without overheating or damage. Short time current rating and rated withstand time shall be same as corresponding circuit breaker.

C.T. core laminations shall be of high grade silicon steel.

Secondary terminals of CT shall be brought out to a terminal block which will be easily accessible for testing and external connections. Facility shall be provided for short circuiting and earthing of CT secondary leads through a removable and accessible link with provision for attaching test link.

Rating plate details and terminal markings shall be according to the latest edition of relevant Indian Standard specification.

Generally separate current transformers (core) shall be used for metering and protection.

POTENTIAL TRANSFORMERS (P.T.)

Potential Transformers shall conform to latest edition of relevant standards.

Potential transformers shall be dry, cast epoxy resin type. The PTs shall be of single phase construction as specified. The PTs shall be capable of operating continuously at 110% of the rated voltage without any damage. When star - star connection is required in non-effectively or ungrounded system, the PTs shall be suitable for continuous operation with a persistent phase to ground fault.

Maximum temperature rise of the transformer at rated burden and with rated primary voltage and frequency shall not exceed 40 Deg.C above an ambient of 45 Deg.C.

The transformer(s) shall be mounted on withdrawable chassis with plug-in type connections on primary. An interlock or automatic shutters shall be provided to prevent access to live HV parts when transformer chassis is withdrawn.

HRC Fuses shall be provided on primary and secondary side. Prospective interrupting current rating of the fuses shall be same as the system fault level.

Voltage transformer ratio, output and class shall be as specified in the data sheet. Name plate as per relevant standards shall be provided on the PT.

PROTECTIVE RELAYS

Relays type and numbers shall be in accordance with the protective scheme specified.

Relays shall be digital microprocessor based having compatibility with PC.

Relays shall be enclosed in rectangular shaped cases, suitable for flush mounting only, dust tight covers projecting from the front cover panel. The case shall be dust

tight, damp proof and tropicalised.

Relays shall be accessible for setting from the front. Access to setting devices shall be possible only after removal of front cover.

Protective relays shall be drawout type. Where it is not possible to provide protective relays of the drawout pattern, fixed type relays with facilities for plugging in a portable test plug shall be provided. Necessary test plugs shall be furnished alongwith the relays.

Relays shall be provided with positive action self reset type with indicator. The indicator(s) shall be visible from the front.

Relays shall conform to relevant standards in all respects.

Relays shall be provided with minimum two pairs of self or hand reset type contacts as specified. Auxiliary relays shall have the number of NO and NC contacts as specified.

SAFETY/PROTECTION INTERLOCKS/FEATURES

Following interlocks and features shall be incorporated for equipment protection and personnel safety under mal-operation. No deviations on these interlocks and safety features are allowed. These interlocks and safety features shall be fail-safe, positive and fool-proof.

a) It shall not be possible to plug-in or isolate a closed circuit breaker. An attempt to do so shall trip the breaker. (In case of breakers with vertical isolation, this will apply to raising and lowering). There shall be a positive locking facility to prevent closing of circuit unless it is in Service or Test position.

b) Closing and opening operations shall be possible only discrete position and not in any position midway. An extension adapter cable with plugs and sockets shall be preferably be provided so that the closing and opening operation of the circuit breaker can be done in fully withdrawn position outside the cubicle.

c) Slow operation of circuit breakers shall be possible only in the circuit breaker in Test or Isolated position.

d) Isolating switches if provided shall be interlocked with respective circuit breakers to prevent them making or breaking the current.

e) The cable earthing switch is so interlocked that it cannot be closed if the circuit breaker trolley is inside the cubicle. On the other hand, if the cable earthing switch is in closed position, the trolley cannot be pushed beyond ‘test’ position.

f) Automatic safety shutters for all openings which will lead to access to the live parts of the switchgear upon withdrawal or any operation the switchgear components/parts shall be provided, preferably with a padlocking facility.

g) Spring of motor operated spring charged mechanism shall not discharge until they are fully charged and charging means are fully disconnected.

h) Where key interlocking is employed, tripping of a closed circuit breaker shall not occur if any attempt is made to remove the trapped key from the mechanism.

i) Anti pumping system shall be provided through relay / contactors.

j) Surge protection shall be provided in each circuit breaker to protect the system from surges.

Any other interlocks which manufacturer may deem to be required for safety and specifically specified separately required for the system shall be included.

All terminals, connections which may be live and exposed for accidental contact shall be adequately shrouded.

Components within cubicles shall be properly labelled to facilitate testing.

EARTHING

The switch board shall be provided at the bottom throughout its entire length with a earth bus of electrolytic copper of adequate size to carry the fault current for the duration of 3 secs. Earth bus shall have two earthing connection facility at its both ends to suit Employer's earthing conductor.

All non-current carrying metal parts, frames and equipment mounted in the switch board shall be bonded to earth bus.

Earthing of moving carriage of drawout equipment shall be achieved by scraping earthing device. The earthing device shall maintain positive earth continuity in all Service Test and all Isolated positions.
It shall be possible to connect each circuit or set of three phase bus bars to earth either through earthing switches or through the earthing truck.

Two earthing trollies for earthing of cables/bus bars and common for all circuit breakers of the same type and rating shall be provided (each panel board shall have separate trollies).

INSTRUMENT & METERS

Electrical indicating instruments shall be digital type with zero adjustment probe from outside the cover.

Ammeters, voltmeters frequency meter/power factor, watt meters, kwh and kvar meters.

Instruments/meters shall be flush mounting type on the panel with flanges protecting outside the panel.

Measuring instruments shall be industrial grade with accuracy of class 1.0 unless specifically indicated.

CONTROL WIRING

All wiring for control, protection, alarm and indicating circuits on all equipment shall be carried out with at least 650V grade, PVC insulated, stranded, tinned copper, 2.5 sq.mm conductors.

All wiring shall be run on the sides of the panels and shall be neatly bunched and cleated without affecting access to equipment mounted in the panel. Where wiring enters or passes through compartments containing HT apparatus then they shall be in earthed metallic conduits or ducts.

All wiring shall be taken to terminal blocks without joints or tees in their run.

All wiring shall be colour coded as follows:

Instrument Transformer AC circuit	:	Red, Yellow & Blue determined by the phase with which the wire is associated.
AC Phase Wire	:	White
AC Neutral	:	Black
DC Circuits	:	Grey
Earth connections	:	Green

Engraved core identification ferrules, marked to correspond with the wiring diagram shall be fitted to each wire. Ferrules shall fit tightly on the wires, without falling off when wire is removed. Ferrules shall be of white colour with black lettering. Each wire shall be identified by letter to denote its function followed by a number to denote its identity at both ends.

All wiring for external connections shall be brought out to individual terminals on a readily accessible terminal block.

All unused auxiliary contacts of the circuit breaker and relays shall be wired upto terminal block.

FITTINGS AND ACCESSORIES

Indicating Lamps

Indicating lamps shall be cluster type LED.

Lamp covers shall be provided with interchangeable coloured lenses of perspex or equivalent of unbreakable material. The lenses shall not discolour in course of time due to heat of the lamp.

Bulbs and lenses shall be interchangeable and replaceable from the front.

Following colours shall be used for the function indicated:

Red	-	Circuit Breaker ‘ON’
Green	-	Circuit Breaker ‘OFF’
White	-	Continuous trip supply supervision
Amber	-	Auto trip
Blue	-	Spring charged
R.Y.B	-	Potential indication

Push Buttons

All push buttons shall be push to actuate the contact type.

Start & Stop push buttons shall be coloured green and red respectively. Reset push buttons shall be yellow in colour and test push buttons shall be blue in colour. All other push buttons shall be black in colour.

Emergency stop push buttons shall be lockable in the operated position, i.e. push to operate and key to release type. Push buttons for emergency stop shall be recessed/shrouded type to avoid accidental operation.

Control & Selector Switches

Control and Selector switches shall be of rotary type, having enclosed contacts accessible only after removal of cover.

All control and selector switches for circuit breakers and instruments shall be mounted on the front of the panel. Control switches for space heater(s) and control supplies shall be mounted inside the panel.

Circuit Breaker control switches shall be provided with pistol grip handles. Selector switches shall be provided with round, knuried handles. All handles shall be black in colour. Properly designated escutcheon plates clearly marked to show the operating positions shall be provided on all switches.

Circuit breaker control switches shall normally have three position close - Neutral - Trip with spring return to neutral position. Switch operating mechanism shall prevent the switch from being operated twice successively in the same direction. Circuit breaker control switch shall have one NO - NC contact alongwith other contacts as required.

All other instruments and selector switches shall have stay put contacts.

Contacts of all control and selector switches shall be rated for 10 Amps at 240V AC or 2 Amps at 220V dc (inductive break). Switch for space heater supply and control voltage supply shall normally be two pole rated for 25A A.C.

Control Terminal Blocks

Box - clamp type, 650V grade line up terminals of minimum 2.5 Sq.mm size shall be provided. Connection to terminals shall be from front.
Not more than one wire on each side shall be connected on any terminal where duplication of terminals block/s is necessary, suitable solid bonding links shall be incorporated.

Terminal blocks at different voltage shall be segregated into groups and distinctly labelled.

Current transformer secondary leads shall be brought to terminal blocks having facility for short circuiting and grounding the secondary.

Terminals shall be numbered for identification and grouped according to function.

Engraved back on white PVC labels shall be provided on the terminal blocks describing the function of the circuit.

Separate terminal stems shall be provided for internal and external wiring.

Control terminal blocks shall be so located that control cables are fully segregated from power cables. Suitable insulated or earthed metal race ways shall be provided for control wiring. Separate undrilled removable gland plate shall be provided for the control cables at the bottom of each panel.

Minimum 20% of total number spare terminals shall be provided for future use.

Name Plates and Labels

One Name plate giving designation of the HV switchboard shall be affixed prominently on top of the switch board. Details of designation will be specified.

Labels giving following details shall be affixed on each feeder panel:

i) Feeder No.
ii) Equipment reference No. & Description
iii) Rating (HP/KW/KVA/Amp.)

All components whether mounted inside or on the door shall be permanently and clearly labelled with reference number/letter or their function. Rating of fuse shall be part of fuse designation. Paper labels, stickers or labels fixed with adhesives are not acceptable. All labels shall be properly fixed by screws with provision to prevent distortion due to expansion.

All labels shall be non-corroding, preferably laminated plastic or rear engraved perspex with white letters on black background.

Labels for feeder panel designation fixed on front side shall be fitted with crome plate, self tapping, counter sunk head screws. These labels shall be of identical size to permit interchange.

Space Heaters

Adequately rated anti-condensation space heaters shall be provided in each cubicle.

Space heater/s shall be trip type, rated with operation voltage of 230V, 50 Hz. AC supply unless otherwise specified.

Each space heater shall be complete with a rotary type ON/OFF switch, HRC fuse MCB in the phase, neutral link in neutral and a control thermostat.

The space heater shall be rated for maintaining the panel inside temperature of panel 45 Deg. C same as outside ambient temperature.

Cubicle Lighting

Each cubicle shall be provided with interior lighting by means of 9-11WCFL light fixture door operated ON/OFF switch shall be provided. The lighting fixture shall be suitable for operation from a 230V single phase, 50 Hz. A.C. supply unless otherwise

specified.

Auxiliary Supply

Auxiliary supply for control, indications, space heater etc. shall be made available at one point on the switch board. Vendor shall provide suitable auxiliary supply in the switch board.

Fuses

All fuses in control, indication and metering circuit shall be HRC link type of approved make.

Mounting of fuse fitting shall ensure adequate dissipation of heat generated and shall facilitate inspection and easy replacement of fuse.

Cable Termination

The switch board panel shall be complete with suitable cable end termination for XLPE insulated cables. Cable and sealing box shall preferably be mounted inside the panel. For XLPE cables adequate space and clearances shall be made for heat shrinkable termination e.g. Reychem or cold flowing stress grading joints.

Two earthing terminals shall be provided in each panel in cable box/cabling chamber for earthing armour/screen.

Where more than one core is terminated on each phase, links suitably designed and properly supported shall be provided to avoid unnecessary bending of cable cores without decreasing the length of insulated cable tail. Electrical clearances which would normally be obtained when using one core per phase shall be maintained.

Double compression type cable glands shall be provided for power and control cables with PVC/XLPE insulated cables.

Where core balance type current transformers are provided on switchgear feeder circuit cable/s for earth fault protection sufficient space, clearance and supporting/mounting arrangement shall be provided for the CT.

When specifically called for, a throat connection may be provided for connection to the bus trunking for incoming supply.

PAINTING:

Painting as per painting clause.

TESTING & INSPECTION

After completion of all work at the manufacturer’s works the switchboards shall be inspected and tested in presence of Purchaser’s representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out. Testing procedure for type/routine tests (well explained) with normal test results based on code shall be submitted to consultant for his review prior to testing.

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by primary or secondary injection method.

iii) Operation of all meters.

iv) Secondary wiring continuity test

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils.

x) CT Polarity test.

Besides above type test will also be witnessed as per relevant code.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried out alongwith copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switch boards.

DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc. Vendor drawings to be based on Purchaser's Control Wiring Diagram, if furnished.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams.

vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducibles shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

TOOLS

One complete set of all special or non-standard tools required for installation, operation and maintenance of the switch board shall be provided. The manufacturer shall provide a list of such tools individually priced with his quotation.

SPARES

The manufacturer shall include the cost spare required for testing & commissioning for HV Switchgear.

QUALITY ASSURANCE

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

9.0 DISTRIBUTION TRANSFORMER :

9.1 DISTRIBUTION TRANSFORMER (OIL TYPE)

9.1.1 SCOPE

The Scope of work shall include under this specification design, manufacturing, supply and delivery to site of 11/0.433 kV, ONAN, outdoor type Transformers with OLTC & AVR and accessories. The transformer losses shall be limited as per IS/ECBC/GRIHA norms.

9.1.2 CODES & STANDARDS

The design engineering manufacturing shall be in accordance with established codes, sound engineering, practices, specifications and shall conform to the statutory regulations applicable in the country. Some of the relevant Indian and British Standards are listed below.

Indian Electricity Act.
Indian Electricity Rules.
Factory Act.

IS-5	:	Colour for ready mixed paints.
IS-3043	:	Earthing.
IS-325	:	Three phase induction motors.
IS-1271	:	Method of high voltage Testing.
IS-2099	:	High Voltage porcelain bushings.
IS-3637	:	Gas operated relays.
IS-6121	:	Cable glands.
IS-2705	:	Current transformer for metering and protection with classification burden and insulation.
IS –2147 (Part I, II & III)	:	Degree of protection provided by enclosures for low voltage. Switchgear & control gears.
C.B.I.P Publication	:	Manual on Transformer.
IS- 3639	:	Fittings and accessories for power Transformer.
IS-3202	:	Code of practice for climate proofing of electrical equipment.
IS-375	:	Marking and arrangement for switchgear, busbars, main connections and auxiliary wiring.
IS-5561	:	Electric Power Connectors.
IS-6600	:	Guide for loading of oil immersed Transformer.
IS-335	:	Specification for insulating oil.
IS-2026&335	:	Distribution transformer.
IS-10028	:	Code of practice for installation and maintenance of transformer.
IP-30	:	National electrical code (NEC) BIS publication.

IS-2208-9224	:	HRC cartridge fuses.
IS-2959	:	Contactors.

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

In case of any deviation /conflict of this specification with the codes & standards, the following order of precedence shall govern

a) Specification, particular specification if any, and drawings.
b) Indian regulations/codes and standards.

9.1.3 SITE CONDITIONS

i)	Design ambient	50 Deg.C. maximum 2 Deg. C. minimum
ii)	Altitude	300M above sea level
iii)	Relative Humidity	98% maximum
iv)	Site environment	Normal

9.1.4 TECHNICAL SPECIFICATION

DISTRIBUTION TRANSFORMER (OIL TYPE):

9.1.5 TRANSFORMER

Transformers (Indoor Type)

The transformers are required for use in the sub-station. The supply voltage is stepped down from 11/0.433 KV for L.T. power distribution.

The transformer shall be designed, manufactured & tested in accordance with the latest Indian standard specifications No. IS: 2026 (Part I),IS1180 Level-2 and that of fittings to Is: 3639 – 166 transformer, oil to IS: 335 and over-loading as per IS: 6600. The transformers supplied shall meet the guaranteed impulse levels.

The transformer shall be adequately designed and effectively cooled to ensure its operation under full load conditions continuously and for short time under overload conditions. All transformers of similar rating shall have identical features & characteristics both mechanical and electrical.

Adequate safety devices shall be incorporated to prevent damage to transformer windings or tank due to overheating or system electrical faults. It should withstand short circuit fault level of 1500 MVA (As per drawing).

The transformer shall have optimum copper and iron losses as per ECBC/IS1180 Lvl-2 / GRIHA norms.

The transformer shall be provided with adequate inter-turn insulation and shall conform to class ‘A’ insulation.

The design shall incorporate every reasonable precaution and provision for safety of all those concerned in the operation and maintenance of the equipment keeping in view the requirements of Indian Electricity Rules. The design and manufacture of the transformers shall ensure its capability to withstand rough handling during transportation and installation. The workmanship shall be of highest grade and manufactured in accordance with the modern practice.

The transformer shall have a maximum continuous rating (as defined in IS:2026, latest issue) at the secondary terminals, of the specified KVA output, at specified normal pressure, frequency, altitude and temperature rise at principal tap.

The transformer shall be designed to work at a standard frequency of 50 Hz.

Unless, otherwise specified herein or in the order the transformer shall be of double wound, 3 phases, mineral insulating oil filled, oil natural and natural air cooled, core type suitable for outdoor installation and suitable for operation in the climate prevailing at site.

Maximum temperature rise at the specified maximum continuous output, pressure ratio and frequency shall not exceed the limits specified in IS:2026 (latest issue) i.e. 70□C.

The Buchholz relay shall be double float design, gas and oil actuated with separate electrical contacts – one for alarm and other for tripping. It shall be complete with glass windows, independent potential and reset contacts.

The normal no-load operating voltage ratio and the connection of the high voltage and low voltage windings shall be as specified delta on primary side and star on secondary side.

Connections and group symbol of the transformer, as specified, shall be according to Is: 2026 i.e. Dyn 11

High voltage phase windings shall be marked both on the terminal boards inside the tank and outside the tank with capital letters, U, V, W. Similarly the low voltage windings of the same phase shall be marked by corresponding small letters, u, v, w. The neutral point terminal being indicated by letter ‘n’.

The vector diagram plate shall clearly indicate the methods adopted for marking the terminals both outside and inside.

The terminals cable box on L.T. sides shall be suitable for cable/bus-duct connection to the L.T. switchgear. Those on H.T. side shall be suitable for 11 KV insulated aluminium conductor XLPE (E) cable of size indicated in dwgs. Cable Terminal boxes shall be Raychem / M. Seal type air insulated box type.

The transformer tank and cover shall be of robust welded construction and sufficiently strong to withstand shocks likely to be encountered during transportation and installation. It shall be made of mild steel plates of adequate thickness.

The tank shall be made of mild steel plates as per IS: 2026, properly welded and gasketted to ensure rigid construction. It shall be able to withstand partial vacuum

against standard atmospheric pressure. All weldings shall be uniform and bars to be ground for smooth surface finish.

All joints shall be fitted with suitable oil tight gaskets. Suitable guides shall be provided for tanking & untanking the transformer core & winding assembly.

All welded joints in the transformer tank as well as radiators shall be as per I.S. specifications.

The radiators shall be provided on the tank to facilitate cooling. These shall be provided with isolating valves at both ends. The valves shall be butterfly type (as per IS: 1228) and leak proof. The radiators shall be constructed out of 1.5mm thick pre-stressed steel of welded construction or of tubular pipe construction. Cooling radiators shall be as per IS: 6600.

Lifting eyes or lugs shall be provided on all parts of the transformer requiring independent handling during assembling or dismantling. In addition the transformer tank shall be provided with lifting lugs and properly secured to the side of the tank for lifting the transformer filled with oil either by crane or by jacks. The tank shall also be provided with two suitable lugs for the purpose of grounding.

The tank shall be equipped with gun metal valves of standard screw connections for external piping for drainage, filtering and sampling of the oil or as per manufacturer's standard.

The transformer tank shall be supported on a structural steel base equipped with forged steel or cast steel single flanged bi-directional rollers suitable for moving the transformer completely filled with oil. Suitable jacks for lifting the transformer for changing the plane of rotation of the bi-directional rollers shall be provided by supplier.

The inside and outside of the tank shall be cleaned thoroughly by chemical derusting agents and shall be coated with insulating paint or varnish.

The design of core should ensure low core losses. The core shall be made of good quality cold rolled grain oriented silicon steel laminations of high permeability. It shall be coated with hot oil proof insulation and bolted together and to the frame firmly to prevent undue vibration. Its design should ensure suitability and reduce to a minimum the transformer excitation current & eddy current losses. The core shall be fully insulated from the winding.

All core-clamping bolts shall be effectively insulated from the laminations in order to eliminate any short circuit paths, magnetic or electrical. The core clamping bolts shall be insulated with enamel or varnish or impregnated paper. The varnish should have been in successful use for at-least five years. The laminations shall be of inter board type. The bolt passing though the core shall be insulated for 2 KV.

The core and coil shall be properly secured to the tank such that core does not shift its position in case the transformer is shifted or during short circuit conditions.

The core shall be provided with lugs for lifting the complete core and coil assembly of the transformer. The core shall be effectively earthed to the tank.

The transformer winding shall be of high conductivity annealed copper conductor.

These shall be fully insulated for rated voltage with minimum class 'A' insulation of high dielectric strength, slow aging characteristics and oil resistant properties. The assembly shall be held in position under aerial thrust likely to be set up under terminal short circuits conditions. It is preferable to provide tow bushings for neutral point earthing (one inside the terminal block and one outside.).

The windings shall be designed to reduce to a minimum out of balance forces in the transformer. The tapping shall be reinforced with insulating tapping as required.

The windings shall be wound to close tolerances and the coils shall be thoroughly vacuum dried and impregnated with varnish or oil.

Liberal oil ducts shall be provided to ensure fluent circulation of oil and proper spacing to prevent formation of hot spot.

Adequate mechanical bracings of the windings shall be provided and installation shall be designed in such a manner so as to ensure a uniform voltage distribution throughout the length of the windings during surge and short circuit conditions.

The windings shall be clamped securely in place so that they will not be displaced or deformed during short circuits. Maximum current density in the high voltage and low voltage windings shall be clearly stated in the tender. It is essential that windings should be subjected to thorough shrinking and seasoning process so that no further shrinking occurs at site. Adjustable devices shall be provided for taking up any possible shrinking of windings in service.

The end turns of the high voltage windings shall be reinforced to the extent of 5% of the windings from the line ends so as to withstand abnormal transient pressure, if required.

The percentage of end turn insulation provided on the transformer shall be clearly stated in the tender. Whole winding of the transformer shall be fully insulated.

Bushing Insulators :

The bushing insulators of the transformer shall be of sufficient creepage length and shall be unaffected by atmospheric conditions due to weather, dust or rapid change of temperature likely to be met at site. These should be fully glazed porcelain type. All bushings shall be marked by means of label with symbols corresponding to connection diagram indicated in the diagram plate.

Transformer oil :

The insulating oil used in the transformer shall be mineral oil of high flash point, low sludge value, low pour point and low viscosity. It shall comply with the requirement of IS: 335 latest issue. The oil must be free from all undesirable impurities which may affect dielectric strength, flash point and cooling action. It must be tested for all the tests specified in IS:335. The transformer oil shall have a good stability against oxidation so that viscosity remains substantially unchanged during the many years of expected service life and without any sludge formation. The transformers shall be supplied topped with mineral insulating oil upto required value for putting in service. The oil shall be tested for its dielectric strength as per Is: 6792 – 1972 and should be not less than 40 KV for 60 sec. and 50 KV instantaneous.

The transformer shall be supplied with first filling of oil. 10% extra oil shall also be supplied in sealed tins for topping at the time of commissioning.

Regulation :

The inherent regulation at normal balanced load at unity and 0.85 lagging power factor at a temperature of 75 dec. C. shall be stated in the tender and contractor shall guarantee the performance figures. The regulation of the transformers shall be as per IS:2026.

Tapping and Tap changing Device.

ON LOAD TAP CHANGING (OLTC) :

The diverter switch contacts shall be housing separate oil chamber not communicating with oil of the main transformer tank. The contacts shall be accessible for inspection without lowering oil level in the main tank and the contact tips shall be replaceable.

The OLTC oil chamber shall have oil filling and drain plug, relief vent and level glass. It shall also be fitted with a separate oil surge relay. The outlet of this relay shall be connected to a separate conservator tank or a totally partitioned compartment of the main conservator. A magnetic oil level gauge with separate potential free contacts for alarm and trip shall be provided.

The equipment shall be suitable for local and remote electrical control and local manual control. The features to be provided with these controls are detailed below:

i) Manual Control :

The cranking device for manual operation of OLTC gear shall be removable and suitable for operation by a man standing on ground level. The mechanism shall be complete with the following:

a) Mechanical tap position indicator which shall be clearly visible from near the transformer.

b) Mechanical operation counter.

c) Mechanical stoppers to prevent over cranking of the mechanism beyond the extreme position

d) The manual control considered as backup to the motor operated tap control shall be interlocked with the motor to block motor start up during manual operation. The manual operating mechanism shall be labelled to show the direction of operations for raising the secondary voltage and vice-versa.

ii) Electrical Control :

This includes the following:

a) Electrical local control from transformer marshall box.

b) Electrical remote control from remote control (RTCC Panel).

The control scheme shall have the following features:

An interlock to cut off electrical control automatically upon recourse being taken to manual control.

c) Selection of point of control local or remote, it shall not be possible for any two electrical controls to be in operation at same time.

d) Reinforcement of the initiating impulse for a tap change, ensuring a positive completion once initiated

e) Step by step operation, ensuring only one tap changes for each tap changing command.

f) Interlock to cutoff the electrical control when it tends to perate the gear beyond either of the extreme tap positions.

g) An interlock to block a counter command for reverse tap change during a tap change until the mechanism comes to rest and resets the circuits for a fresh operation.

The equipment shall be so arranged so as to ensure that when a tap change has commenced it shall be completed independent of the control relays and switches. If a failure of auxiliary supply during a tap change or any other contingency would result in the movement not being completed adequate means shall be provided to safeguard the transformers and its auxiliary equipment. A supply monitoring relay with alarm contacts shall be provided for the tap changer

The auxiliary device for electrical controls of the OLTC shall be housed either in the OLTC driving mechanism box or in Transformers marshalling box. It shall be provided with a circuit breaker with magnetic and thermal O/L devices for controlling the auxiliary supply of the OLTC motor.

Tap position indicator shall be supplied loose for mounting on the RTCC.

On the RTCC there shall be following components also:

i) Raise/Lower switch for manual operation.

ii) Lamp indicating ON LOAD TAP CHANGE in progress.

RTCC panel shall have automatic tap changing feature i.e. whenever voltage fluctuations occur the tap switch shall change automatically to set net output voltage of 11/0.433 KV. For this purpose, a Auto/ Manual selector switch shall be provided in RTCC.

OLTC shall have individually separate breather.

The external surface of transformer shall be painted with epoxy paint shade of IS- 631.

An engraved indicating plate shall be provided for the switch with a movable pointer to clearly show the voltage for which the tappings on each phase are connected. A

provision shall be made so that the switch can be locked at any one of the correct positions. The whole arrangement shall be absolutely rigid and adequately insulated throughout.

Centre of Gravity

The centre of gravity of the assembled transformer shall be low and as near the vertical centre line as possible. The transformer shall be stable with or without oil if centre of gravity is eccentric relative to track either with or without oil, its location shall be shown on the outline drawings.

Winding Temperature Indicator

The winding temperature indicating device shall be complete with current transformer a dial type thermometer with two separate sets of electrical contacts, one for alarm and other for tripping.

Accessories :

Standard fittings as per Is: 2026 and Is: 3639 shall be provided. These fittings shall include the following:

a) On load tap changer with remote tap changer control panel to automatic voltage regulating relay.

b) OLTC conservator with drainage valve, filling hole with cover and silicagel breather and oil level indicator

c) Drain valve with plug or cover plate. The drain valve should be so located that the transformer can be completely drained off oil

d) Two earthing terminals capable of carrying for 30 seconds the full load low voltage current of the transformer.

e) Lifting lugs for active part only.

f) Thermometer pocket with 4” dial type thermometer located in tank wall or covering having an internal diameter of not less than 13mm and depth of not less than 115mm, at a height not lower than the top of the core.

g) Oil level indicator with ‘minimum’ marking.

h) Diagram, Rating plate, terminal making plate engraved with full details as required in Is:2026.

i) Air release device on top of the tank.

j) Explosion vent.

k) Bi-directional rollers (4 Nos.)

L) First filling of oil.

m) Automatic on load tap changer with RTCC and range of taping (+) 5% to (–)

15% in steps of 1.25%.

n) Double diaphragm explosion vent with sight glass.

o) Double float Buchholz relay with glass view window, testing sampling cocks & alarm and trip contacts.

p) Dehydrating breather with silica gel.

q) Marshalling box a long with thermostat and space heaters

r) Isolation valve on both sides of buchholz relay.

s) W.P. thermo junction box.

t) Detachable radiator with top and bottom stop valves and drain and air release plugs.

u) 150 mm dia type oil temperature indicator with maximum reading pointer and alarm and trip contact.

v) 150mm dia magnetic oil level indicator with low level alarm and trip contacts and minimum filling and maximum level markings.

w) Jacking pads with haulage holes.

x) Oil surge relay for OLTC.

z) Access windows for OLTC connections.

aa) Drain cum bottom filter valve 32mm with cover plate.

ab) 100VA, 440/110 V Transformer for RTCC.

ac) Extra neutral bushing for solid earthing.

ad) Pressure equalizer pipe.

ae) L.V. neutral earthing bushing with neutral CT for restricted earth fault relays and differential protection relays etc and supporting insulators for bringing down the earthing strip.

af) Cable terminal boxes on both H.T. and L.T. sides of the transformer and suitable for out-door.

ag) Surge Arresters on HT and LT side.

The relative positions of fittings shall, as far as possible, be in accordance with stipulations made in IS: 2026, latest issue. However, the tenderer shall submit along with his tender a copy of sketch showing relative positions of various fittings of transformer offered by him.

Each transformer shall be supplied with all fittings and accessories etc. which are

normally considered part of the transformer as a unit and necessary for its operation, regardless of whether all the items have been mentioned in the tender enquiry or not.

CONTROL WIRING :

All the indoor control wiring shall have copper conductor and PVC insulated.

The indoor control wiring shall conform to IS : 694 for voltage grade of 1.1 KV for A.C./230 V for D.C.

The conductor cross sectional are shall not be less than 2.5 Sq.mm.

The indoor wiring shall be in surface conduit neatly placed on wall or ceiling either in horizontal or vertical run.

The control wiring which are to be placed outdoor or which are to run in cable trench shall be of 650/1100 voltage grade and shall conform to IS: 1554. The cable shall have minimum dia of conductor to 2.5 sq.mm.

VECTOR GROUP :

Transformer shall have vector group of Dyn 11.

9.1.6 Tests

Transformers shall be subjected to routine & type tests as specified in IS 2026, IS 11171 iec – 726 & given below:

9.1.6.1 Routine Tests

a) Turns ratio measurement at various taps
HV and LV winding resistance
Checking of vector group
Insulation Resistance Test
No Load Loss & No Load current measurement.
Measurement of Load losses at 25%, 50%, 75%, 100% & 110%.
Impedance voltage and impedance.
Separate source voltage withstand test
Heat Run Test.

9.1.6.2 Type Tests

a) Impulse voltage withstand test
b) Short circuit test.
c) Measurement of acoustic noise level.
d) Leakage Test (tank).

The power frequency test voltage for the secondary winding shall be 2.5 KV R.M.S. The transformer shall be charged only after the tests are conducted and approval of local authorities is obtained.

Tenderer may submit type test certificates conducted on similar rated transformers for bid validation.

9.1.6.3 Testing And Inspection

a) The Contractor shall draw up and carry out a comprehensive inspection and testing programme during manufacture and commissioning of the transformer. The programme shall be duly approved by the Consultant.

b) Contractor shall ensure that type tested equipment is only offered and routine test shall be conducted as per relevant standards in presence of Client representative.

9.2 Dry Type Transformer:

1. Scope

This section covers the detailed requirements regarding supply, of transformer required for the sub-station. The transformer shall be suitable for locating indoor with a maximum ambient temperature of 50° C. The losses of the transformer shall be as per Latest ECBC requirement.

2. Codes and Standards

The transformers shall comply with the following Indian Standards as

1. IS 2026 - Part I to V power Transformers.
2. IS 1886 - Installation and Maintenance of Transformers.
3. IS 2099 - Bushings.
4. IS 2705 - Current Transformers.
5. IS 11171 - Dry type power Transformers.
6. IS 1271 - Insulating Materials.

3. General Construction

The transformer shall be totally enclosed of IP 20 protection class step down transformer from 11 KV to 433 volts, Copper wound and of approved make. It shall be double wound cast resin dry indoor type with Delta connections on HV side and star on low tension side. The arrangement of the winding shall be such that there is electrical and magnetic balance under all conditions of operation. The design, treatment and construction of the transformer and bracings of the winding shall be such as to withstand the heavy mechanical and thermal stresses which may be experienced under conditions of daily cycles of heating and cooling due to fluctuations in loads and of dead short circuits on either side of the transformer. The interterm's and end-turns of the HV and LV winding shall be insulated for protection against surges and transients. The insulations shall be of class 'F' or higher conforming to IS 1271. The transformer shall have OFF Load tap changing device on high tension side for tapping from +5% to -15% in steps of 2.5% i.e 9 No. equal steps. In order to view the tapping position an inspection window with glass and neoprene gasket shall be provided on the transformer enclosure. The winding insulation shall be suitable for earthed 33 KV system. The rated frequency shall be 50 Hz and the transformer shall be designed with the frequency

varying by 5% above or below 50 Hz. The desired impedance shall be 6.25% at normal tap and 75° C temperature. All components, frame etc. shall be suitably earthed.

4. Fittings

The transformer shall be complete with the following accessories: -

a). An externally hand operated off circuit tap changing links.
b). Winding temperature indicator complete with thermistor and annunciator (Alarm and trip).
c). Diagram, rating plate, terminal marking plate.
d). Two earthing terminals with lugs at the Centre of the bottom channels supporting the transformer.
e). Lifting arrangement.
f). Four bi-directional rollers.
g). Vector Group Dyn 11.
h). HV Cable Box. Suitable for aluminum conductor armored XLPE (E) cable, (with bottom entry), with detachable glade plate.
i). LV flange for terminating suitable for aluminum armored XLPE Cable/Bus-Duct.
j). Control Box for indications.
k). Separate neutral bushing with earth bar supported on insulator.
l). Disconnecting chamber for H.T cable.
m). ON Load tap changing device

5. Core

The transformer shall have core type construction built up with high grade alloy, low loss CRGO silicon steel laminations with resistant double insulation. The transformer shall be capable of withstanding thermal and mechanical effects of short circuit on the terminals of any winding with full voltage maintained on other winding as per IS: 2026. The impedance at rated voltage and frequency shall be 6.25% plus IS tolerance. Appropriate danger boards shall be fixed around the transformer in order that nobody touches the bare parts of HV and LV windings.

6. Accessories

The transformer shall conform to the IS 11171 and 2026 subject to latest corrections and modifications. HV cable box shall be suitable for XLPE cable of specified size and the entry of cable shall be from a cable trench from the bottom of the enclosure. Separate neutral bushing shall be provided for earthing. Earthing of transformer shall be provided at least at two points. Enclosure shall also be solidly grounded. The bottom of the gland of HV cables should be more than 600 mm. from ground level.

7. Tests

The transformer shall be subjected to the following routine tests at the manufacturer's works before dispatch.

a) Measurement of winding resistance.
b) Voltage ratio, polarity and phase relationship.
c) Measurement of impedance voltage.
d) Load losses.
e) No load losses and no load current.
f) Induced over voltage withstand.

g) Separate source voltage withstands.
h) Partial discharge 25 PC up to 1.2 times the rated voltage.

The quoted rate for the transformer shall include all routine tests to be carried out at the manufacturer's works and all routine tests to be carried out at site as per specifications. The contractor shall quote separately for type tests, which shall be carried out only on the written instructions of client.

8. Type Test

Heat run test shall be carried out for anyone transformer of similar capacity.

9. Recommissioning Tests

1	General inspection	a) Control and relay panels, etc. b) Junction boxes and marshalling kiosks
2	Secondary injection	On all transformer protection relays
3	Primary injection (also to be repeated at the end of all other commissioning tests)	a) Tests on operation and stability of earth fault relays on high voltage side. b) Tests on overcurrent relays on low voltage side. c) Tests on operation and stability of earth fault relays on low voltage side. d) Tests on operation of standby earth fault relays on low voltage side. e) Test on overcurrent relay on high voltage side (when current transformers are not in transformer bushings) f) Voltage compensation.
4	Ratio tests	a) With 415 V applied on high voltage side, measure the voltage between all phases on the low-voltage side for every tap position. b) To check phasing, measure volts: A to a, b and c B to a, b and c C to a, b and c Where A, B AND C are the terminals of three phases on high voltage side and a, b and c are the corresponding terminals on low voltage side. c) Magnetic balance test.

5	Tripping tests	a) High voltage. b) Low voltage c) Inter tripping tests. d) Winding temperature trips.
6	Calibrate earthing resistance	
7	Tap changing tests to check mechanism, indication, buzzer, lamp etc.	
8	Insulation tests	a) On high voltage and low voltage windings. b) On current and voltage transformers, circuits etc.
9	See that neutral earthing switches are closed before making alive.	
10	Check transformers on equal before switching in	a) For transformers in a bank, taps
11	Set down relays before closing in advise control.	
12	Load tests	a) Voltmeter, ammeters etc. on both high and low voltage side. b) Overcurrent. c) No spill in high voltage star point. d) No creeping of contacts on both high and low voltage earth fault relays. e) Voltage on relays.
13	Advise control of any new equipment commissioned.	
14	Low voltage excitation current.	
15	Single Phase, magnetic balance test.	

The power frequency test voltage for the secondary winding shall be 2.5 KV R. M. S. The transformer shall be charged only after the tests are conducted and approval of all concerned local authorities obtained.

10.0 BATTERY & BATTERY CHARGER

This specification define the requirement of battery, float cum boost charger and distribution panel. The equipment covered by this specification shall be inline with the requirements of the latest applicable standards such as:

Bureau of Indian Standard (BIS).
International Electro – Technical Commission (IEC).

10.1 Float cum boost charger and D.C. distribution board.

10.1.1 Float Charger

Float charger shall supply the continuous specified D.C. load and also keep the batteries in fully charged condition. The float charger shall include but not limited to the following.

1 No. triple pole rotary switch with link type HRC fuses and fuse fittings. (On/Off of A.C. mains).

3 Nos. phase indicating lights for A.C. mains ON condition.

3 pole A.C. contactor with over load relay.

A.C. voltmeter 0-500V with selector switch for A.C. input as per requirement.

A.C. ammeter with selector switch for 3 phase supply depending upon the requirement.

Double copper wound, naturally air cooled and impregnated three phase/single phase main transformer with class 'B' insulation and having primary taps at + 10% with 2.5% each tape (as per BOQ).

Three phase full wave rectifier with diodes and SCRs and with protective devices such as chokes, resistor/capacitors (filter circuits) as well as for surge suppression.

Auto-manual selector switch for float charger.

Solid state potential meter to stabilise the D.C. output voltage of float cum boost chargers at 2% of the set valve for A.C. input voltage variation 415V + 10%, frequency variation + 5% from 50 Hz and simultaneous load variation from 0-100% also complete with current limiting device to drop the float charger input voltage, upon over loads to enable the battery to take over.

Double pole ON-OFF rotary switch for float charger output isolation with an auxiliary pole to enable energizing of boost charger in CV mode.

D.C. Ammeter with shunt for float charger output.

Centre zero D.C. ammeter with shunt for measuring the battery current.

D.C. voltmeter with selector switch for measuring the float charges output voltage, boost charger output voltage, battery voltage and Off position.

1 set automatic float/boost change over facility to boost charge the batteries as required.

1 Set filter circuit comprising series chokes, shunt capacitor etc. to limit the ripple contents to 3%.

1 No. series diode to prevent reverse current flow for battery to charger.

1 Set of D.C. over voltage/under voltage detection unit.

1 Set dropper diode to automatically maintain load voltage constant within (24-30) / (110-125V) as required, (contractor with electronic controller).

1 Set of battery earth leakage relay with am-meter for measuring battery earth leakage current.

1 No. double pole ON/OFF switch with HRC link type fuses for charger output.

10.1.2 Boost Charger

The Boost charger shall include the following but not limited to:

a) Triple pole A.C. contactor.

b) Triple pole A.C. On/Off switch with HRC link type fuses.

c) Three phase double copper wound, naturally cooled impregnated transformer having + 10% taping on primary with step of 2.5% taps as required.

d) Three phase full wave rectifier with diodes and SCRs complete with protective devices chokes and filter circuit.

e) Double pole switch with HRC link fuses for boost charger output isolation.

f) D.C. ammeter with shunt for boost charge output current.

g) A.C. contactor with ON/Off indicating light electronic controller to stabilize D.C. output current in C.C. mode and to stabilise D.C. output voltage in C.V. made.

h) CC/CV mode selector switch.

i) Solid state potentio meter for setting constant current and constant voltage.

j) Boost charger D.C. under voltage relay.

k) Boost charger D.C. on indicating lamps.

l) Blocking diode with suitable heat sink.

10.1.3 Annunciation

Static type audio-visual annunciation windows with acknowledge, test and reset buttons and hooter for the following shall be provided on each charger. Facility for by passing the audio alarm on each charger shall be provided.

a) A.C. mains supply failure.

b) Float charger A.C. side over load.

c) Boost charger A.C. side over load.

d) Float charger under voltage D.C. side.

e) Boost charger under voltage D.C. side.

f) D.C. bus bars under voltage load side.

g) Battery earth fault.

h) Float charger over voltage D.C. side.

i) Thyrostor/diode fuse blown off.

Cell Booster

One cell booster shall be provided to charge one to given cells within 10 to 14 hrs. It shall be suitable not to charge newly introduced cells to battery bank but can take care of any treatment to be given to the individually weak cell/cells. All booster shall be suitable for incoming voltage and parameters as described in above paras also the quantity shall be determined by the supplier depending upon the number of cells.

10.1.4 Printed Circuit Board (PCBs)

The PCB's and other electronics circuit operation shall be tested at 50 deg. C. for 48 hrs. at maximum and minimum input voltage and at a maximum load. Failure of any components during testing. The tests shall be repeated after the replacement of faulty/defective component. The temperature of electronic power devices shall be measured and the devices function temperature shall be calculated by the supplier and submitted for verification. The calculated value shall be at least 10-20 deg. C. less than from the maximum rates function temperature of the devices with proper ambient temperature correction applied.

10.1.5 Charging/Distribution Panel

Battery charger and D.C. distribution board shall be housed separately keeping panel height same as these will be mounted side by side only the batteries shall be kept on stand insulator and solid load connection leads between battery to battery terminals, installed in a separator or complete with battery. The charger and distribution board shall be fabricated out of 2mm thick CRCA sheet steel with suitable stiffeners. It shall be free standing having back and front hinged doors, fully compartmentalized and well ventilated vermin and dust proof conforming to IP-32 degree of protection as per BIS. The panels shall be powder coated/epoxy coated as per painting procedures. The panel shall be mounted on MS channel frame.

All instruments shall be panel mounted, back connected, equipment and accessories with touch proof contacts and shall be wired with minimum 2.5mm copper stranded FR PVC insulated 1100 volts grade. Equipment and accessories shall be heat resistant, moisture proof and tropicalised A.C. and D.C. wiring shall be done separately colour coded and properly terminated on 'telemax'/equipment make terminal blocks.

All parts shall be properly shrouded to ensure complete safety of personnel intending routine maintenance by opening the panel doors. Bus-bars shall be shrouded and colour coded.

Panel shall be provided with cable termination lugs and cable glands. Cable glands shall be of single compression type and the panel shall be suitable for top and bottom cable entry.

Cable between the battery bank & charger and charger to DCDB shall be included.

Distribution board shall comprise switch gear and high conductivity electrolytic copper bus bar as mentioned in B.O.Q. and as per schematic diagram. 25x6mm copper earth bus provided at bottom with earth connection at both ends. All non-current carrying metallic parts shall be suitably connected to earth bus. Three ply lamicoid sheet name plate duly served to identify the equipment and accessories.

Testing and Inspection

Batteries shall be tested as per applicable standard including duty cycle test to meet the duty cycle requirement. All the equipment and accessories shall be arranged by supplier free of cost.

The following type and routine test shall be conducted on each charger in accordance with IEC/BIS code as well as functional test on each charger to check the design charger and D.B. shall with stand 2 KV for 1 minute.

The following routine test shall be performed:

Description	Routine Test (bidder shall fill in)
Measurement of inherent voltage regulation	
Insulation test	
Power loss measurement	
Power factor measurement	
Temperature rise test	
Functional test on all the equipments	
Checking & co-ordination of protective devices	

The vendor shall intimate the readiness of the equipment minimum two (2) weeks in advance to enable inspection and witness of tests by Consultant/Purchaser. Equipment shall only be despatched after clearance by Owner.

Witnessing the inspection by Consultant/Purchaser shall not relieve the manufacturer of his responsibility to supply suitable functional and trouble free operation of equipment.

The vendor shall supply complete as built diagram indicating all values of components and accessories alongwith operational, maintenance and installation write-ups free of costs through Consultant. The enclosed data sheet shall be filled by the vendor for evaluation.

Sealed Maintenance Free Battery

The battery shall be of sealed maintenance free type, preferably enclosed in polypropylene container with spun glass microporones matrix type separator.

The battery shall be equipped with explosion proof, pressure regulating and self resealing type safety valve.

The positive and the negative grids shall be made out of long life corrosion resistant alloy. The grids shall be maintenance free.

The battery shall comply to a self discharge rate of less than 1% per week.

The battery shall be equipped with heavy duty lead plated copper connectors.

The average design float life for the system shall be 3 years at 27 Deg.C.

Drawings and Information

To be furnished in accordance with the supplier's data requirements.

Generally following drawings shall be furnished:

1. General Arrangement (GA) Drawings for Battery giving basic room requirements. Floor/wall finish, number of air-changes, requirements of exhaust fans and sinks etc.
2. Installation, operation, maintenance manual for battery.
3. Charging and discharging characteristics of batteries.
4. Other technical particulars as called for in data sheets.

Testing and Inspection

Required copies of the following type test certificates to be furnished before despatch of the batteries.

1. Test for capacities
2. Test for retention of charge.

Acceptance tests to be carried out on each battery or cell, when called for.

Visual inspection of battery and battery accessories will be carried out by purchaser's representative unless this stipulation is waived in writing.

Quality Assurance

Quality Assurance shall follow the requirements of Client/Consultant. Q.A. documents as applicable.

Q.A. involvement will commence at enquiry and follow through to completion and acceptance, thus ensuring total conformity to purchaser's requirements.

Deviations

Deviation from specifications must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specification are met without exception.

11.0 H.T. CABLE (XLPE)

The cross linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS:7098 (Part-I) 1985 and (Part-II) 1973. The screaning shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 11 KV(E) below the ground level in a trench 450mm wide.

After laying and jointing work is completed a high voltage test shall be performed and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost

12.0 CABLE TRAYS

Ladder Type

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and 'C' channel of required width as per design. Bends shall be prefabricated. Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending rediuses for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The perforated cable trays are fabricated out of 2mm thick CRCA sheet steel having minimum 50/75/100mm depth as per B.O.Q. The side of the perforated cable tray shall be bent out side to stiffened. The side edge and there shall be no sharp edge left. The bend, tee, reducing section shall also be factory pre-fabricated. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/aluminium clamps/M.S. clamps as per requirements and approved by Consultant. The cable tray shall be powder coated of approved shall be after primer and pretreatment procedures.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers (ISMC) spaced at every 1500mm. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the Consultant/Site Engineer before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

13.0 EXTERNAL LIGHTING

Street Lighting

The pole shall be erected in plumb, buried at 1/6th of the pole size underground in cement concrete foundation as per details given in the schedule of quantities and the drawing. The excavation shall be made in hard and dense soil as per site. The base plates of steel tubular pole shall be grouted over a 150mm thick 1:2:4 cement concrete bed. Junction boxes that shall incorporate suitable connection, 2 Nos. cable glands and one 5A SP MCB. Two pieces of 50 mm GI pipe shall be fixed to the pole so that PVC aluminium cable could be protected from mechanical damages. An earthing stud with copper lugs for connecting 8 SWG G.I wire for earthing shall be provided on the pole at the position inside the MS box. The incoming and outgoing cables shall be marked with ferrules as required. The poles shall be given a coat of rust preventive bituminous paint on the inside and red oxide primer on the outside at the factory premises. After the erection of the pole, two coats of enamel paint of approved colour shall be applied. Touch up paint shall be given at the time of handling over the work. Marking of circuit and pole number shall also undergo same painting treatment as given above for the pole. The pedestal for street light poles, GI poles and Bollard light shall be provided with wire cut brick tiles of size 230x75x20mm.

A sample of the poles to be erected shall be got approved before procurement and erection. All the poles shall be in accordance with the approved sample.

Outdoor Type Distribution Feeder Pillars

The feeder pillar shall be of the floor mounting type, totally enclosed and weather proof, conforming to IP-65 only incorporating MCCBs/MCBs having a certified rupturing capacity as per bill of quantities in the tender.

The feeder shall be fabricated out 2.00mm thick CRCA sheet steel with stiffeners wherever required. Hinged doors of not less than 2mm thick should be provided at the front and rear of the cubical to provide access for installation, operation, test and inspection. The rear door is provided to facilitate cable termination and the front door for inspection of MCCBs/MCBs and other accessories cable entry through bottom only. All doors should also be fitted with suitable locking arrangements with 6 lever GODREJ pad lock with 2 keys to prevent unauthorized opening. The cubical should be designed for mounting over cement concrete plinth by the roadside and should be of substantial construction capable of withstanding the vibrations normally experienced due to vehicular traffic. The top of the feeder pillars construction to prevent any collection of water due to rain. The front and rear sides of the concrete plinth foundation shall be closed with brick masonry and the surface all round shall be plastered. A gland plate of 3mm thick shall be provided at the bottom of the feeder pillar (removable) for mounting the cable glands. The feeder pillar shall be fitted on an angle iron pedestal at the bottom covered with sheet metal from all the four sides

which facilitates cable bending etc. specially with aluminium cables. Two lifting hooks shall be provided at the top. A door operated switch shall be provided in the feeder pillar so as to switch ON and OFF the lamp fixed in the brass batten holder below the top sheet of the pillar.

The sheet steel materials used in the construction of the cubical should have undergone a rigorous rust proofing process comprising alkaline degreasing, de-scaling in dilute sulphuric acid solution and a recognized phosphating process. After metal treatment, the interior of the cubical should be painted with two coats of air drying red lead primer followed by two coats of air drying anti-condensation paint. The exterior of the cubical should be painted with two coats of primer followed by coat of epoxy paint of approved shade.

Ventilation louvers followed by double find wire mesh shall be provided on the two sides to ensure natural ventilation. All the nuts, bolts shall be cadium plated with spring washers. A minimum spacing from cable connection to the bottom of gland plate shall be 300mm.

The bus bar should be of grade aluminum air insulated with adequate clearance between conductors and earth. These should be colour coded to enable immediate identification of the phases and neutral. The bus bars should be carried on supports made out of SMC insulators. Suitable insulating phase barriers should be provided to prevent accidental short circuits during operation.

The neutral bus bar shall be of same size as per the phase bus bars. The design should allow for neutral cable sockets to be fitted directly to the bus bars. A G.I. earth bar as per B.O.Q. of size 40x6mm together with two cable eyes shall be provided for connections to earth pits. All the cables shall be terminated at

ELMEX terminal block and therefrom wiring shall be done with PVC insulated copper conductor cables to MCBs. The wiring shall be neatly bunched and shall be secured to wiring cradles.

A circuit card holder shall be made inside the front door, 3 ply lamicold, white letter on black ground card duly engraved shall be provided with Circuit No., Pole No., Controlling MCB size etc. identification ferrules for incoming and outgoing cables. Danger plate shall be fixed on both the doors of the feeder pillar.

14.0 DIESEL GENERATING SETS

14.1 GENERAL

This specification is intended to cover supply, installation, testing and commissioning of D.G. Sets and associated accessories.

14.2 SCOPE OF WORK

The scope of work shall include under this specification design, manufacture, supply, loading, unloading, storage, installation, testing and commissioning of the Diesel engine alternator sets & associated accessories including labour, tools, tackles and plants, hardwares and consumables, steel fabrication and items as prescribed below:

Diesel engine alternator set complete with base frame and accessories.

Engine mounted/separately mounted genset (engine + alternator) controller with having inbuilt mechanical & electrical protections and with Electronic (digital) Governor suitable for interfacing with PLC.

Fuel oil system including day service oil tank, piping, valves, filters etc. from engine to service day oil tank. Return fuel line with fuel cooler (if required) and piping with accessories upto day service tank.

Lube oil system with piping etc. (supplier should attached lub. Oil system flow diagram for client's reference & records).

Cooling system with remote radiators with piping, valves, gauges etc.

Engine exhaust emission shall meet latest MOEF norms applicable in India. Engine shall be with critical grade silencer, exhaust piping with mineral wool insulation and aluminum cladding as called for.

Steel fabricated structure/support/hanger including fixing, grouting and bolting etc.

Painting of steel work.

L.T., Control, instrument cabling.

PLC Panel.

DBs & MCC.

Earthing.

The bidder shall also indicate in his offer the time schedule for routine maintenance / overhauling operations necessary for continuous satisfactory operation of D.G. Set.

The item rate shall remain valid for variation to any extent of the estimated quantities given in the Schedule of Quantities.

All equipment shall be of the class most suitable for working under the conditions specified and shall withstand the atmospheric conditions without deterioration.

Minor civil work is included in the contractor's scope of work. However, the responsibility of coordination with the civil and other contracting agencies ensuring completion of turnkey contract rests with the contractor and shall be certified.

Contractor shall co-ordinate with all other agencies working at site for interconnection and safety aspects.

D.G. sets warranty shall be for 2 years from the date of successful commissioning and handing over for any manufacturing defect.

14.3 FEES & PERMITS

The contractor shall obtain all sanctions and permits required for the running of DG sets from all the relevant authorities. All actual fee payable in this regard will be reimbursed against receipt/documentary proof (evidence). On completion of the work, the supplier shall obtain N.O.C from concerned authorities including Chief Electrical Inspectorate, of State in original shall be delivered to the employer through Architect.

14.4 CODES & STANDARDS

The design, construction, manufacture, inspection, testing and performance shall comply with all the currently applicable statutes, safety codes, relevant Bureau of Indian Standards (BIS), British Standards (BS), International Electro Technical

Commission (IEC) publication, NEMA & VDE Standards amended upto date.

Some of the applicable standards are listed below:

IS – 1601	:	Performance and testing of IC engines for general purpose.
BS – 649	:	Performance and testing of IC engines for general purpose.
BS – 4613	:	Electrical performance of rotating electrical machine.
BS – 4999/5000	:	Applicable parts of BS 4999/5000.
IEC – 34-1/ IS – 4722/ VDE – 0530	:	Specification for rotating electrical machines.
IS – 4889	:	Method of determination of efficiency of rotating electrical machinery.
IS – 6491	:	Degrees of protection provided by enclosures for rotating Electricity machinery.
IS – 4729	:	Measurement and evaluation of vibration of rotating Electrical machines.
AIEE – 606	:	Recommended specification for speed governing (1959) of internal combustion engine generator units.
IS – 2705	:	Current transformers.
IS – 1248	:	Electrical indicating instruments.
BS – 5514 / IS – 03046 or IS – 08528 Part 2	:	Reciprocating internal combustion (I.C) engine driven A.C. Generators.
IEEE – 115	:	Test procedure for synchronous machine.

14.5 DESIGN

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The equipment offered by the contractor shall be complete in all respects. Any materials or accessories, which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost to the purchaser.

14.6 PERFORMANCE REQUIREMENT

14.6.1 The equipment shall be capable of delivering power continuously at the generator

terminals, a net output not less than the specified value at 0.8-0.95 p.f. excluding auxiliary power (shall be included over and above), when operating under the site ambient conditions described in this specification. Gen. set should have minimum 50% single step loading capability and it should be able to take full load in less than 25 sec. from start. (The set shall be suitable for prime duty).

14.6.2 The design parameters of the generator and excitation system shall be so chosen that the set is stable while running at any load between no-load and full load and also during starting of motors as specified in Annexure-I. It should also have isochronous speed control with load sensing governing system suitable for parallel running of D.G. sets.

14.6.3 Engine should be heavy duty four strokes, turbo charged after cooler 'V' construction, electric start. Engine should have minimum lube oil change period 300 hrs.

14.6.4 The set shall have vibration limit less than 250 microns (as per ISO 8528 Pat-9) and noise level shall be (75 db (a) at 1 mtr) under all conditions of load. The set shall be dynamically balanced. The set shall be mounted directly on the inertia foundation with AVM Pads. The efficient critical grade silencer shall be provided. Air inlet shall also be provided.

14.6.5 The total harmonics contents should be less than 3% as per IS 4722/1969. The graph & calculation for harmonic distortion shall be submitted.

14.6.6 Contractor to specify and guarantee maintenance contract cost and to give an Undertaking to take a comprehensive maintenance contract after expiry of warranty period for which price may be quoted.

14.6.7 The successful bidder will submit shop drawing of the equipments/accessories selected for this work for the approval of Consultant/ Employer.

14.7 DIESEL ENGINE - CONSTRUCTION

14.7.1 Material of construction of major parts shall be as under or as per manufacturer design.

a) M.S. base frame with anti-vibration mountings.
b) Crankcase / Cylinder block – Alloy grey cast iron.
c) Crank shaft – High carbon steel.
d) Piston – Modified Aluminium Silicon.
e) Piston rings – Heat treated ductile iron ring & grey iron rings.
f) Connecting Rod – Forged medium carbon steel.
g) Cylinder liner – Centrifugally cast alloyed grey iron casting.
h) All other materials of construction shall be as per relevant standard/code.

14.7.2 The Diesel Engine shall be multi-cylinder, totally enclosed, prime continuous duty, direct fuel injection, turbo charged, compression ignition, inter cooled oil engine or with individual cylinder head with provision to measure exhaust temperature and smoke quality.

14.7.3 One common base frame shall be provided for mounting the engine and alternator complete with flexible coupling etc. as required.

14.7.4 All externally mounted hardware shall be high tensile only.

14.7.5 The normal speed of the engine shall be 1500 RPM and the direction of rotation shall be clearly marked on the set.

14.7.6 The engine shall be fitted with an exhaust gas driven turbo charger complete with necessary lubricating system.

14.7.7 The engine shall be fitted with a charge air inter cooler / after cooler of the air/water type. Air from the turbo-charger compressor passes through the inter cooler and then to the engine manifold. The inter cooler shall be of tubular construction or as per manufacturer design with aluminium bronze tubes, mild sheet steel and cast iron water headers.

14.7.8 Diesel engine shall be capable of starting and operating for a few minutes without supply of raw water for cooling.

14.8 GOVERNING SYSTEM

14.8.1 The Governor shall be electronic fuel control type with over speed safety.

14.9 ENGINE STARTING SYSTEM

Starting of the Diesel Engine shall be done by electric starting system.

The electric starting system shall comprise starter motor, starter batteries and battery charger including with all required instruments and accessories. The engine mounted charging alternator shall charge the batteries while engine is running and floor panel mounted solid state battery charger while engine is at stationery. The battery charger shall be of automatic with all metering and control instruments and protections for A/C and D/C circuit. The total system shall be suitable for auto and manual operation including their wiring etc. Calculation for the battery and battery charger capacity as well as complete descriptive circuit diagram shall be submitted for review of Consultant based on 3 consecutive start commands.

14.10 FUEL OIL SYSTEM

14.10.1 The manufacturer shall furnish a mild steel day tank of 990 Ltrs. capacity for individual engine. The day tank shall be suitably located to avoid gravity feed to the engine, shaft driven fuel oil pumps and shall be complete with gauges, manhole, filling, draining and vent connection with valves and level switch for auto filling of tank and for alarm in case oil level goes below low level.

14.10.2 The fuel system shall be provided with full flow simplex oil cartridge filter.

14.10.3 The fuel system shall be equipped with a crankshaft driven fuel pump which will draw the fuel from the day tank via filters and shall be as per the engine manufacturer design.

14.10.4 Direct injection through Injectors.

14.11 LUBRICATING OIL SYSTEM

14.11.1 All lubricating parts of the engine shall be connected to a pressurized lubricating oil distribution piping system being continuously fed by gear type lube oil pump mounted in sump of the engine and driven from the engine gear train. The pumps shall take suction from sump integral with the engine through oil suction pipe, suction strainer and deliver oil to a main gallery via oil cooler / filters. High pressure oil shall be supplied to the main and big end bearings, crank shaft bearings, governor, auxiliary drive gear etc. Suitable lubricating arrangement for engine cylinder valve gear, cams

and pistons at the required level shall be arranged. A pressure relief valve shall be mounted on the main supply header for safety against too high-pressure while starting with cold oil.

14.11.2 The lube oil system shall be provided with full flow simplex lube oil cartridge filters. The minimum lube oil change shall be 300 hrs.

14.11.3 Arrangement shall be provided to bypass the lube oil pressure switches and safety at the starting till the pressure is built up.

14.11.4 The lube oil sump shall be with dip stick with low / high level mark to measure the oil level.

14.11.5 All necessary metering / display such as oil pressure, oil temperature, shall be available on genset controller. Other accessories such as pressure relief valve, bypass valve, pressure switch etc. shall be provided and safeties with necessary wiring.

14.12 COOLING SYSTEMS WITH COOLING TOWER

This section comprises the supply, erection, testing and commissioning of cooling towers conforming to these specifications and in accordance with the requirements as per equipment schedule.

Cooling system shall be with cooling tower, raw water pumps, butterfly valve, balancing valve (if required), non return valve, Y- strainer, temperature & pressure gauges in water circulating pipe line.

Cooling Tower (FRP Construction)

The cooling towers shall be of FRP, vertical forced/induced draft type complete with FRP basin, FRP body, fan and motor assembly, fill media, distribution pipes etc.

General Construction

The body shall be made of FRP (fibre glass reinforced plastic) sections of equal segments, all bolted together. The surface on both inside and outside shall be smooth. For minimum air resistance, the fan deck shall form an integral part of the body.

The water basin shall be of FRP. The basin shall be complete with connections for drain, overflow, make up water, quick fill and float valve.

The support structure for the tower shall be of mild steel duly hot dipped galvanized. The water diffusion deck shall be of rigid PVC fill in honey comb design, arranged in a circular pattern for ease of replacement.

Water Distribution System

The hot water shall be distributed through static head distribution system consisting of headers & sub headers. System shall be unpressurised gravity flow type to save auxiliary power & have low maintenance.

Fan Assembly

The fan shall be of axial flow type with cast aluminum multiple blades of aerofoil

design and adjustable pitch. The fan assembly shall be statically / dynamically balanced.

The fan shall be directly mounted on the motor. The fan motor shall be totally enclosed fan cooled squirrel cage type conforming to IP-55 for outdoor operation.

The fan guard shall be hot dipped galvanized and shall have wire mesh arrangements to prevent bird nesting during idling period.

Ladder
All towers shall be provided with a ladder made of hot dipped galvanized MS members / tubes.

Painting
Cooling Tower FRP shall be UV stabilized gel coated for long life.

Testing

Cooling capacities of the cooling tower shall be computed from the measurements of water flow, rate, temperatures of entering and leaving water and ambient air wet bulb temperature. Water flow rate shall be measured by an accurately calibrated water flow meter and all temperature by an accurate mercury-in-glass thermometer. Computed results shall conform to the specified capacities and quoted ratings.

14.13 COOLING SYSTEMS WITH REMOTE RADIATOR

This section comprises the supply, erection, testing and commissioning of remote flat vertical/ionclined bed radiators (copper tubes with aluminium fins) with electric fan cooler directly or through heat exchanger if mounted distance is more than 15 meter and conforming to the engine manufacturer specification and in accordance with the mechanical requirements of engine complete with piping, valves, filters, electric wiring with local push button station and MCC etc. In case the engine mounted pump head is of inadequate capacity than the secondary booster pump (electric driven) may be addd with heat exchanger balancing at tank and ther auxiliary (item as may be required) to make the circulation water system more efficient without trouble to the engine. The system shall be with interfaced converter for compatability with PLC/BMS. The motor shall be of EFF-1 type as per ECBC and efficiency of motore shall also be as per ECBC.

14.13.1 Heat Exchanger

Heat exchanger shall be water to water, plate type designed for DG duty will be supplied by the DG supplier as part of equipment. The DG set supplier shall ensure that the pump with the engine shall be capable of supplying the required water quantity to maintain the required temperature rise.

PHE shall be complete with following accessories:

- Inlet and outlet connections with necessary shut off valves.
- Pressure gauges and thermometers.
- Drain valve, air vents and purging valve.
- Any other standard accessories necessary with the equipment.

14.13.2 Testing

The PHE shall be designed for a maximum working pressure of 7 Kg/Sq.Cm and shall be tested with a pressure of 10 Kg/Sq.Cm (150 PSIG).

14.13.3 Painting

The Heat Exchanger shall be given two coats of rust preventive primer and finished with enamel paint.

14.13.4 Pipe Work and Valves

General

All piping work shall conform to quality standards and shall be carried out as per specifications and details given hereunder:

Piping

The piping shall be medium class mild steel as per IS:1239/3589.The Butterfly valves shall be of CI. Pipe crosses shall be provided as bends, to permit easy cleaning of drain line. The drain line shall be provided at all the lowest points in the system, as well as equipments, where leakages of water is likely to occur or to remove condensate and water from pump.

Miscellaneous

All piping connections shall be provided in accordance with manufacturer's standard details as approved by Owner/Consultant and ready for regular and safe operation.

During construction pipe ends shall be temporarily closed with sheet metal caps wherever required to prevent debris from entering piping system.

Piping shall be independently supported of all equipment so that the equipment is not stressed by the piping weight or expansion.

The pipes shall be cut accurately according to measurements.

All the low points in piping system shall be provided with valves and capped connections. Isolating valves and drain valves shall be provided for all risers (if required) as per approved drawing to permit repairs without interfering with the rest of the system.

Shut off valves shall be provided at inlet and outlet of unit to permit unit removal for repairs without interfering with the remaining system. Valves shall be located for easy access and operation. No valves shall be installed with handles pointing down, unless unavoidable.

Testing

All piping shall be tested to hydraulic test pressure of at least one and half times the maximum operating pressure but not less than 10 Kg./sq.cm. for a period of not less than 3 hours. All leaks and defects shall be rectified to the satisfaction of the Owner/Consultant without any extra cost.

Painting

All pipes supports, hangers etc. shall be given two coats of red oxide primer.

All pipes shall be given one coat of finish paint of a type and colour as approved by the Owner/Consultant.

14.15 EXHAUST SYSTEM

Engine emission exhaust system shall be controlled the pollution to meet CPCB-4 norms for DG Sets, critical type silencer, piping, bends, thermally insulated aluminum clad exhaust piping etc. Thermal insulation with AL cladding shall be provided on exhaust pipe. Exhaust system pollution level shall be indicated and shall be got approved by authorities. (Exhaust smoke quality & quantity should be within the norms of central & state pollution control board).

14.15 GENSET CONTROLLER

Genset Controller should be of latest design with reliable operations in harsh environment. Control system should be an integrated microprocessor based generator set control system providing voltage regulation, engine protection, alternator protection, operator interface and isochronous governing.

AmpSentry – This has to include integral AmpSentry protection, which should provides a full range of alternator protection function which are matched to the alternator provided.

Power management – Control function should provide battery monitoring, testing and a smart starting control system.

Advanced control methodology – Three phase sensing, FET based full wave rectified voltage regulation and a PWM output for stable operation with all load types.

Communications interface – Should be with PCCNet and Modbus interface.

Regulation compliant – Should be prototype tested: UL, CSA and CE compliant.

Service - InPower™ PC-based service tool should be available for detailed diagnostics, setup, data logging and fault simulation.

Operator panel features should be with the following

Operator panel features – The operator panel, in addition to the alternator, should display the Utility/ AC Bus data.

Operator/ display functions

- Pixels graphic LED backlight LCD with bar graph for displaying electrical parameters
- Auto, manual, start, stop, fault reset and lamp test/panel lamp switches
- Alpha-numeric display with pushbuttons
- LED lamps indicating genset running, remote start, not in auto, common shutdown, common warning, manual run mode, auto

mode and stop

Paralleling control functions

- Digital frequency synchronization and voltage matching
- Isochronous kW and kvar load sharing controls
- Droop kW and kvar control
- Sync check
- Extended paralleling (Peak Shave/Base Load)
- Digital power transfer control (AMF) provides load transfer operation in open or closed transition or soft (ramping) transfer mode

Digital governing

- Integrated digital electronic isochronous governor
- Temperature dynamic governing

Digital voltage regulation

- Integrated digital electronic voltage regulator
- 3-phase, 4-wire line-to-line sensing
- Configurable torque matching

AmpSentry AC protection

- AmpSentry protective relay
- Over current and short circuit shutdown
- Over current warning
- Single and three phase fault regulation
- Over and under voltage shutdown
- Over and under frequency shutdown
- Overload warning with alarm contact
- Reverse power and reverse var shutdown
- Field overload

Engine protection

- Battery voltage monitoring, protection and testing
- Over speed shutdown
- Low oil pressure warning and shutdown
- High coolant temperature warning and shutdown
- Low coolant level warning or shutdown
- Low coolant temperature warning
- Fail to start (over crank) shutdown
- Fail to crank shutdown
- Cranking lockout
- Sensor failure indication
- Low fuel level warning or shutdown

Control functions

- Time delay start and cool down
- Real time clock for fault and event time stamping
- Exerciser clock and time of day start/stop

- Data logging
- Cycle cranking
- Load shed/ dump as per configurable priority
- Configurable inputs and outputs (4)
- Remote emergency stop

14.16 EXCITATION SYSTEM

14.16.1 Alternator shall be provided with a complete rotating diode type brushless excitation system, capable of supplying the excitation current to the generator under all conditions of output from no load to full load and capable of maintaining voltage of the generator constantly at one particular value.

14.16.2 The exciter shall have Class – H insulation but temperature rise limited to Class – F and should be vacuum impregnated.

14.16.3 The excitation system shall comprise a shaft driven A.C. exciter with rotating rectifiers. The rectifiers shall have in-built protection for over-voltage.

14.16.4 The Alternator shall be complete with PMG/auxiliary winding excitation. The exciter shall be fast response type and shall be designed to have a low time constant to minimize voltage transients under severe load changes.

14.16.5 No external supply shall be required during starting and normal running of the alternator.

14.17 ALTERNATOR (415V – 3 Phase, 4 Wire System)

14.17.1 The Alternator shall be industrial type screen protected drip proof. IP-23. Class – H insulation with temperature rise limited to Class-'F', self ventilated, air cooled, rotating field, salient pole, brushless, machine with self excited, self regulated exciter and shall be rated for continuous duty.

14.17.2 The Alternator shall have a continuous rating of not less than the value specified under specific requirement shall be at 0.8.

14.17.3 The short circuit ratio (SCR) of the generator at rated KVA and rated voltage shall not be less than 0.48.

14.17.4 The Alternator shall withstand without mechanical damage, an over speed of 20% for a period of 2 minutes.

The generator/alternator shall with stand over load of 10% for 1 hour every 12 hourly. The terminal voltage shall be adjustable and the range of adjustment shall be $\pm$ 5% of nominal voltage.

14.17.5 The Alternator shall be capable of withstanding without damage/injury for 3 secs., 3 phase short circuit at its terminals, when operated at rated KVA and power factor at 5% over voltage with fixed excitation (3 times the line current for 10 Sec.).

14.17.6 The Alternator shall be capable of withstanding for thirty (30) secs. a current of fifty (50) percent in excess of its rated current, the voltage being maintained, as near the rated value as possible, consistent with max. Capacity of the prime mover.

14.17.7 Six Nos. embedded Resistant temperature detector (RTDs) of platinum. 100 ohm resistance at 0 Degree to measure the winding temperature and 2 Nos., BTDS bearing temperature shall be provided and scanners also shall be provided for measurement of temperature.

14.17.8 The leads of embedded RTDs shall be wired upto the terminal block in a separate auxiliary terminal box. Manufacturer shall indicate the setting values for each RTD/BTD for alarm and trip with scanner and port/RS 232/485 totally compatible with PLC.

14.17.9 All external nuts and bolts shall be of high tensile steel only.

14.17.10 Alternator shall be provided with anti-condensation space heater of adequate rating suitable for 240V, 50 Hz., 1ph A.C. supply and shall be wired upto a separate terminal box.

14.17.11 Two independent earth terminals on the frame, complete with nuts, spring washer and plain washer shall be provided.

14.17.12 Alternator shall be provided with suitable terminal box for terminating TP&N bus-duct/cables droop and protection. CTS within the terminal box duly wired upto the panel shall be provided.

14.17.13 The alternator shall be capable to sustain the unbalanced current between the phases minimum 25% of rated current provide that the KVA rating and maximum current does not exceed 11% of rated current in any phase as per BS-4999 Part-101.

14.17.14 The alternator shall be dynamically balanced complete with rotor and shaft.

14.17.15 Alternator should have bearings at both shaft ends.

14.17.16 Damper winding shall be provided in the pole to damp the oscillations and ensure satisfactory performance during parallel operation.

14.17.17 Winding of 3 phase alternator shall be of star connected and neutral point shall be brought out to the terminal box through protection and earthed with independent earth or through contactor as per scheme.

14.17.18 Protection CT's/PT's shall be mounted above the terminal box with enclosure. Bus duct/cable shall be terminated on terminals through this.

14.17.19 Diesel generating set shall be able to start motor of 30% capacity of D.G. set with a 20% base load.

14.18 TESTS

14.18.1 The Diesel Generator sets shall be tested as per the relevant Standards. Tests on assembled DG sets will be witnessed by the representative of employer with no extra claim to employer. The supplier shall submit test reports complete descriptions/testing procedure units accepted and value obtain from as per the following but not limited to:

Acceptance Tests on D.G. Set (factory and at site).

a) No Load Trial to verify leakages (factory / site)
b) One (1) hour at full load with fuel consumption (factory).
c) One (1) hour at 3/4 load with fuel consumption (factory).
d) One (1) hour at 50% load with fuel consumption (factory).
e) Seven (8) hours at full load (At site).
f) Two (1) hours at 110% load shall be done (At factory.).
g) Noise/vibration test (at site).

Note :Alternator shall be type tested (for same frame in last 5 years) as per the relevant standards and detailed report shall be submitted for review. Type test shall include following tests:

a. Measurement of resistance of stator and rotor windings.
b. Insulation resistance of stator and rotor windings
c. High Voltage tests on stator and rotor windings
d. Open circuit and short circuit characteristics
e. Temperature rise test/heat run test.
f. Regulation test
g. Efficiency test
h. Momentary overload test
i. Vibration and noise level measurement.
j. Over-speed test as well as electronic over speed trip
k. Determination of deviation of voltage wave form
l. Load characteristics test.

e) **Functional Tests (at site)**

i) Functional tests on control panel.
ii) Functional test on starting provision on the engine.
iii) Functional tests on all Field devices.
iv) Functional tests on Genset Controller.

f) **Measurement of Vibration**

The vibration shall be measured at Load as close to maximum achievable load and shall not exceed 250 microns.

g) **Noise Level (Sound Pressure Level) Check**

Noise level measurement shall be done generally as per CPCB / MOEF and ISO 8528 guidelines. The measurement shall be carried out with a calibrated dB (sound level) meter.

Sound level shall be measured all round the Diesel Generator set & at a distance of 1m / 0.5 m (as applicable as per CPCB / MOEF / rating) from the Acoustic Enclosure / DG Room building and it should be 75 dB**(a)** for below 800KW rating & there shall be 25 dB**(a)** insertion loss for above 800KW rating.

14.18.2 Test Certificate

a. Test Certificate shall be submitted in eight (8) copies.

b. The test certificates shall be furnished to the purchaser for prior approval before dispatch of any equipment from works and the approval in writing from purchaser shall be essential to effect dispatch of the equipment.

c. The test reports shall furnish complete identification of the data including serial number of each equipment.

14.19 TOOLS AND TACKLES

a. The contractor shall furnish a list of required tools to the purchasers necessary for maintenance of DG Set.

14.20 SPARES

The manufacturer/ tenderer shall also furnish a complete list of fast moving spares.

14.21 DRAWINGS, DATA & MANUALS

Drawings and details of typical foundation requirement, lube oil circulation flow diagram, cooling system flow diagram, fuel oil system flow diagram shall be furnished along with each of the bid. Installation, operation and maintenance manuals shall be supplied along with the DG Set.

14.22 DEVIATION

Should the contractor desire to deviate from this specification in any way, he shall draw specific attention to such deviation giving complete reasoning.

Unless such deviations are recorded in the separately attached Deviation Sheets, as submitted with offer, it will be taken for granted that the offer is made in conformity with this specification.

14.23 QUALITY ASSURANCE PROGRAMME

Quality Assurance shall follow the requirements of Owner/ Consultant as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

14.24 GUARANTEED PERFORMANCE

The contractor shall furnish, along with the offer, the technical particulars as called in the Annexure 'II' & 'III'. The performance figures quoted in the technical particulars sheets shall be guaranteed within the tolerance permitted by relevant standards. In case of failure of equipment to meet the guarantee, the purchaser reserves the right to rejected the equipment.

14.25 PACKING FOR SHIPMENT

14.25.1 The equipment shall be suitably protected by respective packing for the shipment distance and weather conditions involved.

14.25.2 For transportation, if totally enclosed boxes are not used, the equipment shall be mounted on skids with necessary protection. However, items like instruments and other components not assembled with equipment shall be separately marked with equipment number and part number for case of identification.

ANNEXURE-I

TECHNICAL PARTICULARS OF SILENT DIESEL GENERATOR SETS

1.	Quantity and Rating at prime duty	:	250 KVA DG set with provision at 0.8 p.f. (Unit shall be rated for feeding continuous prime load).
2.	Mode of Operation	:	Parallel operation, Auto start, auto synchronizing, load sharing and load management, on manual with relay back-up and as shown in SLD
3.	Engine/Alternator		
3.1	Output rating at ambient temp of 50Deg.C(for each) at prime duty	:	250 KVA DG set with provision at 0.8 p.f. (Unit shall be rated for feeding continuous prime load).
3.2	Class of insulation for Stator & Rotor (For calculation & testing)	:	Class 'H' limited to Class 'F'
3.3	Rated voltage & Frequency	:	415 Volts, 50 Hz. three phase 4 wire A.C.
3.4	Maximum permissible time for building up rate and voltage from stand still	:	Less than 5 seconds
3.5	Variation of voltage from no load to full load	:	±1% of rated voltage
3.6	Voltage variation	:	±1%
3.7	Capacity of largest motor load	:	30% capacity of DG Set
3.8	Dynamic voltage response & permissible voltage drop at generator terminals during largest rating motor starting	:	Less than 15% of rated voltage under operating condition at 3.6 & 3.7 above
3.9	Temperature detectors with scanner/converter	:	8 Nos. resistance temperature detectors of type PT-100 for winding temperature and bearing temperature measurements.
3.10	Type of excitation system	:	PMG type/ Auxiliary plus relating field diode.
3.11	Type of control for voltage regulator	:	Local/Remote (Manual/Automatic)
4.	Miscellaneous		

4.1	Type of fuel for engine	:	High speed diesel in accordance with F-DMA or F-DMS as per ISO 8217. (IS : 1460 1974 amended upto date)
4.2	Day Oil tank capacity	:	450 Ltrs
4.3	Maximum permissible starting time for attaining full speed	:	Less than 2 seconds
4.4	Engine Starting	:	Electric starting system
4.5	Type of Governor Electronic Fuel Control	:	Electronic fuel controlled with mechanical over-speed protection complete with solid-state potentiometer for remote operation.
4.6	Lubrication system	:	Pressure fed type.
4.7	Cooling System	:	Remote radiator with all accessories
4. 8	Engine cranking system	:	To be included
4.9	Noise Level	:	75 dl A at 1 metre
4.10	Vibration limit	:	Less than 130 micron

Technical literature, testing procedure with acceptable value shall be submitted along with the bid.

Any deviation shall be explained with supporting documents shall also be submitted.

ANNEXURE -II

The following will be the part of the D.G. Set supply but not limited to these:

(a) Engine Specification:

- Engine governor
- Fuel and lube oil Simplex type filters
- lube oil pressure & coolant temperature monitoring.
- Control panel

(b) Generator 415 V : Alternator/Engine

- According to the standard IEC,VDE, BS, ANSI
- Flanged on engine, connection with elastic coupling
- Double long life re-greasable bearings
- Single and ventilated discharge at the drive end
- Insulation class H, temperature rise class F (for calculation purpose).
- Enclosure: IP23
- Excitation: PMG/auxiliary winding.
- Dual AVR with auto manual changeover.
- 6 Stator and 2 bearing PT 100 sensors with analog converter.
- Preheating resistance
- Overload capacity : 110% of 1 hour at every 6 hours.
- Unbalanced load : The unbalanced current between phases shall not exceed the rated current by 30%.
- Radio interference : Within limits of CISPR standard (less than 5%).
- Regulation performances: The voltage is kept constant within +/-1%
- Manual voltage adjustment +/-5%
- Dynamic balancing of the complete rotor and shaft
- Short circuit withstanding : 3 times the line current for 10 secs.
- Vibration sensor with converter.

Auxiliaries supply:

The panel should incorporate the power outgoings for the following genset auxiliaries:

- Battery charger (SMPC)
- Ventilation and anti-condensing resistance for control panel.
- Alternator anti-condensing heater.
- Pre-lube oil pump.
- Raw water pump (cooling tower).
- C.T. fan (cooling tower).
- Return fuel cooler.

NOISE AND VIBRATION CONTROL IN DIESEL GENERATOR ROOM

1.0 REQUIREMENTS

1.1. The noise control measures envisaged for D.G. set room and ventilation system shall include sound absorbing treatment to DG room with sound reducing doors. Ventilation system shall be provided with silencers as well as provision of primary and secondary residential silencer (exhaust mufflers) in the engine exhaust piping.

1.2. The vibration control measures shall include vibration isolation (anti vibration

mountings). The anti-vibration mounting and vibration isolators shall be mounted either under the base frame or under the foundation block with 13 mm static deflection

1.3. With noise and vibration control measures, the following end criteria are required to be achieved.

a)	Sound level outside D.G. room 1 m away from external wall	:	75dBA
b)	Sound level on terrace, 1 m away from D.G. exhaust	:	75dBA
c)	Peak acceleration in generator room or in spaces on upper Floor due to operation of D.G. set at primary Excitation frequency.	:	0.01 gm
d)	Vibration level	:	Less than 130 microns

1.4 All items offered must be supported by design calculations to justify design criteria.

1.5 The insulation shall then be entered with 0.5 mm thick aluminium sheet.

The insulation material shall conform to the following:

a) Insulation material shall be suitable for application ranging upto 50º C

b) Insulation material shall confirm to BS 476 Part 4, 1970 amended upto date. I.e. for incombustible low fire propagation (index 13.58) extremely low spread of flame (class 1 BS 476 part 7), Non-emission of dense smoke and toxic gases (low toxicity index 0.86), non-depletion of oxygen (high oxygen index 70%)

c) The insulation material shall be inorganic and shall be fungi and vermin proof.

d) As per BS 2972. The insulation material shall be vibration and jolting resistance, moisture contents less than 2%, water absorption less than 2%, odourless etc.

The thermal insulation values shall be as per IS:8183 and BS:3958, Part I – 5 amended uptodate.

2.0 SPECIFICATIONS

2.1 Sound absorbing treatment in generator rooms shall be done with 75 mm thick resin bonded mineral wool of density 32 kg/cum shall be used to insulate walls, ceiling and doors etc, of the room

2.2 The installation shall be carried out as mentioned below:

2.2.1 An air space of 50mm between wall and acoustics material shall be kept.

2.2.2 Fix 24 SWG GI channels of suitable size longitudinally and crosswise at 600-mm interval. The channels shall be filled with resin bonded glass wool before fixing.

2.2.3 Install 24 gauge x 12 mm x 12 mm GI wire netting inside of the channel frame work taking care to leave air space of specified thickness between G.I. wire netting and wall.

2.2.4 Fix insulation with 7 mil (0.18 mm) thick glass cloth backing on the room side and ceiling, inside the remaining gaps formed by the channel frame work.

2.2.5 The ventilation inlet and exhaust silencer shall be constructed out of GI sheet with mineral wool acoustic fill. Silencer shall rated for acoustic and aerodynamic requirement.

2.2.6 Primary exhaust mufflers shall be of reactive design and residential type offering minimum 30dBA of insertion loss at low frequencies. The muffler shall be as recommended by engine manufacturer.

2.2.7 Secondary exhaust muffler shall be 'straight through' dissipative design and shall offer atleast 30 dBA of insertion loss at mid and high frequency.

2.2.8 Sound reducing doors shall be of all steel construction with adequate compression seals at head sides and threshold so as to offer minimum STC 35 performance.

2.2.9 Vibration isolators shall be rubber-in-shear with high deflection neoprene inserts. For insulation under inertia block, compressed corkboard of adequate density or river sand loaded for optimum performance (50-100 psi) shall be used.

3.0 EXHAUST PIPE INSULATION

Exhaust pipe insulation shall be carried out with mineral wood (rigid pipe sections) of 150 kgs/m3 for temp above 250º C. The material for pipe insulation shall be factory faced with aluminium foil reinforced with kraft paper. The aluminium foil shall extend by min. 50 mm on one side of pipe side along the length to seal all longitudinal joints etc.

4.0 OUTDOOR TYPE ACOUSTIC ENCLOSURE FOR D.G. SET

a) Silent DG set container is of modular construction with the provision to assemble and dismantle easily as per the site condition,

b) There are not protruding parts.

c) The container is fabricated out of CRCA sheet of 14 SWG

d) The sheet metal components are hot dip seven tank pretreated.

e) To have long lift of container it is pure polyester based powder coated (inside as well outside). All nut and bolts/hardware are zinc coated.

f) Fuel tank at the base of silent DG set is having required capacity. It is provided with breather, drain plug.

g) The fuel level can be indicated with the help of fuel gauge meter.

h) There is provision for filling the fuel from outside as in the case of automobiles with locking arrangement.

i) Battery is accommodated in a separate tray in the container.

j) There is provision for drain plugs for draining mobile oil/diesel

k) The doors are gasketed with high quality EPDN gaskets to avoid leakage of sound.

l) The door handles are lockable type,

m) Sound proofing of enclosure is done with high quality rock wool/mineral wool conforming to IS:8183 of 50mm thickness and density at 96 Kgs/cu.m

n) The rock wool is further covered with fibre glass cloth and perforated powder coats sheets.

o) A special residential silencer is provided with in the DG to control exhaust noise.

p) Specially designed attenuators are provided to control sound at air entry to the container and exist from the container.

q) To make the system vibration free, engine and alternator (single bearing) is mounted on anti-vibration pads.

r) Temperature of enclosure does not exceed beyond 5 Deg.C of ambient temperature.

s) The blower runs 2/3 minutes after stopping of DG set.

t) The enclosure is provided with high enclosure temperature safety device.

u) There is provision of emergency shutdown from outside the container

v) There is any arrangement for illumination inside the canopy.

w) Noise level is 75 dB(A) at 1 meters distance.

AMF SYSTEM

CONTROL PHILOSOPHY

AUTOMATIC STARTING & STOPING OF ENGINES

The system should come in operation after sensing of grid failure and or the voltage drops below preset value. The 'PLC' shall issue the command to 'Master' D.G. In case the D.G. set do not start in the 1st cranking, two more cranking attempts shall be made with proper intervals. Even then if engine fails to start, indication must appear on MMI/Monitor 'SET FAILS TO START' & alarm shall be generated. The PLC shall give the command to the next D.G. in selected sequence.

D.G. set has started and put on load. The system shall start monitoring voltage, Frequency and load, if the load exceeds asettable limit. The next D.G. shall be started to prevent D.G. over loading. The process shall continue till all the D.G.s have been started.

At any point of time, the engines are under loaded and the load is capable of being catered by less than the numbers of running D.G.'s. Stop command shall be given to the D.G. running for shortest duration at that moment.

On restoration of mains and sensing the healthiness of the same, the load shall be transferred to mains. The D.G.'s shall be given stop command after a settable time delay ensuring adequate cooling down of the engine.

15.0 INTELLIGENT ADDRESSABLE FIRE ALARM

15.1 INTELLIGENET ADDRESSABL FIRE ALARM SYSTEM

A.0 GENERAL

A.1 SCOPE OF WORK

A.1.1 These specifications shall cover the Design, Supply, Erection, Testing, and Commissioning of Intelligent Addressable Fire Alarm Systems

A.1.2 The work is to be carried out is illustrated in the drawings attached. These drawings are open to change as per suitable design submitted by the tenderer.

A.2.2 The tender drawings indicate only the general scheme of requirement and the extent of work covered in this contract. The equipment and their associated works such as Cabling, etc. may be re-arranged in the space allotted subject to the approval of Engineer-in-charge. It is the Contractor's responsibility to ensure that his work is coordinated with the work of other agencies/client.

A.2. SCHEDULE OF REQUIREMENTS

A.2.1 Intelligent Addressable Fire Alarm System requirements are shown in the tender drawings and described briefly in other chapter of these specifications.

A.2.2 Tenderers are advised that the location of detectors and other accessories etc. as given in these drawings and specifications are indicative and for tenderers guidance.

A.2.3 It is the intent of these specifications to define a state-of-art integrated Fire Alarm System, which is user friendly, modular, flexible and expandable. The system is to be designed, installed, customised, tested, commissioned and supported by a local office or agent of the manufacturer by Engineers skilled in providing functional and efficient solutions to the needs of the Engineer in charge.

A.2.4 The contractor shall have an in-place support facility in India equipped with Competent Support Staff, Spare Parts Inventory and all the necessary Test and Diagnostic Equipment to provide support within 24 hours of any breakdowns.

A.2.5 All electronic equipment shall conform to the pertinent regulations governing radio frequency electromagnetic interference and should be so labelled.

A.2.6 All system components and sub-systems are to be fault tolerant and provide satisfactory operation without damage at $\pm$ 10% of the rated voltage and at $\pm$ 3 Hz variation in line frequency.

A.3. TECHNICAL DATA

A.3.1 The Tenderer shall submit comprehensive technical information for all the equipment and material. This must include but not necessarily be restricted to, all data as

A.3.2 Technical catalogues and performance Tables/ Curves of all equipment and machines must be submitted with the offer.

A.3.3 Information given by the tenderer under chapter "SCHEDULE OF TECHNICAL

DATA" is meant for general information only. In case of discrepancies between tender specifications and details given by the tenderer under chapter "SCHEDULE OF TECHNICAL DATA", the decision of Engineer-in-charge will be final and binding on Contractor unless departures are indicated by the Tenderer

A.4. PERFORMANCE GUARANTEE AND TESTING

A.4.1 The Contractor shall execute the work on the basis of indicative designs hereby given and accepted by him with or without modifications or new designs submitted by him at the tender stage and accepted by Engineer in charge, as the case may be. All Variations, i.e. additions, omissions or substitutions necessitated at anytime for any reason whatsoever, shall be deemed to have been accepted by the Contractor as not vitiating the performance based nature of this contract. If any such variations, irrespective of whether such variations are intended to be executed by other agencies employed by the Engineer-in-charge, have any bearing on the performance of this Contract, the same shall immediately be brought to the notice of Engineer-in-charge by the Contractor in writing. In any case the Contractor shall have to guarantee for due and proper performance of the works agreed to be so erected.

A.4.2 The Fire Detection installation shall be designed and guaranteed to perform as indicted in other parts of these specifications and drawings read in conjunction with statutory requirements.

A.4.3 All equipment shall be tested at manufacturer's Works **as per latest relevant BIS specifications** or in the absence of IS specification approved testing methods shall be followed and Test Certificates/ Reports submitted to the Engineer-in-charge. The contractor shall intimate in advance the probable date of such tests to the Engineer-in-charge to enable their representatives to witness the tests if they so desire. But under no circumstances shall this absolve the Contractor of his responsibility for Performance of the Equipment or System.

A.4.4 In addition to the above, all equipment and systems shall be tested after installation as required by various statutory authorities, certifying agencies and as required by various sections of these specifications.

A.4.5 The Contractor shall take full responsibility for proper operation of the entire system including debugging and proper calibration of each component and sub-system.

A.4.6 The Contractor shall leave necessary provisions required for fixing instruments, gauges, meters, etc. for testing the installation even if these are not shown on the drawings. All such instruments, services etc. needed for the tests shall be arranged by the Contractor at his own cost.

A.4.7 It is the sole responsibility of Contractor to obtain all the necessary approvals from the statutory authorities, either prior to, during or after installation as required. All tests specified herein-after and witnessed/ approved by Engineer-in-charge, may be deemed to be invalid at the option of Engineer-in-charge, if the requisite, final and unconditional approvals from the concerned statutory authorities are not obtained by the Contractor.

A.4.8 The Contractor shall intimate in writing to Engineer-in-charge as and when individual components of the installation are ready for tests required for further progress of

erection. All such tests shall be carried out as per these specifications and/ or as directed by Engineer-in-charge and recorded in the presence of Engineer-in-charge or his authorized representatives.

A.4.9 On completion of erection, the contractor shall thoroughly clean all the equipment, inspect and check the entire installation for correctness and completeness and furnish a detailed report on all components of the installation to Engineer-in-charge.

A.4.10 The Contractor shall intimate in writing to Engineer-in-charge, the proposed date of initial startup.

A.4.11 The Contractor shall, on approval of Engineer-in-charge, proceed with necessary pre-commissioning activities and tests and put the installation initial operation and start-up during which preliminary adjustments and addressing shall be carried out.

A.4.12 Based on preliminary observations during the initial operation described above, necessary modifications/ repairs/ replacements/ etc. if any shall be carried out by the Contractor to the entire satisfaction of Engineer-in-charge. On successful completion of initial operation, the Contractor shall proceed with trial runs.

A.4.13 Notwithstanding approval of tests or equipment or materials by Engineer-in-charge etc., up to the tests in static state as described here-in above, the Contractor shall be required to perform site tests to prove correctness of ratings and performance of equipment and materials supplied and installed by him, in normal operating condition.

A.4.14 All equipment shall be capable of performing the duties specified in these specifications without damage, distortion or failure of any component.

A.4.15 The performance of various equipment individually shall not be less than quoted ratings and consumption of power shall not exceed the ratings quoted by the tendered, when tested in normal operating condition. Otherwise the equipment / material are liable for rejection.

A.4.16 All test instruments shall be calibrated for accuracy prior to taking the performance tests.

A.4.17 Failing satisfactory performance of equipment and/ or overall installation after rectification etc. as stated above, the Engineer– in-Charge, at his sole discretion, reserves the option of charging liquidated damages for such non-performance or demand supply and installation of new installation all at no extra cost to Engineer-in-Charge or demand for full refund of all "On Account" payments made to the Contractor for that part of the work which has failed to perform, and the Contractor shall be obliged to do so as directed by the Engineer-in-Charge.

A.5. CODES & STANDARDS

A.5.1 The Fire Alarm system shall comply with latest requirements **of EN54/**IS/IEC standard

A.5.2 In general the system and all components shall have **EN54/VDS / UL Approval**.

A.6. SHOP DRAWING:

A.6.1 The contractor shall prepare detailed shop drawing co-ordinated with all services and submit to the consultant for his approval or the Engineer in charge before commencing the work.

A.6.2 The shop drawing shall show all setting out details and physical dimensions of all components in the system i.e. conduit and cable routes etc

A.6.3 Approval of these drawings do not relieve the contractor of his responsibility to meet with the intent of the specifications.

A.7. INSTALLATION:

A.7.1 Installation shall be in accordance with the local and state codes, as shown on the drawings, and as recommended by the equipment manufacturer.

A.7.2 All fire detection and alarm system devices, control panels and remote enunciators shall be flush mounted or surface mounted as per instructions of the Engineer-in-charge.

A.7.3 Manual call boxes shall be suitable for surface mounting or semi-flush mounting and shall be installed at a height of not less than 1,000 mm, or more than 1200 mm above the finished floor level.

A.7.4 At the final inspection, a factory-trained representative of the manufacturer of the major equipment shall demonstrate that the system functions properly in every respect.

A.8 DEMONSTRATION:

A.8.1 The Contractor shall completely check out, calibrate and test all connected hardware and software to ensure that the system performs in accordance with the approved specifications and sequences of operations submitted.

A.8.2 This demonstration shall consist of the following:

a) Display and demonstrate each type of data entry to show site specific customizing capability.
b) Demonstrate parameter changes.
c) Demonstrate scan, update and alarm responsiveness.

A.9 MANUALS

The following manuals shall be provided at the time of Handing over:

A.9.1 An Operator’s Manual shall contain graphic explanations of keyboard use for all operator functions specified under Operator Training.

A.9.2 Computerized printouts of all data file layouts including all point processing programming details, flowcharts, etc.

A.9.3 On completion of works **"As Built"** drawings for completed installation shall be prepared by the Contractor and (6) Six copies of the same will be supplied to the

Engineer-in-Charge. In addition, (6) Six sets of all Operation Manuals, Technical Literature for the various components of equipment, Controls and Accessories installed, Recommended Spares and Services Manuals will be supplied by the Contractor to the Engineer-in-charge.

A.10. TRAINING & HANDING -OVER

A.10.1 All training by the Contractor shall utilize manuals and as-built documentation and the on-line help utility.

A.10.2 Operator training shall include:

a) Sequence of Operation review
b) Sign ON - Sign OFF
c) Selection of all displays and reports
d) Commanding of points, keyboard
e) System initialization
f) Trouble shooting of sensors (determining bad sensors)
g) Password modification

A.10.3 Supervisor training shall include:

a) Password assignment/modification
b) Operator assignment/modification
c) Operator authority assignment/modification
d) Point disable/enable
e) Terminal and data segregation/modification

A.11 GUARANTEE

A.11.1 The contractor shall guarantee the entire Intelligent Addressable Fire Alarm system installation as per specifications both for components and for system as a whole. All equipment shall be guaranteed for **One year from the date of handed over to the Department** against unsatisfactory performance or breakdown due to defective design, manufacture and/or installation. The installation shall be covered by the conditions that the whole installation or any part thereof found defective within one years from the date of completion shall be replaced or repaired by the contractor free of charge as decided by the Engineer-in-Charge.

A.11.2 The guaranty shall cover the following:-

a) Quality, strength and performance of materials used.

b) Safe mechanical and electrical stress on all parts under all specified conditions of Operation.

c) Satisfactory operation during the guarantee period.

d) Performance figures and other particulars as specified by the tendered under

A.11.3 Labour to trouble shoot, repair, reprogram or replace system components shall be furnished by the contractor at no charge to the Engineer-in-charge during the guarantee period.

A.11.4 All corrective software modifications made during guarantee period shall be updated on all user documentation.

A.12. MISCELLANEOUS:

A.12.1 The onus of incorporating the **statutory requirements as per local rules** and obtaining necessary approval for the fire alarm systems shall rest fully with the Contractor.

A.12.2 The installation shall be carried out using new Equipment/ Materials complying with applicable standards in a workmanship like manner. Engineer-in-charge reserves the right to reject any part of installation having poor workmanship.

A.12.3 All minor Masonry, Carpentry and Civil works such as cutting / opening in Masonry Walls/ Internal Partitions, Chasing on Walls, etc. and making good the same to match existing surface shall be done by the Contractor, wherever asked for by the Engineer-in-charge or his authorized representative. Nothing extra shall be paid on this account.

B: SYSTEM DESCRIPTION

B.1 SCOPE OF WORK

The work shall comprise entire labour including supervision and all materials necessary to make a complete installation to the entire satisfaction of the department. The term complete installation shall mean, not only major items of equipment covered by these specifications, but also incidental sundry components necessary for complete execution and satisfactory performance of the installation, with all labour charges, whether or not these have been mentioned in detail in the tender documents. The work shall include data entry, programming, start up test and demonstration, training of personnel for maintenance and operation, submission of construction and installation drawings and wiring diagrams, as built documents and system guarantee.

B.1.1 The Contractors' scope of work will include all items of work as per these specifications, drawings, terms and conditions of contract etc. and briefly described in schedule of quantities. This shall include, but not be restricted to the following: -

a) Intelligent Addressable Optical /Thermal type Multisensor Smoke Detectors.
b) Intelligent Addressable Thermal Detectors.
c) Addressable Manual Call Points (Resetting Type)
d) Microprocessor Based Modular Intelligent Addressable Main Fire Alarm Control Panel for connecting and monitoring the Fire Detectors and other devices.
e) Low /High Intensity Hooters activated from the Panel.
f) Providing suitable compatibility in the Main Fire Alarm Control Panel for the Public Address System, audio Amplifiers, speakers & required wiring.
g) Electrical works, including Cabling, Earthing etc. for the installation.
h) All other works associated with above items as per specifications, drawings and conditions of contract and the Fire Brigade requirements except those specifically excluded in Schedule of Quantities.

B.1.2 Unless otherwise indicated in Schedule of Quantities and drawings, the Contractor's scope of work will exclude only the following items of work and services, which will be arranged by the Engineer-in-charge through other contractors, if required.

a) Provisions of adequate AC, single/ three phase, 230/415 V, 50 HZ supply with earthing for Fire Control Panels etc.

B.2 GENERAL DESCRIPTION OF INTELLIGENT FIRE ALARM SYSTEM

2.1 The detectors shall be Addressable Intelligent optical/ Thermal detectors.

2.2 The number of detectors and location shall confirm to relevant standards but not less than one detector **per 120-sq. meter area at 16m height**. Addressable intelligent optical detectors shall be used. The detectors shall give the visual and audible alarm at the respective control Panel. The panels shall be located in the respective ground floor control rooms.

2.3 **The fire alarm panel shall operate 240V± 10% 50Hz**. The FDAS shall also be provided with a dedicated standby power supply system (battery and charger) capable of maintaining the system for a period of not less than 24 hours after failure of ac power supply after which sufficient battery shall remain to provide full load operation for at least 30 minutes in line with IS 2189.

2.4 The FRLS cables shall be used from detectors to the alarm panel confirming to the relevant IS and from reputed manufacture.

2.5 The system should be able to detect any type of smoke, fire and heat in the respective site area.

B.3. DETAILED DESCRIPTION OF THE SYSTEM COMPONENTS:

BASIS OF DESIGN

An Intelligent Modular/ Expandable Fire Alarm System (IFAS) shall be provided to effect total control over the life safety services required in the building.

The system shall be provided with Addressable fire alarm initiating, annunciating and control devices.

The addressable and intelligent system shall be such that smoke sensors, thermal sensors, manual call points, etc., can be identified with point address.

The FAS shall be able to recognize normal and alarm conditions, below normal sensor values that reveal trouble condition, and above normal values that indicate either an alarm condition or the need of maintenance.

Read-out or address an actual detector location. The operator shall also be able to adjust alarm and alarm thresholds and other parameters for the smoke sensors.

Provide a maintenance/pre-alert/fault alarm capability at smoke sensors to prevent the detectors from indicating a false alarm due to dust, dirt etc.

Provide alarm verification of individual smoke sensors. Systems that perform alarm verification on a zone basis shall not be acceptable. Alarm verification shall be printed on the printer at the Control Station's printer to enhance system maintenance and identify possible problem areas.

Provide local numeric point address and LED display of device and current condition

of the point.

Each detector shall use state-of-the-art Microprocessor Circuitry with error, detector self-diagnostics and supervision programs.

The detection of the fire shall be taken at the detector level.

Multi-Criteria Detectors shall be offered where by **the** system logic activation is based on any three inputs from the detector i.e. smoke, fixed heat or rate of rise heat.

Provide outputs that are addressable, i.e. outputs shall have point address. The operator shall be able to command such points manually or assign the points to Logical Point Groups (Software Zones) for pre-programmed operation.

In the event of a fire alarm, but not in a fault condition, the following action shall be performed automatically.

a. The System Alarm LED on the main fire alarm control panel shall flash.

b. A local sounder shall be sounded.

c. The LCD display on the main fire alarm control panel shall indicate all information associated with Fire Alarm condition including the type of alarm point and its location within the premises.

d. Printing and history storage equipment shall log the information associated with the Fire Alarm Control Panel condition, along with the time and date of occurrence.

e. All system output programs assigned via control-by-event programs that are to be activated by a particular point in alarm shall be executed, and the associated system outputs (alarm notification appliances and/or relays) shall be activated.

FIRE ALARM CONTROL PANEL (FACP)

The Addressable Fire Alarm Control Panel (FACP) shall be networkable type. FACP shall has its own microprocessor, software and memory. In the event of failure of the central or communication breakdown between the central station and the FACP, the FACP shall automatically operate on stand-alone mode without sacrificing any functions.

The networking should be peer to peer type wherein all information is available on all the panels

The panel should be modular microprocessor based in nature and should be **expandable from single loop to up to 32 loops with each loop capable of up to 250 detectors.**

FACP shall supervise detection circuits and shall generate an alarm in case of abnormal conditions.

FACP shall provide general purpose inputs for monitoring such functions as low battery or AC power failure. FACPs shall provide tamper protection and commendable outputs, which can operate relays or logic level devices.

Smoke detectors shall be powered using the FACP-based smoke detection circuits. FACPs shall provide for resetting smoke detectors, fault-isolation and sensor loop operation. It shall be possible to mix different fire devices within the same FACP to optimize field wiring.

It shall be possible for the panel to have a loop length with different modules **offering up to 3 km Loop length** of devices from the panel.

FACPs shall provide monitoring and control of one floor or area or for multiple floors or areas. FACPs shall meet the following requirements to assure the integrity and reliability of the system:

a. The FACP shall be Vds **/ UL listed** independently as a fire alarm control panel.

b. The FACP should have **integrated power distribution module** and fixed cabling done internally to guarantee a clear and tidy cable feed.

c. The panel should have a **LCD touch screen Megapixel screen** with white background lighting and keypad. The display should enable a flexible design of the operating menu with variable keys and message windows.

d. FACP should have menu Based operation.

e. All materials and components used in the panel are specified as per **Vds / UL Certification**.

f. The panel should have a 120V/230V AC power supply unit in plug-in design with rack and panel connector is a 24VDC/6A single. Output power supply. The module should be protected against overvoltage and reverse polarity. The output voltage is monitored and regulated externally.

g. LCD display at the FACP shall be provided to indicate point in alarm or trouble. In such systems, means for manually scanning the points in trouble shall be provided and a trouble and alarm LED shall be used to indicate that there are points in alarm/trouble. The alarm/trouble LED shall only extinguish when all alarm/troubles are cleared from the loop.

h. It shall be possible to command test, reset and alarm silence from the FACP. FACP should have freely configurable detector zone displays from 1 to 32,000

i. FACP should have a programmable software timer for automatic switching of day operation mode to night operation mode, switching of mode of operation of automatic multi-criteria fire detectors

j. FACP one freely programmable key switch with 2 switch positions for code mode, day operation, switch-off and reset

k. FACP modules encapsulated for rugged handling as EMC protection for electronics**.**

l. Programming & logging in of all panels in network is possible from any panel.

m. FACP should have at least **10,000 history logs**.

n. The fire panel must display the mixed operation of bidirectional, digital data transmission between detector and control panel for uniform switching of fire peripherals via a two-wire stub and/or loop topology in a local security network (LSN) and direct current line technology (conventional zone

o. Direct connection of a stub line to a loop at any location without additional interfaces.

p. Graphics-capable touch screen with white background lighting and screen size of at least 14.5 cm for display and operation of alarm messages, malfunctions, switching and control procedures and plain text displays of customer-specific data such as location data

q. Programmable software timer for automatic switching of day operation mode to night operation mode, switching of mode of operation of automatic multi-criteria fire detectors

r. Individual detector and detector zone switch-off

s. Output of stored messages in plain text on touch screen.

t. Linking of detector information for generating switch commands, e.g. to panels, as well as activation of monitored LSN control elements

u. One freely programmable key switch with 2 switch positions for code mode, day operation, switch-off and reset

v. The FACP shall have Drift Compensation facility to compensate for environment.

w. The display on FACP shall provide indication for AC Power, System Alarm, System Trouble/Security Alarm, Display Trouble and Signal Silence. This would mean that in the event of change of any logic, detector / zone sequence alteration, the operator can initiate these by use of the LCD touch pad & alpha-numeric keys on the FACP panel to reconfigure the above parameters.

DETECTORS & ADDRESSABLE DEVICES

General features common to all detectors:

Built-in-response indicator: Each detector shall incorporate indicator “LED” at the detector which shall blink in normal condition and glow steady on actuation of the detector to locate the detector which is operated while on fire. The detector shall not be affected by the failure of the response indicator lamp. The Led **should be visible from a 360 deg view**

Maintenance: All detectors shall be fitted either with plug-in system or bayonet type connections only, from the maintenance and compatibility point of view.

Construction: The components of the detectors must not be damaged by static over voltage.

Addressable Optical/Thermal Smoke Detectors

Smoke detectors shall be addressable devices, and shall connect with two wires to one of the Fire Alarm Control Panel loops. The detectors shall be ceiling mounted type

The detectors shall provide electronic address-setting by means of configuration software.

The area covered by each smoke/heat detector shall be as per EN – 54 / IEC / IS guidelines.

Each detector shall have **in built fault isolation unit**.

Addressable Thermal Detectors

Thermal detectors shall be intelligent and addressable devices, and shall connect with two wires to one of the Fire Alarm Control Panel loops.

The detectors shall use an electronic detector to measure thermal conditions caused by a fire and shall, on command from the control panel, send data to the panel.

Each detector shall have **in built fault isolation unit.**

Addressable Duct Detector

Addressable automatic fire detector for monitoring of ventilation ducts which can perform alarm pattern analysis (pattern comparison of fire characteristics), with even response sensitivity for all fires with smoke development. For installation in special housing, such that the trigger displays remain visible after installation.

Evaluation of characteristics according to signal increase rate and signal strength. There is a significant reduction in deceptive alarms where detection equipment is constant.

Features:
- Contamination detection
- Detector remote inquiry
- Self-monitoring
- Automatic addressing
- Additional manual addressing for the use of existing networks with stub branches
- Integrated isolators at input and output so that all elements in the loop maintain operational availability, even if there is a short circuit. This means that no cable is required to maintain functionality.

Special Housing for accommodating a special detector that detects smoke in ventilation ducts, with input and output for air sample extraction, streamlined connection pipes for optimum air flushing of the detector, with dust-proof connection board for the loop outside the air flow, with air intake and exhaust pipe, seals and the required installation material

Features:
- Air intake and exhaust pipe, extendable up to 3m
- Detector's trigger display visible when housing is closed
  Simple mounting to ventilation duct via expanding nuts (supplied)
- Filter in air intake and exhaust route
- Cover can be monitored when housing is open

Beam Type Smoke Detectors :

With transmission, receiver, and evaluation units, for detecting light and dark smoke over a distance of min. 10 m and max. 100 m with extra width of up to 14 m
- Stable metal housing
- Volume control with 15 increments for self-activated Compensation for

contamination and intentional aging
- Separate outputs for alarm and malfunction
- Measurement output for calibration and service mode
- Connection to detector's primary line using potential-free relay double-throw contacts

Protection category: IP 54
Operating temperature range: -20 C to +55 C

Response sensitivity: 40% VdS / IS / IEC compliant
Response time: Alarm- 5 Seconds
Malfunction : 1 Second

Addressable Manual Stations

Addressable manual stations shall be provided to connect to the Fire Alarm Control Panel loops.
The manual stations shall on command from the Control Panel send data to the panel representing the state of the manual station.
Stations shall be suitable for surface mounting.

Fire Telephone System

Telephone jacks shall be provided for the two way communication to and from the Fire Alarm Panel. It shall enable the Fire fighters to make fast & accurate evacuation control. The operator should get an indication in the panel with address from which telephone jack is activated.

AUTO-DIALER SYSTEM

The auto telephone dialer shall be high quality, automatic voice message communicator. It shall be a pre recorded audio alarm message followed by an alarm triggered by any one of the pre-programmed inputs.

The auto dialer shall be connected to the nearest Fire Control Station and also to the Security room.

Minimum 4 numbers of 12 digits shall be stored & minimum duration of alarm or voice message shall be 16 second.

Dialing method shall be pulse or tone programmable.

Addressable Monitor Modules

- Programming of the input normal state "open" or "closed" independently selectable for each input
- Pulse contact monitoring for detection of high resistance contacts
- Monitoring of contacts for "open" and "closed" states on lines
- For flush mounting in standard electrical boxes
- Addressing of interface either automatically or via code switch (allowing unique assignment of installation location to address)

Addressable Control Module :

- Output should electrically isolated from loop
- Switching of currents and voltages up to **1 A at 30 V DC & Max of 6 A/30 V DC or 10 A at 120 VDC/230V AC/24V DC**
- owner supply to interface via two-wire line (line supply)
- Addressing of interface either automatically or via code switch (allowing unique assignment of installation location to address)

Addressable Sounder Base

- The Addressable Sounder Base shall be compatible with the Fire detection and alarm panel offered.
- It shall be roof mounted or wall mount type.
- It shall be microprocessor based intelligent, addressable type.
- It shall work at the same operating voltage of detectors.
- It shall generate audio alarm on command from the fire detection and alarm panel.
- It shall be able to carry out self diagnosis and automatic device mapping.
- It shall be able to withstand ambient temperature upto 50 deg.C.
- It should be able to generate at least **32 different types of tones.**

Technical specifications

i) Operating voltage 15 V DC. . 33 V DC
ii) Current consumption < 5 mA at maximum sound pressure level
iii) Maximum sound pressure level is 100 dB(A) according to EN54-3
iv) 32 tones programmable from the fire detector control panel
v) Frequency range of 450 Hz to 2 900 Hz
vi) Various signals for pre-alarm and alarm
vii) Protection category according to DIN 60529: min IP 42
viii) Operating temperature range min -25°C to +85°C
ix) High resistance to electromagnetic effects. Approved for DIN EN 61000-4-4 Electrical fast transient/burst immunity test with 2 KV Delivery and installation ready for use

Flasher

The flasher should support have flexibility to accept detector base or Sounder base with no additional cabling or power supply, synchronized flash rate of 1Hz.

Response Indicators

Remote Response Indicator shall be installed outside the areas normally kept closed to identify the detectors response even if the room is locked. These indicators shall be able to indicate the status of the corresponding detectors in these areas.

PC based Graphical user interface

The system shall be provided with a PC based Graphical user interface. It shall comprise of hardware and software i.e, GUI.

a) Hardware: Listed below are the specification of the hardware of PC

Hardware Description

COM port : Max. 4 (one COM port per control panel)

Inputs: USB/LPT, CD-ROM, 3.5" disk drive
CPU :min. 2 GHz
RAM:1024 MB (server), 1024 MB (client)
Hard drive memory : 500 GB
Network card :100 Mbit

Software Description
Operating system :Windows 2000 SP4, Windows XP SP2, Windows 2003 server, Windows 2008(Latest)
Internet Explorer : Version 5.5 SP1 or 6.0(Latest)
MSDE :Version MSDE 2000 SP3a
Microsoft :IIS Version 5.0 (Windows 2000, Windows XP) Version 6.0 (Windows 2003 server), Windows 2008(Latest)

b) Software: A brief description of the GUI is given below.

- It shall display the plant layouts with building, floor, zone and location details.
- It shall display the alarm status of the detectors, manual call points
- It shall check, display and log the health of different components in the system.
- It shall be able to generate and print alarm status reports, fault status reports.
- It shall have facility for alarm acknowledgement, reset and test functions.
- It shall communicate with the fire detection and alarm panel via RS-232/RS-485 serial port or Ethernet port.
- It shall facilitate the programming of the fire detection and alarm panel and other components.
- It shall be possible to program and display different messages of normal, fault and alarm conditions.

Installation

Installation shall be in accordance with the IS 2189, NEC, NFPA 72, EN 54, local and state codes, and as recommended by the major equipment manufacturer.

All fire detection and alarm system devices, control panels and remote annunciators shall be flush mounted or surface mounted as per direction given by E-in-C.

Manual fire alarm boxes shall be suitable for surface mounting or semi-flush mounting.

Commissioning Procedure shall be carried out in a methodical sequence as follows

Start-up,

Configuration,

Operability adjustment, Stable operation, Final adjustment

The Contractor shall finalize captured FDAS data to be recorded and the manner in which the data is to be taken.

Instruction

Instruction shall be provided as required for operating the system. Hands-on demonstrations of the operation of all system components and the entire system including program changes and functions shall be provided.

The contractor and/or the systems manufacturer's representatives shall provide a typewritten "Sequence of Operation."

16.0 VOICE NETWORKING

(Hybrid Voice & Telephonic system)
Special Points for Passive Components:

- All copper & Fiber component should be from single OEM as per the approved makes.
- All passive components should be RoHS (Restriction of Certain Hazardous Substances) complied. Declaration-RoHS Should be clearly mentioned on datasheet of each Passive Component.
- There should be a minimum of 20 years warranty assurance for all supplied component.
- The manufacturer of Passive component should be a technology development partner with any of the leading Manufacturer of Active Component.
- Bidder has to submit an authorization letter from the OEM only specific to this work. All bids without the authorization letter will be liable to be rejected.
- All work related to fiber including digging, laying of HDPE Pipe/Hume Pipe/Conducting will be in the bidders scope. The Bidder Should take in consideration all the cost involved for the same, nothing shall be paid extra on account for this.
- Bidder has to support the complete system for one year after the completing the installation and assign one dedicated resource for the same for one year on their own cost only.
- Bidder should have adequate facilities, manpower and staff for installation testing and commissioning and can provide after sales services. OEM has to authorize their System Integrator in this regards stating that they will Support the solution through their SI.

Special Points for Active Components:

- All components should be from same OEMs as per the approved makes.
- All components should be RoHS (Restriction of Certain Hazardous Substances) complied. Declaration-RoHS Should be clearly mentioned on datasheet of each Active Component.
- There should be a minimum of 1 years warranty assurance for all supplied component.
- Bidder has to submit an authorization letter from the OEM only specific to this work. All bids without the authorization would be rejected.
- Bidder has to support the complete system for one year after the complete installation and assign one dedicated resource for the same for one year on their own cost only.
- Bidder should have adequate facilities, manpower and staff for installation testing and commissioning and can provide after sales services. OEM has to authorize their System Integrator in this regards stating that they will Support the solution through their SI.

Proposed System must meet the following minimum technical specifications:

Sr. No.	Description	Compliance Yes / No
1	**Cat-6A Mounting Cords for Data**	
	Guaranteed to meet or exceed the channel specifications of Amendment 1 to ISO/IEC 11 801:2002 Class EA and ANSI/TIA-568-C.2 Category 6A up to 500 MHz when used as part of a CAT 6 A UTP Channel in registered installations	
	ETL/cETL listed	
	Qualifies for the OEM minimum 20-Year Extended Product Warranty and Applications Assurance	
	Factory terminated patch cords with Anti-Snag RJ-45 Interface	
	Patch Cord should be round in shape	
	Available in LSZH versions	
	Available in Solid cordage	
	When used with the same manufacturer cable, the channel should be supporting a short channel of 5 meters	
	RoHS Compliant	
2	**CAT 6A – 24 Port Patch Panel for Data and Voice field**	
	Guaranteed to meet or exceed TIA/EIA 568-C.2 Category 6A and ISO/IEC Class EA specifications	
	Copper panels shall be upgradeable to intelligence in the field at a later stage with the Intelligent Upgrade Kit	
	Upgrade shall be performed without network disruptions, without the removal of patch cords	
	Solution shall offer customers the option to deploy intelligence immediately or in phases, according to needs and budgetary requirements	
	Panel shall be available in the loaded versions	
	Panel shall be available in 24-port configurations with universal A/B labeling and 110 connector terminations on rear of panel allowing for quick and easy installation of 22 to 24 AWG cable	
	Panel shall be equipped with a removable rear mounted cable management bar loaded with the cable organizers, which would allow grouping 6 cables	
	UL listed, UL-C certified and ACA approved	
	RoHS compliant	
	Architectural design and flexibility - supports 5 meter cables in 3 and 4 connector channels, 3 meter cables in 2 connector channels and cross connect cords down to 1 meter	
	Straight constructions	
	Elegant design where even the mounting screws are concealed	
3	**15 U/9U Wall Mount Rack, Cable Manager**	
	Single Section Unit	
	Rigid frame that can be fixed to the wall	
	Adjustable 19” rails in the front and rear	
	Top and bottom cable entry facility	
	Front section with glass door and lock	

Sr. No.	Description	Compliance Yes / No
	600mm wide x 500mm deep	
4	**200,300,1200 Pair MDF Box with Mounting Frame**	
	Should be Category 6 IDC patch panel prepackaged with wiring block with legs, insert labels, label holders, jumper troughs, metal back panel duct assembly, screws washers and an instruction sheet for termination of incoming pairs. Rate shall include suitable size of lockable 1.6mm thick CRCA sheet steel enclosure duly powder coated	
5	**25 Pair Riser cable**	
	Solid copper conductors insulated with expanded polyethylene covered by a PVC sheet	
	Core shall be covered with a layer of plastic tape and overlaid with a corrugated PVC plastic	
	Suitable to be used without conduit. The cable shall meet. EIA/TIA -568, C S A T -529, IEEE 802.3 & 10 B A S E -T	
	Pair sizes shall be as per the schedule of quantities	
	Maximum DC Resistance 26.5 ohm per 100 ft	
	Maximum DC Unbalanced Resistance 17%	
	Mutual Capacitance at 1 Khz 16 nF per 1000 ft	
	Solid copper conductors insulated with expanded polyethylene covered by a PVC sheet	
	Core shall be covered with a layer of plastic tape and overlaid with a corrugated PVC plastic	
5	**DK PS Frame**	
	Equipped with DX Gas Based in Rack Cooling System where Hot and cold aisle is maintained within the rack. It should have heat exchanger to remove high levels of waste heat from server enclosures and provide uniform, effective, affordable cooling for Servers, in addition to similar IT equipment (switches etc) installed in server enclosures. Each DX Gas cooling system should be a closed unit consisting of a cooling system and cool either one or two server enclosures	
	Integrated DX Gas Based heat exchanger should guarantee a cooling output of up to 7 KW with redundancy, combined with standard server enclosure dimensions, the lowest possible weight and comprehensive possibilities for monitoring	
	Server must be maintained at +10°C to +35°C temperature and humidity 10-90% non condensing for 24 x 7 whole year	
	Air/Gas Based heat exchanger is mounted in side of the rack	
	Gas Based should offer enclosure-based cooling separate from the room air and is thus also able to reduce the noise level.	
	Unit should be capable of providing cooling for one server rack	
	Hot server air is drawn off to the rear of the server rack. After cooling, it is expelled left and right over the whole enclosure uniformly over the entire height of the rack and is thus made	

Sr. No.	Description	Compliance Yes / No
	available to the IT equipment once more	
	Provision for monitoring and leakage management must be incorporated	
	Monitoring and alarm management for all physical parameters in addition to energy efficient operation is required	
	Require parameters and their performances	
	Cooling Output: Minimum 7 KW with redundancy	
	Cooling medium: R410a	
	Cooling system- Mount with zero U space	
	Reliability of the system is a must requirement	
	Sensors should communicate as per the followings: Technical Specifications	
	Network interface: IEEE 802.3 10/100BaseT Full Duplex	
	Basic protocols: TCP/IP, SNMP V1.0, Telnet, FTP, http	
	Additional features: NTP, SSH, SSL, DHCP	
	Rack Size should be 800/1000W x 2000(42UH) x 1200D	
	Covered front and back, top and bottom	
	Base Frame should be provided	
	Copper earth bus bar for full height with 15 (or higher) earth wire and 15 (or higher) conductor connector should be provided	
	All rack enclosures should be certified against UL Safety Standard	
	Racks should be populated with 24 (or higher) numbers of C13 and 9 (or higher) numbers of C19 Sockets with MCB & with sufficient cable	
	Load bearing capacity will be 1000Kg	
	All racks of data Centre should be fitted with automatic rear door opening system:- The door should open automatically in case of failure of the Cooling system, high temperature and fire	
	All required room preparation and civil –electrical etc. works, appropriate for installation of SERVER –clusters and cooling systems, should be done at Data Centre by the vendor. It includes false ceiling, lighting, painting (Room walls to be painted with enamel paint to minimize dust),etc. All required specific type of room preparation for the installation of rack based DX cooling system to be provisioned by the bidder	
	The data Centre will be provisioned with structured power distribution system. The 3-Phase commercial conditioned 440V/50Hz power supply will be made available at the Distribution panel along with MCCB	
	This Main Distribution panel should be used by the provider to distribute power to all power consuming devices used in data Centre such as: UPS, Air-Conditioning system, Data Center cooling system etc… The wiring should be carried out by the vendor by using fire retardant appropriate rating electrical cable	
	All Power socket & Plugs for Racks, UPS Power will be provided by Client. UPS panel and rack PDU in scope of vendor/ bidder	
	The system should be fitted with an IP enabled CCTV based surveillance system for monitoring of activity outside the IT Data Centre	

Sr. No.	Description	Compliance Yes / No
	The system must be supplied with 2 Nos of IP Based Cameras (one on the front side & another on the rear side), The system should have the facility of remote viewing over IP network and recording	
	Rack front door should be fitted with biometric bases access control system	
	Delivery of an active extinguishing system that detects and extinguishes fires in closed server and network cabinet	
	High-performance fan must extract air samples for smoke analysis into the system's measuring chamber	
	Integrated extinguishing system must trigger if the concentration of smoke exceeds the limits	
	Extinguishing process must not be electrically conducting and must be fast and residue-free. NOVEC1230 must be used as the extinguishing gas	
	Extinguisher container must be integrated into one RU housing. The fire detection and extinguishing system should be fully rack mounted and fully automatic	
	Access sensors must be designed so that they may be connected to the active extinguishing system. It must not be possible to trigger the active extinguishing system when the doors are open	
	Two 42 U Racks for Information Technology Devices with integrated active cooling and hot air Exhaust with redundant external UPS	
	7 KW or higher Capacity	
	7KW conditioner with variable scroll compressor in N + N Configuration Units	
	Should be mounted vertically for providing uniform cooling inside the Rack	
	Cooling unit should not occupy any U Space	
	Both the units should be integrated and mounted Active Cooling	
	Rack mount Redundant 2 x 10 KVA UPS with minimum back up time of 10 minutes	
	Batteries to be mounted in rack	
	30 U or higher per rack	
	AC power catered by redundant UPS on power strip with proper indicator and Earth Bus Bar on standard Rack PDU	
	Temperature, Humidity, Door switch Sensor, Access Control, Fire and water leak sensor	
	Event Alerts, SNMP, email notification	
	1U rack based fire suppression and detection system with NOVEC 1230	
	Minimum warranty and support for 1 year for active cooling devices and UPS	
6	**6 Core Single Mode Fiber (Armored) Cable**	
	9/125µm (OS1) single mode	
	Corrugated steel armor, UV resistant cable sheathing - meets or exceeds the performance requirements of Telcordia GR-20,	

Sr. No.	Description	Compliance Yes / No
	Issue 2 and ICEA 640, and is tested in accordance with relevant EIA-455 series FOTPs for Fiber optic cables	
	Gel-free design with water swell able tape provides dry water blocking	
	Sheath markings for positive identification, quality traceability, and length verification	
	Bend radius Dynamic: 20 x Cable O.D. Static: 10 x Cable O.D	
	Tensile rating Installation: 600 lbf (2700 N)	
	Long term: 200 lbf (890 N)	
	125 lbf/in (220 N/cm)	
	Long term: 63 lbf/in (110 N/cm)	
	Storage/shipping temperature -40° to 167°F (-40° to 75°C)	
	Installation temperature -22° to 140°F (-30° to 60°C)	
	Operation temperature -40° to 158°F (-40° to 70°C)	
	Attenuation Singlemode: 0.40dB/km @ 1310nm; 0.30dB/km @ 1550nm	
	Individual Component should have individual QC No. to provide lifetime traceability	
7	**12 and 24 ports Fiber LIU Loaded with SC SM Coupler**	
	Pre loaded, Slide out drawer, Slides forward 300mm	
	Two-piece, all metal body construction	
	cable entry via PG11 glands, 5mm blown fiber glands, 20mm knockouts or 30mm rubber grommets	
	Dedicated white labeling areas on drawer front for individual fiber adapters and overall enclosure labeling	
	Mounting hardware and fiber routing accessory kit included; contains 2 fiber management spools, two 30mm size rubber grommets, one cable gland, Cable Ties and #12-24 and M6 x 1 mounting screws	
	Integral brackets mount to 19" wide EIA-310/IEC 60297 compatible rack or cabinet for OS1, 9/125µm -Factory configured with 6 duplex SC adapters & 12 duplex SC adapters (Blue, Zirconia Ceramic Split sleeves)	
	Individual Component should have individual QC No. to provide lifetime traceability	
	Pre loaded, Slide out drawer, Slides forward 300mm	
8	**SC SM Pigtail**	
	Fiber optic patch cords include duplex LC and/or SC connectors on both ends	
	Fiber optic pigtails include simplex SC on one end and open (unterminated) on the other end	
	Patch cords and pigtails meet requirements of TIA/EIA-568-C.3.1	
	FOCIS compliant / TIA/EIA-455-21A Complaint	
	Compliant with TIA/EIA 568-C.3-1	
	ISO/IEC 11801 IEC-61754-7 (international)	

Sr. No.	Description	Compliance Yes / No
	TIA-604-5 (FOCIS-5)	
	UL 1666 (OFNR) flame ratings	
	Meets UL 1666 (OFNR) flame rating for standard compliant safety For OS1, 9/125µm	
	Pigtail - SC to pigtail, 900um buffered fiber, 1 Mtr	
	Individual Component should have individual QC No. to provide lifetime traceability	
9	**SC-LC SM Fiber Patch Cords (3 Mtr)**	
	Fiber optic patch cords include duplex LC and/or SC connectors on both ends	
	Fiber optic pigtails include simplex SC on one end and open (unterminated) on the other end	
	Q.C. identification label to provide lifetime traceability for each patch cord and/or pigtails	
	FOCIS compliant / TIA/EIA-455-21A Complaint	
	Compliant with TIA/EIA 568-C.3-1	
	ISO/IEC 11801 IEC-61754-7 (international)	
	TIA-604-5 (FOCIS-5)	
	UL 1666 (OFNR) flame ratings	
	Meets UL 1666 (OFNR) flame rating for standard compliant safety For OS1, 9/125µm	
	Patch Cord - SC to LC duplex, 1.6mm jacketed, 3 Mtr	
	Individual Component should have individual QC No. to provide lifetime traceability	
10	**6 Core Multi Mode Fiber (Armored) Cable**	
	Fiber Type Multi-mode 50/125µm OM3	
	Jacket	
	Water blocking	
	Sheath markings for positive identification, quality traceability, and length verification	
	Bend radius Dynamic 20 x Cable O.D.; Static: 10 x Cable O.D	
	Tensile rating (_<12 fibers) Installation 660 N; Long Term: 165 N	
	Tensile rating (>12 fibers) Installation 1300 N; Long Term: 330 N	
	Storage temperature -40° to 65°C	
	Installation temperature -20° to 50°C	
	Operation temperature -20° to 50°C	
	Attenuation 3.5dB/km @ 850nm; 1.5dB/km @ 1300nm	
	Quality Control	
11	**12/24 Port Fiber LIU Loaded with SC MM Coupler**	
	Pre loaded, Slide out drawer, Slides forward 300mm	
	Two-piece, all metal body construction	
	cable entry via PG11 glands, 5mm blown fiber glands, 20mm knockouts or 30mm rubber grommets	
	Dedicated white labeling areas on drawer front for individual	

Sr. No.	Description	Compliance Yes / No
	fiber adapters and overall enclosure labeling	
	Mounting hardware and fiber routing accessory kit included; contains 2 fiber management spools, two 30mm size rubber grommets, one cable gland, Cable Ties and #12-24 and M6 x 1 mounting screws	
	Integral brackets mount to 19" wide EIA-310/IEC 60297 compatible rack or cabinet for OS1, 9/125µm -Factory configured with 6 duplex SC adapters & 12 duplex SC adapters (Blue, Zirconia Ceramic Split sleeves)	
	Individual Component should have individual QC No. to provide lifetime traceability	
12	**SC MM Pigtail (1.0 Mtr)**	
	Fiber optic patch cords include duplex LC and/or SC connectors on both ends	
	Fiber optic pigtails include simplex SC on one end and open (unterminated) on the other end	
	Q.C. identification label to provide lifetime traceability for each patch cord and/or pigtails	
	Patch cords and pigtails meet requirements of TIA/EIA-568-C.3.1	
	FOCIS compliant / TIA/EIA-455-21A Complaint	
	Compliant with TIA/EIA 568-C.3-1	
	ISO/IEC 11801 IEC-61754-7 (international)	
	TIA-604-5 (FOCIS-5)	
	UL 1666 (OFNR) flame ratings	
	Meets UL 1666 (OFNR) flame rating for standard compliant safety For OM3, 50/125µm	
	Pigtail - SC to pigtail, 900um buffered fiber, 1 Mtr	
	Individual Component should have individual QC No. to provide lifetime traceability	
13	**SC-LC MM Fiber Patch Cords (3 Mtr)**	
	Fiber optic patch cords include duplex LC and/or SC connectors on both ends	
	Fiber optic pigtails include simplex SC on one end and open (unterminated) on the other end	
	Q.C. identification label to provide lifetime traceability for each patch cord and/or pigtails	
	FOCIS compliant / TIA/EIA-455-21A Complaint	
	Compliant with TIA/EIA 568-C.3-1	
	ISO/IEC 11801 IEC-61754-7 (international)	
	TIA-604-5 (FOCIS-5)	
	UL 1666 (OFNR) flame ratings	
	Meets UL 1666 (OFNR) flame rating for standard compliant safety For OS1, 9/125µm	
	Patch Cord - SC to LC duplex, 1.6mm jacketed, 3 Mtr	
	Individual Component should have individual QC No. to provide	

Sr. No.	Description	Compliance Yes / No
	lifetime traceability	
14	**Fiber Runner 4x4 QuikLock Coupler**	
	Pre-assembled to provide fast mechanical assembly of components	
	No tools required for installation; bolts loosen for component disassembly	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
	Pre-assembled coupler quickly joins two sections of channel and/or fittings	
	Mechanically attaches without tightening bolts	
	Bolts release using 3/8" nut driver to allow coupler to be removed if necessary	
15	**Fiber Runner 4x4 Channel, Hinged Cover, Snap On Hinged**	
	System is comprised of channel, couplers, fittings and brackets designed to segregate, route and protect fiber optic and high performance copper cabling runs to and between equipment racks within a data center, telecommunications room or service provider facility	
	Robust 4x4 system ideal for use with smaller cable counts	
	Multiple spillout options provide versatility to mate to various equipment and rack configurations	
	Couplers and Brackets reduce system installation time dramatically	
	Channel, covers, fittings and other non-metallic system components made from V-0 flame class rated material	
	Compatible with all sizes of Routing Systems, cable management, and racks	
	Compliant with the applicable tests in Telcordia GR-63-CORE Network Equipment Building Systems (NEBS) Level 3	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
16	**Fiber Runner 4x4 QuikLock Trapeze Bracket - 1/2" Threaded Rod**	
	A full complement of brackets is available for attaching system components to ladder rack, threaded rod, auxiliary framing, strut, equipment racks and raised floor pedestals	
	Used to support the 6x4 and 4x4 systems by spanning two threaded rod drops	
	Can be installed from above or below	
	Bracket is secured to each threaded rod with two nuts	
	Pre-assembled slide clamps enable fast assembly to channel	
	Use 7/16" nut driver on slide clamps	

Sr. No.	Description	Compliance Yes / No
17	**Fiber Runner Spill-Over Junction with 2x2 Exit**	
	Spill-overs allow safe transition from horizontal to vertical runs	
	2" (50.8mm) bend radius control	
	Transition to channel, slotted channel, and corrugated loom tubing	
	Assembles onto 4x4, 6x4, 12x4, or 24x4 Fiber Routing Channel, spilling over the side into a 2x2 vertical exit	
	Requires coupler to attach 2x2 Fiber Channel and fittings to the vertical exit	
	Mounts directly to existing installation with no alteration required	
	Mounting hardware provided for secure attachment	
18	**Fiber Runner Spill-Over Junction with 2x2 Exit - Fiber Runner 4x4 Channel Cover**	
	Spill-overs allow safe transition from horizontal to vertical runs	
	2" (50.8mm) bend radius control	
	Transition to channel, slotted channel, and corrugated loom tubing	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
	Used to fully enclose 4x4 channel in conjunction with the spill-over junction	
	Cover snaps onto the channel base	
	Hinged feature allows easy access to add or remove cables	
19	**Fiber Runner 2x2 QuikLock Coupler**	
	Pre-assembled to provide fast mechanical assembly of components	
	No tools required for installation; bolts loosen for component disassembly	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
	Pre-assembled coupler quickly joins two sections of hinged channel and/or fittings	
	Mechanically attaches without tightening bolts	
	Bolts release using 5/16" nut driver to allow coupler to be removed if necessary	
20	**Corrugated Loom Tubing - 1.5" I.D.**	
	Corrugated Loom Tubing is offered for applications where spiral wrap or braided expandable sleeving may be difficult to install or where they do not offer the amount of protection required	
	This version features a lengthwise slit which makes it easy to install onto a bundle of wires or a pre-assembled harness	

Sr. No.	Description	Compliance Yes / No
	assembly	
	Protects and reduces the risk of damage to wiring	
	Resistant to crush, impact, and abrasion	
	Slit wall design eases installation	
	Can be held in place using push mount cable ties or mounts	
	Applications include control panel wiring and cable harness management	
	Order number of reels required	
21	**Fiber Runner 2x2 Hinged Channel - Mounting Holes**	
	2x2 Routing System is comprised of channel, couplers, fittings and brackets designed to segregate, route and protect fiber optic and high performance copper cabling runs to and between equipment racks within a data center, telecommunications room or service provider facility	
	2x2 system ideal for use with smaller cable counts	
	Channel, covers, fittings and other non-metallic system components made from V-0 flame class rated material	
	Couplers reduce system installation time dramatically	
	Compatible with all sizes of Fiber Routing Systems, cable management, and racks	
	2x2 Fiber Hinged and Slotted Channels can be used with 2x2 Duct Fittings and Brackets	
	Compliant with the applicable tests in Telcordia GR-63-CORE Network Equipment Building Systems (NEBS) Level 3	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
	Used to carry the cables horizontally throughout the system	
	Accepts hinged cover	
	Use Coupler to attach channel and/or fittings	
22	**Fiber Runner 4x4 End Cap**	
	Complete selection of fittings feature bends radius control to prevent excessive bends in high performance copper and fiber optic cabling	
	Minimum 2" (50.8mm) bend radius control fittings	
	Protects against signal loss and performance degradation	
	Assemble using couplers	
	Optional split covers snap onto each fitting	
	Covers feature 3/4" (19mm) gap to allow cable to be laid in	
	Used for closing off open ends of the channel or fittings	
	No coupler required	
	Push-on installation	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
23	**Fiber Runner 4x4 Horizontal Tee Fitting**	

Sr. No.	Description	Compliance Yes / No
	The complete selection of fittings feature bend radius control to prevent excessive bends in high performance copper and fiber optic cabling	
	Minimum 2" (50.8mm) bend radius control fittings	
	Protects against signal loss and performance degradation	
	Assemble using couplers	
	Optional split covers snap onto each fitting	
	Attaches to 4x4 channel and/or fittings to create a 90° horizontal branch from straight horizontal runs	
	Covers feature 3/4" (19mm) gap to allow cable to be laid in	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
24	**Fiber Runner 4x4 Horizontal Tee Split Cover**	
	The complete selection of fittings feature bend radius control to prevent excessive bends in high performance copper and fiber optic cabling	
	Minimum 2" (50.8mm) bend radius control fittings	
	Protects against signal loss and performance degradation	
	Assemble using couplers	
	Optional split covers snap onto each fitting	
	Optional split cover for the horizontal tee fitting	
	Covers feature 3/4" (19mm) gap to allow cable to be laid in	
	For other standard colors replace suffix YL (Yellow) with OR (Orange) or BL (Black)	
	Snap-on feature allows cover to be installed and removed with no tools required	
	Creates radiused 3/4" (19mm) opening for easy access to add or remove cables	
25	**Fitting, 1-Port Spill out to 1.5" (38mm) Inside Diameter Corrugated Tubing**	
	Spill-overs allow safe transition from horizontal to vertical runs	
	2" (50.8mm) bend radius control	
	Transition to channel, slotted channel, and corrugated loom tubing	
	Used to route cable into one piece of 1.5" (38mm) diameter split corrugated tubing	
	Used with a spill-over junction with a 2x2 exit, 2x2 Fiber fittings, and the 2x2 Fiber channel	
	Securely holds split corrugated tubing to ensure system integrity and easy access to add or remove cables	
26	**QuikLock Hardware Nut Driver**	
	7/16" nut driver for use with the Fiber Systems	
27	**Full-length blanking shade blanks**	

Sr. No.	Description	Compliance Yes / No
	Adjustable blanking solution that can blank out as few as 4 or as many as 45 rack units	
	Requires no tools or hardware to install	
	Easy and efficient installation and deployment	
	Can easily be raised or lowered to allow service to components within the cabinet	
	Requires no tools or hardware to install	
28	**2 port faceplate with Gang Box**	
	Meets or exceeds all applicable standards: UL 94V-0 flammability rating	
	Wall plate housing shall be a one-piece, single-gang flush mount style that is compatible with British Standard BS 4662 for flush-mount electrical boxes and BS 5733 for surface mount electrical boxes	
	Easy and efficient installation and deployment	
	Can easily be raised or lowered to allow service to components within the cabinet	
	It shall provide 1-, 2-, or 4-ports in a flat design, as well as 1- and 2-ports in an angled design to facilitate optimal cable management	
	High-impact, fire-retardant plastic rated UL 94V-0 and compliant with TIA/EIA-568-B specifications	
	Screws must conceal after installation of faceplate	
	RoHS Compliant	
	Faceplate should have shutter on each port	
29	**LSZH Cat 6A-10G speed unshielded twisted pair**	
	True UTP Cable	
	Round in shape having nominal Outer diameter of the cable should not exceed 0.285 in. (7.24 mm)	
	Should not have any kind of shielding (Floting or fixed)	
	The cable should be made available in a we-tote box, which protects the environment	
	Should have 4 pair construction with finned inner jacket surface and isolator member for all pairs & also all 4 pairs should have a separator in between 2 wires which will provides the extra margin of performance required for high band-width applications	
	Should be available in Low smoke Zero halagon versions to meet the installation and safety requirements	
	Flame Spread Test – IEC 60332-3	
	Smoke Opacity Test – IEC 61034	
	pH/Conductivity – IEC 60754	
	Guaranteed to meet or exceed the channel specifications of Amendment 1 to ISO/IEC 1180:2001 Class EA, and ANSI/TIA-568-C.2 Category 6A up to 500 MHz when used as part of a CAT 6 A U/UTP Channel installations	

Sr. No.	Description	Compliance Yes / No
	OEM should provide minimum 20 years of Extended product warranty and application assurance	
	Cable, patch cords and connecting hardware shall be UTP components that do not include internal or external shields, or drain wires	
	OEM should have published performance guidelines and installation instructions	
30	**UTP Cat-6A Information Outlet**	
	Guaranteed to meet or exceed the channel specifications of Amendment 1 to ISO/IEC 11801: 2002 Class EA and ANSI/TIA-568-C.2 Category 6A when used as part of a CAT 6 A UTP Channel in registered installations	
	When used with the same manufacturer cable, the channel should be supporting a short channel of 5 meters	
	Should be a non-keystone product	
	Snaps into standard faceplates, surface-mount boxes, consolidation point boxes, and Modular Panels	
	Can also be mounted either at 90 degrees (straight) or 45 degrees (angled) in the faceplate	
	Universal design and label supports both T568 A & B wiring	
	IDC connector terminations on rear of base allow quick and easy installation of 22 to 24 AWG cable	
	UL and cUL listed	
	Can support network line speeds up to at least 10 gigabits per second	
	Should be part of the OEM's minimum 20-Year Extended Product Warranty and Applications Assurance	
	RoHS Compliant	
31	**Core Switch with Chassis Based**	
	General Features & Performance	
	Should be Rack Mountable	
	Minimum switching capacity: 500 Gbps or more	
	Minimum forwarding rate: 250 Mpps or more	
	Should support internal redundant power supply	
	Should provide wire-speed and non-blocking performance on all the ports	
	Minimum IPv4 & IPv6 Routes : 8000	
	MAC addresses support: 32,000	
	VLANs support: 1000 active VLANs	
	Should be IPv6 ready from day 1	
	Should support IEEE 802.3az EEE (Energy Efficient Ethernet)	
	Should support 9K or higher Jumbo frames	
	Should support minimum 8 ports in a single Ether Channel group or equivalent protocol for Bandwidth aggregation	
	Should have NetFlow or sFlow from day one	
	Interfaces	

Sr. No.	Description	Compliance Yes / No
	Should have minimum 8x 1/10GBaseX SFP+ ports for uplinks	
	Should have high availability with minimum of 160 Gbps connectivity (8x10G or 2x40G). Necessary modules / ports / cables needs to be supplied from day 1 with dual controller cards equipped in active-active redundancy	
	Should have Virtual PortChannel (vPC) or vLAG or VSS or equivalent technology providing Layer 2 multipathing through the elimination of Spanning Tree Protocol and enables fully utilized bisectional bandwidth and simplified Layer 2 logical topologies without the need to change the traditional management and deployment models	
	Layer-III Features	
	Should have basic IP Lite Layer 3 routing - Static Route IPv4, Static Route IPv6, Inter-vlan routing, OSPF, PIM-SM & PBR from day 1	
	Should be upgradable to support enhanced IP Lite Layer 3 routing - BGP and VRF as and when required without replacing the hardware	
	Layer-II Features	
	Should support IEEE 802.1Q VLAN encapsulation	
	Should support 802.1d, 802.1s, 802.1w & 802.3ad protocols	
	Should support Spanning-tree root guard to prevent other edge switches becoming the root bridge	
	Should support PVST / PVST+ or equivalent spanning tree protocol	
	Should support sub 50ms ring protection as per IEEE 802.17/equivalent protocol	
	Should support Unidirectional Link Detection Protocol (UDLD) or equivalent protocol to allow unidirectional links failure detection	
	Should support Link Layer Discovery Protocol (LLDP) / CDP or equivalent protocol	
	Should have Layer 2 IEEE 802.1p (class of service [CoS]), 8 hardware queues per port, Per-port QoS configuration, Differentiated services code point (DSCP) marking, CoS-based egress queuing, Egress strict-priority queuing and ACL-based QoS classification (Layers 2, 3, and 4)	
	Should support IGMP snooping v1, v2 & v3 Security	
	RADIUS / TACACS, which allows centralized control of the switch and restrict unauthorized users from altering the configuration	
	Should support IEEE 802.1x to provide port-based user authentication	
	Should support port security and Secure Shell (SSH)	
	Management	
	Should have a Manageability through a common network-management software on a per-port and per-switch basis	
	Should support SNMP versions 1, 2, and 3 and RMON	
	Should support Network Time Protocol (NTP)	
	Configuration through the CLI, console, Telnet, SSH and Web Management	
	Should support Trivial File Transfer Protocol (TFTP) to reduce	

Sr. No.	Description	Compliance Yes / No
	the cost of administering software upgrades by downloading from a centralized location	
	Should have dedicated out of band 10/100/1000 base Tethernet port and dedicated serial console port	
	The High available switch shall also act as an Centralized management / provisioning console to ensure Zero touch replacement of field switches across network in case of any switch failure and also ensure the last running configuration is pushed through the core switch upon successful detection of the new replaced field unit without any human intervention	
	The High available switch shall also act as an Centralized management / provisioning console for dynamic policy roll out across the switches or for selected switches in the network using instant access/equivalent technology	
32	**Layer 3 Distribution Switch**	
	General Features & Performance	
	Should be Rack Mountable	
	Minimum switching capacity: 168 Gbps or more	
	Minimum forwarding rate: 95 Mpps or more	
	Minimum DRAM 512 MB and 128 MB Flash	
	Should support internal redundant power supply	
	Should provide wire-speed and non-blocking performance on all the ports	
	Minimum IPv4 & IPv6 Routes : 250	
	MAC addresses support: 16,000	
	VLANs support: 1000 active VLANs	
	Should be IPv6 ready from day 1	
	Should support IEEE 802.3az EEE (Energy Efficient Ethernet)	
	Should support 9K or higher Jumbo frames	
	Should support minimum 8 ports in a single Ether Channel group or equivalent protocol for Bandwidth aggregation	
	Should have Net Flow or sFlow from day one	
	Interfaces	
	Minimum of 24 x 10GBaseX SFP+ ports with module with scalability to 32x10G SFP+ slots	
	Minimum 2x 10GBaseX SFP+ ports for uplinks	
	Should have dedicated flexstack or equivalent stacking with minimum 80 Gbps or more Stacking bandwidth to stack upto 2 switches into a single virtual switch. Necessary stacking modules / ports / cables needs to be supplied from day 1	
	Should support sub 50ms ring protection as per IEEE 802.17/equivalent protocol	
	Layer-III Features	
	Should have basic IP Lite Layer 3 routing	
	Should have basic IP Lite Layer 3 routing - Static Route IPv4, Static Route IPv6 and Inter-vlan routing from day 1	
	Should be upgradable to support enhanced IP Lite Layer 3 routing - OSPF and HSRP / VRRP as and when required without	

Sr. No.	Description	Compliance Yes / No
	replacing the hardware	
	Layer-II Features	
	Should support IEEE 802.1Q VLAN encapsulation	
	Should support 802.1d, 802.1s, 802.1w & 802.3ad protocols	
	Should support Spanning-tree root guard to prevent other edge switches becoming the root bridge	
	Should support PVST / PVST+ or equivalent spanning tree protocol	
	Should support Unidirectional Link Detection Protocol (UDLD) or equivalent protocol to allow unidirectional links failure detection	
	Should support Link Layer Discovery Protocol (LLDP) / CDP or equivalent protocol	
	Should have Layer 2 IEEE 802.1p (class of service [CoS]), 8 hardware queues per port, Per-port QoS configuration, Differentiated services code point (DSCP) marking, CoS-based egress queuing, Egress strict-priority queuing and ACL-based QoS classification (Layers 2, 3, and 4)	
	Should support IGMP snooping v1, v2 & v3 Security	
	RADIUS / TACACS, which allows centralized control of the switch and restrict unauthorized users from altering the configuration	
	Should support IEEE 802.1x to provide port-based user authentication	
	Should support port security and Secure Shell (SSH)	
	Management	
	Should have a Manageability through a common network-management software on a per-port and per-switch basis	
	Should support SNMP versions 1, 2, and 3 and RMON	
	Should support Network Time Protocol (NTP)	
	Configuration through the CLI, console, Telnet, SSH and Web Management	
	Should support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location	
	Should have dedicated out of band 10/100/1000 base Ethernet port and dedicated serial console port	
33	**Wireless LAN Controller which can control up to 100 APs**	
	General Requirements	
	All Wi-Fi components should be from single OEM	
	OEM should be in Wi-Fi business for at least 10 years and should be present in India for minimum 6 years	
	Essential Features	
	Controller should be 19” Rack mountable 1U/2U height	
	WLAN Controller should have minimum 2 nos. of 10/100/1000 Ethernet Ports and one Console port	
	Proposed Controller should be ready for supporting 50 AP’s from day one with scalability for 100 AP support in future without adding any new hardware. Each controller (primary and	

Sr. No.	Description	Compliance Yes / No
	Redundant) should be able to support minimum 300 campus connected AP's or more with support of seamless roaming access over L2/L3 network	
	Redundancy Features: Controller Must provide Active: Active/Active: Standby with 1+1 and N+1 redundancy. The controllers will be implemented in HA mode	
	There should be 100% redundancy for Primary controller i.e N: N including Hardware and desired licenses to support AP's	
	General Feature	
	Controller should support Spectrum Analysis feature to detect interference from different sources	
	System should provide real-time charts showing interference for access point, on a per-radio, per channel basis	
	Ability to map SSID to VLAN and dynamic VLAN support for same SSID	
	Support automatic channel selection for interference avoidance	
	Controller must support 802.11k and 802.11r	
	Auto Deployment of AP's at different locations	
	Access points can discover controllers on the same L2 domain without requiring any configuration on the access point	
	Access points can discover controllers across Layer-3 network through DHCP or DNS option	
	Security & Monitoring	
	Controller should support following for security & Authentication	
	WIRELESS SECURITY: WEP, WPA-TKIP, WPA2-AES, 802.11i	
	AUTHENTICATION : 802.1X, local database	
	External AAA servers : Active Directory, RADIUS, LDAP	
	System should provide DOS attacks and Intrusion Detection & Prevention and Control for any Rough Access Points	
	AP should be able to scan for rogue access points and the controller should be able to locate them on a floor map. The controller should be able to send a notification to the administrator when a rogue AP has been detected	
	Controller should support CAPWAP/LWAPP protocol	
	System must be able to provide L2/L3/L4 Access Control	
	Controller should support L2 Client Isolation so User cannot access each other's devices. Isolation should have option to apply on AP or SSID's	
	Controller should support Access Control based on Identity/Role/ Device/Time or Application	
	IPv4 & IPv6 support from Day 1	
	Should support onboard and external DHCP server	
	Controller should support integrated or External AAA server including Microsoft AD and Linux based open source AAA servers	
	Proposed architecture should be based on controller based Architecture with thick AP deployment. While encryption / decryption of 802.11 packets should be able to perform at the AP	
	Controller should support OS/Device finger printing and device	

Sr. No.	Description	Compliance Yes / No
	type based policies i.e allow or deny, Bandwidth rate limit, VLAN mapping	
	Controller shall be manageable using CLI, Telnet/SSH, HTTP based GUI and SNMPv2/v3	
	Controller should be able to present a customizable dashboard with information on the status of the WLAN network	
	Controller should be able to raise critical alarms by sending an email. The email client on the controller should support SMTP outbound authentication and TLS encryption	
	Addition : NIL Overwriting: NIL Correction : NIL Deletion: NIL AE(E) IIIDEMPED EE(E) IIIDEMPED AE(P) IIIDEMPC PM IIIDEMPC	
	Vendor should specify if all features are available with the basic access controller pricing or if the support of some features require the acquisition of some licenses. The vendor should specify which feature requires which type of licensing including its cost	
	Self-healing (on detection of RF interference or loss of RF coverage) and vendor should provide their Interference mitigation techniques for same Domain interference (interference from AP's connected to same Controller) and from other AP's and 2.4Ghz devices (Microwave's, Radio's etc.)	
	Controller should have BYOD features and Guest Access management procedure where user may use internet without entering to Enterprise SSID and should be time restricted	
	QoS features	
	Per SSID or dynamic Per user bandwidth Rate Limiting	
	Dynamic RF management that provides the capability to pause channel scanning / adjust RF scanning intervals based on application and load presence	
	Capability to provide preferred access for “fast” clients over “slow” clients (11n vs. 11g) in order to improve overall network performance	
	System must support Band Steering where 5 Ghz clients are forced to connect over 5Ghz Radio to provide better load balancing among 2.4Ghz and 5Ghz Radios	
	Support advanced multicast features and WMM support to provide best performance on Video applications	
	Should have Voice Call Admission control	
	Client Management	
	Controller should provide a Guest Login portal in order to authenticate users that are not part of the organization	
	Controller should be able to provide a web-based application that allows non-technical staff to create Guest accounts with validity for fixed duration like hours or days	
	Controller/integrated System should be able to send password direct through Email and SMS to the user	
	User should be able to generate password their self for Guest Wi-fi access	
	Controller/Integrated System should be able to generate one click password for single user, multiple users or single user	

Sr. No.	Description	Compliance Yes / No
	multiple devices	
	System should support user management features like Rate limiting based on time based WLAN Access & User profile per WLAN etc	
	Wi-Fi Alliance certified	
34	**Layer 2 Switch 48 Port**	
	General Features & Performance	
	Should be Rack Mountable	
	Minimum switching capacity: 216 Gbps or more	
	Minimum forwarding rate: 130 Mpps or more	
	Minimum DRAM 512 MB and 128 MB Flash	
	Should support internal redundant power supply	
	Should provide wire-speed and non-blocking performance on all the ports	
	Minimum IPv4 & IPv6 Routes : 250	
	MAC addresses support: 16,000	
	VLANs support: 1000 active VLANs	
	Should be IPv6 ready from day 1	
	Should support IEEE 802.3az EEE (Energy Efficient Ethernet)	
	Should support 9K or higher Jumbo frames	
	Should support minimum 8 ports in a single EtherChannel group or equivalent protocol for Bandwidth aggregation	
	Should have NetFlow or sFlow from day one	
	Interfaces	
	Minimum of 48 x 10/100/1000 BaseT POE+ RJ 45 Ethernet Ports (must provide POE+ power on all 48 ports simultaneously)	
	Minimum 4x 10GBaseX SFP+ ports for uplinks	
	Should have dedicated flexstack or equivalent stacking with minimum 80 Gbps via 40G ports or more Stacking bandwidth to stack up to 8 switches into a single virtual switch. Necessary stacking modules / ports / cables needs to be supplied from day 1	
	Should support sub 50ms ring protection as per IEEE 802.17/equivalent protocol	
	Layer-III Features	
	Should have basic IP Lite Layer 3 routing - Static Route IPv4, Static Route IPv6 and Inter-vlan routing from day 1	
	Should be upgradable to support enhanced IP Lite Layer 3 routing - OSPF and HSRP / VRRP as and when required without replacing the hardware	
	Layer-II Features	
	Should support IEEE 802.1Q VLAN encapsulation	
	Should support 802.1d, 802.1s, 802.1w & 802.3ad protocols	
	Should support Spanning-tree root guard to prevent other edge swicthes becoming the root bridge	
	Should support PVST / PVST+ or equivalent spanning tree protocol	
	Should support Unidirectional Link Detection Protocol (UDLD) or	

Sr. No.	Description	Compliance Yes / No
	equivalent protocol to allow unidirectional links failure detection	
	Should support Link Layer Discovery Protocol (LLDP) / CDP or equivalent protocol	
	Should have Layer 2 IEEE 802.1p (class of service [CoS]), 8 hardware queues per port, Per-port QoS configuration, Differentiated services code point (DSCP) marking, CoS-based egress queuing, Egress strict-priority queuing and ACL-based QoS classification (Layers 2, 3, and 4)	
	Should support IGMP snooping v1, v2 & v3	
	Security	
	RADIUS / TACACS, which allows centralized control of the switch and restrict unauthorized users from altering the configuration	
	Should support IEEE 802.1x to provide port-based user authentication	
	Should support port security and Secure Shell (SSH)	
	Management	
	Should have a Manageability through a common network-management software on a per-port and per-switch basis	
	Should support SNMP versions 1, 2, and 3 and RMON	
	Should support Network Time Protocol (NTP)	
	Configuration through the CLI, console, Telnet, SSH and Web Management	
	Should support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location	
	Should have dedicated out of band 10/100/1000 base Ethernet port and dedicated serial console port	
35	**Layer 2 Switch 24 Port**	
	General Features & Performance	
	Should be Rack Mountable	
	Minimum switching capacity: 168 Gbps or more	
	Minimum forwarding rate: 95 Mpps or more	
	Minimum DRAM 512 MB and 128 MB Flash	
	Should support internal redundant power supply	
	Should provide wire-speed and non-blocking performance on all the ports	
	Minimum IPv4 & IPv6 Routes : 250	
	MAC addresses support: 16,000	
	VLANs support: 1000 active VLANs	
	Should be IPv6 ready from day 1	
	Should support IEEE 802.3az EEE (Energy Efficient Ethernet)	
	Should support 9K or higher Jumbo frames	
	Should support minimum 8 ports in a single EtherChannel group or equivalent protocol for Bandwidth aggregation	
	Should have NetFlow or sFlow from day one	
	Interfaces	
	Minimum of 24 x 10/100/1000 BaseT POE+ RJ 45 Ethernet	

Sr. No.	Description	Compliance Yes / No
	Ports (must provide POE+ power on all 48 ports simultaneously)	
	Minimum 2x 10GBaseX SFP+ ports for uplinks	
	Should have dedicated flexstack or equivalent stacking with minimum 80 Gbps via 40G ports or more Stacking bandwidth to stack up to 8 switches into a single virtual switch. Necessary stacking modules / ports / cables needs to be supplied from day 1	
	Should support sub 50ms ring protection as per IEEE 802.17/equivalent protocol	
	Layer-III Features	
	Should have basic IP Lite Layer 3 routing - Static Route IPv4, Static Route IPv6 and Inter-vlan routing from day 1	
	Should be upgradable to support enhanced IP Lite Layer 3 routing - OSPF and HSRP / VRRP as and when required without replacing the hardware	
	Layer-II Features	
	Should support IEEE 802.1Q VLAN encapsulation	
	Should support 802.1d, 802.1s, 802.1w & 802.3ad protocols	
	Should support Spanning-tree root guard to prevent other edge swicthes becoming the root bridge	
	Should support PVST / PVST+ or equivalent spanning tree protocol	
	Should support Unidirectional Link Detection Protocol (UDLD) or equivalent protocol to allow unidirectional links failure detection	
	Should support Link Layer Discovery Protocol (LLDP) / CDP or equivalent protocol	
	Should have Layer 2 IEEE 802.1p (class of service [CoS]), 8 hardware queues per port, Per-port QoS configuration, Differentiated services code point (DSCP) marking, CoS-based egress queuing, Egress strict-priority queuing and ACL-based QoS classification (Layers 2, 3, and 4)	
	Should support IGMP snooping v1, v2 & v3	
	Security	
	RADIUS / TACACS, which allows centralized control of the switch and restrict unauthorized users from altering the configuration	
	Should support IEEE 802.1x to provide port-based user authentication	
	Should support port security and Secure Shell (SSH)	
	Management	
	Should have a Manageability through a common network-management software on a per-port and per-switch basis	
	Should support SNMP versions 1, 2, and 3 and RMON	
	Should support Network Time Protocol (NTP)	
	Configuration through the CLI, console, Telnet, SSH and Web Management	
	Should support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location	
	Should have dedicated out of band 10/100/1000 base Ethernet port and dedicated serial console port	

Sr. No.	Description	Compliance Yes / No
36	**Access point**	
	APs should support the 802.11a, 802.11b, 802.11g and 11n and ac standards. It should also support 802.11ac standard in the 5 GHz band	
	Simultaneous client support on both dual band radio is essential	
	Shall provide Min 22 dBm Radio output power for both Radio's	
	Should support minimum 2x2 or higher MIMO on both radio bands with an aggregate capacity of 1.150Gbps	
	Access points should be centrally managed but In some small isolated environments the AP should be able to function as a full-fledged stand-alone access point without the requirement of a controller	
	Security mechanisms should be in place to protect the communication between the Access Point controller and the Access Points	
	Since most radio interference come from the WLAN network itself the vendor should specify what mechanisms such as beam steering/ adaptive antenna technology/ beam forming are available in combination to focus the energy on the destination STA and minimize radio interference with the surrounding of the AP. The vendor should specify if the activation of such feature is still compatible with 802.11n spatial multiplexing	
	Since the WLAN network will be using an unlicensed band the solution should have mechanisms that reduce the impact of interference generated by other radio equipment operating in the same band. Describe techniques supported	
	Access point should be able to detect clients that have dual band capability and automatically steer those client to use the 5GHz band instead of the 2.4GHz band	
	Antennas to be dual polarized and should be integrated inside the access point enclosure to minimize damage and create a low profile unit that does not stand out visually	
	Access point should have at least 1 10/100/1000Mbps Ethernet ports with POE support for 802.11af standard	
	Access point should support 802.1q VLAN tagging	
	Access point should support WPA2 enterprise authentication and AES/CCMP encryption. AP should support Authentication via 802.1X and Active Directory	
	Implement Wi-Fi alliance standards WMM, 802.11d, 802.11h and 802.11e	
	Access Point should provide for concurrent support for high definition IP Video, Voice and Data application without needing any configuration. This feature should be demonstrable	
	Channel selection based on measuring throughput capacity in real time and switching to another channel should the capacity fall below the statistical average of all channels without using background scanning as a method	
	Should support Transmit power tuning in 1dB increments in order to reduce interference and RF hazards	

Sr. No.	Description	Compliance Yes / No
	Device antenna gain (integrated) must be at least 3dBi and should provide automatic interference rejection of about 10dB	
	Should support up to 200 clients per AP	
	Should support DHCP Option 82 in standalone mode (without Controller) as well as in Managed mode (with Controller)	
	For troubleshooting purposes, the administrator should have the ability to remotely capture 802.11 and / or 802.3 frames from an access point without disrupting client access	
	Operating Temperature: 0°C - 45°C	
	Operating Humidity: 10 % - 95% non-condensing	
	Should be plenum rated and comply to RoHS	
	Should be WiFi certified; WiFi certificate to be enclosed	
	Should be WPC approved; ETA certificate to be enclosed	
	Device should be UL 2043 Plenum Rated	

17.0 CCTV

Integrated IP CCTV Security system

- The IP camera family shall include a choice of
    - Fixed-format Mega pixel dome models.
    - Fixed-format Mega pixel Bullet models.
    - Panoramic multi sensor dome models. (minimum of 4 sensors ; image format compliant to law of land)
- Fixed-format High resolution dome models. These IP cameras shall offer M-JPEG, H.264 and MPEG-4 video compression in order to align with or optimize network bandwidth and video storage provisioning.
- These IP cameras shall include megapixel-resolution models, and shall offer several lens options.
- The Megapixel-resolution IP cameras shall be supplied with Megapixel lenses. The housing enclosure for megapixel cameras shall be IP66 compliant. Suitable mounting accessories are supplied as per the mounting needs.
- All cameras shall support a Power over Ethernet (PoE) interface.
- The dome cameras shall offer a sensor based true wide dynamic range of 100 db.
- The bullet cameras shall offer a sensor based true wide dynamic range of 100db.
- The cameras shall be capable of generating (At Least) up to 2 simultaneous video streams, with the following attributes:
    - Individual camera feeds shall be recorded by the VMS at different compression, resolution and capture rate settings simultaneously.
    - An adaptive transmission algorithm shall throttle these video streams to a preset maximum data rate or scale that rate based on variable network bandwidth available at the time of transmission.
- All IP cameras shall provide backlight compensation.
- IP Cameras shall meet the following minimum technical specifications:

Sr. No.	Description	Compliance Yes / No
1	**IP DOME Micro Dome Duo**	
	Camera Type Dual Sensor dome camera	
	Image Sensor 10MP (2 x 5MP)	
	True WDR up to 100dB at Full Resolution	
	Dual Encoder H.264/MJPEG	
	True Day/Night Functionality	
	Privacy Mask, Motion Detection, Flexible Cropping, Bit Rate, Control, Multi-Streaming, Multicasting, and Forensic Zooming	
	All-in-One H.264 Total Power Over Ethernet (PoE) Solution	
	Full Resolution	
	Lens Type 2x8 mm MP	

Sr. No.	Description	Compliance Yes / No
	Compression Type H.264 (MPEG-4, Part 10)/Motion JPEG	
	Network Protocols RTSP, RTP/TCP, RTP/UDP, HTTP, DHCP, TFTP	
	Industry Standard ONVIF Profile S	
	UL, CE & FCC Certified	
	Environmental	
	Real-time Motion Detection	
	Backlight Compensation	
	IP66, IK-10,PoE	
2	**IP DOME (Indoor) Camera**	
	Camera Type IP Indoor Dome Camera	
	Image Sensor 2 MP , 1080p, 30 fps	
	3.3-10 mm manual vari-focal lens	
	True WDR up to 100dB at Full Resolution	
	Dual Encoder H.264/MJPEG	
	True Day/Night Functionality	
	Privacy Mask, Motion Detection, Flexible Cropping, Bit Rate, Control, Multi-Streaming, Multicasting, and Forensic Zooming	
	All-in-One H.264 Total Power Over Ethernet (PoE) Solution	
	Lens Type 1.3 MP	
	Compression Type H.264 (MPEG-4, Part 10) / Motion JPEG	
	Network Protocols RTSP, RTP/TCP, RTP/UDP, HTTP, DHCP, TFTP, QoS, IPv4, IPv6, 802.1x	
	Industry Standard ONVIF Profile S	
	UL, CE & FCC Certified	
	Environmental	
	Real-time Motion Detection	
	Backlight Compensation	
	IP66, IK-10,12VDC/24VAC/PoE	
3	**IP BULLET Camera**	
	Camera Type IP Indoor Bullet Camera	
	Image Sensor 1080p (2.1MP)	
	3-9mm Remote Focus/Zoom Motorized P-Iris Lens	
	True WDR up to 100dB at Full Resolution	
	Dual Encoder H.264/MJPEG	
	True Day/Night Functionality with Mechanical IR Cut Filter and IR LEDs	
	Privacy Mask, Motion Detection, Flexible Cropping, Bit Rate, Control, Multi-Streaming, Multicasting, and Forensic Zooming	
	All-in-One H.264 Total Power Over Ethernet (PoE) Solution	
	Compression Type H.264 (MPEG-4, Part 10) / Motion JPEG	
	Network Protocols RTSP, RTP/TCP, RTP/UDP, HTTP, DHCP, TFTP, 8 0 2.1x	
	Industry Standard ONVIF Profile S	
	UL, CE & FCC Certified	
	Environmental RoHS, REACH, WEEE	

Sr. No.	Description	Compliance Yes / No
	Real-time Motion Detection	
	Backlight Compensation	
	IP66, IK-10,12VDC/24VAC/PoE	
4	**Server Storage NVR for Main Control Rooms**	
	Enterprise Storage Server Suitable for Up to 256 Cameras with 24 HDD supports up to 96TB expandable to 288TB by adding storage bay, dual power supply. Intel high-performance quad-core 64 bit processor, Pluggable, 1+1 redundant power supplies optional, Network port with Gigabit Ethernet, support Ethernet port bind, load sharing, RAID & recording management, system log, alarm handling, Support device discovery protocol, API way to communication with monitoring platform, stream media search and send protocol, Support integration with the third party software platform by API	
5	**VMS Software supporting up to 256 Cameras**	
	Unlimited client access, PTZ Control, Remote Viewing, Remote Storage, Playback. Supports JPEG, AVI, WAV export formats, Hourly schedules, Email Notification. This includes Camera and Base licenses	
6	**Hard Disk Special Surveillance 4TB 3.5" SATA HDD internal(For Servers)**	
7	**MS Windows 2008 Server**	
	MS Windows 2008 Server R2 x64, Intel i5 Xeon Quad Core processor, 8 GB RAM, 2TB HDD, 2GB Graphics Card. With CD/DVD player, Mouse and Keyboard	
8	**Professional Grade Video Wall Display**	
	Screen Size 55”	
	Native resolution 1920 x 1080 (16:9)	
	Backlight Direct-lit LED	
	Display orientation Portrait and landscape	
	Nominal bezel size 1.7mm combined bezel to bezel	
	Brightness 500 nits (cd/m2)	
	Contrast ratio 4000:1	
	Viewing angle: 178° h/v	
	Signal inputs 2 x HDMI, DisplayPort	
	DisplayPort Loop out	
	Designed for 24/7 operation	
9	**6/9 U Wall Mount Rack**	
	power Strip, PDU, 2 nos of Cable manager and Hardware	

Sr. No.	Description	Compliance Yes / No
	Mounting Kit	
10	**6 U Outdoor Pole/Wall Mount Rack**	
	Power Strip, PDU, 2 nos of Cable manager and Hardware Mounting Kit, IP 65 Rated	
11	**42 U Floor Mount Rack**	
	power Strip, PDU, Cable manager and Hardware Mounting Kit	
12	**Layer-3 Distribution Switch 24 Gigabit Ports**	
	General Features & Performance	
	Rack Mountable	
	Minimum switching capacity: 168 Gbps or more	
	Minimum forwarding rate: 95 Mpps or more.	
	Minimum DRAM 512 MB and 128 MB Fl.	
	Should support internal redundant power supply.	
	Should provide wire-speed and non-blocking performance on all the ports.	
	Minimum IPv4 & IPv6 Routes : 250.	
	MAC addresses support: 16,000.	
	VLANs support: 1000 active VLANs.	
	Should be IPv6 ready from day 1.	
	Should support IEEE 802.3az EEE (Energy Efficient Ethernet).	
	Should support 9K or higher Jumbo frames.	
	Should support minimum 8 ports in a single Etherchannel group or equivalent protocol for Bandwidth aggregation.	
	Should have Net Flow or sFlow from day one.	
	Interfaces	
	Minimum of 24 x 10G BaseX SFP+ ports with module with scalability to 32x10G SFP+ slots.	
	Minimum 2 x 10G BaseX SFP+ ports for uplinks.	
	Should have dedicated flexstack or equivalent stacking with minimum 80 Gbps or more Stacking bandwidth to stack up to 2 switches into a single virtual switch. Necessary stacking modules / ports / cables needs to be supplied from day 1.	
	Should support sub 50ms ring protection as per IEEE 802.17/equivalent protocol.	
	Layer-III Features	
	Should have basic IP Lite Layer 3 routing.	
	Should have basic IP Lite Layer 3 routing - Static Route IPv4, Static Route IPv6 and Inter-vlan routing from day 1	
	Should be upgradable to support enhanced IP Lite Layer 3 routing - OSPF and HSRP / VRRP as and when required without replacing the hardware.	
	Layer-II Features	
	Should support IEEE 802.1Q VLAN encapsulation	
	Should support 802.1d, 802.1s, 802.1w & 802.3ad protocols	

Sr. No.	Description	Compliance Yes / No
	Should support Spanning-tree root guard to prevent other edge switches becoming the root bridge	
	Should support PVST / PVST+ or equivalent spanning tree protocol	
	Should support Unidirectional Link Detection Protocol (UDLD) or equivalent protocol to allow unidirectional links failure detection	
	Should support Link Layer Discovery Protocol (LLDP) / CDP or equivalent protocol	
	Should have Layer 2 IEEE 802.1p (class of service [CoS]), 8 hardware queues per port, Per-port QoS configuration, Differentiated services code point (DSCP) marking, CoS-based egress queuing, Egress strict-priority queuing and ACL-based QoS classification (Layers 2, 3, and 4).	
	Should support IGMP snooping v1, v2 & v3 Security	
	RADIUS / TACACS, which allows centralized control of the switch and restrict unauthorized users from altering the configuration	
	Should support IEEE 802.1x to provide port-based user authentication	
	Should support port security and Secure Shell (SSH)	
	Management	
	Should have a Manageability through a common network-management software on a per-port and per-switch basis	
	Should support SNMP versions 1, 2, and 3 and RMON	
	Should support Network Time Protocol (NTP)	
	Configuration through the CLI, console, Telnet, SSH and Web Management	
	Should support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location	
	Should have dedicated out of band 10/100/1000 base Ethernet port and dedicated serial console port	
13	**Layer-2 Distribution Switch 24 Gigabit Ports**	
	General Features & Performance	
	Rack Mountable	
	Minimum switching capacity: 216 Gbps or more	
	Minimum forwarding rate: 130 Mpps or more	
	Minimum DRAM 512 MB and 128 MB Flash	
	Should support internal redundant power supply	
	Should provide wire-speed and non-blocking performance on all the ports	
	Minimum IPv4 & IPv6 Routes : 250	
	MAC addresses support: 16,000	
	VLANs support: 1000 active VLANs	
	Should be IPv6 ready from day 1	
	Should support IEEE 802.3az EEE (Energy Efficient Ethernet)	
	Should support 9K or higher Jumbo frames	
	Should support minimum 8 ports in a single Ether Channel group	

Sr. No.	Description	Compliance Yes / No
	or equivalent protocol for Bandwidth aggregation.	
	Should have NetFlow or sFlow from day one.	
	Interfaces	
	Minimum of 24 x 10/100/1000 BaseT POE+ RJ 45 Ethernet Ports (must provide POE+ power on all 24 ports simultaneously).	
	Minimum 4x 10GBaseX SFP+ ports for uplinks	
	Should have dedicated flexstack or equivalent stacking with minimum 80 Gbps via 40G ports or more Stacking bandwidth to stack up to 8 switches into a single virtual switch. Necessary stacking modules / ports / cables needs to be supplied from day 1.	
	Should support sub 50ms ring protection as per IEEE 802.17/equivalent protocol.	
	Layer-III Features	
	Should have basic IP Lite Layer 3 routing - Static Route IPv4, Static Route IPv6 and Inter-vlan routing from day 1.	
	Should be upgradable to support enhanced IP Lite Layer 3 routing - OSPF and HSRP / VRRP as and when required without replacing the hardware	
	Layer-II Features	
	Should support IEEE 802.1Q VLAN encapsulation	
	Should support 802.1d, 802.1s, 802.1w & 802.3ad protocols	
	Should support Spanning-tree root guard to prevent other edge swicthes becoming the root bridge	
	Should support PVST / PVST+ or equivalent spanning tree protocol	
	Should support Unidirectional Link Detection Protocol (UDLD) or equivalent protocol to allow unidirectional links failure detection	
	Should support Link Layer Discovery Protocol (LLDP) / CDP or equivalent protocol	
	Should have Layer 2 IEEE 802.1p (class of service [CoS]), 8 hardware queues per port, Per-port QoS configuration, Differentiated services code point (DSCP) marking, CoS-based egress queuing, Egress strict-priority queuing and ACL-based QoS classification (Layers 2, 3, and 4)	
	Should support IGMP snooping v1, v2 & v3	
	Security	
	RADIUS / TACACS, which allows centralized control of the switch and restrict unauthorized users from altering the configuration	
	Should support IEEE 802.1x to provide port-based user authentication	
	Should support port security and Secure Shell (SSH)	
	Management	
	Should have a Manageability through a common network-management software on a per-port and per-switch basis	
	Should support SNMP versions 1, 2, and 3 and RMON	
	Should support Network Time Protocol (NTP)	
	Configuration through the CLI, console, Telnet, SSH and Web Management	

Sr. No.	Description	Compliance Yes / No
	Should support Trivial File Transfer Protocol (TFTP) to reduce the cost of administering software upgrades by downloading from a centralized location	
	Should have dedicated out of band 10/100/1000 base Ethernet port and dedicated serial console port	
14	**Layer 2 Industrial Switches, 8 Ethernet POE+ Ports**	
	Device should have 8 10/100 POE+ ports, and 4 100FX/1000Base-X SFP ports.	
	All PoE ports IEEE 802.3af and 802.3at compliant and support up to 30W concurrently	
	-40°C to +75°C operating temperature	
	Highly Resilient LACP, Spanning tree STP, RSTP & MSTP, fast Ring fail-over and G.8032 ERPS protection options.	
	Port-based /tag-based VLAN, IEEE 802.1ad/QinQ VLAN.	
	Multicast/Broadcast/Flooding Storm Control	
	IEEE802.1x access control	
	PoE PSE power management and PD power consumption	
	Operating Mode	
	Store and forward, L2 wire-speed/non-blocking	
	switching engine	
	MAC Addresses- 8K	
	Jumbo Frames- 9K Bytes	
	Copper RJ45 Ports	
	10/100 Mbps or 10/100/1000 Mbps depending on model	
	IEEE 802.3af and IEEE 802.3at on POE enabled ports	
	MDI/MDIX Auto-Crossover	
	Auto-negotiation, full and half duplex	
	Ethernet Isolation- 1500VRMS 1 minute	
	Pluggable SFP Ports	
	100FX SFP and 100/1000BaseX SFP Transceiver	
	Bridging, VLANS, Multicast	
	Flow Control IEEE 802.3x (Full Duplex) and Back-Pressure (Half Duplex)	
	VLAN Capacity- 1024	
	Port-based VLANs; MAC-based VLANs; IP Subnet-based VLANs	
	Protocol-based VLANs	
	IEEE 802.1Q tag-based VLANs	
	IEEE 802.1ad Double Tagging (Q in Q)	
	IGMP v1, v2, v3 with up to 1000 multicast groups	
	IGMP snooping and querying	
	Immediate leave and leave proxy	
	Throttling and filtering	
	IEEE 802.1ab Link layer Discovery Protocol (LLDP)	
	ITU G.8032 Ethernet Ring Protection Switching (ERPS)Traffic Management and QOS	
	Priority — IEEE 802.1p QoS	
	Queues per port- 8	

Sr. No.	Description	Compliance Yes / No
	Scheduling – Strict, Weighted Round Robin	
	Port-based shaping	
	Security	
	Port Security — IP and MAC-based access control, IEEE 802.1X authentication Network Access Control, RADIUS and TACACS+ AAA (Authentication, Accounting and Authorization)	
	Device should have 8 10/100 POE+ ports, and 4 100FX/1000Base-X SFP ports.	
	All PoE ports IEEE 802.3af and 802.3at compliant and support up to 30W concurrently	
	-40°C to +75°C operating temperature	
	Highly Resilient LACP, Spanning tree STP, RSTP & MSTP, fast Ring fail-over and G.8032 ERPS protection options.	
	Port-based /tag-based VLAN, IEEE 802.1ad/QinQ VLAN.	
	Multicast/Broadcast/Flooding Storm Control	
	IEEE802.1x access control	
	PoE PSE power management and PD power consumption	
	Operating Mode	
	Store and forward, L2 wire-speed/non-blocking	
	switching engine	
15	**Media convertor**	
	Device should have 8 10/100 POE+ ports, and 2 100FX/1000Base-X SFP ports.	
	All PoE ports IEEE 802.3af and 802.3at compliant and support up to 30W concurrently	
	-40°C to +75°C operating temperature	
	Highly Resilient LACP, Spanning tree STP, RSTP & MSTP, fast Ring fail-over and G.8032 ERPS protection options.	
	Port-based /tag-based VLAN, IEEE 802.1ad/QinQ VLAN.	
	Multicast/Broadcast/Flooding Storm Control	
	IEEE802.1x access control	
	PoE PSE power management and PD power consumption	
	Operating Mode	
	Store and forward, L2 wire-speed/non-blocking	
	switching engine	
	MAC Addresses- 8K	
	Jumbo Frames- 9K Bytes	
	Copper RJ45 Ports	
	10/100 Mbps or 10/100/1000 Mbps depending on model	
	IEEE 802.3af and IEEE 802.3at on POE enabled ports	
	MDI/MDIX Auto-Crossover	
	Auto-negotiation, full and half duplex	
	Ethernet Isolation- 1500VRMS 1 minute	
	Pluggable SFP Ports	
	100FX SFP and 100/1000BaseX SFP Transceiver	
	Bridging, VLANS, Multicast	
	Flow Control IEEE 802.3x (Full Duplex) and Back-Pressure (Half Duplex)	

Sr. No.	Description	Compliance Yes / No
	VLAN Capacity- 1024	
	Port-based VLANs; MAC-based VLANs; IP Subnet-based VLANs	
	Protocol-based VLANs	
	IEEE 802.1Q tag-based VLANs	
	IEEE 802.1ad Double Tagging (Q in Q)	
	IGMP v1, v2, v3 with up to 1000 multicast groups	
	IGMP snooping and querying	
	Immediate leave and leave proxy	
	Throttling and filtering	
	IEEE 802.1ab Link layer Discovery Protocol (LLDP)	
	ITU G.8032 Ethernet Ring Protection Switching (ERPS)Traffic Management and QOS	
	Priority — IEEE 802.1p QoS	
	Queues per port- 8	
	Scheduling – Strict, Weighted Round Robin	
	Port-based shaping	
	Security	
	Port Security — IP and MAC-based access control, IEEE 802.1X authentication Network Access Control, RADIUS and TACACS+ AAA (Authentication, Accounting and Authorization)	
	Device should have 8 10/100 POE+ ports, and 4 100FX/1000Base-X SFP ports.	
	All PoE ports IEEE 802.3af and 802.3at compliant and support up to 30W concurrently	
	-40°C to +75°C operating temperature	
	Highly Resilient LACP, Spanning tree STP, RSTP & MSTP, fast Ring fail-over and G.8032 ERPS protection options.	
	Port-based /tag-based VLAN, IEEE 802.1ad/QinQ VLAN.	
	Multicast/Broadcast/Flooding Storm Control	
	IEEE802.1x access control	
	PoE PSE power management and PD power consumption	
	Operating Mode	
	Store and forward, L2 wire-speed/non-blocking	
	switching engine	
16	**Media convertor**	
	1000 Mbps with Industrial grade standard with IP 6 rated with PoE injection	
	For rest of the item please refer IT and Data Networking System	
	Integrated ACS System	
17	**Boom Barrier**	
	assemblies with Barrier length 4 meters, Installation: Outdoor, Drive: Electric motor, Finish: - Control unit- Powder coated in a suitable color - Boom- Powder coated white then applied with	

Sr. No.	Description	Compliance Yes / No
	bright red color reflecting tape strips	

18.0 1 & 3 PHASE ENERGY METER

Technical Specifications for 1 Phase Electronic Energy Meter of Class1.0 Accuracy

18.1. SCOPE

This specification covers the design, engineering, manufacture, testing and calibration at manufacturer's works before dispatch, packing, supply and delivery of Class 1.0 accuracy, electronic energy meter, suitable for connection to LT single phase 2 wires, 240 V system. The static whole current electronic meter shall offer current range of 5-30 A, 10-60 A (first digit indicates the Basic Current & second digit indicates the Maximum Current of the respective meters) for tariff purposes, as per requirement given in this specification.

18.2. STANDARDS APPLICABLE

Unless specified elsewhere in this specification, the performance & testing of the meters shall conform to the following Indian/International standards, to be read with upto-date and latest amendments/revisions thereof.

S. No.	Standard No.	Title
1	IS 13779 and its latest amendment	Specification of AC Static Watt hour meters class 1.0 & 2.0
2	IS 15959	Data Exchange for Electricity Meter, Reading, Tariff and Load Control – Companion Specification

Meter matching with requirements of other national or international standards which ensure equal or better performance than the standards mentioned above shall also be considered. When the equipment offered by the tenderer conforms to standards other than those specified above, salient points of difference between standards adopted and the standards specified in this specification shall be clearly brought out in the relevant schedule.

Manufacturer should have valid BIS License for the offered energy meters and ISI mark should be given on meter rating plate. Copy of BIS license needs to be enclosed with the tender.

18.3. CLIMATIC CONDITION

The meters to be supplied against this specification shall be suitable for satisfactory continuous operation under the following tropical conditions. Meters shall be capable of maintaining required accuracy under hot, tropical and dusty climate.

1.	Maximum ambient air temperature in shade.	45 Deg. C
2.	Relative humidity	95% non condensing
3.	Maximum altitude above mean sea level	Up to 1000 meters.
4.	Maximum wind pressure	150 Kg/m. sq.

5.	Average number of tropical monsoon (conditions) per annum	4 months
6.	Average annual rain fall	10 cms to 100 cms.
7.	Seismic level(Horizontal accn)	0.30g
8.	Isoceraunic level (days per year)	40

18.4. General Technical Requirement

Application : 1 phase 2 wire
Rated Secondary Voltage : 240 volts (Phase to Neutral)
Current Rating : 05-30A, 10-60A
Rated Frequency : 50 Hz.
Accuracy class : 1.0
Power Factor : Unity to Zero (all power factor lag / or lead)

The meter shall start and continue to register on application of 0.2% of basic current at Unity P.F., as per relevant standards.

18.5. POWER SUPPLY VARIATION

The meter should be suitable for working with following supply system variations.

System	1 Phase 2 Wire
Specified range of operation	70% to 130% of reference Voltage i.e. 240 V
Frequency	50Hz +/-5%

If phase to phase voltage (415V±10%) is applied continuously between phase and neutral of the meter, the meter should not get damaged and continue to record correctly within class 1.0 accuracy after restoration of normal supply.

18.6. ACCURACY

Class of accuracy of the meter shall be 1.0. The accuracy shall not drift with time.

18.7. POWER CONSUMPTION

1- Voltage Circuit: The active and apparent power consumption in each voltage circuit including the power supply of meter of reference voltage, reference temperature and reference frequency shall not exceed 1 watt and 1VA.
2- Current Circuit: The apparent power taken by Current circuit at basic current reference and reference temperature shall not exceed 0.5VA.

18.8. STARTING CURRENT

The meter shall start registering energy at 0.2% of basic current at unity power factor

and shall be fully functional within five seconds after the rated voltage is applied.

Running at no load: When voltage is applied and no current flows in the current circuit, the test output of the meter shall not produce more than one pulse.

18.9. MAXIMUM CONTINUOUS CURRENT

The rated maximum current for the meter shall be 100% of Imax at which the meter purports to meet the accuracy requirement. Meter terminals should be suitable to carry 150% of I_{max}.

18.10. GENERAL & CONSTRUCTIONAL REQUIREMENTS

18.10.1 Meters shall be designed and constructed in such a way so as to avoid causing any danger during use and under normal conditions. However, the following should be ensured.

- Personal safety against electric shock
- Personal safety against effects of excessive temperature.
- Protection against spread of fire
- Protection against penetration of solid objects, dust & water

18.10.2 The meter shall be designed with application specific integrated circuit and shall be manufactured using SMT (Surface Mount Technology) components. Power supply and voltage divider circuits may be of PTH technology. The meter should be housed in a safe, high grade engineering Polycarbonate casing of projection mounting type.

18.10.3 All insulating material used in the construction of meters shall be non-hygroscopic, non-ageing and of tested quality. All parts that are likely to develop corrosion shall be effectively protected against corrosion during operating life by providing suitable protective coating.

18.10.4 The meter shall at least conform to the degree of protection IP 53for protection against ingress of dust, moisture and vermin’s.

18.10.5 The meter shall be supplied with a transparent extended terminal block cover (ETBC). Extended terminal cover shall have top side hinge arrangement so that it remains associated with meter always.

18.10.6 The meter case, terminal block and ETBC shall be made of unbreakable, high grade non-flammable polycarbonate or equivalent high grade and good quality engineering plastic. The terminal block should have terminal holes and shall be of sufficient size to accommodate the conductors, meeting the requirement of IS 13779.

18.10.7 The meter case shall have one full transparent window for display. The window shall be integrated part with the meter casein such a way that it cannot be removed undamaged.

18.10.8 The manner of fixing the conductors to the terminal block shall ensure adequate and durable contact such that there is no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimized. Electrical connections shall be so designed that contact pressure is not transmitted through insulating material. The terminals shall be made of brass to provide better conductivity. The clearance and creepage distance shall conform to relevant clause of IS 13779:1999

18.10.9 The meter shall be compact in design. The entire construction shall be capable of withstanding stresses likely to occur in actual service and rough handling during transportation. The meter shall be convenient to transport and immune to shock and vibration during transportation and handling.

18.10.10 The meter should not saturate on passing of direct current, which can cause the meter either to stop recording or record inaccurately as per IS 13779 in phase and neutral both.

18.10.11 The meter shall have a design life of at least 10 years. The manufacturer should have conducted accelerated life tests of the proposed design to ensure the design life

18.11. ANTI-TAMPER FEATURES

The meter should have features to prevent/detect common ways of tamper and fraud.

18.11.1 Reversal of line and load terminals

On interchanging the load and line wires the meter shall register accurate energy.

18.11.2 Interchanging of phase and neutral wires

Even on interchanging the phase and neutral wires the meter shall register accurate energy.

18.11.3 Drawing of current through local earth

The meter shall register accurate energy even if the load is not terminated back to the meter and instead current is drawn partially of fully through a local earth irrespective of the phase and neutral connections to the meter. The earth indication in the form of annuciator shall be made available.

18.11.4 Drawing of load by disconnecting Neutral of meter & outgoing Earth: When neutral is disconnected from both load side and supply side, the meter should record energy as per rated parameters (Vref, UPF & actual current). However, meter shall start registering energy at a current of 1.0 Amps under these tamper conditions. Accuracy should be within ±3% for this case.

It is preferable to have metering with the help of internal battery under single wire mode.

Influence of external High Magnetic Field: Meter shall be provided with appropriate magnetic shielding so that any external magnetic field (A.C. electromagnet or D.C. magnet) as per the value specified in IS 13779(With latest amendment) applied on meter would not effect the proper functioning of meter.

However, the meter should log the presence of abnormal magnetic induction with date & time in case the meter is affected. Under such conditions the positive variation may be beyond 4%. Meters shall offer compliance to requirements of CBIP-304 and its amendments for tampering using external magnets and meter should record energy at Imax whenever the meter gets affected during that condition.

The magnet event indication in the form of annuciator shall be available under such condition

18.11.5 Meter Body Opening : It is preferable to have a single integrated base and cover so that chances of cover opening are reduced. Even if the meter case is removed forcibly, it should leave a clear evidence of being opened. The meter shall additionally have provision for detection and logging of opening of meter cover. The meter must detect / log with date and time meter body opening tamper, body opening tamper must also be logged in absence of power supply.Cover open indication in display sequence shall also be available in tamper status display.

18.11.6 Neutral Disturbance : The measurement by meter shall not get influenced by injection of spurious signals (like AC Voltages/chopped AC signal/DC signal / pulsating DC etc) in neutral of meter. The meter shall be immune to other common forms of Neutral Disturbance using diode, variable resistance and capacitor circuits in neutral. In case the meter accuracy is disturbed under ND, it should be able to log the event and record energy at reference parameters (Vref, UPF and actual current) with the error band of ±3%.The neutral disturbance event indication in the form of annuciator shall be available under such condition.

18.11.7 Events

The meter shall be capable of recording minimum 100 events in memory with date and time stamp. Following events should be logged in different compartments on FIFO basis

- Current Reversal
- Earth loading/Load imbalance (Partial/Full earth)
- Power on off
- Magnetic influence in case meter is affected.
- Neutral Disturbance in case meter is affected.
- Front cover open (Non Roll over event)
- Single Wire metering

18.12. DISPLAY

18.12.1 The measured value(s) shall be displayed on Liquid Crystal display (LCD) display. The height of the digit shall be minimum 8.0 mm. The KWh and kVAh energy registration under normal power on condition shall take place on 5 complete digits and 1 decimal.LCD should contain the suitable legends/annunciators for event notification.

18.12.2 The data should be stored in non-volatile memory (NVM). The non-volatile memory should retain data for a period of not less than 10 years under un-powered condition. Battery back-up memory will not be considered as NVM.

18.12.3 For accessing display, meter shall have one actuator. On short press, next display shall activate.

18.12.4 The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

18.12.5 In addition to providing serial number of the meter on the display plate, the meter serial number shall also be programmed into meter memory for identification through communication port for CMRI/meter reading print out.

18.13. DISPLAY SEQUENCE

The meter shall display the required parameters in two different modes as follows:

A) Auto Display Mode:

The following parameters shall be displayed in an auto-cycle mode, in the following sequence:-

1. LCD Test
2. Real Time
3. Date
4. Cumulative Active energy forwarded reading (kWh)
5. Cumulative Apparent energy forwarded (kVAh)
6. Last Bill Active, activeForwarded energy
7. Instantaneous Load (KW)
8. Last Bill Maximum demand in kW and kVA)

9. Billing counts
10. Cumulative Tamper Occurrence Count

B) Actuator Mode:-

1. LCD Test.
2. Real Time
3. Date
4. Instantaneous phase voltage
5. Phase and Neutral Line current
6. Instantaneous PF
7. Frequency
8. Maximum demand kW, kVA for Current month
9. Tamper information (Last occurred and restored event with date and time)

The meter shall also be capable of offering a high resolution display mode which shall enable conducting of dial testing by the user in the shortest possible time and hence as a minimum; the meter shall be capable of offering a resolution of 2 digits after decimal (and 4 digits before decimal) for the high resolution Wh display.

18.14. MAXIMUM DEMAND REGISTRATION &RESET

Meter shall continuously monitor & calculate the average maximum demand for each demand interval time of 30 minutes and maximum of these in a calendar month shall be
stored along with date and time when it occurred. The maximum demand shall automatically reset at 24:00 hrs. of the last date of each calendar month for which minimum 30 years calendar shall be programmed by the manufacturer.

The integration period shall be set as 30 minutes, on real-time basis.

The billing purpose parameters (active forwarded energy, maximum demand in kW and kVA) shall be registered and shall be available for a minimum period of last 6 months.

18.15. TIME OF USE MONITORING

The meter shall offer the capability of time of use monitoring for energy. Minimum 4rate registers shall be capable of being configured for TOD monitoring for Peak/Off peak hours.

18.16. LOAD PROFILE RECORDING

The meter shall be capable of monitoring and recording load profile information for voltage, activeand apparent energy for every 30 minutes interval for at least 100 days duration.

18.17. MIDNIGHT ENERGY SNAPSHOT RECORDING

The meter shall be capable of recording energy snapshot for at least 35 days.

18.18. SELF DIAGNOSTIC FEATURE

The meter shall be capable of performing complete self diagnostic check to monitor integrity of data memory location at all time. The meter shall have indication for unsatisfactory/nonfunctioning/malfunctioning of the following:

a) Time and date
b) Real Time Clock (RTC) status
c) Battery status

18.19. METER READING UNDER POWER OFF MODE

Provision to read the meter in no power condition shall be made. In case of power failure Auto mode shall be disabled. The actuator shall be used for displaying the Bill 1 KWh, Bill 1 maximum demand kW on display. In case of power failure meter data download for History energy, maximum Demand & all the events through CMRI (common meter reading instrument) shall be possible. Industrial grade primary battery of long life shall be used.

18.20. COMMUNICATION

The meter should have a galvanically isolated optical communication port for data communication with CMRI on 9600 bps. The port shall be compatible with IEC 1107 (in line with Indian companion specs).

The optical port provided on the meter shall have the capability to transmit the data by connecting the external cable in all 360 degrees i.e. shall be insensitive to cable orientation.

The meter shall also support an optional RS 232 communication port for remote meter reading. The connector type shall be micro USB.

Also meter shall support the open protocol (Indian companion specification- IS 15959) for relevant single phase meter data logging. For local meter reading, it shall be possible to do entire meter data download within 150 seconds (containing instantaneous values, load survey, 6 histories and events)

18.21. CMRI/BCS REQUIREMENTS

The Common Meter Reading Instrument (CMRI) should be capable of being loaded with user friendly software for reading/downloading meter data. Windows based Base Computer Software (BCS) shall be provided for receiving data from CMRI and downloading instructions from base computer software to CMRI.

This BCS should have, amongst other requirements, features and facilities described later in this specification, the facility to convert meter reading data into user definable ASCII file format so that it may be possible for the user to integrate the same with the user's billing data and process the selected data in desired manner. All the data available in the meter including energy, MD, and history data should be convertible to user defined ASCII file format for integration with third party software. The user shall

have the flexibility to select the parameters to be converted into ASCII file. The vendor shall also supply the necessary CMRI software.

18.22. MARKING OF THE METER

The marking on every meter shall be in accordance with relevant clauses of IS 13779.

The basic marking on the meter nameplate shall be as follows:

a) Manufacturer's name & trade mark
b) Type Designation
c) No. of phases & wires
d) Serial number
e) Year of manufacture
f) Reference Voltage
g) Rated Current
h) Principal unit(s) of measurement
i) Meter Constant (imp/kwh)
j) Class index of meter
k) "Property of _____"
l) Purchase Order No. & Date

18.23. CONNECTION DIAGRAM & TERMINAL MARKINGS

The connection diagram of the meter shall be clearly shown on terminal cover.

18.24. OUTPUT DEVICE

The meter shall have a test output accessible from the front and capable of being monitored with suitable testing equipment while in operation at site. The test output device shall be provided in the form of LED output.

The relation between test output and the indication on display shall comply with the marking on the name plate (imp per kWh).

18.25. ELECTRO-MAGNETICCOMPATIBILITY AND INTERFERENCE REQUIREMENT

The meter shall meet EMI/EMC requirements as specified in the relevant standards described in Clause 2.0 of this specification.

18.26. MINIMUM TESTING FACILITIES

The manufacturer should have the necessary minimum testing facilities for carrying out the following tests:

- AC voltage test
- Insulation resistance test
- Test of limits of errors
- Test of meter constant
- Test of starting condition
- Test of no load condition
- Repeatability of error test
- Test of power consumption

The manufacturer should have duly calibrated Reference standard meter of Class 0.2 accuracy or better. Manufacturer also should possess fully computerized meter test bench system for carrying out the relevant routine/acceptance tests as well as facility to generate test reports for each and every meter tested.

18.27. TESTS

The test reports/certificate/records for all type tests specified having been successfully performed on the type of the meter offered shall be submitted with the tender. The bidder shall clearly bring out the deviations from this specification clause by clause whether on account of tests or manufacturing process or features incorporated in the meter. The tender lacking with above information and without supporting test reports for meter meeting the requirement of tests laid in this specification are likely to be rejected.

a) Type Tests:

The Energy meter offered shall be fully type tested at any accredited test laboratory as per IS 13779 relevant standards but test reports shall not be more than two years old from the date of opening of bid. The bidder shall furnish type test reports along with the bid.

b) Acceptance Test :

All acceptance tests as stipulated in the relevant standards shall be carried out by the supplier in the presence of the purchaser's representative.

c) Routine Tests:

All routine tests as stipulated in the relevant standards shall be carried out and routine test-certificates/reports shall be submitted to the purchaser for approval and also placed inside individual meter packing. Three copies of user manual shall be required in soft copy (CD).

GTP of 1 Phase Electronic Energy Meter of Class 1.0 Accuracy

Sr. No.	Technical Specification Requirements	Bidder's Offer
1.	Applicable Standard	
2.	Class of Accuracy 1.0	
3.	Type of Meter	
4.	Reference Voltage (Vref)	
5.	Basic Current (Ib)	
6.	Maximum Current (Imax)	
7.	Maximum withstand Current for two hours	
8.	Maximum withstand voltage for 15 minutes The meter should be capable enough to withstand phase to phase voltage of 415 V±10%continuously	
9.	Rated frequency i.e. 50 Hz	
10.	Power Factor Range (-1 to +1)	

Sr. No.	Technical Specification Requirements	Bidder's Offer
11.	Operating temperature range (as per IS)	
12.	Starting Current (0.2 % of Ib)	
13.	Fixing of case in such a way that leave the physical evidence if it is opened.	
14.	Materials of the terminal block should conform to the relevant clause of the specification	
15.	Details of screw provided on each terminal for fixing stranded wire	
16.	The terminal cover should be fixed with case through upper hinge	
17.	Voltage and Current Circuits should be solidly connected inside the meter without any links	
18.	Components of the PCB should be surface mounted except power component	
19.	Power consumption in voltage circuit (<1 W &1 VA)	
20.	Power consumption in current circuit (<0.5 VA)	
21.	Overall dimension of the meter with ± tolerance	
22.	Overall weight of the meter with ± tolerance	
23.	Impulse voltage withstand capacity (10 kV)	
24.	Auto display mode	
25.	Manual mode display	
26.	The meter shall be provided with suitable facility for downloading all data through optical port provided on the meter through CMRI.	
27.	Display Details Backlit, 8 mm height, six digit LCD with tamper annunciators.	
28.	Accuracy of RTC	
29.	The meter should be equipped with the facility to read the parameters during power cut. Same actuator shall be used for display access and reading.	
30.	Indications should be provided to facilitate test output pulse	
31.	Guaranteed Accuracy within different ranges of voltage and P.F.	
32.	Meter should run with no load on 70% to 120% of the rated voltage	
33.	The meter should be immune to DC magnetic fields as per the IS 13779	
34.	The meters should record energy as per rated parameters even when neutral from the incoming and outgoing is removed	
35.	The accuracy of the meter should not be affected with the application of abnormal voltage / frequency generating device such as spark discharge of approximately 35 kV. The meter shall be tested b y feeding the output of this device to the meter in any of the following manner for 10 minutes	

Sr. No.	Technical Specification Requirements	Bidder's Offer
	• On any of the phase and neutral terminal • On any connecting wires of the meter • Voltage discharge with 0-10mm spark gap • At any place in the load circuit	
36.	The meter should be designed with application specific integrated circuit and should be manufactured using Surface Mount Technology (SMT) components	
37.	The meter should be capable to detect the opening of the case in power off conditions also	
38.	For local meter reading the meter should be capable enough to provide entire meter data and the download time should be within 150 seconds	
39.	The meter should have a reliable power supply for operation over a wide range of voltages.	

TECHNICAL SPECIFICATION FOR STATIC 3 PHASE 4 WIRE DIRECT CONNECTED STATIC TRIVECTOR ENERGY METER

1. OBJECTIVE & SCOPE

This specification shall cover design, engineering, manufacture, assembly, inspection, testing at manufacturers works before dispatch, supply and delivery at destination any where in "state", Class 1.0 accuracy class static 3 phase–4 wire tri-vector energy meter. The meter shall be suitable for measurement of energy and power, demand requirement in an AC balanced/unbalanced system over a power factor range of zero lag to unity. These meters should have communication port to interface for remote meter reading.

2. SERVICE CONDITION

The meter shall be suitable for satisfactory continuous operation under the following tropical conditions:-

Maximum ambient temperature	:	50 °C
Maximum ambient temperature in shade	:	45 °C
Relative Humidity	:	10 to 95%
Maximum wind pressure	:	150 Kg/m. sq.
Maximum altitude above mean seal level	:	1000 meters
Isoceraunic level	:	50 days/year
Seismic level (Horizontal acceleration)	:	0.3g

Moderately hot and humid tropical climate

3. APPLICABLE STANDARDS

The whole current energy meter shall be of accuracy Class 1.0 and conform to relevant clauses of following standards or report: -

1.	IS 13779	AC Static Transformer Operated Watt-hour and VAR-Hour Meters, class 1.0.
2.	CBIP Technical report no. 111	Specification for common Meter Reading Instrument
3.	IS :9000	Basic Environmental Testing Procedures for Electronic & Electrical Items.
4.	ETD 13 (6211)	DLMS Indian Companion Standard – Category ‘C’ for consumer metering

Unless otherwise specified elsewhere in this specification the static meters shall conform to the latest version available of the standard as specified above.

4. GENERAL TECHNICAL REQUIREMENT

Application	:	3 phase 4 wire
Rated Secondary Voltage	:	240 volts (Phase to Neutral)
Current Rating	:	05-30A, 10-60A, 20-100A
Rated Frequency	:	50 Hz.

Accuracy class	:	1.0
Power Factor	:	Unity to Zero (all power factor lag / or lead)

The meter shall start and continue to register on application of 0.2% of basic current at Unity P.F., as per relevant standards and shall work satisfactorily with the following supply system variation:

Voltage	:	Vref + 30% to -30%
Frequency	:	50 Hz ±5%

Temperature : The standard reference temperature for performance shall be 27 °C. The mean temperature co-efficient shall not exceed 0.03%.

The reactive accuracy class of the meter shall be same as the active accuracy class
The meter shall be able to continuously withstand phase to phase voltage of 500V

5. INFLUENCE QUANTITIES:

The meter should be designed and protected such that all external effects and influences shall not change its performance & shall work satisfactorily within guaranteed accuracy limits, as specified in IS 13779, under the presence of influence quantities.

6. CONSTRUCTION

The case, winding, voltage circuit, sealing arrangements, registers, terminal block, terminal cover & name plate etc, shall be in accordance with the relevant standards. The meter should be compact & reliable in design, easy to transport & immune to vibration & shock involved in the transportation & handling. The construction of the meter should ensure consistence performance under all conditions especially during storms/heavy rains/very hot weathers. The insulating materials used in the meter should be non-hygroscopic, non-ageing & have tested quality. The meter should be sealed in such a way that the internal parts of the meter become inaccessible.

The meter should employ latest technology such as Application Specific Integrated Circuit (ASIC) to ensure reliable performance. The mounting of the components on the PCB should be Surface Mounted Technology (SMT) type except some power supply related component. The electronic components used in the meter should be of high quality.

6.1 GENERAL MECHANICAL REQUIREMENTS

The construction of the meter shall be rigid & suitable to withstand shock & vibration involved in transportation & handling, as specified in IS 13779. Meter shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal conditions, so as to ensure especially personal safety against electric shook, safety against effect of excessive temperature, protection against spread of fire, protection against penetration of solid objects, dust and water. The design of meter shall conform to IP 51 class degree of protection against dust and moisture as per relevant standards.

6.2 TROPICAL TREATMENT

All parts, which are subject to corrosion under normal working conditions, shall be protected effectively. Any protective coating shall not be liable to damage by ordinary handling or damage due to exposure to air, under normal working conditions. Meters shall withstand solar radiation. The meters shall be suitably designed and treated for normal life & satisfactory operation under the hot and hazardous tropical climatic conditions as specified in clause no. 2. The meter shall work from -10°C to +55°C and RH 95% non-condensing type.

6.3 METER CASE

The housing of the meter shall be safe high-grade Engineering plastic or any other high quality insulating material and shall be very compact in design. All the insulation materials used in the construction of meter shall be non-hygroscopic, non ageing & of tested quality, capable of withstanding resistant to heat & fire. The construction of the meter offered shall be such that it can be sealed independently and the cover cannot be removed with the use of a tool, without breaking the seal. The case of offered meters shall be so constructed that any non-permanent deformation shall not prevent the satisfactory operation of the meter. The meter shall have a transparent cover and opaque base with seamless ultrasonic welding.

6.4 TERMINALS -TERMINAL BLOCK

The base of the meter shall have a terminal block at the bottom made out of high grade engineering plastic so as to facilitate bottom connection and having capability to carry maximum value of current.

The material of the terminal block shall be capable of passing the tests given in IS 13779.

The terminal holes in the insulating material shall be of sufficient size to accommodate the insulation of the conductors. The diameter of the terminal hole for current terminals shall not be less than 9 mm & shall be of adequate length in order to have proper grip of conductors / crimping pins with the help of two screws.

The terminal block shall satisfy all the conditions such as clearance & creepage distance between terminals & surrounding part of the meter as specified in relevant clause of IS 13779. The material of terminal and connection screws should be brass.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there shall have no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimised. Electrical connections shall be so designed that contact pressure shall not be transmitted through insulating material.

6.5 TERMINAL BLOCK COVER

The terminals block cover for the energy meters shall be extended transparent type, which can be sealed independently of the meter cover. The ETBC shall have a clear space of 45-±5mm, thus allowing sufficient clearance space for inserting cables. ETBC shall have a top side hinge arrangement for easy access of terminal for wire termination. The terminals, their fixing screws and the insulated compartment housing them shall be enclosed by extended terminal cover in such a way that no part of meter or accessories at terminal block shall be accessible from the front of the meter. There shall be provision of fixing of seals so that screws cannot be loosened without breaking the seals.
The terminals shall not be accessible without removing the seal(s) of terminal cover when energy meter is mounted on the meter board.

6.6 WINDOW

The energy meter cover shall be made of high-grade engineering plastic with a clear window. The window shall be of transparent material shall be such that it cannot be removed undamaged without breaking the meter cover seals.

6.7 QUALITY

Overall the quality of the meter should be good and the service life of the meter shall be more than the guarantee period. The material, components used for manufacturing the meter shall be of premium quality. The LCD display shall not fade with time and the display

annunciators should be visible. Functionality of the meter shall not be affected by the harsh environmental conditions. Quality meters shall be given preference and the performance of previous installed meters shall be analysed before awarding the tender. Aesthetically, the meter shall be of premium quality.

7. COMMUNICATION PORT

a) **LOCAL COMMUNICATION PORT**
The energy meter shall have a galvanically isolated IEC 1107 optical communication port located in front of the meter for data transfer to or from a hand held Data Collection Device. The sealing provision should be available for optical port.

b) REMOTE COMMUNICATION PORT
Meter shall have an additional communication port (RS 232) in the form of RJ11 port to interface external modem for remote data collection. RS 232 (RJ11) port shall be located under the terminal cover.

Both the ports will support communication on DLMS and should be accessible through a DLMS compliant HHU.

8. DATA DOWNLOADING CAPABILITY
Meter shall support a minimum baud rate of 9600 on optical port as well as RS 232 remote communication port. It shall be possible to read selective data set from the meter from the meter. as specified in ETD 13 (6211).

9. DISPLAY OF MEASURED VALUE:
The measured value(s) shall be displayed on seven segments, seven digit Liquid Crystal Display (LCD) display unit/register, having minimum character height of 10 mm.

The data should be stored in non-volatile memory. The non-volatile memory should retain data for a period of not less than 10 years under unpowered condition. Battery back-up memory will not be considered as NVM.

It should be possible to easily identify the single or multiple displayed parameters through symbols/legend on the meter display itself or through display annunciators.

The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

The principle unit for the measured values shall be kWh for active energy, kVArh for reactive energy & kVAh for apparent energy. Bidder shall mention the scale in which the meter displays the energy values.

Required display list will be given at the time of order. However it will be in line with companion standard such as:

- Real Time
- Date
- Line currents
- Phase to Neutral Voltages
- Phase wise Power Factor
- Frequency
- Active, Reactive and Apparent Power

- Cumulative tamper count
- Cumulative MD reset Count
- Cumulative active forwarded energy
- Cumulative reactive lag forwarded energy
- Cumulative reactive lead forwarded energy
- Cumulative apparent forwarded energy
- Universal active maximum demand with date and time
- Universal apparent maximum demand with date and time
- Present PT status
- Present CT status
- Other status
- Last occurred and restored tamper with date and time
- High resolution active forwarded energy (up to 4 decimal point)
- High resolution reactive lag forwarded energy (up to 4 decimal point)
- High resolution reactive lead forwarded energy (up to 4 decimal point)
- High resolution apparent forwarded energy (up to 4 decimal point)

Above listed displays shall be configurable in three different pages in push mode for easy access in mains on condition. First page should contain the instantaneous parameters, second page, for energy and demand values, and third page for tamper related displays.

The meter should have visual quadrant representation on the LCD for energy measurement. Relevant quadrant in which metering is taking place should be in on state for ease of understanding.

Parameter value with relevant OBIS code should also be simultaneously available along with the respective values on the display.

10. ELECTROMAGNETIC COMPATIBILITY

The static energy meters shall conform to requirements listed in relevant standards and shall also be protected against radiated interference from either magnetic or radio-frequency source.

10.1 IMMUNITY TO ELECTROMAGNETIC DISTURBANCE

The meter shall be designed in such a way that conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or substantially influence the meter and meter shall work satisfactorily under these conditions as per relevant standards

NOTE: the disturbances to be considered are: -

(a) Harmonics
(b) Voltage dips and short interruptions
(c) Conducted transients
(d) D.C. and A.C. magnetic fields
(e) Electromagnetic fields
(f) Electrostatic discharges

10.2 RADIO INTERFERENCE SUPPRESSIONS

The meter shall not generate noise, which could interfere with other equipment, and meter shall work satisfactorily as per relevant standards

10.3 INFLUENCE OF HIGH MAGNETIC FIELD

The meters shall be provided appropriate magnetic shielding so that any external magnetic field (AC/DC electromagnet) as per IS 13779 applied on meter would not affect the proper

functioning of the meter and meter shall work satisfactorily as per relevant standards.

11. STARTING CURRENT
The meter shall start and continue to register at the current 0.2% of Ib.

12. RUNNING WITH NO LOAD
When the 115% of rated voltage is applied with no current flowing in the current circuit, the meters shall not register any energy and test output of the meter shall not be more than one pulse/count on "no load".

13. POWER CONSUMPTION

13.1 The active and apparent power consumption in each voltage circuit at reference voltage; temperature and frequency shall not exceed 1.0 W and 4 VA per phase respectively.

13.2 The apparent power consumption in each current circuit at basic current, reference frequency and reference temperature shall not exceed 1.0 VA per phase.

14. CALIBRATION & TEST OUTPUT
All the meters shall be tested, calibrated and sealed at works before despatch. Further, no modification of calibration shall be possible at site by any means.

However, it shall be possible to check the accuracy of energy measurement of the meter in the field by means of LED output on meter. Meter should have two calibration LEDs for accuracy measurement for different energies. Out of these, one should be kept fixed on kWh and other one shall be configurable for rest two (kVArh, kVAh). Resolution of the test output shall be sufficient to enable the starting current test in less than 10 minutes.

15. CONNECTION DIAGRAM
The connection diagram of the meter shall be clearly shown for 3 phase 4 wire system, on the terminal cover. The meter terminals shall also be marked and this marking should appear in the above diagram.

16. QUANTITIES TO BE MEASURED:
The meter shall be able to provide the following data in line with Category ‘C’ type as per ETD 13 (6211).

a) Instantaneous Parameters
b) Block Profile / Load Survey data for 30 minute capture time block.
c) Parameters for billing.
d) Abstract quantities
   - Name Plate Details
   - Programmable parameters
e) Event Conditions.

The meter shall be able to measure and provide the parameters listed in the guideline document.

The OBIS code for each parameter shall be as identified in Indian companion standard.

17. ABNORMAL EVENTS:
The meter should have features to detect the occurrence and restoration of, at least, the following common abnormal events:

a) **Missing Potential:** The meter shall be capable of detecting and recording occurrence and restoration with date and time the cases of Potential failure (one phase or two phases). All potential missing cases shall be considered as power failure.

b) **Current imbalance**: The meter shall be capable of detecting and recording occurrence and restoration with date and time of Current unbalance (for more than a defined persistence time).

c) **Current Reversal:** The meter shall be capable of detecting and recording occurrence and restoration with date and time if the current is flowing in reverse direction in one or more phases. The meter shall continue to record in forwarded direction even in case of CT reversal.

d) **Power on/off**: The meter shall be capable to record power on /off events in the meter memory. All potential failure should record as power off event.

e) **Magnetic Influence** - The Meter shall be capable of detecting and recording of presence of abnormal magnetic influence near the meter, if the magnetic influence affects the meter functionality. The meter should record at Imax on account of magnetic influence. Separate legend for magnet event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader.

f) **Voltage unbalance** – Meter shall detect voltage unbalance if there is unbalance in voltages.

g) **Over Current** – When load condition at any phase i.e. Line current at any phase goes more than defined limit , this will be detected as Over current condition.

h) **CT Open** – The meter should detect phase wise current circuit open when the circuit is opened from meter side.

i) **CT Bypass** – The condition should be detected whenever the current terminal is bypassed in the meter

j) **Neutral Disturbance** – The meter should detect neutral disturbance if any spurious signal is applied at the meter's neutral.

k) **High and Low Voltage**: The meter should detect under and over voltage events respectively if voltage falls / rise from defined limits.

l) **Cover Open**: The meter shall be able to detect cover open occurrence event if cover is opened in mains on or off condition. Separate legend for cover open event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader

m) In absence of one phase and neutral, meter should record the event with date and time and maintain the accuracy with in ±3%.

A separate register is additionally required for defraud energy registration.

The above shall be selectable and will be in line with ETD 13 (6211) : Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification

The meter shall keep records for the minimum last 300 events (occurrence + restoration) for above abnormal conditions. Each event shall be logged with date and time of occurrence/restoration with snapshot of voltage, current power factor and active energy (except cover open, power on-off). It shall be possible to retrieve the abnormal event data locally using a hand held unit (HHU) through the meter's optical port & same can be viewed / analysed at base computer end in simple and easily understandable format.

18. ABNORMAL VOLTAGE/FREQUENCY DEVICE TEST:

The accuracy of the meter would not be affected with the application of abnormal voltage/ frequency generating device having spark discharge of approximately 35KV. The meter will be tested by feeding the output of this device to meter in any of the following manner for 10 minutes:

i) On any of the phase or neutral terminals.
ii) On any connecting wires of the meter.
iii) Voltage discharge with 0-10 mm spark gap.
iv) Spark on meter body.
v) At any place in load circuit.

The accuracy of the meter will be checked before and after the application of above device.

19. BILLING HISTORY & LOAD SURVEY: -

The meter shall have sufficient non-volatile memory for recording history of energy parameters for minimum last twelve billing cycles (Bill date shall be 00 hrs of the 1st date of the calendar month by default – programmable)

Following parameters shall be made available for last 60 days with integration period of 30 min:

- Active forwarded energy
- Reactive lag energy
- Reactive lead energy
- Apparent forwarded energy
- Phase wise voltage
- Phase wise current
- Avg power factor

These load survey and history data can be retrieved with the help of Meter Reading Instrument on local interrogation or remotely using the remote communication interface.

20. Daily Energy snapshot

The meter shall record the daily mid night energy snap for 60 days for active forwarded energy (kWh) and apparent forwarded energy.

21. MD REGISTRATION

The meter shall continuously monitor and calculate maximum demand for each interval of time, which may be programmable as a block of 30 minutes . At the end of every demand integration period the new calculated MD shall be compared with the previous MD and meter shall store whichever value is higher.

22. MD RESET

The meter shall have any of the following MD resetting options: -

(a) Automatic reset at the end of a certain predefined period (say, end of the month)
(b) Manual resetting arrangement (MD reset button) with sealing facility.
(c) MD reset through authenticated transaction

23. SELF DIAGNOSTIC FEATURE

The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all time. The meter shall have indication for unsatisfactory/non-functioning/malfunctioning of the following:

a). Time and date on meter display
b). All display segments on meter display
c). Self diagnostic (RTC, NVM information) on display

24. OTHER SALIENT FEATURES OF METERS

a) It should be possible to check the healthiness of phase voltages by phase indicator available on meter display.
b) The meter shall have provision of reading in the absence of power through an internal battery. It shall be possible to access the display in power off condition. It shall also be possible to do meter data download through MRI under power off condition.
c) The meter should work accurately irrespective of phase sequence of the supply.

25. TEST AND TEST CONDITIONS

- Acceptance test: All acceptance tests as per relevant standards shall be carried out in the presence of utility representatives.
- Routine Test: All the routine tests as per –IS 13779 shall be carried out and routine tests certificates shall be submitted for approval of purchaser.

GUARANTEED TECHNICAL PARTICULARS FOR 3 PHASE 4 WIRE WHOLE CURRENT TRIVECTOR ENERGY METER

S.No.	Item	Bidder's data
1.	Type	
2.	Application	
3.	Rated Voltage	
4.	Rated Current	
5.	Frequency	
6.	Minimum starting current in % of base current	
7.	Power loss in potential circuit	
8.	Power loss in current circuit	
9.	Change in error due to	
	i. Variation in frequency	
	ii. Variation in voltage	
10.	Accuracy Class	
11.	Total Weight of meter	
12.	Details of case	
13.	Standard to which the meter confirm	
14.	Type of Energy Registration Mechanism.	
15.	MD Reset Mechanism	
16.	MD reset button with sealing provision	
17.	Two LEDs for accuracy measurement	
	Working range	
18.	Voltage	
19.	Current	
20.	**Display details**	
	i. Display Cycle (page mode display)	
	ii. Period of display of each	

S.No.	Item	Bidder's data
	parameter	
	iii. Display scroll-lock facility	
	iv. Backlit LCD	
	v. Relevant OBIS codes for parameter	
	vi. Legend for Cover open detection	
	vii. Legend for Magnet event	
21.	Power on in absence of mains	
	i. Internal / External Battery	
	ii. Display access	
	iii. Reading (Data downloading)	
22.	Total Events (300 nos)	
23.	Load Survey	
24.	Parameter Logged	
25.	Logging interval	
26.	No. of days of Load Survey	
27.	Daily Energy Snap i. Parameters ii. No. of Days	
28.	Time of the day Zone	
29.	Capability for fraud Prevention & detection	
30.	Sealing and Locking Arrangement	
31.	Type of communication i. Local- Optical port IEC 1107 ii. RS 232 port for remote comms	
32.	Event Logging Current Related events: • CT reversal (phase wise) • Current imbalance • Over Current • CT open (phase wise) • CT Bypass Voltage related events • PT missing (phase wise) • Voltage unbalance • High and low voltage Others: • Magnet • Neutral Disturbance • Low Power factor Non Rollover events • Front Cover open Power on-off events	

TECHNICAL SPECIFICATION FOR STATIC 3 PHASE 4 WIRE CT OPERATED STATIC TRIVECTOR ENERGY METER

26. OBJECTIVE & SCOPE

This specification shall cover design, engineering, manufacture, assembly, inspection, testing at manufacturers works before dispatch, supply and delivery at destination anywhere in "state", Class 0.5s accuracy class static 3 phase–4 wire CT operated three-vector energy meter. The meter shall be suitable for measurement of energy and power, demand requirement in an AC balanced/unbalanced system over a power factor range of zero lag to unity. These meters should have communication port to interface for remote meter reading.

27. SERVICE CONDITION

The meter shall be suitable for satisfactory continuous operation under the following tropical conditions:-

a)	Maximum ambient temperature	:	50 °C
b)	Maximum ambient temperature in shade	:	45 °C
c)	Relative Humidity	:	10 to 95%
d)	Maximum annual rainfall	:	1450 mm’
e)	Maximum wind pressure	:	150 Kg/m. sq.
f)	Maximum altitude above mean seal level	:	1000 meters
g)	Isoceraunic level	:	50 days/year
h)	Seismic level (Horizontal acceleration)	:	0.3g
i)	Moderately hot and humid tropical climate		

28. APPLICABLE STANDARDS

The CT operated energy meter shall be of accuracy Class 0.5 for active/ reactive / apparent energy and conform to relevant clauses of following standards or report: -

IS 14697: 1999	Specification for A.C Static Transformer operated Watt Hour & VAR – Hour meters, class 0.5s
CBIP Technical Report No. 304	Specification for A.C. Static Electrical Energy Meters.
IS 15959 (Companion specification)	DLMS Indian Companion Standard – Category ‘C’ for consumer metering

Unless otherwise specified elsewhere in this specification the static meters shall conform to the latest version available of the standard as specified above.

29. GENERAL TECHNICAL REQUIREMENT

Application	:	3 phase 3 wire
Rated Secondary Voltage	:	240 volts (Phase to neutral)
Rated secondary Current (I Basic)	:	5 Amps
Rated Frequency	:	50 Hz.
Accuracy class	:	0.5s (the meter should meet the same class of accuracy for reactive energy also)
Power Factor	:	Unity to Zero (all power factor lag / or lead)

The meter shall start and continue to register on application of 0.1% of basic current at Unity P.F., as per relevant standards and shall work satisfactorily up to maximum continuous current of 2 times rated basic current with the following supply system variation:

Voltage	:	Vref ± 30%
Frequency	:	50 Hz ±5%

Temperature: The standard reference temperature for performance shall be 27 °C. The mean temperature co-efficient shall not exceed 0.03%.

The reactive accuracy class of the meter shall be same as the active accuracy class
The meter shall be able to continuously withstand phase to phase voltage of 500V

30. INFLUENCE QUANTITIES:
The meter should be designed and protected such that all external effects and influences shall not change its performance & shall work satisfactorily within guaranteed accuracy limits, as specified in IS 14697: 1999 / CBIP technical report – 304, under the presence of influence quantities.

31. CONSTRUCTION
The case, winding, voltage circuit, sealing arrangements, registers, terminal block, terminal cover & name plate etc, shall be in accordance with the relevant standards. The meter should be compact & reliable in design, easy to transport & immune to vibration & shock involved in the transportation & handling. The construction of the meter should ensure consistence performance under all conditions especially during storms/heavy rains/very hot weathers. The insulating materials used in the meter should be non-hygroscopic, non-ageing & have tested quality. The meter should be sealed in such a way that the internal parts of the meter become inaccessible.

The meter should employ latest technology such as Application Specific Integrated Circuit (ASIC) to ensure reliable performance. The mounting of the components on the PCB should be Surface Mounted Technology (SMT) type except some power supply related component. The electronic components used in the meter should be of high quality.

31.1 GENERAL MECHANICAL REQUIREMENTS
The construction of the meter shall be rigid & suitable to withstand shock & vibration involved in transportation & handling, as specified in IS 14697. Meter shall be designed and constructed in such a way as to avoid introducing any danger in normal use and under normal conditions, so as to ensure especially personal safety against electric shook, safety against effect of excessive temperature, protection against spread of fire, protection against penetration of solid objects, dust and water. The design of meter shall conform to IP51 class degree of protection against dust and moisture as per relevant standards.

31.2 TROPICAL TREATMENT
All parts, which are subject to corrosion under normal working conditions, shall be protected effectively. Any protective coating shall not be liable to damage by ordinary handling or damage due to exposure to air, under normal working conditions. Meters shall withstand solar radiation. The meters shall be suitably designed and treated for normal life & satisfactory operation under the hot and hazardous tropical climatic conditions as specified in clause no. 2. The meter shall work from -10°C to +55°C and RH 95% non-condensing type.

31.3 METER CASE
The housing of the meter shall be safe high-grade Engineering plastic or any other high quality insulating material and shall be very compact in design. All the insulation materials used in the construction of meter shall be non-hygroscopic, non ageing & of tested quality, capable of withstanding resistant to heat & fire. The construction of the meter offered shall be such that it can be sealed independently and the cover cannot be removed with the use of a tool, without breaking the seal. The case of offered meters shall be so constructed that any non-permanent deformation shall not prevent the satisfactory operation of the meter. The meter shall have a transparent cover and opaque base with seamless ultrasonic welding.

31.4 TERMINALS -TERMINAL BLOCK

The base of the meter shall have a terminal block at the bottom made out of high grade engineering plastic so as to facilitate bottom connection and houses solid nickel plated brass terminals having capability to carry maximum value of current.

The material of the terminal block shall be capable of passing the tests given in IS 14697: 1999.

The terminal holes in the insulating material shall be of sufficient size to accommodate the insulation of the conductors. The diameter of the terminal hole for current terminals shall not be less than 5.0 mm & shall be of adequate length in order to have proper grip of conductors / crimping pins with the help of two screws.

The terminal block shall satisfy all the conditions such as clearance & creepage distance between terminals & surrounding part of the meter as specified in relevant clause of IS 14697: 1999.

The manner of fixing the conductors to the terminals shall ensure adequate and durable contact such that there shall have no risk of loosening or undue heating. Screw connections transmitting contact force and screw fixing which may be loosened and tightened several times during the life of the meter shall be such that the risk of corrosion resulting from contact with any other metal part is minimised. Electrical connections shall be so designed that contact pressure shall not be transmitted through insulating material.

31.5 TERMINAL BLOCK COVER

The terminals block cover for the energy meters shall be extended transparent type, which can be sealed independently of the meter cover. The ETBC shall have a clear space of min 40$\pm$5mm, thus allowing sufficient clearance space for inserting cables. ETBC shall have a top side hinge arrangement for easy access of terminal for wire termination. The terminals, their fixing screws and the insulated compartment housing them shall be enclosed by extended terminal cover in such a way that no part of meter or accessories at terminal block shall be accessible from the front of the meter. There shall be provision of fixing of seals so that screws cannot be loosened without breaking the seals.

The terminals shall not be accessible without removing the seal(s) of terminal cover when energy meter is mounted on the meter board.

31.6 WINDOW

The energy meter cover shall be made of high-grade engineering plastic with one window. The window shall be of transparent material ultrasonically welded with the meter cover such that it cannot be removed undamaged without breaking the meter cover seals.

31.7 QUALITY

Overall the quality of the meter should be good and the service life of the meter shall be more than the guarantee period. The material, components used for manufacturing the meter shall be of premium quality. The LCD display shall not fade with time and the display annunciators should be visible. Functionality of the meter shall not be affected by the harsh environmental conditions. Quality meters shall be given preference and the performance of previous installed meters shall be analysed before awarding the tender. Aesthetically, the meter shall be of premium quality.

32. COMMUNICATION PORT

a). **LOCAL COMMUNICATION PORT**
The energy meter shall have a galvanically isolated IEC 1107 optical communication port located in front of the meter for data transfer to or from a hand held Data Collection Device. The sealing provision should be available for optical port.

b). REMOTE COMMUNICATION PORT
Meter shall have an additional communication port (RS 232) in the form of RJ11 port to interface external modem for remote data collection. RS 232 (RJ11) port shall be located under the terminal cover.

Both the ports will support communication on DLMS and should be accessible through a DLMS compliant HHU

33. DATA DOWNLOADING CAPABILITY
Meter shall support a minimum baud rate of 9600 on optical port as well as RS 232 remote communication port. It shall be possible to read selective data from the meter as specified in the companion standard.

34. DISPLAY OF MEASURED VALUE:
The measured value(s) shall be displayed on seven segments, seven digit Liquid Crystal Display (LCD) display unit/register, having minimum character height of 10 mm.

The data should be stored in non-volatile memory. The non-volatile memory should retain data for a period of not less than 10 years under unpowered condition. Battery back-up memory will not be considered as NVM.

It should be possible to easily identify the single or multiple displayed parameters through symbols/legend on the meter display itself or through display annunciators.

Meter shall have Scroll Lock facility to display any one desired parameter continuously from display parameters.

The register shall be able to record and display starting from zero, for a minimum of 1500 hours, the energy corresponding to rated maximum current at reference voltage and unity power factor. The register should not roll over in between this duration.

The principle unit for the measured values shall be Wh/kWh/MWh for active energy, VArh/kVArh/MVArh for reactive energy & VAh/kVAh/MVAh for apparent energy based on secondary current. Bidder shall mention the scale in which the meter displays the energy values.

Required display list will be given at the time of order. However it will be in line with companion standard such as:

- Real Time
- Date
- Line currents
- Phase to Neutral Voltages
- Phase wise Power Factor
- Frequency
- Active, Reactive and Apparent Power
- Cumulative tamper count
- Cumulative MD reset Count
- Cumulative active forwarded energy

- Cumulative reactive lag forwarded energy
- Cumulative reactive lead forwarded energy
- Cumulative apparent forwarded energy
- Universal active maximum demand with date and time
- Universal apparent maximum demand with date and time
- Present PT status
- Present CT status
- Other status
- Last occurred and restored tamper with date and time
- High resolution active forwarded energy (up to 4 decimal point)
- High resolution reactive lag forwarded energy (up to 4 decimal point)
- High resolution reactive lead forwarded energy (up to 4 decimal point)
- High resolution apparent forwarded energy (up to 4 decimal point)

Above listed displays shall be configurable in three different pages in push mode for easy access in mains on condition. First page should contain the instantaneous parameters, second page, for energy and demand values, and third page for tamper related displays.

The meter should have visual quadrant representation on the LCD for energy measurement. Relevant quadrant in which metering is taking place should be in on state for ease of understanding.

Parameter value with relevant OBIS code should also be simultaneously available along with the respective values on the display.

35. ELECTROMAGNETIC COMPATIBILITY

The static energy meters shall conform to requirements listed in relevant standards and shall also be protected against radiated interference from either magnetic or radio-frequency source.

35.1 IMMUNITY TO ELECTROMAGNETIC DISTURBANCE

The meter shall be designed in such a way that conducted or radiated electromagnetic disturbance as well as electrostatic discharge do not damage or substantially influence the meter and meter shall work satisfactorily under these conditions as per relevant standards

NOTE: the disturbances to be considered are: -

(g) Harmonics
(h) Voltage dips and short interruptions
(i) Conducted transients
(j) D.C. and A.C. magnetic fields
(k) Electromagnetic fields
(l) Electrostatic discharges

35.2 RADIO INTERFERENCE SUPPRESSIONS

The meter shall not generate noise, which could interfere with other equipment, and meter shall work satisfactorily as per relevant standards

35.3 INFLUENCE OF HIGH MAGNETIC FIELD

The meters shall be provided appropriate magnetic shielding so that any external magnetic field (AC/DC electromagnet) as per CBIP Technical Report no. 304 applied on meter would not affect the proper functioning of the meter and meter shall work satisfactorily as per relevant standards.

36. STARTING CURRENT
The meter shall start and continue to register at the current 0.1% of Ib.

37. RUNNING WITH NO LOAD
When the 115% of rated voltage is applied with no current flowing in the current circuit, the meters shall not register any energy and test output of the meter shall not be more than one pulse/count on "no load".

38. POWER CONSUMPTION

38.1 The active and apparent power consumption in each voltage circuit of the CT Operated meters at reference voltage; temperature and frequency shall not exceed 1.0 W and 4 VA per phase respectively.

38.2 The apparent power consumption in each current circuit for the CT Operated meters at basic current, reference frequency and reference temperature shall not exceed 1.0 VA per phase.

39. CALIBRATION & TEST OUTPUT
All the meters shall be tested, calibrated and sealed at works before despatch. Further, no modification of calibration shall be possible at site by any means.

However, it shall be possible to check the accuracy of energy measurement of the meter in the field by means of LED output on meter. Meter should have two calibration LEDs for accuracy measurement for different energies. Out of these, one should be kept fixed on kWh and other one shall be configurable for rest two (kVArh, kVAh). Resolution of the test output shall be sufficient to enable the starting current test in less than 10 minutes

40. CONNECTION DIAGRAM
The connection diagram of the meter shall be clearly shown for 3 phase 4 wire system, on the terminal cover. The meter terminals shall also be marked and this marking should appear in the above diagram.

41. QUANTITIES TO BE MEASURED:
The meter shall be able to provide the following data in line with Category ‘C’ type as per IS 15959 - Indian Companion Specification.

a) Instantaneous Parameters
b) Block Profile / Load Survey data
c) Parameters for billing.
d) Abstract quantities
   • Name Plate Details
   • Programmable parameters
e) Event Conditions.
f) Billing profile parameters.
g) Time of day registers.

The meter shall be able to measure and provide the parameters listed in the guideline document. The OBIS code for each parameter shall be as identified as per DLMS /COSEM protocol in line with Indian companion standard.

42. ABNORMALITY EVENTS DETECTION:
The meter should have features to detect the occurrence and restoration of, at least, the following common abnormal events:

a) **Missing Potential:** The meter shall be capable of detecting and recording occurrence and restoration with date and time the cases of Potential failure (one phase or two phases). All potential missing cases shall be considered as power failure.

b) **Current imbalance**: The meter shall be capable of detecting and recording occurrence and restoration with date and time of Current unbalance (for more than a defined persistence time).

c) **Current Reversal:** The meter shall be capable of detecting and recording occurrence and restoration with date and time if the current is flowing in reverse direction in one or more phases. The meter shall continue to record in forwarded direction even in case of CT reversal.

d) **Power on/off**: The meter shall be capable to record power on /off events in the meter memory. All potential failure should record as power off event.

e) **Magnetic Influence** - The Meter shall be capable of detecting and recording of presence of abnormal magnetic influence near the meter, if the magnetic influence affects the meter functionality. The meter should record at Imax on account of magnetic influence. Separate legend for magnet event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader.

f) **Voltage unbalance** – Meter shall detect voltage unbalance if there is unbalance in voltages.

g) **Over Current** – When load condition at any phase i.e. Line current at any phase goes more than defined limit , this will be detected as Over current condition.

h) **Neutral Disturbance** – The meter should detect neutral disturbance if any spurious signal is applied at the meter's neutral.

i) **High and Low Voltage**: The meter should detect under and over voltage events respectively if voltage falls / rise from defined limits.

j) **Cover Open**: The meter shall be able to detect cover open occurrence event if cover is opened in mains on or off condition. Separate legend for cover open event shall be made available on LCD. This legend shall remain in on state till meter reading so that it will come in to notice of meter reader

The above shall be selectable and will be in line with IS 15959 : Data Exchange for Electricity Meter Reading, Tariff and Load Control – Companion Specification

The meter shall keep records for the minimum last 300 events (occurrence + restoration) for above abnormal conditions. Each event shall be logged with date and time of occurrence/restoration with snapshot of voltage, current power factor and active energy (except cover open, power on-off). It shall be possible to retrieve the abnormal event data locally using a hand held unit (HHU) through the meter's optical port & same can be viewed / analysed at base computer end in simple and easily understandable format.

43. ABNORMAL VOLTAGE/FREQUENCY DEVICE TEST:

The accuracy of the meter would not be affected with the application of abnormal voltage/ frequency generating device having spark discharge of approximately 35KV. The meter will be tested by feeding the output of this device to meter in any of the following manner for 10 minutes:

i) On any of the phase or neutral terminals.
ii) On any connecting wires of the meter.
iii) Voltage discharge with 0-10 mm spark gap.
iv) Spark on meter body.
v) Spark on the optical and RS 232 port.
vi) At any place in load circuit.

The accuracy of the meter will be checked before and after the application of above device.

44. LOAD SURVEY: -
Meter should support parameters as mentioned in IS-15959 for Category "C" .

Following parameters shall be made available for last 60 days with integration period of 15 min. Out of which the utility should be able to select any five parameters

- Real time clock ,date and time.
- Current, Ir
- Current, Iy
- Current, Ib
- Voltage ,V Rn
- Voltage ,V Yn
- Voltage ,V Bn
- Active forwarded Energy
- Reactive lag forwarded energy
- Reactive lead forwarded energy
- Apparent Energy

These load survey can be retrieved with the help of Meter Reading Instrument on local interrogation or remotely using the remote communication interface.

45. TIME OF DAY REGISTERS
The meter shall have support of eight TOD registers and rate registers for demand and energy monitoring in peak and off peak time zones. TOD rate and MD registers are required for active and apparent energy channels.

46. MD REGISTRATION
The meter shall continuously monitor and calculate maximum demand for each interval of time, which may be programmable as a block of 15 minutes or 30 minutes (30 minutes by default). At the end of every demand integration period the new calculated MD shall be compared with the previous MD and meter shall store whichever value is higher.

47. MD RESET
The meter shall have any of the following MD resetting options: -
(a) Automatic reset at the end of a certain predefined period (say, end of the month)
(b) Manual resetting arrangement (MD reset button) with sealing facility.
(c) MD reset through authenticated transaction

48. SELF DIAGNOSTIC FEATURE
The meter shall be capable of performing complete self-diagnostic check to monitor the circuits for any malfunctioning to ensure integrity of data memory location at all time. The meter shall have indication for unsatisfactory/non-functioning/malfunctioning of the following:
a) Time and date on meter display
d) All display segments on meter display
e) Self diagnostic (RTC, NVM information) on display

49. OTHER SALIENT FEATURES OF METERS

- It should be possible to check the healthiness of phase voltages by phase indicator available on meter display.
- The meter shall have provision of reading in the absence of power through an internal battery. It shall be possible to access the display in power off condition. It shall also be possible to do meter data download through MRI under power off condition.
- The meter should work accurately irrespective of phase sequence of the supply.

50. TEST AND TEST CONDITIONS

- Acceptance test: All acceptance tests as per relevant standards shall be carried out in the presence of utility representatives.
- Routine Test: All the routine tests as per – IS 14697 shall be carried out and routine tests certificates shall be submitted for approval of purchaser.

GUARANTEED TECHNICAL PARTICULARS FOR 3 PHASE 3 WIRE CT OPERATED TRIVECTOR ENERGY METER FOR CONSUMER METERING

S.No.	Item	Bidder's data
1.	Type	
2.	Application	
3.	Rated Voltage	
4.	Rated Current	
5.	Frequency	
6.	Minimum starting current in % of base current	
7.	Power loss in potential circuit	
8.	Power loss in current circuit	
9.	Change in error due to	
	i. Variation in frequency	
	ii. Variation in voltage	
10.	Accuracy Class	
11.	Total Weight of meter	
12.	Details of case	
13.	Standard to which the meter confirm	
14.	Type of Energy Registration Mechanism.	
15.	MD Reset Mechanism	
16.	MD reset button with sealing provision	
17.	Two LEDs for accuracy measurement	
	Working range	
18.	Voltage	
19.	Current	
20.	**Display details**	
	i. Display Cycle (page mode display)	
	ii. Period of display of each parameter	
	iii. Display scroll-lock facility	
	iv. Backlit LCD	
	v. Relevant OBIS codes for parameter	
	vi. Legend for Cover open detection	
	vii. Legend for Magnet event	
21.	Power on in absence of mains	
	i. Internal / External Battery	
	ii. Display access	

S.No.	Item	Bidder's data
	iii. Reading (Data downloading)	
22.	Total Events (300 nos)	
23.	Load Survey	
24.	Parameter Logged	
25.	Logging interval	
26.	No. of days of Load Survey	
27.	Time of the day Zone	
28.	Capability for fraud Prevention & detection	
29.	Sealing and Locking Arrangement	
30.	Type of communication i. Local- Optical port IEC 1107 ii. RS 232 port for remote comms	
31.	Event Logging Current Related events: • CT reversal (phase wise) • Current imbalance • Over Current Voltage related events • PT missing (phase wise) • Voltage unbalance • High and low voltage Others: • Magnet • Neutral Disturbance • Low Power factor Non Rollover events • Front Cover open Power on-off events	

19.0 UN-INTERRUPTED POWER SUPPLY(UPS)

A. GENERAL

19.1 INTRODUCTION

The UPS systems (True online double conversion VFI type as per IEC 62040-3) will be working in parallel sharing entire load. Battery backup shall be as per data sheet with each UPS Module. The batteries shall be placed in battery room separately. This specification defines the electrical and mechanical characteristics and requirements for a continuous duty, highly reliable, solid state Uninterruptible Power Supply systems. The UPS shall provide high quality AC power for sensitive electronic equipment loads. It should also supply clean power. Under no conditions will the protected system get direct supply from the raw mains unless there is fault in the protected system. All the manufactures have to ensure that their product confirm to the specification set in this documents, failure to do so will result in the disapproval of the product.

19.2 Submission

All technical submissions shall be approved by the EPC contractor prior to the respective stages of construction with respect to the approved design and development documents. In case of major deviations, it shall be brought under the notice of consultant for its review and approval.

B. System Description

19.3 Design Requirements-UPS Module

A. Input power factor & THDi: Input power factor of the UPS shall be as per data sheet enclosed herewith greater than 0.99 lag. & THDi shall be less than 5 % No harmonic filters are to be employed to achieve the parameters mentioned above.

19.4 Mode of Operation

The UPS shall be designed to operate ONLY as an ON LINE reverse transfer system in the following modes:

Normal: The critical AC load is continuously supplied by the UPS Inverter.

The rectifier / charger derive power from AC Input source and supplies DC power to the Inverter while simultaneously charging power reserve battery. Isolation transformer shall also be provided on inverter output side.

Emergency: Upon failure of AC Input power, the critical AC load is supplied by the Inverter which without any switching obtains power from the battery. There shall be no interruption in power to the critical load upon failure or restoration of the AC input source.

Recharge: Upon restoration of AC input power during the emergency mode of operation, the rectifier/ charge shall automatically restart, walk - in and gradually assume the inverter and battery recharge loads.

Bypass: If the UPS must be taken out of service for maintenance or repair or should the

inverter overload capacity be exceeded, automatic static transfer switch shall perform reverse transfer of the load from the inverter to bypass source with no interruption in the power to the critical AC load in sync mode. The static bypass switch should be bi-directional. The static should also have an overload rating of 10 times of rated load for at least 100 m sec (5 cycles).

A manually operated Maintenance Bypass Switch should be incorporated into UPS cabinet that will connect the load

19.5 Battery Requirements

Battery should be designed to provide 30 minutes back up. Battery should be sealed maintenance free type. The UPS module shall have the Battery Circuit breaker mounted in the battery Rack. When this breaker is opened no battery voltage should be present in the UPS enclosure. The UPS module should be disconnected automatically when the battery reaches to the minimum discharge voltage level or when signaled by other control functions.

C. Product

19.6 Materials

All materials of the UPS shall be new, of current manufacture, high grade and free from all defects and shall not have been in prior service except as required during factory testing. All active electronic devices shall be solid-state. Control logic and fuses shall be physically isolated from power train components to ensure operator safety and protection from heat. All components shall be accessible from the front.

19.7 Construction and Mounting

The UPS unit comprised of Input Isolator, Rectifier/ Charger, Inverter, Static Transfer switch. Maintenance Bypass Isolator switch and static bypass Isolator switch shall be housed in a free standing steel enclosure with key lockable doors. Front access only shall be required for expedient servicing, adjustments and installation. The enclosure will be built to comply with IP20 when the doors are open.

19.8 Cooling

Cooling of the UPS shall be by forced air. Low velocity fan shall be used to minimize audible noise. Fan power shall be provided by the UPS output. Temperature shall be monitored by thermal sensors.

19.9 Cable Entry

Standard cable entry for the UPS module shall be from BOTTOM/TOP as site requirement.

19.10 Service Area Requirements

All serviceable sub-assemblies shall be capable of being replaced from front of the UPS (Front access only). The UPS modules shall require no more than 1.5 meter of front service access room and shall not require rear or side access for service.

D. Components

19.11 Rectifier / Charger

General: The term rectifier / charger shall denote the solid - state equipment and controls necessary to convert incoming AC power to regulated DC power for input to the controlled, IGBT Bridge with constant voltage / current limiting control circuitry. The input harmonic currents are to be limited to less than 5 % by using DSP based technology.

Input current Walk - in: The rectifier / charge shall contain time walk - in circuit that causes the unit to gradually assume the load over a 0-30 sec time interval after input voltage is applied.

Fuse Failure protection: Power semi - conductors in rectifier / charge shall be fused with fast acting fuses so that loss of any power semi - conductor shall not cause cascading failures.

DC Filter: The rectifier / charger shall have an output filter to minimize ripple voltage into the battery. Under no conditions shall ripple voltage into the battery exceed 1% RMS. The filter shall be adequate to ensure that the DC output at the rectifier charge will meet the Input requirements of the Inverter. The inverter shall be able to operate from the rectifier charger with the Battery disconnected.

Battery Recharge: In addition to supply power for the inverter load, the rectifier/ charger shall be capable of producing battery charging current to recharge the batteries. After the battery is recharged, the rectifier / charge shall maintain the battery at full charge until the next emergency operation. Charging shall be an automatic cycle per DIN 41772 characteristics I-U. Both float and recharge voltage shall be adjustable. Charge voltage can also be manually controlled.

19.12 Inverter

The term inverter shall denote the solid state equipment and controls to convert DC power from the rectifier / charge or battery regulated AC power for supporting the critical load. The inverter shall be IGBT based / Sine Weighted pulse width modulated (PWM) design capable of providing the specified AC output.

Overload capacity: Inverter shall be capable of supplying current and voltage for overload exceeding 100% and up-to 150% of full load current for min. of 30 sec. A status indicator and audible alarm shall indicate overload operation. The UPS shall transfer the load to bypass when overload capacity is exceeded.

Fault clearing and current Limit: Without bypass supply available, the inverter shall be capable of supplying and overload current of 150% of its full load rating in excess of 30 sees. For greater currents, or longer time duration, the inverter shall have electronic current limiting protection to prevent damage to components. The inverter shall limit the output current to 250% of the nominal current & deliver for minimum 150ms to clear the fault. The inverter shall be self-protecting against any magnitude of connected output overload.

Output Frequency: The output frequency of the inverter shall be controlled by an oscillator. The oscillator shall hold the inverter output frequency to +/- 0.1% for state and transient conditions.

The output harmonic shall not be greater than 2% at 100% for linear load and maximum 5% at 100% nonlinear load. The UPS shall be capable of handling load of crest factor better than 3:1.

Inverter efficiency shall be greater than and equal to 95% at 100% load.

19.13 Display and Controls

Monitoring and Control: The UPS shall be provided with a micro - processor based unit status display and controls section designed for convenient and reliable user operation. A system power flow diagram, a percentage load and battery time remaining display shall be provided as part of the monitoring and controls sections, which depicts a single line diagram of the UPS. Illuminated visual indicators shall be of the long - life light - emitting diode (LED) type. All of the operator controls and monitors shall be located on the front of the UPS cabinet. The monitoring functions such as metering, and alarms shall be displayed on an alphanumeric LCD panel. LCD panel shall be provided with following monitoring functions and indicators (each alarm and notice condition shall be accompanied with an audible alarm).

NORMAL: This symbol shall be lit when the UPS is operating in Normal Mode.
BATTERY - This symbol shall be lit when the UPS is operating in battery mode.
BYPASS - This symbol shall lit when the UPS is operating in bypass mode. Warning - this symbol shall lift when the system needs attention. Some notice shall be displayed and shall include.

a. UPS on Maintenance Bypass
b. Inverter Unsynchronized
c. Battery on load
d. Load on Bypass
e. Mains Failure

4. ALARM- This symbol shall lit when a situation requires immediate attention. All alarm shall be accompanied by the Audio alarm. Alarm shall include

a. Emergency Stop
b. Inverter Off or Failed
c. Over temperature
d. Overload
e. Rectifier off or failed

Power Status Diagram: A mimic panel A mimic panel (Shall be separate and not in the Display LCD) shall be provided to depict a single line diagram of the UPS. Indicating lights shall be integrated within the single line diagram to illustrate the status of the UPS. These six LEDs shall indicate the following status.

- Input / PFC
- Load on Bypass
- Load on Inverter
- Load on Battery
- Load Supply LED

Battery Management Systems: The UPS shall contain a battery management system with the following feature.

The battery management system shall provide battery time available, or percentage remaining with operating in battery mode.

The battery management system shall provide the imminent shutdown to signal a low battery condition.

Remote Monitoring: Web enabled remote monitoring is required to monitor all the UPS system.

19.14 Static Transfer Switch

General: A static transfer switch and bypass transfer switch shall be provided as an integral part of the UPS. The static switch shall be a Bi-directional naturally commutated high-speed static (SCR type) device rated to carry fully load current continuously. The static transfer switch control logic shall contain an automatic transfer logic circuit that senses the status of the inverter logic signals, and operating and alarm signals. This control circuit shall provide an uninterrupted transfer of the load to an alternate bypass source, without exceeding the transient limits, when an overload or malfunction occurs within the UPS, or bypassing the UPS for maintenance.

Uninterrupted Transfer: The transfer control logic shall automatically turn on the static transfer switch, transferring the critical AC load to the bypass source, after the transfer logic sense any of the following conditions.

Inverter Overload capacity exceeded

Critical AC load over- voltage OR under- voltage

UPS fault conditions

The transfer control logic shall inhibit an automatic transfer of the critical load to the bypass source if any of the following conditions are present.

Bypass frequency out of limits

Bypass out of synchronization range with invert output.

Uninterrupted Retransfer: Retransfer of the critical AC load from the bypass source to Inverter output shall be automatically initiated unless inhibited by manual control. The transfer control logic shall inhibit an automatic retransfer of the critical load to the inverter if one of the following conditions exists.

Bypass out of synchronization range with Inverter output.

Inverter/ Bypass voltage difference exceeds the preset limits

UPS faulty conditions presents.

Overload conditions exists in the excess of inverter full load ratings.

19.14.1 Maintenance Bypass Isolator

A manually operated maintenance bypass isolator shall be incorporated into the UPS cabinet to directly connect the critical load to the inverter if one of the following conditions exists.

Bypass out of synchronization range with Inverter output.

Inverter/ Bypass voltage difference exceeds the preset limits.

UPS faulty conditions presents.

Overload conditions exists in the excess of inverter full load ratings.

19.14.2 Isolation

The UPS shall have an galvanic isolation transformer K-13 rated with copper winding at output of inverter to protect the system.

19.15 Remote Emergency Power Off (REPO)

Provision shall be available for adding a REPO switch to meet specific site needs. The REPO switch shall be electronically shut down the UPS by turning off the rectifier, inverter static switch.

19.16 Communications

RS-485 Interface Card & SNMP CARD

The UPS shall have internally fitted RS-485 interface card & SNMP Card that will provide real-time status information over a 2 or 4-wire RS-485 connection. The RS-485 interface Card will support Mod Bus RTU and J Bus.

SMS Master (Site Monitoring Software)
Functions of Site Monitor include:

Easy to install: Site Monitor is designed to operate under Windows, Linux, Solaris, AIX, HP-UX operating systems.

Current data query: Current equipment operating data and alarm data can be queried.

Alarm notification: Site Monitor can send email, short message to or phone the user in the event of an alarm.

Remote control: The equipment can be controlled from a remote site through Site Monitor.

Remote adjustment: The equipment parameters can be set from a remote site through Site

Monitor.

Convenient report query: Site Monitor provides equipment alarm report, equipment data report and operation log report, and supports report display by page and data export functions.
Powerful user management function: Users can be added, modified, deleted, and given different levels of software operation authorities according to their duties.

Powerful online data backup and recovery: Providing quick system data backup and recovery without affecting other users.

Execution

19.17 Field Quality Control

Factory trained field service personnel shall perform the following inspections and test procedures during startup.

19.18 Visual inspection

Inspect equipment for sign of damage
Verify installation as per drawing
Inspect cabinet for foreign object
Verify neutral and ground conductors are properly sized and configured.
Inspect battery cases
Inspect battery for proper polarity
Verify all printed boards are configured properly

19.19 Mechanical Inspection

- Check all control wiring connections for tightness
- Check all power wiring connections for tightness
- Check all terminal screws, nuts, and/or spade lugs for tightness.

19.20 Electrical Inspection

Check all fuses for continuity
Confirm input voltage and phase rotation is correct
Verify control transformer connections are correct for the voltage being used
Assure connections and voltage of the battery strings

19.21 Documentation

The manufacturer shall supply minimum 2 sets of an installation manual with installation. Start up trouble shooting guide and operation instruction of the specified system. The manufacturer shall train at least two engineers at their factory free of cost.

19.22 Installation

A service engineer fully trained on the UPS by the manufacturer shall install the UPS. The manufacturer will have to conduct load/site study prior to the commissioning of the UPS. A copy of the load/site study report will have to be submitted with required comments.

19.23 Service capability

The manufacturer should have the independent service setup with engineers who are fully trained in the UPS. All the service personnel's should have the latest power measurement equipment's, which will be required during the process of site study, installation and maintenance. The manufacturer should have ISO 9001 certification to ensure the quality of the service.

All the manufacturers' service engineers should mobile communication, for instantaneous communication as and when the need arises.

The manufacturer should have the capability to provide consultancy on the aspect of power quality as and when required for which they should have their own power solution. (Product and technology)

The response time to attend the complaint shall be less than two hours in normal working hours. The manufacturer should have the facility to provide night service as and when required.

The Criterions to be fulfilled by the Supplier for Quoting against this Enquiry.

Sr.No.	Criterions	Required
A.	Service Support	Round the clock back-up service support should be available in surroundings (i.e. 24 hrs throughout the year, just a phone call away). (Supplier must submit the document supporting the above requirement.)
B.	Manufacturing Base	The supplier shall have a manufacturer base in India for manufacturing equivalent or higher rating of UPS system.
C.	Performance Track Record	The supplier must have a proven track record of at least 3 years in the country & shall show the reference of the customer base.
D.	Total Quality Management Assurance (Desirable)	The supplier must have TQM recognition in IT equipment manufacturing field from any IT association of India.
E.	Factory Inspection	Will be carried out by Consultant/client at the manufacture works.

DATA SHEET

A	**Input**	
1	Input Voltage	
2	Input Voltage tolerance	
3	Input Frequency	
4	Input Frequency tolerance	
5	Input THDi	
6	Input Power factor at nominal voltage and full load	
7	Input current limit	
8	Power walk - in period	
9	Input circuit	
B	**Output**	
1	Module full load rating kVA / kW	
2	Rated voltage	
3	Rated current	
4	Output voltage adjustment range	
5	Output power factor range	
6	Internal oscillator stability	
7	Mains synchronization tracking	
8	Max. rate of change of frequency	
9	Output voltage harmonics a] Linear load b] Non - linear load (Crest factor of 2.7:1)	
10	Crest Factor	
11	Overload rating	
12	Overload trip	
13	AC - AC efficiency	
14	Inverter limit short	
15	Transient Response (Voltage)	
16	a) 100% load change b) Manual transfer of load from UPS to bypass and vice - versa c) Automatic transfer of load form UPS to bypass	
17	Transient recovery time	
18	Parallel Operation:	
C	**DC Characteristics for 10min Battery run time on full load**	
1	Total Battery AH required	
2	Nominal DC bus voltage	
3	Battery Circuit Breaker with UV Coil	
4	Battery fully discharge voltage	
5	Allowable voltage drop in battery cables	
6	Battery float voltage	
7	Battery end voltage	
8	DC Bus voltage ripple	

9	Battery recharge current limit	
10	No. of cells	
D	**Controls**	
1	Battery circuit breaker (mounted separately in its own enclosure)	
2	Maintenance Bypass Isolator	
3	Alarm acknowledge / Reset button	
4	Inverter On-Off Pushbutton for Manually switching of the Inverter	
5	Emergency off push button	
E	**Measuring Instruments**	
1	LCD panel for Measuring Output voltages, Output currents and Frequency, Battery Voltage and Charging / Discharging current.	
2	LCD panel should display status of the Battery capacity and backup Time in minutes.	
F	**Protections**	
1	RC surge suppressor.	
2	Sustained under voltage on input side	
3	Phase loss on input side.	
4	Negative sequence on input side	
5	Semiconductor fuses in the lines for thyristor	
6	Snubbed circuit for device dv/dt protection	
7	Charge input current limit	
8	HRC fuses for filter capacitors	
9	Battery current limit	
10	DC over voltage	
11	Low battery	
12	Semiconductor fuses at inverter	
13	Overload	
14	Over temperature for the inverter	
15	HRC fuses in the control circuit	
G	**Indications (Alarms)**	
1	Inverter Failure	
2	Overload (if load exceeds 100%)	
3	Overload shutdown	
4	Emergency shutdown	
5	Equipment over temperature	
6	Maintenance Bypass ON	
7	DC over-voltage	
8	Low battery	
9	Battery on load	
10	Mains failure	
11	Rectifier Failed or Off	
12	Inverter Unsynchronized	

13	Load on bypass	
14	Output voltage error	
15	Mechanical Dimensions:	
	• Weight of UPS - Kg	
	• Dimension of UPS (WxD xH) in mm	
16	Ventilation	
17	Colour (two tone)	
18	Protection Level	
19	Environmental:	
20	Operating temperature	
21	Max. Temp, for 8 hr. day	
22	Relative humidity	
23	Altitude	
24	Storage temp.	

20.0 ON GRID-TIED SOLAR PV POWER PLANT

20.1 SCOPE OF WORK

The general character and the scope of work to be carried out under this contract is illustrated in Schedule of work. The Contractor shall workas a System Integrator for providing an end to end Solution for the above, including but not limited to design, supply, erect, testing , commissioning of the required Solar Photo Voltaic power plant with accessories, peripherals like Power conditioning units, cables, cable tray, junction boxes, Cable termination & connections sockets & other suitable accessories, earthing, solar interface panel between PCUs, Main LT panels of Electrical Substation-6, Data Acquisition & storing, Metering, DC system & Bus etc. and installation, performance testing, commissioning, warranty, annual maintenance, etc. The bidders have to ensure the planning and smooth execution of the project. The Contractor shall carry out and complete the said work under this contract in every respect in conformity with the contract documents and with the direction of and to the satisfaction of the Engineer in charge. The contractor shall furnish all labour, materials and equipments as listed and specified otherwise, transportation and incidental necessary for supply, installation, testing and commissioning of the complete system as described in the Specifications. The work shall also include interfacing the PV Plant with the nearest grid equipments.

20.2 Solar Photo Voltaic Module

The Solar PV module will be minimum 240 to 340Wp 24V nominal rating

Solar modules offered shall be certified as per IEC 61215-2005 and IEC 61730 -1, - 2.

SPV module shall contain mono/poly crystalline high-power silicon solar cells. The solar cell shall have surface anti-reflective coating to help to absorb more light in all weather conditions.

The module frame shall be made of aluminium or corrosion resistant material, which shall be electrolytic ally compatible with the structural material used for mounting the modules.

Photo electrical conversion efficiency of SPV module shall not be less than 16%.

Fill factor of the module shall not be less than 0.70

Each module shall have low iron tempered glass front for strength & superior light transmission. It shall also have tough multi-layered polymer back sheet for environmental protection against moisture & provide high voltage electrical insulation.

Solar PV module shall be highly reliable, light weight and shall have a service life of more than 25 years.

The rated output of any supplied module shall not vary by more than 3% from the average power rating of all ratings. Each module, therefore, has to be tested and rating displayed.

The module shall perform satisfactorily in relative humidity upto 95% and temperature between – 40°C and 85°C.

The solar modules should have suitable encapsulation & sealing arrangements to protect the silicon cells from the environment. The encapsulation arrangement shall ensure complete moisture proofing for the entire life of solar modules.

Bidder must consider Shading Losses as per the relevant Industry Standard & Practice while designing the proposed power plant.

Guarantee on power output of solar module will be as follows:

End of Year	Guaranteed Output
1	98.5%
10	93.5%
25	86%

Marking: Each module shall carry the following clear and indelible markings:
i. Name, monogram or symbol of manufacturer;
ii. Type or model number;
iii. Serial number;
iv. Polarity of terminals or leads (colour coding is permissible)

Maximum system voltage for which the module is suitable date & place of manufacture;

20.3 Module Mounting Structure

The Plant and equipment will be installed on the civil foundation/structures to be constructed by the Contractor. the contractor shall make arrangement for the foundation or anchor bolts or other embedment's, at his own cost.

The array structure shall be so designed that it will occupy minimum space without scarifying the output from SPV panels.

Design drawings with material selected shall be submitted for prior approval

The structure shall be designed to allow easy replacement of any module & shall be in line with the site requirements

The array structure shall be made of hot dipped galvanized MS angles of suitable size.

The support structure design & foundation shall be designed to withstand wind speed upto 150 kmph using relevant Indian wind load codes.

The module alignment & tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation.

All fasteners shall be of stainless steel of grade SS 316.

The array structure shall be grounded properly using maintenance free earthing kit

Galvanized (Hot Dip) Steel Structural must be considered for all type of structural steel proposed for the power plant

The mounting of solar modules shall be done on rooftop and entire Fabrication of elevated structure and the structure atop sloping roofs shall be done by the Bidder.

20.4 Power conditioning unit

Power Conditioning Unit (PCU) consists of an electronic Inverter along with associated control, protection and data logging devices. The system shall incorporate a unidirectional

inverter and should be designed to supply the AC power to the grid created by Diesel Generator without any disturbance to the loads. The power conditioning unit shall adjust the voltage and frequency levels to suit the Grid also. All three phases shall be supervised with respect to rise/fall in programmable threshold values of frequency. PCU shall confirm to below standards

- IEC 61727:2004: Characteristics of the utility interface
- IEC 62116:2008: Islanding prevention measures for utility-interconnected
- photovoltaic inverters.
- IEC 62109-1:2010: Safety of power converters for use in photovoltaic power systems
- IEC 60068-2-6:1995-03 – Environmental testing - Part 2 Vibration (sinusoidal)
- IEC 60068-2-1:2007 Environmental testing – Part 2-1: Tests – Test A: Cold
- IEC 60068-2-2:2007 Environmental testing – Part 2-2: Tests – Test B: Dry heat
- IEC 60068-2-14:2009 Environmental testing – Part 2-14: Tests – Test N: Change of
- temperature
- IEC 60068-2-21:2006 Environmental testing – Part 2-21: Tests – Test U: Robustness
- of terminations and integral mounting devices
- IEC 60068-2-27:2009 Environmental testing – Part 2-27: Tests – Test Ea and
- guidance: Shock
- IEC 60068-2-30:2005 Environmental testing – Part 2-30: Tests – Test Db: Damp
- heat, cyclic (12h + 12 h cycle)
- IEC 60068-2-75:1997 Environmental testing – Part 2: Tests; test Eh: Hammer tests
- (IEC 6212:2002 – IK code)
- IEC 60068-2-78:2001 Environmental testing – Part 2-78: Tests; Test Cab: Damp
- heat, steady state
- IEC 60068-2-21:2006 – Robustness of terminations and integral mounting devices
- IEC 60068-2-27:2009 – Shock
- IEC 60068-2-30:2005 – Damp heat, cyclic (12h+12h cycle)
- IEC 60068-2-75: 1997: – Hammer tests (IEC 6212:2002 – IK code)
- IEC 60068-2-78:2001-08 – Test cab: Damp heat, steady state
- IEC 61683:2000 – Photovoltaic systems – Power conditioners

20.4.1 General requirement

Each PCU shall be compliant with IEC 61683:2000 or equivalent. The DC (PV) to AC conversion efficiency of the PCU shall be at least 98% for output ranging from 20% of full load to 100% load. The Applicant shall specify the conversion efficiency at different load (25%, 50%, 75% and 100%). Overload capacity should be warranted up to 25 years. The PCU shall have internal protection arrangement against any sustained fault in the feeder line and against lightning in the feeder line The PCU shall have the required protection arrangements against earth leakage faults. Specifically, the PCU should be three phase power conditioning unit using static solid-state components. DC lines shall have suitably rated isolators to allow safe start up and shut down of the system. Circuit breakers used in DC and AC lines must be rated suitably. The PCU shall be suitable for Grid integration operation. Each solid state electronic device shall have to be protected to ensure long life of the inverter as well as smooth functioning of the inverter. The PCU shall have anti - islanding protection in the event of outage of grid. And should reconnect the grid automatically after restoration of grid. The PCU shall have arrangement for adjusting DC input current and should trip against sustainable fault downstream and shall not start till the fault is rectified.

Suitable synchronizing methodology shall be provided for synchronizing the AC output from the inverters. The Applicant has to provide remote as well as local monitoring. The entire inverter cabinet shall have to be adequately protected taking into consideration the atmosphere and weather prevailing in the area. Preferably the cooling air shall not enter into

hardware cabinet. Dimension and weight of the PCU shall be indicated by the Applicant in the offer. Power consumption by PCU during operation & standby condition should be mention by Applicant in the offer. In case of imported P.C.U all M.N.R.E related documentation for waiving of import and custom duties has to be done by applicant.

The PCU shall include appropriate self protective and self diagnostic feature to protect itself and the PV array from damage in the event of PCU component failure or from parameters beyond the PCU's safe operating range due to internal or external causes. The self-protective features shall not allow signals from the PCU front panel to cause the PCU to be operated in a manner which may be unsafe or damaging. Faults due to malfunctioning within the PCU, including commutation failure, shall be cleared by the PCU protective devices.

20.4.2 Modes of PCU

Standby mode:
The control system shall continuously monitor the output of the solar power plant until pre-set value is exceeded and that value to be indicated.

Basic system operation (Full auto mode):
The system shall automatically 'wake up' in the morning and begin to export power provided there is sufficient solar energy and the grid voltage and frequency is in range.

Maximum power point tracker (MPPT):
MPPT control algorithm shall adjust the voltage of the SPV array to optimise solar energy fed into the grid.

Sleep mode:
Automatic 'sleep' mode shall be provided so that unnecessary losses are minimized at night. The power conditioner must also automatically re-enter standby mode when threshold of standby mode reached.

20.4.3 Inverter

The inverter output shall always follow the grid in terms of voltage and frequency. This shall be achieved by sensing the grid voltage and phase and feeding this information to the feedback loop of the inverter. Thus, control variable then controls the output voltage and frequency of the inverter, so that inverter is always synchronized with the grid.

Efficiency	> 98.3%
Output frequency 50Hz	inverter to follow grid f frequency upto +/-5 Hz of the nominal output frequency during normal
Maximum Input voltage	1000V
THD (at point of connection)	Less than 3 %(of rated power)
Ambient temperature	-20 to 50 deg C without any derating in nominal inverter Rating and 60 deg C with derating
Humidity	100 % non- condensing
Input DC Range	400 V to 800 V
Reactive Power Capability	0.8 (leading) and 0.8 (legging)
Maximum Permissible Voltage	1000 V
Enclosure	IP 65 (Outdoor rated)

The Inverter shall have following features:

- Auxiliary power consumption shall be < 0.5% of rated power and maximum loss in sleep

mode shall be less than 0.02%
- Sinusoidal current modulation with excellent dynamic response.
- Unit wise & integrated Data logging.
- Dedicated Ethernet for networking
- Protection against
- over-under current
- Over voltage & under voltage,
- Over and under frequency
- Sync loss
- Over temp.
- Line to line fault
- Short circuit

Protection against lightning
a). Surge voltage induced at output due to external source
b). Set point pre-selection for VAR control
c). Remote control via telephone modem or mini web server
d). Integrated protection in the DC and three phase system
e). Insulation monitoring of the PV array
f). Ground fault detector – which is essential for large PV generators in
g). view of appreciable discharge current with respect to ground.
h). Over voltage protection against atmospheric lightning discharge to the
i). PV array is required.
j). The power conditioner must be entirely self-managing and stable in
k). operation. A self-diagnostic system check should occur on start up.
l). Functions should include a test of key parameters on start up.

20.4.4 Computer Aided DATA acquisition system

The plant shall be automatically monitored by data acquisition system. There shall be simultaneous data logging (5 minutes Intervals), recording and display system for continuous monitoring of data for different parameters of different sub systems, power supply of the power plant at DC side and AC side. An integrated data acquisition system shall be supplied which should be capable of communicating with all inverters and provide information of the entire Solar PV power plant.

Computer Aided Data Acquisition Unit in the form of personal computer (PC) Supporting with competent internal hardware and software shall be a separate & individual system comprising of different transducers to read the different variable parameters, A/D converter, Multiplexer, Demultiplexer, 16 Interfacing Hardware & Software, Industrial Type PC, which will be robust & rugged suitable to operate in the Control Room Environment. Reliable sensors for Solar Radiation, Temperature & other Electrical Parameters are to be supplied with the data logger unit. System shall provide measurement and recording along with instantaneous of 5 minute daily, monthly and annual average of following parameters:

a) Power at grid terminal
b) Ambient temperature near array field.
c) Wind Speed
d) AC and DC side Power of each inverter
e) Solar irradiation/isolation
f) Voltage at inverter
g) Any other parameter considered necessary by supplier based on current prudent practice. System shall provide 5 minute daily, monthly and annual average of following parameters:

h) Exported Energy to grid
i) Energy of each inverter
j) Solar Radiation
k) Temperature.

All data shall be recorded chronologically date wise. The data file should be MS Excel compatible. The data logger shall have internal reliable battery backup and data storage capacity to record all sorts of data simultaneously round the clock. All data shall be stored in a common work sheet chronologically. Representation of monitored data in graphics mode or in tabulation form. All instantaneous data can be shown in the Computer Screen. The applicant shall provide compatible software and hardware so data can be transmitted via standard modem must be compatible with Modbus or TCP/IP protocol for communication.

Provision shall be available in the PCU for remote monitoring of following parameters

- DC power input
- input voltage
- DC current
- AC power output
- AC voltage (all the 3 phases and line)
- AC current (all the 3 phases and line)
- Power factor

In addition to the above, energy values to be displayed the number of PCUs is indicative only. The bidder may design the system to extract maximum efficiency with inbuilt redundancy.

20.4.5 Data Logging and Instrumentation

The solar power plant shall be provided with Data logging system using PLC. The PLC shall be also used for string monitoring. The PLC used for data logging shall be computer conversant to monitor the data over internet and on computer using software and Ethernet cable.

20.4.6 DC distribution board/Array Junction Box

DC distribution board shall be provided in between solar array and PCU. The junction boxes shall be made of FRP / Thermo Plastic with impact resistant transparent cover, waterproof, dust free, vermin with IP65 protection. The terminals shall be connected to copper bus bar arrangement of proper sizes. The junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus bar for easy identification and cable ferrules shall be fitted at the cable termination points for identification. Array junction box shall have suitable reverse blocking diodes of minimum DC blocking voltage of 800 V with suitable arrangement for its connecting. The array box shall also have suitable surge protection.

The junction boxes shall have suitable arrangement for the following:

Combine groups of modules into independent charging sub-arrays that shall be wired to the controller. Provide arrangement for disconnection for each of the groups.

Provide a test point for each sub-group for quick fault location.

To provide group array isolation.

The rating of the JB’s shall be suitable with adequate safety factor to inter connect the Solar

PV array.

Bypass Diode

Fuses of suitable rating for Overloading protection of array section.

20.4.7 Surge protection system

The DIN channel mountable pluggable surge protection shall be installed in a network configuration, consisting of a single block MOV (Metal Oxide Varistor) based surge arrester having nominal surge handling capacity of 15 KA 8/20 µs & maximum surge handling capacity of 30 KA 8/20 µs to provide protection between (L+, L-, earth). All surge arresters in these network configurations shall be of same manufacturer. The Protection unit shall be based on Single block High Capacity Metal Oxide Varistors (MOV), capable of handling 15 KA 8/20 µs surges and shall be able to give an indication in the event module failure and shall be pluggable to facilitate the onsite replacement without disturbing the lines. One extra set of replacement protective device shall be furnished to the job site. Protection shall be manufactured to withstand a maximum continuous operating voltage of not less than 115% of normal RMS system voltage.

20.4.8 Cables and Hardware

Cables of appropriate size to be used in the system shall have the following characteristics:

- Will meet IS 694/1554 standard
- Temp. Range –10ºC to +80ºC.
- Voltage rating 660/1000V
- Excellent resistance to heat, cold, water, oil, abrasion, UV radiation Flexible

Cabling on DC side of the system shall be as short as possible to minimize the voltage drop in the wiring. Components and hardware shall be vandal and theft resistant. All parts shall be corrosion-resistant. The system description, general/technical requirements etc. are given for general guidance only. The supplier/manufacturer shall submit the detail design of the complete solar generating system by using their software to optimize the combination of modules considering the specific location, insulation, nature of load etc.

20.4.9 Energy Meter

An Energy Meter shall be provided to measure the delivered quantum of energy to the load.

Meter must be provided with the RS485 port.

Energy Meter should be import/export type ABT compliant, 0.5 Class of accuracy and must be modbus compliant for further integration with Central Monitoring Systems.

20.4.10 Shop Drawings

All shop drawing shall be prepared on computer through AutoCAD system based on Architectural drawings and site measurement within award of work. Contractor shall furnish for the approval of the Engineer in charge, detailed shop drawings of all equipment and material giving following information.

- Layout of PV arrays and associated equipment, panels.
- Cable & Cable tray layout.
- Earthing layout/Location system
- Single line diagram, control schematic showing make type and description of all components and accessories.

The detailed design, calculations, energy simulation for arriving as the system capacity & the energy generation capacity. The details of all losses starting from solar incident level upto solar metering level shall also be provided along with detail calculations. The design shall be based on data for the Location of site of work.

These shop drawings shall contain all information required to complete the Project as per specifications and as required by the Engineer in charge. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-inquantity statement at the completion of all shop drawings. Minimum4 sets of drawings shall be submitted after final approval along with soft copy.

20.4.11 Completion Drawings

Contractor shall submit completion drawings as and when work in all respects is completed.

These drawings shall be submitted in the form of four sets of CDs and four portfolios (300 x 450 mm) each containing complete set of drawings on approved scale indicating the work as - installed.

These drawings shall clearly indicate following:

- Location and rating of PV arrays/ PCU's
- Location and details of panels, and other particulars including approved fabrication drawings of panel.

Complete wiring diagram, as installed and scheduled showing all connections in the complete electrical system.

Routing and particulars of all LT cables and trays.

Single line diagram, power schematic, control schematic with detailed bill of materials, showing makes, types and description of all components and accessories.

20.4.12 Inspection and Testing

The Engineer in charge / of his Authorized representative carry out inspection and testing at manufacturer's works. No equipment shall be delivered without prior written confirmation from Engineer in charge. The contractor has to make all arrangement for inspection at factory/ Site. However, the deptt will bear all cost related to their officers travelling, lodging, boarding, etc.

Upon completion of work the performance test shall demonstrate the following among other things:

- Equipment installed complies with specification in all respects and is of the correct rating for the duty and site conditions.
- All items operate efficiently and quietly to meet the specified requirements as per the warranty /guaranty.
- All circuits are correctly protected /modify as per the site protective devices are properly coordinated.
- All non-current carrying metal parts are properly and safely grounded in accordance with the specifications and appropriate codes of practice.
- All equipments shall also compliance the performance requirements as per Contract

requirement.

20.4.13 Approval & Clearance

All associated activities required for necessary clearances / permissions / approvals / licenses from concerned Electrical authorities so their govt / strategy / Ducal bodies are in the scope of supplier if required.

20.4.14 Earthing and Protection

The array structure of the PV yard shall be grounded properly using adequate number of earthing kits. All metal casing / shielding of the plant shall be thoroughly grounded to ensure safety of the power plant. Earthing shall be in line with IE rules. The earthing & grounding shall also meet the requirement of PV module/cell manufacturer. Detailed specifications have been provided in the Earthing section.

20.4.15 Solar Power Plant Data Monitoring System

Computer Aided Data Acquisition Unit shall have features for simultaneous monitoring and recording of various parameters of different sub-systems, power supply of the power plant at the AC side.

Computer Aided data Acquisition Unit shall be a separate & individual system comprising of different transducers to read the different variable parameters, Interfacing Hardware & Software, Industrial type PC, which will be robust & rugged suitable to operate in the Control Room Environment.

The PC shall of Industrial type, rugged & robust in nature of operate in a hostile environment. The PC have minimum intel Core 2 Duo processor having 2 x 150 GB HDD with 2 GB RAM. The PC shall also have 17 inches Colour monitor, DVD Drive with writer, multimedia kit and UPS backup. The printer shall be of industrial type rugged & robust in nature. The printer shall be equipped for printing.

The data acquisition system shall perform but not limited to the following operations and Measurement and continuous recording of
(a) Inverter Output.
(b) System Fréquence.
(c) Energy Delivered to the GRID in KWH.
(d) Generated Output In KWH

The data file should be MS excel compatible. All data shall be stored in a common work sheet chronologically. Representation of monitored data in graphics mode or in tabulation form. All instantaneous data can be shown in the Computer Screen.

Communication interface the entire system can be operated and monitored via several interfaces (RS232/RS485/ MPI/ Profibus/ Telephone modem/Ethernet) to have compatibility.

Grid connected solar power shall feed load of common E&M services of residential buildings**.**

21.0. LIFTS

21.1 General

To provide complete electric with Machine Room Passenger lifts and Supply, Installation Testing of Passenger Lifts for **Complex** as per schedule of quantities and drawing including design, manufacture, installation at site, testing and commissioning of the same to the Engineer-in-charge satisfaction. No consideration will be given to extra payment based upon difference in interpretation of the specification and drawings.

21.2 Scope

- Safety to personnel and equipment during both operation and maintenance
- Reliability of service
- Minimal fire risk
- Ease of maintenance and convenience of operation
- Automatic protection of all electrical equipment through selective relaying system
- Maximum interchangeability of equipment
- Fail safe feature.
- Suitability of applicable environmental factors

These specifications define the basic guidelines of the system as necessary for lifts. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere. Compliance with these specifications and or approval of any of Contractor's documents shall in no case relieve the Contractors of his contractual obligations.

All works to be performed and supplies shall be affected as a part of contract requirement, specific approvals/review of Engineer-in-Charge. Major activities requiring approvals / review shall include but not be limited to the following:-

- General Arrangement drawings for the lifts including section through lift pit and lift shaft,
- Quality assurance procedures,
- Field testing and commissioning procedures
- Engineering activities to be performed by Contractor shall include but not be limited to the following as relevant to the scope of work included in the project specification.
  a) Control and protection scheme.
  b) Making of shop drawings with bill of materials.
  c) Factory inspection and testing procedures.
  d) Field testing and testing procedure.
  e) Preparation of as-built drawings
  f) Any other work/activity, which is not listed above, however is necessary for the completion of lift/system.

21.3 Tests

Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the Owner / Engineer-in-Charge and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre commissioning tests are to be performed as per relevant I.S. codes given and shall be included in the Contractor's quality assurance programme.

Commissioning Tests

The available instruments and control equipment will be used during such testes and the Contractor will calibrate all such measuring equipment and devices as far as practicable.

However, un-measurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted with specified load capacity for the respective lifts.

All instruments, tools and tackles required for the successful completion of the Commissioning Tests shall be provided by the Contractor, free of cost.

Pre-commissioning test shall be carried out as per relevant IS Codes and / or as specified elsewhere in the tender.

The Contractor shall be responsible for obtaining clearances from the concerned authorities for commissioning of the equipment. However necessary fee for these clearances, if any shall be reimbursed by Owner on production of requisite documents in original.

21.4 Packaging

All the equipment's shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken into account by the Contractor. The Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, warfare and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. Owner takes no responsibility of the availability of the wagons etc.

21.5 Protection

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic protecting device. All ends of all valves and piping and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage. The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

21.6 Codes and Standards

The following Indian Standard Specifications and Codes of Practice, currently applicable and as per amended updated as of date irrespective of dates given below, shall apply to the equipments and the works covered by this contract. In addition the relevant clauses of the Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

- Electric Traction Lifts – Guide line for outline dimension IS 14665 (Part-1)–2000
- Electric Traction Lifts – Code of practice for installation IS 14665 (Part-2)–2000
- Electric Traction Lifts – Safety Rules IS 14665 (Part-3)–2000
- Electric Traction Lifts – Components IS 14665 (Part-4)–2000
- Electric Traction Lifts – Inspection manual IS 14665 (Part-5)–2000
- Glossary of terms relating to wire ropes IS 2363 – 1981
- Steel wire suspension ropes for lifts and hoists IS 2365 – 1977
- Flexible Trailing Cables for lifts IS 4289 – 1984
- 1100 volt grade XLPE insulated Armored cables IS 7098
- 1100 volt grade PVC insulated Armored cables IS 1554 – 1988
- 1100 volt grade FRLS PVC insulated copper conductor wires IS 694
- Rigid steel conduits IS 9537 – 1981
- Flexible steel conduits IS 3480 – 1966
- Safety procedure and practices in electrical works IS 5216 – 1982

- Electrical installation fire safety of buildings — IS 1646 – 1997
- Electric Traction Lifts Part – 4 Components — IS 14665 (Part-4/ Sec 1&9):2001
- Electric Traction Lifts Part – 5 Inspection Manual — IS 14665 (Part-5): 1999
- Specifications for hoist way door-locks — IS 7754-1975
- Rules for design, installation, testing and Operation of lifts, escalators and moving parts — IS 1735-1975
- In addition the relevant clauses of the following, as amended up to date shall apply.
- The Indian Electricity Rules 1956
- The Indian Electricity Act 1910
- State Lift Rules
- Fire safety regulations pertaining to lifts

The tenderers shall also take into account local and State regulations as in vogue for the design and installation of lifts.

Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable. BIS certified equipment shall be used as a part of the Contract.

21.7 Electric Supply

The available system of electric supply is 415 volts +10% -10%, - 3 phase 4 wire AC 50 Hz system and 240 volts between phase and neutral. Any equipment/ component operating at other than the above mentioned power supply shall be provided with necessary transformers/voltage stabilizers. The amount of power required for lifts shall be indicated in the tender. Power shall be provided at one point to be indicated by the tenderer. All subsequent electrical systems shall be deemed to be included in the scope of this contract.

21.8 Site Conditions

Lift shall be designed considering the following:

Ambient Temperature	-	45 Degree C.
Relative Humidity	-	100 %
Mean Seal Level	-	300m

21.9 Drawings

Before the commencement of work, the lift contractor on receipt of building drawings, shall prepare and submit all drawings necessary shop drawings showing the general arrangement of the lift equipments for the approval of the Engineer-in-Charge and these drawings will become part of the contract. Contractor shall also check the exact dimensions of the lift shaft at site, before taking up the manufacturing the equipment at site.

21.10 Painting

All exposed metal work furnished under these specifications, except as otherwise specified shall be properly spray painted over an anti-corrosive primer coat.

21.11 Civil Work to be Done by Lift Contractor: (Included in Contract)

a) To provide scaffolding in the hoist way required for erection of lift.

b) To carry out minor civil work, such as modification and making good the pocket/cutout in wall/ceiling for car, counter weight, rail bracket, hall buttons, indicators and laying of sills in positions or any other work required for smooth operation commissioning of lifts.

c) To provide and fix the steel items such as machine beams, bearing plate in the

machine room, lift shaft for installation of machinery. Separators wherever required and buffer support channels and vertical iron ladder in lift.

d) Providing of hoisting beam, lifting hook in the in lift shaft for hoisting of equipment during erection and to facilitate maintenance in future including their fixing etc.

e) Providing and fixing of necessary sill supporting projections, sheet steel facia plates on all landings as per requirements.

21.12 Work Not Included

The employer shall provide the following:

a) A hoist way properly framed and finished including pit of required depth with drain including water proofing, as per approved lift supplier drawing. The hoist way walls shall be neatly plastered to avoid dust accumulation.

b) Properly lighted and ventilated machine room (in case of lifts with Machine Rooms) and hoist way shall also have lights including power plugs point at landing as per requirement including access doors, ladder and guards as required. Walls & ceiling shall be properly finished to avoid accumulation of dust.

21.13 Maintenance Contract - 1 Year

Bidders are to quote their rates for annual maintenance contract for maintenance of all the lifts. The maintenance shall start after expiry of sales service guarantee period for all the lifts.

21.14 Warranty

The bidder shall provide for one year warranty after commissioning against all manufacturing defects and shall provide for free replacement of all materials having manufacturing defects.

21.15 Permission to Install the Lifts And License to Run the Lifts from Relevant Authorities

It shall be the responsibility of the successful tenderer for obtaining the necessary permission, if required, to install the lifts from the relevant local authorities and subsequently to have the installation inspected by the relevant local authorities and arrange to obtain the license to run the lifts. All relevant papers connected for obtaining the permission and final inspection will be signed by the Owner / Engineer-in-Charge. The requisite fee for this purpose shall be payable on the production of original receipts on this account.

21.16 Erection

The lift Contractor shall commence the erection of the lift equipments immediately after receipt of the complete equipments from their works and complete the work to the satisfaction of the Engineer-in-charge within the stipulated time. The lift installation shall be handed over in perfect working order on completion of the work.

21.17 Tests

The following tests shall be carried out as per relevant IS requirement.

a) Insulation and earth test for all electrical apparatus.

a) Continuous operation of the lift full load conditions for one hour. This shall be as per I.S. specifications.

21.18 Testing

Testing at manufacturers works of the various equipments and components as required by I.S Codes/Standards & other applicable/European Standards shall be done by the successful tenderer before dispatching the materials to site. The tenderer shall furnish a

certificate for the same.

If the authorized representative of Owners, wishes to participate/witness these tests the scheduled dates for the same will be informed well in advance before carrying out such tests.

Various tests required to be done as per I.S. Codes / European Standards at site of the installation shall be carried out in the presence of the Engineer-in-Charge.

21.19 Hoist Motor

(a) Each elevator shall be provided with individual A.C.Motor. Motor shall be 415 Volt AC 3 phase, 50 cycles. The motor shall be designed for lift duty i.e., for repeated starts and shall be of high capacity integral motor with class F insulation and equipped with thermal protection. It shall be AC reversible type for elevator service with high starting torque and low starting current. It shall be with minimum sound during operation and shall comply with latest relevant IS specifications for lifts.

(b) Protection for motor - Provision shall be made for over load protection of motor. Protective relay shall be provided on the controller to protect the lift equipments against low voltage and phase failure. The slow speed winding of this motor shall function automatically when the car is approaching a floor so as to provide a greater stopping accuracy.

(C) Reverse phase relay - A reverse phase relay shall be provided on the individual controller to protect the lift equipment against phase reversal, low voltage and phase failure switches. Relays shall have suitable contact to withstand wearing due to frequent make/break operation of the floor controlled in the machine room and in the contact hoist way.

21.20 Braking System

The brakes shall be used only to hold the counter weight and car in position .The brakes should not be used for stopping the lift. The electromechanical brakes mounted on the motor and gear shall work on rectified D.C. supply. The brakes shall be fitted with self –aligning shoes and operated on power release principal to ensure safety if the power supply fails. The brake should be capable of operation automatically by various safety devices, current failure and by normal stopping of car. It should be possible to release the brake manually, such releases requiring the permanent application of manual force so as to move the lift car in short stops. For this purpose one set of brake release equipment shall be supplied. The tenderer shall specify the make of rectifiers for DC supply. Provisions made in IS –10923:1984 shall be compiled with. Stopping of the lifts shall not be achieved electrically but by electromechanical system.

21.21 Control

The control shall be by microprocessor controlled electronically regulated A.C. Variable Voltage & Variable Frequency drive using pulse width modulation (PWM) with phase reverse relay.

21.22 Controller With Drive System

Controller with Simplex / duplex full collective control and selective, drive control with digital technology having Thyristor controlled acceleration and deceleration and digital tachometer on warm shaft.

21.23 Hoistway

a) Car Frame: A suitable car frame shall be provided with adequate bracing to support the platform and car enclosure. The buffer striking plate on the underside of the car-frame platform assembly must fully compress the buffer mounted spring in the pit before the plunger reaches its lower limit of travel.

b) Platform, Heavy Loading Type: The car platform shall be arranged to accommodate one piece load weighing up to 25% of the rated capacity, such as wheeled food carts, passenger's baggage, etc. The platform shall be recessed 25mm for flooring Granite / Marble stone flooring as per approved samples pattern.
c) Car Guide Rails: Tee section steel rails with brackets and fasteners. (as applicable).
d) Spring Buffer: Helical coil spring type. (as applicable).
e) Wiring: Wiring for hoist way electrical devices included in scope of the elevator system, hall panel, pit emergency stops switch, and the travelling cable for the elevator car.

21.24 Car Frame Safety Gear And Governor

The car frame which supports the car platform and enclosure shall be made of structural steel and equipped with suitable guides and car safety device mounted under car platform. The safety gear shall be of instantaneous type. Car safety, to stop the car whenever excessive descending speed is attained, shall be operated by a speed governor through a continuous steel rope. Suitable device shall be provided to cut off power from the motor and apply the brake on application of safety.

21.25 Thermal Overload Protection

Auto thermal overload protection is to be provided to protect the driving motor against overloads. If the car is overloaded, it will not start. The overload indicator and the sounding buzzer shall signal the overload condition.

21.26 Priority Control

Switching on the key contact and at the same time pressing the required floor buttons will allow a direct travel to the selected floor while the already registered car commands will be cancelled.

21.27 Full Load Control

Full loaded cars should respond only to car commands. Floor calls remain registered and are served by the next available not fully loaded cars.

21.28 Counter Weight

All counter weights shall be cast iron and shall travel between rigid guides of steel frame capable of withstanding buffer impacts. Suitable metallic counter weights guard of required length shall be provided at the bottom of the hoist way.

21.29 Car Safety And Governor

The car safety is to be provided to stop the car whenever excessive descending speed is attained and runs more than 10 seconds in the same directions. The safety shall be operated by a centrifugal speed governor located at the top of the machine or hoist way and connected to the governor through a continuous steel rope, Suitable means shall be applied to cut off power from the motor and apply brake to stop the elevator immediately & after that the elevator shall restart automatically in normal speed.

21.30 Sound Reduction

The lift contractor shall provide necessary sound reduction materials, preferably anti-vibration pads of proper density to effectively isolate the machine from the machine beams or flooring.

21.31 Terminal And Final Limits

Terminal switches shall be provided to slow down / stop the car at the terminal landings.

These terminal switches shall act independently of the operating device or final limits switches. Ultimate or final limit switches shall also be provided to automatically cut off the power and apply brake in case the car travel beyond terminal landings.

21.32 Terminal Buffer

Suitable spring buffers shall be installed to stop the car and counter weight at the extreme limits of travels. Buffer must be suitable for installation in the space available.

21.33 Guides

Car and counter weight guides shall be of rigid steel guides shall be of machined 'T' section only. The size being in accordance with relevant European EN 81 standards, it shall be capable of withstanding the forces resulting from the application of car or counter weight safety devices.

21.34 Ropes

The hoist ropes shall be of traction steel of suitable size, construction and number to ensure the proper operation of elevator and shall give satisfactory wearing qualities. The Governor rope shall be of steel. The factor of safety should be as given in IS – 4666.No car or counter weight ropes shall be repaired or lengthened by splicing .Fixing arrangements shall confirm to IS – 2365-1977 shall be complied with."

21.35 Car Platform

The car platform shall be framed construction and designed on the basis of rated load evenly distributed. The flooring shall be sound isolated platform having 6mm chequered plate with tough wearing floor cover and fire resistant material and final finish with approved granite stone.

Car's stoppage accuracy at floors shall be within ± 3mm.

21.36 Car Enclosure Or Body

The car body shall be approved finish stainless steel material. The car shall have suspended ceiling with arrangement for air through pressure fan mounted on the roof of car and in direct lighting shall be with LED lamp fixtures evenly distributed in the cabin. Ceiling / wall interior material finishes to be submitted with offer.

21.37 Cabin Finishes

a) **For Passenger Lifts**: The car body shall be in approved finish stainless steel panels, the car floor will be of approved stone materials. The car shall have a suspended ceiling with arrangement for air through a pressure fan mounted on the roof of the car & indirect lighting shall be done with LED lamps fitting evenly distributed on the cabin finishes for the service lifts /Dumb waiters.

b) **Other Cabin Features**

i) Telephone cabinet with phone and lead up to the machine room. Microphone with switch along with communication cable between cabin car and Centralized Security Room shall also be provided.
ii) Full height infrared light-ray with photo-electric cells across the car entrance.
iii) Door reversal feature in case of obstruction of doors.
iv) Hand rail only on rear side.
v) Braille signage on door and operation Panel.
vi) Voice announcement system in the car & at landings, to announce the position of the elevator car in the hoistway as the car passes through or stops at any floor issued by the elevator.

21.38 Car Door

Stainless steel finish as per brief technical sheet. The door panels to be of center opening type with horizontal sliding doors & shall be of minimum 1 Hr Fire Rating.

21.39 Landing Door

As per car door specifications

21.40 Car And Landing Door Operators

An electric door operator for opening and closing the car door and the landing door shall be provided. It shall consist of a machine on the elevator car for each stopping at a landing. The car door and the landing door shall be mechanically connected and shall move simultaneously while opening and closing. Every landing door shall be provided with a locking device which shall comply with the following requirements:-

a) It shall not be possible to open the landing door from the landing side until the lift car is within that particular relevant zone.
However, provision shall be made for opening the door by means of special key for use in case of an emergency.

b) It shall not be possible for the car to be started or kept in motion unless all the landing doors and car door are closed and locked except when the car is coming to a stop at that landing within the levelling zone.

c) The electrical and mechanical parts of all locking devices shall be of suitable design and construction.

d) An electric contact for each car door shall be provided which shall prevent car movement away from the landing unless the door is in closed position.

The car doors and landing doors shall open automatically as the car is stopping at a landing. The closing of car door and landing door must occur before the car is set in motion. An electronic device shall be provided to stop and reverse the doors during their closing motion.

21.41 Door Hangers And Tracks

The car and the landing door shall be provided with two point suspension sheave type hangers complete with tracks. Sheaves and rollers shall be of steel with moulded nylon collar and shall include shielded ball bearing. Tracks shall be suitable steel section with smooth surface. The landing doors shall also consist of headers, sills, frames etc. as required.

21.42 Car Door Safety Shoe

Full height car operating panel shall be installed on the car door panel. In the event of a person interrupting the beam, the closing operation of the doors (the car and landing doors) shall return to the open position. The closing operation of the doors shall also be reversible by pressing a button (Door Open button) in the lift car operating panel.

21.43 Car and Car Frame

I. The passenger cars shall be isolated from frames to prevent vibration being transmitted from the ropes and guide shoes. Lateral and upward motion of the car shall be restrained by locking blocks but there should not be metal contact between the car and the frame. The top of the car shall be held firmly by rubber braced clamps welded to each side of the car's canopy. In addition, the side panels shall be coated with a layer of bituminous sound deadening compound. The car frames shall be of suitable steel section properly and securely braced and shall be sufficiently rigid to withstand the operation of the safety gear without permanent deformation of car frame.

II. All passenger lifts shall be of metal construction with center opening sliding steel doors, side panels in stainless steel finish. The car enclosure will be provided with fan with grill for ventilation. The floor of the lift car shall be granite stone over suitable structural steel

frame. (Sample is to be approved by Engineer-in-charge). Following shall also be provided in the passenger lifts :-

a. False ceilings – As per Para 36, Stainless Steel (Stainless steel finish and panels as per manufacturer) fitted with LED light fittings through two row of translucent fixture & Pressure fan with grills. The fan shall be connected on electric mains independent of mains supplying power to lift machine. Ventilation opening shall be provided inside the enclosure as per standard practice of lift manufacturers. To permit switching off the power supply to the lift without switching off the fan and the light, a separate circuit with control in machine room shall be provided in machine room.
b. One number full car operating panel with buttons in stainless steel finish integral full height. Operating panel to be with Braille signage for PWD's.
c. Digital car position indicator in car and car position indicators at ground floor & landings of all upper floors.
d. Car direction indicator showing up/down directional movement of car is to be fitted on the ground floor and on each landing (at all upper floors).
e. Battery operated alarm bell and emergency light with recharge equipment (charger) including invertors and batteries. The lighting shall automatically come on in case of failure of normal lighting supply.
f. Overload warning indicator in car.
g. One specification plate showing rated load, passenger capacity and other installation details/ rating.
h. DO's and DONTs notice for lift operation duly framed.
i. Fireman's switch at main lobby.
j. Call Registration indicator for the purpose of registering the requirement of car at a particular landing.
k. Digital Floor position indicator.
l. A three pin plug socket with switch for a hand lamp shall be fitted on top of the lift car for use by person working thereon.
m. Hands free intercom system.
n. Voice synthesizer.
o. Voice Announcement system in each & landings for People with Disabilities (PWD's).

21.44 Car Direction Indicator

Digital signal indicator in the car shall be provided by the appropriate arrow being illuminated to indicate the car travel direction.

21.45 Emergency Light In Car

A trickle charged battery operated emergency light lamp shall be provided in the car which shall operate automatically in case of power failure for minimum 90 minutes.

21.46 Alarm Bell

An emergency alarm bell shall be provided. The alarm bell shall be located at the ground floor landing and push for the same shall be at the car operating panel. The system shall be operated by batteries with trickle charger and the bell/siren should work the moment the alarm button in the car is pressed.

21.47 Communication System

Telephone system with cables shall be provided between cabin car and machine room for each lift. In addition to this, microphone with switch shall be provided in each lift cabin so that operator/passenger can talk to main security personnel sitting at centralized room in case of emergency.

21.48 Call Button In Landings

An 'up' push button and a 'down' push button at each intermediate landing and a single push button at each terminal landing shall be provided to call the lift car in a particular landing for travelling in a desired direction. The push buttons shall have call registration lights and shall illuminate when a button is momentarily pressed to indicate that the call is registered and the direction of the call is registered. The button shall remain illuminated until the call is answered. The top covers of the push button boards at the landings shall be of stainless steel.

21.49 Floor Position Indicator & Direction Arrows

Digital signal indications at all landings shall be provided by the appropriate numeral and direction arrows being indicated when the car is passing the corresponding floor. The indicator shall remain illuminated when the car is stopped at a floor. The top cover of the floor position and direction arrow indicator units shall be stainless steel.

21.50 Electronic Door Detector

On each side of the lift entrance door and car door panel's, infrared light sensor unit shall be mounted in such a way to continuously monitor the light beam. (no. of beams shall be more than 100). When any beam is disturbed, an electronic circuit shall be interrupted and the doors operating mechanism shall return the door to open position. When the entrance is clear the lift door shall close automatically. Opening of the doors may also be accomplished by pressing the "Door Open Button" in the car operating panel.

21.51 Emergency Key

Emergency key or equivalent device shall be provided as required by the elevator supplier.

21.52 Detailed Instructions

Inside the lift car suitable instruction for passengers on car operating panel will be displayed. Such instructions in lift car shall indicate capacity, Nos. of persons; 'No Smoking' and such other instructions as are suitable for proper and safe operation of the lifts.

21.53 Fire Man Switch

Each lift will have fireman switch for access of fireman. The operation of this switch shall cancel all calls to this lift and lift will stop at the next nearest landing if travelling upward. The doors will not open at this landing and the lift will start travelling to ground floor. Incase of its travel in the downward direction when the fireman's switch is operated, it will go straight to ground floor direct without stopping enroute. The emergency stop button inside the car will become inoperative during the journey. Once the car has reached the ground floor, it shall be safely under the command of fireman by car buttons, landing calls being isolated. The lift can be put in normal use by putting the fireman switch in its original position.

21.54 Operation

The operation shall be Simplex/Duplex, full collective-selective with or without attendant. It shall generally function in the manner described below:-

On every intermediate landing is a Up/Down button with 'Call Registered' lights. The extreme positions have one call button with a "Call Registered" lights. Inside the car is the complete set of buttons and a key operated change over switch to facilitate operation with or without attendant. However, in this case the car attends to all calls registered inside the car and also at the landings, in the ascending or the descending order. If it is landing, the last stop is the top-most registered call. After this, it automatically reverses the direction of travel and attends to all calls registered "Down" on this downward trip, irrespective of the sequence in which the calls are registered. The car will answer all calls in a sequenced order depending upon the direction in which it is travelling. If the key is turned to 'Attendant' operation, and

also lift operation can select the direction of travel by pushing the right buttons in the car.

21.55 Emergency Stop Switch

On top of the lift car an emergency stop switch shall be provided for use by maintenance personnel. Similar switches shall also be provided in the car. Operation of these switches shall render the car and landing buttons in operative and cancel all registered calls.

21.56 Emergency Battery Device

The emergency battery unit shall consist of suitable capacity of SMF (Sealed Maintenance Free) batteries with battery charger having auto trickle boost rate of charge. The unit shall be of such a capacity that in case of power failure, the lift shall come to the nearest landing automatically. The Bidder will submit calculations for batteries and battery charger before procurement.

21.57 Automatic Terminals Stop (Rescue Device)

The elevator hall be equipped with an automatic stopping device arranged to bring the car to a stop at the terminal landings, independent of the regular operating device in the car .This safety device is required so that in case of controller failure or power failure, the lift should not get stuck in the shaft. With this device, the lift will come to the nearest landing and its doors will open and the person can come out of the lift. All power-operated doors shall have a full length infra red light curtain safety to retract the door in the event of coming across any obstacle during closing of door.

21.58 Electrical Wiring

Power wiring between the controller and main board and controller to various landings shall be done in heavy gauge M.S. conduits confirming to Indian Electricity Rules and Specifications for electrical works. All cables shall be PVC insulated of appropriate size and voltage grading. Complete copper wiring for the entire lift installation will be used.

All multi-core trailing cables employed for the car shall satisfy the requirement of relevant IS and / or European Standard. There shall be separate trailing cables for the controls, for the lighting and fan and for signal circuits. The length of the cable shall be adequate to prevent any strain due to movement of the car. All cables shall be so tagged for easy identification. Trailing cables shall be so suspended, anchored and run that the strain on individual cable conductor shall be reduced to a minimum and the cables are free from contact with the car counter weight, shaft sides etc. No intermediate jointing shall be permissible in the trailing cable.

21.59 Machine

The machine shall be, of gearless traction type for variable speed equipment for all passenger lifts and shall include electric motors, electromechanical brakes, chromium molybdenum steel shave shafts and a sheave all completely mounted on a single base or bed plate. The worm shaft will be provided with taper roller bearings to take the end thrust and self aligning spherical roller bearing will be furnished for the sheave shaft to ensure alignment and long bearing life. The driving sheave will be grooved to ensure sufficient traction and minimum rope wear. Adequate means of lubrication will be provided for all bearings and the worm gear. The machines shall be equipped with an arrangement for manual winding of machine for testing purpose or for operation when the power supply fails.

21.60 Dual Operation With Attendant

Provision shall be made for automatic operation as given below:

(a) Without attendant

(b) With attendant : For the use of attendant, the following additional equipment shall be added to car operating panel:

(i) Key operated switch for cutting in/out additional requirements for “With Attendant” operations
(ii) Emergency buttons
(iii) Car Call indicators

21.61 Automatic Self Levelling Devices

This device shall be operated in slow speed to bring the car door in level with landing door; the tenderer should specify the leveling errors that can be achieved by them.

21.62 Light Fixtures

Suitable composite LED light fittings as specified, recessed in the false ceiling and operated by a switch in the car operation panel shall be provided. A light point along with bulb shall be provided about 5 cm above ground level for the purpose of providing proper light in the pit. Properly earthed lighting arrangement shall be provided in the hoist way in the form of 9 watt CFL volts Bulk-head fitting at each floor level.

21.63 Car Operating Panel

The car operating panel shall be flush –mounted to full height in car enclosure and shall contain the following:

(a) Bank of buttons to correspond to various floors / landings served.
(b) Emergency switch for stopping the car independent of regular operating device.
(c) Emergency alarm bell button connected to the alarm bell located at the main floor landing or adjacent to hoist way. The alarm should be operated through DC battery.
(d) Light / Fan control switches.
(e) A key operated switch to operate lift “Automatic without attendant” and “With attendant”.
(f) All call buttons, signals, control switches and car operating panel shall be numbered / mounted on stainless steel finish panel to full height and flush mounted.
(g) Overload warning indicator in car.
(h) Battery operated emergency light.
(i) Digital temperature indicator in car.

21.64 Trailing Cable

The trailing cable shall have flame retarding and moisture resistant outer cover. They shall be flexible and shall be suitably suspended to relieve strain in the individual conductors.

A. The works listed as under shall be arranged by Lift contractor and deemed to be included in the quoted rates.

a) All cutting of walls, floors or partitions together with any repairs made necessary thereby, including grouting in position like bolts, cills, steel members, indicator, button boxes etc., after they are fitted in position.
b) Scaffolding including temporary barricade required for lift works in elevator hoistway during the erection period and to remove the same thereafter.
c) Facia Plates are to be provided and installed by the Lift contractor.
d) All painting works of elevator material.

B. The Employer shall ensure the provisioning of the following:-

(a) Provisioning of continuous cill bearing area for each hoist way entrance of such construction as to assure secure anchorage and support for each cill.
(b) Painting works of hoist way except of Elevator materials.
(c) Lighting / Power Points of hoist way and pit.
(d) Hoisting hook in the ceiling of the hoist way.

C. Tenderer's lump sum price in Schedule 'A' shall be deemed to include for full and entire completion of all works in accordance with good engineering practice and recognized principles. If any additional civil works required other than mentioned in above to suit the lift well as constructed at site shall also be got executed by the lift contractor under his own arrangement, and the cost of same shall be deemed to have been included by them. The details of construction that may not have been inadvertently specified but are apparently and obviously required for making the lifts functional shall be deemed to be included in the lump sum rate quoted by the contractor. Decision of Engineer-in-Charge in such matter shall be final and binding.

D. The lift tenderer has to work in close liaison with the building contractors.

E. Braille signage shall be provided in each Lift in each Block.

ELECTRICAL VEHICAL CHARGER

Supply Installation testing Commissioning of following rating chargers with oudoor IP65 Canopy with following specifications

Parkbay DC Charger (Mode-3) Power Level 2: Normal Power ~24KW and above, 3 phase 415VAC(-40% to +20%), Frequency:50 Hz +/-5%, output supply: DC 12/24 Volt, Operational temperature range : -25 to 55 0C (outdoor), -5 to 55 0C (Indoor), RH up to 95%, Charging Device as per Device/protocol: IS-17017-23, EV-EVSE Communication as per IS-17017-24, ISO- 15118, Infrastructure Socket as per IS-17017-2-2/3, Vehicle Connector as per IS-17017-2-3 Vehicle Inlet/ Connector As per EV manufacturer, suitable for 4 wheelers. Indoor use: at least IP42; Outdoor use: at least IP54. Mechanical Strength: protection of the external enclosure against mechanical impact shall be IK08 according to IEC 62262. O/L,S/C protection. Insulation Resistance > 1 M Ω. Cable Length: 7.5 m. RCD having a rated residual operating current not exceeding 30 mA; Separate RCD for multiple outputs. Tele communication port of the EV supply equipment according to IS 13252 (Part 1) : 2010.OCPP(Open charge point protocol) 1.6J upgradable to ocpp 2.0. Device Should follow 17017 series of IS codes in general and the installation of the system shall comply with relevant IS Codes.

Light EV DC Charger (Mode 4) Power Level 1: Up to 7 kW, Input power supply: 1phase 230 +10% Volt/3phase 415 Volt, Frequency: 50 Hz +/-5%, output supply: 12/24 Volt DC.

Operational temperature range : -25 to 55 0C (outdoor), -5 to 55 0C (Indoor), RH up to 95%, Charging Device as per IS-17017-25, EV-EVSE Communication:IS-17017-25, one Charge Point Plug/ Socket as per IS-60309 and IS-17017-2, Vehicle Inlet/ Connector As per EV manufacturer, suitable for 2 Wheelers and 4 wheelers. Indoor use: at least IP42; Outdoor use: at least IP54. Mechanical Strength :protection of the external enclosure against mechanical impact shall be IK08 according to IEC 62262.O/L,S/C protection. Insulation Resistance > 1 M Ω. Cable Length: 7.5 m. RCD having a rated residual operating current not exceeding 30 mA; Separate RCD for multiple outputs. Telecommunication port of the EV supply equipment according to IS 13252 (Part 1) : 2010. OCPP(Open charge point protocol) 1.6J upgradable to ocpp 2.0. Device Should follow 17017 series of IS codes in general and the installation of the system shall comply with relevant IS Codes.

Light EV AC Charger (Mode-3) Power : 7 kW, Input power supply: 1phase 230 +10% Volt, output supply: 230 Volt AC, Frequency:50 Hz +/-3%, Operational temperature range : -25 to 55 0C (outdoor), -5 to 55 0C (Indoor)., RH up to 95%, Charging Device as per

IS-17017-22-1 EV-EVSE Communication: as per relevant IS Codes, Bluetooth Low Energy, one Charge Point Plug/ Socket as per IS-60309 and IS-17017-2, Vehicle Inlet/ Connector As per EV manufacturer, suitable for 2 Wheelers and 4 wheelers. Indoor use: at least IP42; Outdoor use: at least IP54. Mechanical Strength: protection of the external enclosure against mechanical impact shall be IK08 according to IEC 62262.O/L,S/C protection. Insulation Resistance > 1 M Ω. Cable Length: 7.5 m. RCD having a rated residual operating current not exceeding 30 mA; Separate RCD for multiple outputs. Telecommunication port of the EV supply equipment according to IS 13252 (Part 1): 2010. OCPP(Open charge point protocol) 1.6J upgradable to ocpp 2.0. Device Should follow 17017 series of IS codes in general and the installation of the system shall comply with relevant IS Codes.

FIRE SUPPRESSION SYSTEM

Clean Gas Fire Suppression Systems : 34/80/120/140/180 ltr completely CCOE approved high pressure seamless BIS 7285 approved Cylinders having 34/80/120/140/180 ltr capacity, UL/FM approved based Novec 1230 clean agent stored pressurized system with PESO approved valve assembly . The system also to be fitted with digital pressure gauge to monitor pressure and temperature with safety burst disc safety cap, elbow and other accessories, mounting bracket, container straps, NRV , Pressure operated control head which shall allow for pressure actuation of gas mounted, manually operated actuator to actuate the gas flooding process with the help of a lever, flexible rubber hose with wire bralded enforcement to route the gas from the storage cylinder to the discharge piping, to be connected to the discharge outlet of gas cylinder valve & to be terminated at the system piping or discharge manifold, Flexible actuation hose complete as required. Designated to provide proper flow rate & distribution Novec 1230 gas to flood the hazard area as per latest NFPA 2001.

The system shall sustain upto 65oC operating temperature. filling facility shall be in India and shall be UL approved. The complete gas suppression system shall be UL/FM approved. As system is UL/FM approved , the software for calculation used to be UL/FM approved. The documentary evidence to pe provided for all approval during the time of bidding.

34/80 ltr complete PESO approved high pressure seamless BIS 7285 approved Cylinders with contact pressure gauge and Peso approved valve, respective size mounting bracket

Novec 1230 manufactured by 3M, with Zero Ozone Depletion Potential and Very Low Global Warming Potential of 1 with 20 Years Blue Sky Warrantee against any regulatory Bans and Restrictions. UL Listed & FM approved Master Cylinder Kit complete comprises of Electric Control Head operated electrically from the detection and control system with a manual actuator and Wire Braided Flexible Rubber Hose with Elbow and connectors complete assembly to Connect Novec 1230 Cylinder Assembly Discharge outlet with Discharge Pipe or Discharge Manifold. On any displacement of solenoid valve, master cylinder kit shall be able to notify the fault by audio/visual mean. UL Listed / FM approved

Warning Signs and Plates for Inside Room and Outside Room application.

Discharge Nozzles to Discharge Novec 1230 Gas in the Hazard Area as hydraulic calculation and flow rate required in 180 Deg/360 Deg Discharge Pattern. UL Listed / FM approved

Discharge pressure switch with actuation hose and fittings to connect - standard (UL/FM)

Discharge Pipe with Support and Fittings, CS Seamless to ASTM A-106 Schedule 40.

Fire Alarm System with respect to Room size Automatic Gas Extinguishing Panel. 2 No’s of

programmable Initiating Device Circuit and 1 No's of Releasing Agent circuit, with the independent correlation of any no of initiating devices circuit . History event log shall be at least of 256 events. UL Listed / FM approved/IS 2189.

Conventional Multicriteria Detector with base.
Manual Release Switch & Abort Switch . The Dual action Manual release switch to provide the signal of fire manually to Gas release panel. Abort Switch. The Dual action Abort switch to provide the signal of fire manually to Gas release panel for abort.

Audio Visual Alarm for pre alarm in case of single zone detection & discharge alarm in case of second zone detection.

Response Indicator.
Supplying, laying, testing and commissioning of following sizes of Low Smoke Zero Halogen Silicon Insulated Fire Survival Cable with Drain Wire Armoring, solid copper conductor cable approved by LPCB as per BSEN 50200:2015 PH 120 (Fire, Mech Shock & Water 120 Minutes @ 830 deg Celsius, Fire & Mech Shock every 5 Min for 2 Hours- Both test conducted on same sample) and BS-6387 CWZ The cable shall sustain 950 deg. C. The cable shall be BS EN 60332-1-2:2004 for Bunched Flame Retardancy (installed as a single or bunched cable self extinguishes leaving the upper cable sheath unaffected showing the cable does not propagate fire). Cable shall be guaranteed for 10 years from the date of manufacture marked on the cable 2C X 1.5sqmm.
Installation of a System, Complete job

FIRE SUPPRESSION IN PANEL : UL Certified Extinguishing agent filled in PESO Approved Filling Station: 5 Kg FK-5-1-12 Clean agent filled in PESO approved stored pressure type seamless steel cylinder as per IS 7285 with DLP Valve Assembly, Safety Burst Disc at 28 Bar and Mounting Bracket with all necessary fittings & supports Stored Pressure type fitted with Pressure gauge, UV Resistance, Operating Pressure 15 bar, Hydraulic Pressure Tested to 250 bar, Burst Pressure at 350 bar, Red Powder coated.

UL Certified Extinguishing agent filled in PESO Approved Filling Station: 10 Kg FK-5-1-12 Clean agent filled in PESO approved stored pressure type seamless steel cylinder as per IS 7285 with DLP Valve Assembly, Safety Burst Disc at 28 Bar and Mounting Bracket with all necessary fittings & supports Stored Pressure type fitted with Pressure gauge, UV Resistance, Operating Pressure 15 bar, Hydraulic Pressure Tested to 250 bar, Burst Pressure at 350 bar, Red Powder coated.

UL Certified Linear pneumatic Heat Detection Tube for automatic fire detection & suppression system made by special modified polyamide (PA), color red RAL300, burst temperature 1000C to 1400C, inner diameter 4mm, outer diameter 6mm. Pressurized with dry nitrogen at 15 bar pressure with all necessary fittings & supports.

Master Control Unit with audio visual alarm Control Panel, 12 Volt battery, 2 NO/NC potential free relay contact for Main Fire Alarm/BMS/SCADA Integration. Gas discharge led indicator, battery led indicator, system status Led indicator , AC power ON Led indicator with all necessary fittings & supports.

BOOM BARRIER :- Automatic boom barrier shall be consisting of following specifications. Boom Barrier Front Design: Round Barrier, Color : Silver/Grey Color, PARKI Electromechanical Drive ,Mechanism 6meters boom arm Illuminated, Boom Arm (Red/Green) ,Opening Speed :3.5 Sec Reverse on Obstable Detection , intelligent control mechanism, Automatic Fault Detection Arrow , Led Indication on barrier body (Red/Green) ,Duty Cycle 100 %, IP Rating : IP 55, RS 485 Communication complete in all respect.

II. SPECIAL CONDITIONS OF ELECTRICAL WORK

1.0 GENERAL

1.1 All electrical work shall be carried out in compliance with specifications given hereunder in this section and in compliance with Indian Standard Specifications and Indian Electricity Acts and Rules in force. The works shall also conform to any special requirement of local State Electricity Board. In any case, the above mentioned rules, regulations etc. are not in accord, the decision of the Architect/ Engineer-in-Charge regarding rules to be followed or manner of execution of work shall be final and binding.

1.2 Work shall be executed through licensed electrical contractor approved by the Owner/Architect. These special conditions of contract shall be read in conjunction with the General Conditions of Contract, Schedule of Quantities, Technical Specifications, Drawings and other documents relating to the work and shall have preference over laid down general conditions and specifications.

1.3 Notwithstanding the sub-division of the documents into these separate sections and volumes, every part of each shall be deemed to be supplementary and complementary to every other part and shall be read with and into the contract, so far as it may be practicable to do so.

1.4 The contractors shall mobilise and employ sufficient resources to achieve the detailed schedule within the broad frame work of the accepted methods of working and safety. The contractor shall provide everything necessary for the proper carrying out of the work, including tools, plants and other materials.

4.1.5 No additional payment will be made to the contractor for any multiple shift work or other incentive methods contemplated by him in his work schedules even though the time schedule is approved by the Architect/Engineer-in-Charge.

1.6 The work shall be executed as per the programme drawn or approved by the Architect and it shall be so arranged as to have full coordination with any other agency employed at site. No claim for idle labour shall be entertained nor shall any claim on account of the delay in the completion of the building work to be tenable except extension of time secured by the Contractor as stated elsewhere.

1.7 The Contractor shall permit free access and afford normal facilities and usual conveniences to other agencies or departmental workmen to carry out connected work or other work services under separate arrangements. The Contractor will not be allowed any extra payment on this account.

1.8 All soil, filth or other matter of any offensive nature taken out of any trench, sewer drain, caspool or other place shall not be deposited on the surface, but shall at once be carted away by the contractor free of charge to a suitable pit or place to be provided by him.

1.9 The contractor shall provide all equipment, instruments labour and such other assistance required by the Engineer-in-Charge for measurement of the work, materials etc.

2 .0 MATERIALS

2.1 All materials, equipments, fittings and fixtures used in electrical works shall conform to the attached Appendix-A. All material shall be new, sound and robust in construction and well finished. Surplus material after completion of work shall be taken back by the contractor and the cost shall be recovered if the advance payment has been made earlier by the Client.

2.2 Unless otherwise stated in the conditions of contract, samples of all materials, fittings and fixtures to be supplied by the Contractor shall be submitted to the Architect/Engineer-in-charge for his approval. The contractor shall not commence the work until the samples are approved, in writing from the Owner/Architect. The Contractor shall ensure that all the materials incorporated in the work are identical in all respects with the approved sample. All samples not destroyed in testing shall be returned to the Contractor after completion of contract. No payment shall be made for samples destroyed in testing.

3.0 DRAWINGS

3.1 The drawings, specifications and bill of quantities shall be considered as a part of this contract. Any work or materials shown on the drawings but not included in the schedule of quantities or vice versa, shall be executed as if specifically called drawings indicate the extent and general arrangement of various equipments and their wiring etc. and are essentially diagrammatic. The work shall be installed if found essential to coordinate the installation of this work with other trades shall be made without any additional cost to the Owner. The data given herein and on the drawings is as could be secured, but its complete accuracy is not for the assistance and guidance of the contractor, the exact locations, distances and levels will be governed by the space conditions. The contractor shall be responsible to check exact location of all electrical outlets, the routes and lengths of cables etc.

4.0 CLARIFICATIONS OF DISCREPANCIES

4.1 In case of any discrepancy between specifications and drawings etc. furnished by the Architect or disputes in respect thereof, the interpretation of CONSUATANT and Engineer- In-Charge shall be final and binding.

5.0 WORK AND WORKMANSHIP

5.1 The work shall be of the highest standard, and confirm to the technical specifications both as regard its design and workmanship. Modern tools and first class, latest techniques shall be employed for its execution.

5.2 Any damage done to the building during the execution of work shall be responsibility of the contractor and it shall be made good by him, at his cost, to the entire satisfaction of the Architect.

5.3 All electrical work shall be executed by skilled and duly licensed electricians under the direct supervision of whole time, fully qualified electrical Engineers and Supervisors. The contractor shall produce requisite evidence regarding the qualifications of his Engineers, supervisors and other workers.

5.4 The contractors shall possess all the relevant and valid licences as per the regulations of the Indian Electricity Rules and the Local Electrical Inspector's

requirements.

5.5 The work shall have to be co-ordinated with the building work and other allied jobs/trades to the entire satisfaction of Engineer-in-Charge.

6.0 Certificate of Inspection

6.1 The contractor shall be responsible for getting the installation inspected and approved by the electrical Inspector and other local electric supply company as required.

6.2 The contractor shall obtain and deliver to the Owner the certificate of final inspection and approval of the local electrical authorities concerned. The inspection fees etc. shall be borne by the contractor which shall be reimbursed by owner on producing documentary proof.

6.3 In case of any defects are pointed out by the Electrical Inspector, the contractor shall remove these defects at his own cost and arrange for re-inspection or inspection by the Electrical Inspector, till such time the installation is finally approved and the required certificate is issued. The contractor shall bear all expenses and deposit the necessary fees for subsequent inspection by the Electrical Inspector.

6.4 The Architect shall have full powers to get the material or workmanship etc. inspected and tested by an independent agency, at the contractor's expenses in order to ascertain their soundness and adequacy.

7.0 MISCELLANEOUS

7.1 A site order book will be maintained at site which will be in the custody of the Owner or his representative and all instructions given to the contractor will be recorded in the site order book and the same has to be signed by the contractor to comply with the instructions given therein.

7.2 After completion of the work the whole installation shall be tested by the contractor in the presence of the Architect Engineer-in-charge. The tests shall comply the following I.E.E. Regulations and shall be submitted alongwith the final bill.

a) The result of the insulation test shall comply with the I.E.E. Regulations 1101 to 1108A and 1008B as may be applicable.

b) Test shall be carried out to ascertain that all the non-linked SP switches have been connected to the phase conductor.

c) The continuity test of the earthing system shall comply with I.E.E. Regulations 1108 to 1109 to the latest addition. If the result of the above tests does not comply with the I.E.E. Regulations, the contractor shall be bound to rectify the faults so that the required results are obtained. The contractor shall be responsible to provide all the necessary testing instruments, such as magger insulation tester, earth tester multimeter, AVO meter etc. for carrying out the above tests.

7.3 The work will not be considered as complete and taken over by the employer till all the components of the work after being completed at site in all respects have been inspected/tested by the Architect/Owner to his entire satisfaction and a completion certificate issued by the Owner/Architect to this effect.

7.4 Shop drawing for electrical work e.g. equipment, cable earthing and conduit layout for all systems shall be prepared by contractor and got approved before starting of the work.

7.5 At the completion of the work and before issuance of certificate of virtual completion, the contractor shall submit 6 sets of drawing, two tracing and 2 CDs containing of each drawing to Owner of each layout drawings drawn at approved scale indicating the complete conduit wiring/cabling/earthing as installed.

7.6 Contractor shall submit 2 sets of photograph for electrical installation carried out.

7.7 The contractor will submit within 15 days of the award of work, a detailed schedule of programme of work.

8.0 PREAMBLE TO SCHEDULE OF QUANTITIES

8.1 Tender shall be on the basis of item rates which shall include the cost of materials, labours, all taxes, duties and all other services required for the complete installation, testing and commissioning in accordance with the relevant IS Codes in practice including the fees for inspection together with the liabilities and obligations as detailed in the general conditions of contract. It will also be the responsibility of the tenderer to obtain all types of sanctions etc. like power/ light connections and the drawings etc. if any, required by the concerned local authorities.

8.2 Prices shall remain firm and free from variation due to rise and fall in the cost of materials and labours or any other price variation whatsoever whether during extended period of completion, if any.

8.3 Item rates shall remain valid for any variation in the estimated quantities given in schedule of quantities.

8.4 In order to facilitate the technical scrutiny of the various quotations, the tenderer must supply with their quotations detailed technical particulars make catalogues and erection drawings for various items under different parts specified in the schedule of quantities.

8.5 Power supply shall be 3 phase, 4 wire, 415/230 Volts A.C. and frequency of 50 cycles per second. All consuming devices shall be suitable for voltage and frequency mentioned above.

8.6 The drawing and specifications lay down minimum standard of equipment and workmanship and the deviations. In the absence of any deviations, it will be deemed that the tenderer is fully satisfied with the intents of the specifications & drawings and their compliance with the statutory and fire insurance provisions including local codes. Where the drawings and specifications conflict, the more stringest shall apply.

8.7 All equipments and the installations shall be tested as specified and a test certificate in the prescribed form as required by the local supply authorities shall be furnished.

8.8 The entire installation shall be guaranteed against defective materials or workmanship for a period of 12 months from the date of the installation certified by the consultant and taken over by the owner. During the guarantee period all the defects shall be rectified by the contractor free of cost.

8.9 The successful tenderer shall submit the shop drawings for wiring L.T. boards, distribution boards and any other to the consultant for approval prior to start the work. The approval of these drawings will be general and will not absolve the contractor of the responsibility of the correctness of these drawings. Atleast 6 copies of the approved drawings shall be supplied to the consultant for their distribution to the various agencies at site at no cost to the employer.

8.10. The position of distribution boards and switchboards may require some minor adjustments due to either site requirements or change in structural layout. All such changes from the position, shown in the drawings, shall be required to be incorporated without any extra payment or deduction for change in length of wiring etc.

8.11 The tenderers must see the site conditions and take all the aforesaid and foregoing factors while quoting the rates, as no extra will be allowed on any ground arising out of or relating to the aforesaid and foregoing.

8.12 In single phase (230-V) A.C. supply system circuit wires of same phase shall be drawn in same conduit. For 3 phase, 4 wire wiring system wires of different colour shall be used and for insulated neutral only black colour wire shall be used.

8.13 The successful tenderer shall include in his rates for painting with 3 coats of synthetic enamel paint to match the surroundings or as directed by the consultant for all down rod hangers pertaining to light fixtures, fans, steel structure used for electrical work at no extra cost.

8.14 The successful tenderer shall supply completion drawings of the entire installation on tracing cloth as well as 3prints of each drawing showing the complete wiring diagram as executed at site drawn to scale approved by the consultant after the completion of work but before completion certificate is given by the consultant.

8.15 After laying and jointing the cables shall be subject to necessary tests as stipulated in IS:5959 (Part-I):1970.

8.16 As more than one make is mentioned, prior approval of particular make for use shall be obtained from the Consultant as per his discretion. All samples of all electric fittings and other accessories shall be approved by the consultant prior to their installation. In case there is a substantial cost difference be indicated in the tender itself or it will be deemed that any of the specific make of material may be asked by the consultant at the quoted prices.

8.17 No alteration whatsoever is to be made to the text of quantities of this schedule of quantities, unless such alteration is authorised in writing by the consultant. Any such alteration or addition shall, unless authorised in writing, be dis-regarded when tender documents are considered.

8.18 Any error in description or in quantity or omission of items from the contract shall not vitiate this contract but shall be corrected and demand to be a variation required by the consultants.

8.19 All measurements shall be taken in accordance with the Indian Standard Electrical Installation in buildings method of Measurements of IS:5908:1970, unless otherwise specified.

8.20 The contractor shall provide, within one month after completion of the work or

alongwith the final bill, three sets of manuals properly bound which shall contain the following information:

a) Description of installation items using main items of equipments.

b) Description of all equipments and system operation with trouble shooting manuals.

c) Line diagram of each system including main feature of equipments and showing method of setting controls.

d) Method of fault finding, routine, adjustment and wiring diagram.

e) Description of routine maintenance, oil and greasing points and recommended lubricants.

f) Manufacturer service manuals for all equipments.

g) Spares reference manuals.

8.21 The contractor shall provide the following at no extra cost to the Employer:

a) Danger Notice Boards

b) Treatment for electric shock giving details of FIRST AID TREATMENT with chart diagrams (mounted in suitable frame).

c) Line wiring diagrams of the electrical system mounted in suitable frame.

8.22 The contractor will remove all the debris & surplus earth from work site (belonging to his work) free of cost.

III. TESTING OF INSTALLATION

1.0 GENERAL

Inspection and testing of the installation shall be carried out as per IEC such as:

a) Insulation Resistance and wiring continuity test.
b) Earth resistivity and continuity test.
c) Test of polarity of non linked single pole switches.

Besides the above any other test specified by the Local Authorities shall also be carried out by the contractor.

All tested and calibrated instruments for testing, labour, materials and incidentals necessary for conducting the test shall be arranged by the contractor at his own cost.

2.0 INSULATION RESISTANCE TEST

The insulation shall be measured between the earth and whole system of conductors or any section there of with all fuses in place and all switches closed except in concentric wiring, all lamps in position or both poles of the installation otherwise electrically connected together, a direct current pressure of not less than twice the working pressure provided that it does not exceed 660 volts for medium voltage circuits. Where the supply is derived from the 3 wire (AC or DC) or from a poly phase system. The neutral pole of which is connected to earth, either direct or through added resistance. The working pressure shall deemed to be that which is mentioned between the phase conductor and the neutral.

The insulation resistance measured as above shall not be less than 50 divided by the number of points on the circuit provided that the whole installation shall not be required to have an insulation resistance greater than one megohm.

The insulation resistance between the frame work of housing of power appliances and all live parts of each appliances shall not be less than that specified in the relevant standard specification or where there is no specification shall not be less than half a megohm.

The insulation resistance shall also be measured between all conductors connected to one pole or phase conductor of the supply and all the conductor connected to the middle wire or the neutral or to the other pole or phase conductor of the supply and its value shall not be less than that specified in above clause.

3.0 TESTING OF EARTH CONTINUITY PATH

The earth continuity conductor including metal conduit and metallic envelopes of cables in all cases shall be tested for electric continuity and the electrical resistance of the same alongwith the earth lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrode to any point in the earth continuity<conductor in the completed installation shall not exceed one ohm.

4.0 TESTING OF POLARITY OF NON-LINKED SINGLE POLE SWITCHES

In a two wire installation the test shall be made to verify that all non-linked single pole switches have been fitted in the same conductor through out and such conductor shall be labelled or marked for connected to outer or phase conductor or to the non earthed conductor of the supply.

In a three wire or a four wire installation a test shall be made to certify that every non-linked single pole switch is fitted in a conductor which is labelled or marked for a connection to one of the outer or phase conductor of the supply.

5.0 LOAD BALANCING TESTS

After satisfactory completion of the project the contractor has to check balancing of loads by actual measurements for lighting loads only.

CHECK LIST (ELECTRICAL)

Name of Project_____

Running Account Bill No:_____

Sl. No.	ITEMS	STATUS	REMARKS
1.	Approval of Samples		
	a) Conduits and accessories		
	b) Wiring		
	c) Switch Accessories		
	d) Luminaries		
	e) D.B. / Panels		
	f) Other material		
2.	Approval of Shop Drawings		
	a) For conduit layout		
	b) For DB & Panels		
	c) Layout of Equipment		
	d) L.T. Switch Board/ O.H Bus Bar		
	e) Earthing Layout etc.		
	f) Fire Alarm System		
	g) Street Lighting & Cable Layout		
3.	Joint Signature for all measurements for Bills		
	a) Client		
	b) Architect		
	c) Contractor		
4.	Application for Extension of Time		
	a) Submitted		
	b) Not required.		
5.	Insurance		
	a) Submitted as per Contract		
	b) Valid Upto		
6.	Safety Measures		
	a) Taken at Site by Contractor		
	b) Certified by R.E.		
7.	Approval of Extra/Substituted Items from Client		
	a) Received		
	b) Under Scrutiny		
	c) Under Checking of Client		
	d) Anticipated Extra Items, if any to be checked		

Signature of Tenderer *Signature of Employer*

Sl. No.	ITEMS	STATUS	REMARKS
8.	Inspection		
	a) Equipments		
	b) Waived of inspection		
9.	Extra Items/Substituted Items		
	a) Analysis of Extra Items submission		
	b) Approval of extra items		
10.	Deviation Statement		
	a) Submitted		
	b) Not required at this stage		
11.	Secured Advance Bill		
	a) Material received in good condition.		
	b) Test report for equipment/material		
	c) Supporting documents		
12.	Defects List		
	a) Submitted by R.E.		
13.	Rectification of Defective Works		
	a) Rectification started at site		
	b) Rectification under program		
	c) Rectification not yet started		
14.	Electrical inspector / fire authority approval		
15.	Submission of as-built Drawings with tracings and CDs		
16.	Handing over of Installation		

Checked by: .....

CHECK LIST (SUB-STATION EQUIPMENTS)

NAME OF PROJECT:

RUNNING ACCOUNT BILL NO.:

Sl. No.	Items	Documents Received	Remarks
1.	Approval of Samples		
	Earthing Materials		
	Lugs		
	Gland		
	Cables		
	D.B./Panels		
	Other Material		
2.	Approval of Shop Drawings		
I.	Manufacturer Drawing		
	H.T. Panels		
	L.V. Panels		
	Transformers		
II.	Layout Drawings		
	Transformers with Foundation Details		
	Cable Routes		
	Earthing Layout		
	Other Accessories Layout		
3.	Joint Signature for all measurements for Bills		
	Client		
	Architect		
	Contractor		
4.	Application for Extension of Time		
	Submitted		
	Non required		
5.	Insurance		
	Submitted as per Contract		
	Valid upto		
6.	Safety Measures		
	Taken at site by Contractor		
	Certified by R.E.		
7.	Approval of Extra/Substituted Items for Client		
	Received		
	Under Scrutiny		
	Under Checking of Client		
	Anticipated Extra Items, if any to be checked		
8.	Inspection		
	Equipments		
	Waived of Inspection		
9.	Extra Items/Substituted Items		
	Analysis of Extra Items Submission		
	Approval of Extra Items		

Signature of Tenderer *Signature of Employer*

Sl. No.	Items	Documents Received	Remarks
10.	Deviation Statement		
	Submitted		
	Not required at this stage		
11.	Secured Advance Bill		
	Material received in good condition		
	Test report for equipment/material		
	Supporting Documents		
12.	Defect List		
	Submitted by R.E.		
13.	Rectification of Defective Works		
	Rectification started at site		
	Rectification under program		
	Rectification not yet started		
14.	Testing of System as per specifications		
15.	Submission of as-built drawings with tracings and soft copy		
16.	Handing over of installation		
17.	Statutory Approvals		
	Shop drawing for sub-station equipments		
	Sanction of load		
	Estimates		
	Connection/Supply		
	Electrical Inspector Approvals		

Signature of Contractor……..

Signature of R.E……..

CHECK LIST FOR ELECTRICAL WORKS
SUB-STATION WORKS

NAME OF PROJECT:_____

FINAL BILL : _____

SL. No.	ITEMS	DOCUMENTS RECEIVED	REMARKS
1.	Detailed joint measurement duly signed by the Client/Consultant		
2.	Extra item approvals from Client		
3.	Extension of Time approval from Client		
4.	Defect Rectification Certificate from Client		
5.	Statutory approval as per Contract		
6.	Quantity deviation statement with price		
7.	Test certificate with manuals for all items		
8.	Complete drawing for equipments and earthing system as installed with tracing		
9.	Completion Certificate		
10.	Test result of equipments, earth tests including site testing and commissioning reports		
11.	Inventory and handing over note		
12.	Warranty/Guarantee Certificate for equipments		
13.	Chief Electrical Inspectorate/State Electrical Statutory Bodies' Certificate as applicable and as per Contract		

CONTRACTOR RESIDENT ENGINEER-CONSUATANT CLIENT

CHECK LIST FOR UNINTERRUPTED POWER SUPPLY (UPS) SYSTEM

Name of Project_____

Running Account Bill No:_____

SL. No.	ITEMS	DOCUMENTS RECEIVED	REMARKS
1	Approval of Shop Drawings		
	a) Layout of Equipment		
	b) Schematic Diagram		
2.	Joint Signature for all measurements for Bills		
	a) Client		
	b) Architect		
	c) Contractor		
3.	Application for Extension of Time		
	a) Submitted		
	b) Not required		
4.	Insurance		
	a) Submitted as per Contract		
	b) Valid Upto		
5.	Safety Measures		
	a) Taken at Site by Contractor		
	b) Certified by R.E.		
6.	Approval of Extra/Substituted Items from Client		
	a) Received		
	b) Under Scrutiny		
	c) Under Checking of Client		
	d) Anticipated Extra Items, if any to be checked.		
7.	Inspection		
	a) Equipment's		
	b) Waived of inspection		
8	Extra Items/Substituted Items		
	a) Analysis of Extra Items submission		

SL. No.	ITEMS	DOCUMENTS RECEIVED	REMARKS
	b) Approval of extra items		
9.	Deviation Statement		
	a) Submitted		
	b) Not required at this stage		
10.	Secured Advance Bill		
	a) Material received in good condition.		
	b) Test report for equipment / material		
	c) Supporting documents		
11.	Defect List		
	a) Submitted by R.E.		
12.	Rectification of Defective Works		
	a) Rectification under program		
	b) Rectification under program		
	c) Rectification not yet started		
13.	Electrical Inspector Approval		
14.	Submission of as-built drawings with Tracings, Operation & Maintenance Manual (4 Sets)		
15.	Handing Over of Installation		

Checked by: .....

ROJECT :_____

CLIENT :_____

CONTRACTOR :_____ Date_____

SAFETY CHECK LIST

		Yes	No
1.	Are helmets provided and worn where any danger of falling objects exists?		
2.	Is proper slope, angle of repose, shoring, step-down provide for Trenching/Earth work?		
3.	Are openings/pits covered or barricaded properly?		
4.	Are ladders in good working condition and rungs are in position?		
5.	Are proper props, bracing for scaffolding, shuttering provided?		
6.	Are guard rails and Toe boards provided in staging, scaffolding / platforms?		
7.	Are naked nails in timber boards bent removed?		
8.	Is insertion of loose wires in sockets without using plugs in force?		
9.	Is use of gloves while using hand help equipment in force?		
10.	Is improper jointing of cables/wires prevailing at site?		
11.	Is the work place properly illuminated?		
12.	Is fire extinguishers available at Site/Stores?		
13.	Is house-keeping in order? Are materials stacked properly in an earmarked place?		

Name & Signature of Contractor	Resident Engineer (Client)	Resident Engineer (Consultant)

CHECK LIST (D.G. SETS)

NAME OF PROJECT:
RUNNING ACCOUNT BILL NO.:

Sl. No.	Items	Documents Received	Remarks
1.	**Approval of Samples**		
a)	Earthing Materials		
b)	Lugs		
c)	Gland		
d)	Cables		
e)	D.B./Panels		
f)	Other Material		
2.	**Approval of Shop Drawings**		
I.	Manufacturer Drawing		
a)	D.G. Sets		
b)	L.V. Panels		
c)	Batteries and Battery Charger		
d)	L.V. Bus Duct		
II.	Layout Drawings		
a)	D.G. Room with Foundation Details		
b)	Cable Routes/Bus Duct Layout		
c)	Earthing Layout		
d)	Other Accessories Layout		
3.	**Joint Signature for all measurements for Bills**		
a)	Client		
b)	Architect		
c)	Contractor		
4.	**Application for Extension of Time**		
a)	Submitted		
b)	Non required		
5.	**Insurance**		
a)	Submitted as per Contract		
b)	Valid upto		
6.	**Safety Measures**		
a)	Taken at site by Contractor		
b)	Certified by R.E.		
7.	**Approval of Extra/Substituted Items for Client**		
a)	Received		
b)	Under Scrutiny		
c)	Under Checking of Client		
d)	Anticipated Extra Items, if any to be checked		
8.	**Inspection**		
a)	Equipments		
b)	Waived of Inspection		
9.	**Extra Items/Substituted Items**		
a)	Analysis of Extra Items Submission		

Signature of Tenderer *Signature of Employer*

Sl. No.	Items	Documents Received	Remarks
b)	Approval of Extra Items		
10.	**Deviation Statement**		
a)	Submitted		
b)	Not required at this stage		
11.	**Secured Advance Bill**		
a)	Material received in good condition		
b)	Test report for equipment/material		
c)	Supporting Documents		
12.	**Defect List**		
a)	Submitted by R.E.		
13.	**Rectification of Defective Works**		
a)	Rectification started at site		
b)	Rectification under program		
c)	Rectification not yet started		
14.	**Testing of System as per specifications**		
15.	**Submission of as-built drawings with tracings and soft copy**		
16.	**Handing over of installation**		
17.	**Statutory Approvals**		
a)	Electrical Inspector Approvals		
b)	Pollution Control Board Approvals		
c)	Any Other Approvals.		

Signature of Contractor……..

- Signature of R.E……..

FIRE FIGHTING WORKS

TECHNICAL SPECIFICATIONS

SECTION I
GENERAL INSTRUCTIONS

1.0 GENERAL REQUIREMENTS

1.1 Scope of Work

1.1.1 The form of Contract shall be according to the “Conditions of Contract”. The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

1.1.2 Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in the Schedule of Quantities and/or shown on the Plumbing Drawings.

1.1.3 Without restricting to the generally of the foregoing, the sanitary installations shall include the following:-

A. Fire Fighting Works

a. Hydrant System

b. Sprinkler System

c. Fire Extinguishers

1.1.4 Services rendered under this section shall be done without any extra charge.

1.2 Specifications

1.2.1 Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

1.2.2 Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with upto date amendments as applicable in the contract and or as per the requirement of the client or its representative.

1.2.3 Works not covered above in para 1.2.1 and 1.2.2 shall be carried out as per relevant Indian Standards and in case of its absence as per British Standard Code of Practice.

1.3. Execution of Work

1.3.1 The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

1.3.2 The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

1.3.3 On award of the work, Contractor shall submit a schedule of construction in the form of a PERT Chart or BAR Chart for approval of the Project Manager/Architect/Consultant. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

1.4 **Drawings**

1.4.1 Fire drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and other services drawings.

1.4.2 Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

1.4.3 Contractor shall verify all dimensions at site and bring to the notice of the Project Manager all discrepancies or deviations noticed. Decision of the Project Manager shall be final.

1.4.4 Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

1.4.5 All drawings issued by the Architects/Consultant for the work are the property of the Architects/Consultant and shall not be lent, reproduced or used on any works other than intended without the written permission of the Architects/Consultant.

1.5 **Inspection and Testing of Materials**

1.5.1 Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevant Indian Standards.

1.5.2 For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

a) Theodolite, Steel tapes
b) Dumpy level
c) Weighing machine
d) Plumb bobs, Spirit levels, Hammers
e) Micrometers, Tachometers
f) Thermometers, Stoves
g) Hydraulic test machine
h) Smoke test machine

1.5.3 All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.

1.5.4 All Testing Equipment shall be preferably located in a special room meant for the purpose.

1.5.5 Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the Architects or kept at site in a sample room as prepared by the owners. Any materials declared defective by Project

Manager/Architect/Consultant shall be removed from the site within 48 hours.

1.6 **Metric Conversion**

1.6.1 All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

1.6.2 Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

1.7 **Reference Points**

1.7.1 Contractor shall provide permanent Bench Marks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

1.7.2 All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

1.8 **Reference Drawings**

1.8.1 The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled.

1.8.2 All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the Project Manager or Architects.

1.9 **Shop Drawings**

1.9.1 The Contractor shall submit to the Project Manager three copies of the shop drawings.

1.9.2 Shop drawings shall be submitted under following conditions:-

(a) Showing any changes in layout in the plumbing drawings.

(b) Equipment layout, piping and wiring diagram.

(c) Manufacturer's or Contractor's fabrication drawings for any materials or equipment supplied by him.

1.9.3 The Contractor shall submit two copies of catalogues, manufacturer's drawings, equipment characteristics data or performance charts as required by the Project Manager.

1.10 **Completion Drawings**

1.10.1 On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the Project Manager. These drawings shall have the following information.

a) Run of all piping, diameters on all floors, vertical stacks and location of external services.

b) Ground and invert levels of all drainage pipes together with location of all manholes and connections upto outfall.

c) Run of all water supply lines with diameters, locations of control valves, access panels.

d) Location of all mechanical equipment with layout and piping connections.

No completion certificate shall be issued unless the above drawings are submitted.

1.10.2 Contractor shall provide two sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

1.10.3 All "Warranty Cards" given by the manufacturers shall be handed over to the Project Manager.

1.13 Testing

1.11.1 Piping works shall be tested as specified under the relevant clause(s) of the specifications.

1.13.2 Tests shall be performed in the presence of the Project Manager/ Consultant.

1.11.3 All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

1.11.4 Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

1.11.5 Contractor shall provide all labour, equipment and materials for the performance of the tests.

1.14 Site Clearance and Cleanup

1.12.1 The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

1.12.2 After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

1.12.3 On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

1.15 License Permits and Authorities

1.13.1 Contractor must keep constant liaison with the Municipal/statutory authority and

obtain all approval of all drainage, water supply and other works carried out by him.

1.13.2 Contractor shall obtain, from the Municipal and other authority's necessary completion certificate(s) with respect to his work as required for occupation of the building. Contractor shall obtain permanent water supply and drainage connections from authorities concerned. Employer shall pay all fees/deposits as required to be paid to the authorities towards connection charges.

1.14 **Recovery of Cost for Materials issued to Contractors Free of Cost**

1.14.1 If any materials issued to the Contractor free of cost, are damaged or pilfered, the cost of the same shall be recovered from the Contractor on the basis of actual cost to owner which shall include all freight and transportation, excise duty, sales tax, octroi, import duty etc. plus 100%. The decision on the actual cost given by the Employer shall be final and binding on the Contractor.

1.15 **Cutting of Water Proofing Membrane**

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of Project Manager/Architects. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion of work at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully water proof as per specifications and details of water proofing approved by Architects.

1.16 **Cutting of Structural Members**

No structural member shall be chased or cut without the written permission of the Project Manager.

1.17. **Materials Supplied by Owner**

1.17.1 The Contractor shall verify that all materials supplied by the Employer confirm to the specifications of the relevant item in the tender. Any discrepancy found shall be brought to the notice of the Project Manager.

1.18 **Materials**

Unless otherwise specified and expressly approved in writing by the Project Manager, only materials of makes and specifications approved by Engineer-in-charge with the specifications shall be used.
If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the Project Manager and returned to the Contractor at the appropriate time.

SECTION – I

FIRE HYDRANT SYSTEM

1.0 Scope of work

1.1 The scope of work shall cover supply, fabrication, installation, testing and commissioning of the fire hydrant system covering the following but not limited to:

a) Fire Hydrant pumps, electric and diesel driven as shown in the equipment schedule, drawings and as required.

b) Jockey pump, electric driven as shown in the equipment schedule, drawings and as required.

c) Engine Control Panel.

d) Hydrant mains, external ring and yard hydrants.

e) Wet risers in the building as specified and shown on drawings.

f) Landing valves, hose reels, hose cabinets etc.

g) Fire brigade breaching, siamese connections and connections to pumps and appliances.

1.2 The contractor shall get the Fire Fighting System approved by the Chief Fire Officer of Local Fire Service.

2.0 Standards

2.1 The fire hydrant installation shall conform to and meet with the requirements set out by the following:

2.1.1 As relevant IS Code of practice for the safety of buildings (General) fire fighting equipment and its maintenance.

2.1.2 As relevant IS Code of practice for installation of internal fire hydrant in multi-storeyed building.

2.1.3 Compliance with the local fire brigade and the fire enforcing authorities as specifically laid down by them.

3.0 Fire pump

3.1 The fire pump shall be single stage / double stage suction centrifugal type with split casing type and direct driven by electric motor or diesel engine as specified. The pump rating and performance shall conform to the equipment schedule and meet the TAC duty requirements.

3.2 Pump casing shall be of close grained cast iron with bronze impeller. The shaft sleeve shall be brass or SS 304 and the trim shall be brass or bronze.

3.3 Pump shall be capable of delivering 150% of the rated capacity at 65% of the rated head and the no-delivery head shall be not more than 140% (150% in case of end suction type) of the rated delivery head. The pump casing shall withstand 1.5 times the no-delivery pressure or 2 times of the duty pressure whichever is higher.

3.4 The pump shall be either electrically driven or diesel driven with direct flexible coupling.

3.5 The electric drive motor shall be squirrel cage induction conforming to IS 325 - 1978 and rated for continuous duty (S1). Motor shall have not less than class F insulation and minimum enclosure of IP22. The starter shall be air cooled fully

automatic star delta or auto transformer type. Starters shall conform to IS 8544 and rated for AC-3 duty conditions.

3.6 Drive rating shall be based on the largest of the following:

a) Rated pump discharge at rated head

b) 150% of rated discharge @ 65% of rated head

c) Maximum power absorbed by the pump in its operating range i.e. no-delivery to free discharge.

The diesel engine shall be naturally aspirated (non-turbocharged) and electrically started. The engine shall be complete with starting batteries full-wave selenium rectifier charger, isolator, leads, mounting frame etc. Engine rating shall be same as for the electric motor. The detailed specifications of the engine are at Clause no 6.0.

4.0 Accessories

4.1 The Fire Pumps shall be complete with the following accessories:

a) Suction and discharge eccentric reducers

b) Pump coupling guard

c) Common base frame, fabricated mild steel or cast iron.

4.2 Each pump shall have independent set of pressure switches. The pressure switch shall be snap action SP DT switch rated 10A @ 220 V operated through a stainless steel diaphragm. The switch shall have a pointer for manual adjustment of set point, and all electrical connections shall be terminated in a screwed terminal connector. The entire unit shall be encased in a cold drawn steel (heavy gauge) enclosure. The diaphragm shall be designed for a maximum operating pressure of the system. Each pressure switch shall be provided with a pressure gauge in parallel as shown on the drawings and all gauges and pressure switches shall be mounted in an instrument panel with necessary control piping and drainage facility.

5.0 System operation and control panels

5.1 The fire pump shall be started automatically on loss of pressure and the operation sequence of the booster and fire pumps shall be as follows:

a) Jockey Pump shall start when the system pressure drops by 0.35 kg/cm2 and stop when the system pressure is re-established.

b) The Fire Pump shall start when the system pressure drops by 1.0 kg/cm2 and shall continue to run till manually switched off.

c) Jockey and fire pump starting shall be indicated on the panel with a red indication lamp.

5.2 The motor starters (direct on line or star-delta) shall consist of electrically actuated contactors. The starter shall be complete with ON-OFF push buttons, timers and auxiliary contacts and shall be fully automatic. There shall be an indicating lamp with each of the pumps and an ammeter and selector switch with the fire pumps. Fire pump starting shall be annunciated through an electric siren.

5.3 The starter along with isolator shall be housed in a 14 SWG MS box duly rust inhibited through a process of degreasing and phosphating.

5.4 All cabling to and from the pumps to starter and control switch shall be carried out through armoured PVC cables of approved makes. Cables shall be laid in accordance with section "M V CABLING". The pump motors and panels shall be

double earthed in accordance with IS 3043-1966 or as shown on drawings and as approved.

6.0 Diesel Engine

6.1 The diesel engine shall be of multi cylinder type four stroke cycle with mechanical (airless) injection, cold starting type.

6.2 The engine shall be designed with regard to ease of maintenance, repair, cleaning and inspection. This will also provide interchangeability of parts.

6.3 All parts susceptible to temperature changes shall have tolerance for expansion and contraction without resulting in leakage, misalignment of parts or injury to parts.

6.4 The engine shall be capable of both automatic and manual start. Generally the engine shall start automatically, but in case of the auto-start system failure the engine shall be capable of manual start. Engine shall be able to start without any preliminary heating of combustion chamber; cranking mechanism shall also be provided. All controls / mechanisms which have to be operated in the starting process, shall be within easy reach of the operator. A day oil tank constructed from minimum 1.6 mm thick sheet MS sheet of 200 litres capacity shall be provided as per Engine manufacturer's guide line.

6.5 A high torque D.C. motor charged by battery shall initiate automatic start of diesel engine. The battery shall hold adequate retainable charge to provide the starting of the diesel engine. Starting power will be supplied from storage batteries. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression. Battery shall be lead acid type of 12 V, 180 Ah capacity.

6.6 The battery banks shall be used for no other purpose other than starting of the engine and shall be fully charged at all times with provision for trickle & boost chargers. After start of the engine the charger shall be disconnected, the battery being fed from the engine dynamo.

6.7 The engine shall have a speed control device (Governor) which will control the speed under all conditions of load. The governor shall be suitable for operation without external power supply.

6.8 The Engine shall an adjustable governor to regulate engine speed within a range of 10 % between shut-off and maximum load conditions of the pumps. The governor shall be set to maintain rated pump speed at maximum pump load.

6.9 The Governor shall have an over speed shutdown device to shutdown the engine at a speed approximately 20 % above rated engine speed with manual reset, so that the automatic engine controller will indicate an over speed signal until the device is manually reset to normal operating position.

6.10 The Diesel Engine shall cooled by a Heat Exchanger and the Contractor shall be make arrangement for continuous supply of such water.

6.11 The engine shall be mounts on a base plate of fabricated steel construction. Adequate access shall be provides to the big end and main bearings, camshaft and governor drives, water jackets etc.

6.12 The engine shall have a base plate made from M S sections. There shall be reasonable space at the big end, camshaft, water jackets, governor drives and main bearings.

6.13 The engine shall be provides with intake and discharge ductwork, inlet filter and

silencer, outlet muffler, expansion joints, dampers etc. as necessary for efficient operation. Intake air shall be taken from inside the building in which the engine is located, but the exhaust shall be discharged into the air.

6.14 The diesel engine shall be provides with adequate instrumentation. The gauges etc. as required are provides for in the Engine Panel.

7.0 **Diesel Pump Panel:**

7.1 The Panel shall consist of the following:

7.1.1 Engine Starting System:

It shall be provided with a Lead Acid of minimum 180 Ah capacity to provide adeqaute throttle for starting.

7.1.2 Engine Instruments and Control Panel:

- It shall be complete with required connections to set and comprising:
- Inlet and out let water temperature gauge (dial type)
- Lubrication oil pressure gauge.
- Lubrication oil Temperature gauge.
- Automatic Start Stop Device.
- The Engine shall be provided with Manual Start / Stop Switch by means of Push Buttons.
- Start Stop and Failure Control Device.
- Start key for manual starting.
- Stop Push Button for manual stopping of engine.
- Starting failure indication by lamp and Horn Unit.
- Engine temperature control with failure indication by red lamp.
- Engine temperature very high indication by audio alarm and automatic stopping of engine.
- Engine set in operation indication by green lamp.
- Mains supply available indicated by yellow lamp.
- Push Button for Audio Alarm reset.
- Push Button Failure Indication by lamps.
- The Panel shall also have an Auto / Manual / Test / Off Selector Switch.

8.0 Fire hydrants and hose reels

8.1 Hydrants shall be provides internally and externally as shown on the drawings. Internal hydrants shall be provides at each landing of and escape staircase and additionally depending on the floor area as shown on drawings. Landing valve shall be single headed gunmetal valve with 63 mm dia outlets and 80mm inlet conforming to IS 5290-1969. Landing valve shall have flanged inlet and instantaneous type outlets and mounted at 1.0m above the floor level. Instantaneous outlets for the hydrants shall be of standard pattern approved and suitable for 63mm dia fire brigade hoses. Wherever necessary, pressure reducing orifices plate and shall be provided so as to limit the pressure to 3.5 kg/sqcm or any other rating as required by the Local Fire Authority.

8.2 Each landing valve shall have a hose reel cabinet as shown on drawings.

a) Landing valve with single 63 mm dia outlet and 80 mm dia inlet.

b) First-aid hose reel with 30 m long 25 mm dia high pressure double braided rubber hose (IS:444 marked) with 25 m dia Ball Valve.

c) 2 Nos. 15.0 Meter long 63 mm dia Reinforced Rubber Lined (RRL) hoses with gun metal I.S. marked instantaneous couplings.

d) One gun metal branch pipe.

8.3 The First Aid Hose shall conform to IS 884-1969 and be wound on a heavy duty circular hose reel with a bracket. The hose shall be permanently connected on one end to the Wet Riser through a 25m Ball Valve with necessary hose adapter and a gun metal nozzle at the other end.

8.4 Hoses shall be in two lengths of 15.0 m each, of RRL type with instantaneous couplings, neatly rolled into bundles and held in position with steel brackets. Hoses shall be tested and certified by the manufacturer, to withstand an internal water pressure of not less than 35 kg/sqcm without bursting. The hose shall also withstand a working pressure of 7 kg/sqcm without leakage.

8.5 The hose cabinet shall be fabricated from 2mm mild steel sheet duly rust inhibited through a process of degreasing and phosphating. The cabinet shall have double flap hinged doors with 4mm clear glass and shall have necessary openings for riser main and brackets for all internals. The cabinet shall receive two coats of red oxide primer both inside and outside before two after coats of final paint of approved color shade.

8.6 External hydrants shall be as per IS : 5490 with hand wheel control and a 80 mm dia pipe stand post. Hydrants shall be located at least 2m away from and within 15m from the building wall.

8.7 Each hydrant shall be provided with a hose cabinet containing 2x15m 63 dia RRL hoses with couplings. The cabinet shall contain a branch pipe and nozzle. The cabinet shall be 900 x 600 x 400 fabricated out of 2 m mild steel sheet duly rust inhibited through a process of degreasing, phosphating etc. The cabinet shall receive two coats of red oxide primer, inside and outside, before 2 coats of final painting of approved shade. The cabinet shall be wall-mounted or free standing with its own steel legs depending on the site conditions and as shown on drawings and as approved.

8.8 The fire brigade connection shall consist of two / three/four headed as specified in BOQ 63mm dia gun metal outlets with built-in check valve and drain plugs connected to a 150mm dia outlet connection to the water reservoir or to the hydrant main. The fire brigade collecting head shall conform to IS 904-1965.

9.0 Test & commissioning

9.1 The Jockey & fire pump starting and stopping shall be tested by opening the test valve and record the following and the valves should be as furnished below:

1) Jockey pump start/stop

System pressure at start-up	:	5.0 kg/sqcm
System pressure at stop	:	7.0 kg/sqcm
Time elapsed from start to stop	:	2 Seconds

2) Hydrant Pump start

System pressure at start-up	:	4.0 kg/sqcm

3) Diesel Engine Pump start : 3.0 Kg/sqcm

9.2 Maintained system pressure while discharging the landing valve at the highest point.

a)	Pump end	:	7.0 kg/sqcm
b)	Highest outlet	:	3.5 kg/sqcm
c)	Intermediate points	:	5.0 kg/sqcm

10.0 Mode of measurement

- Hydrant pump with mounting frame, excluding concrete foundation shall be measured per unit.
- Jockey pumps same as hydrant pump.
- Instrument panel with pressure gauges, pressure switches, control piping etc. shall be measured as one unit.
- Control cabling from pressure gauge panel to the respective starters shall be measured in running meter and paid at unit rates.

SECTION II

PIPING FOR FIRE FIGHTING SYSTEM

1.0 Scope

1.1 The scope of work covers, supply, fabrication, laying, testing, painting and commissioning of the entire piping system for the fire fighting installation i.e. fire hydrant and sprinkler systems.

2.0 Piping

2.1 External

2.1.1 All External pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought GI steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.

2.1.2 Black mild steel pipes, when laid underground, shall be protected against corrosion by two coats of hot bitumen and 2mm thick wrapping of pypkote. Fittings shall be weld able wrought iron, suitable for butt welding and 10% of the welded joints shall be radio graphically tested and found in order. The welded joints shall be random selected for testing in consultation with the Engineer-in-charge. All flanges shall be slip-on welded type to IS 6392 with a 3mm fibre-reinforced teflon gasket and rated for 2.0 N/sq. mm.

2.1.3 Underground mains shall be laid not less than 750 mm below the ground level and shall be at least 2m away from the building face and supported on concrete pedestals at every 3.5m and held on with galvanised iron clamps. Concrete thrust anchors shall be provided at all bends and tees as shown on drawing and as directed. All excavation for pipe laying shall be carried out with sufficient width for making proper joints. Backfilling shall be done only after the piping is hydro-statically pressure tested. Piping shall be constantly kept clean till tested.

2.1.4 All valves shall be housed in brick masonry chambers over 150mm cement concrete (1:3:6) foundation. The brick walls of the chamber shall be plastered inside and outside with 20mm cement sand plaster 1:4 with a floating coat of neat cement. Chambers shall be 650 x 650 mm clear for depths upto 1200 mm and 1000 x 1000 mm for depths beyond. Each chamber shall have a cast iron surface box approved by the Engineer in-charge.

2.1.5 Piping laid above ground shall be supported on cement concrete (1:2:4) pedestals raising the bottom of the pipe at least 150mm over the ground level and held to the pedestals with galvanized clamps. Pedestals shall be made at 3.0m centre to centre and as shown on drawings. Cement concrete 1:2:4 thrust anchors shall be provided at all tee-off points and change of direction as shown on drawings and as required. Pipes laid on walls and ceiling shall have galvanized steel brackets.

2.2 Internal

2.2.1 All internal pipes shall be, unless otherwise specified, heavy quality mild steel tubes to IS 1239 using wrought steel heavy duty screwed fittings. Flanges shall be provided to mate with valves and other equipment and shall conform to IS 6392. Flanges shall be screwed type. Flanges shall be rated for 2.0 N/sqmm.

2.2.2 Valves shall be suitable for external piping.

2.2.3 All pipes shall be of approved make and best quality without rust marks. Pipes and fittings shall be fixed in a manner as to provide easy accessibility for repair, maintenance and shall not cause obstruction in shafts, passages etc. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanship manner. Pipes shall be securely fixed to walls and ceilings by suitable supports at intervals specified. Only approved type of anchor fasteners shall be used for RCC ceiling and walls.

2.2.4 All pipes shall be adequately supported from ceiling or walls through structural supports fabricated from mild steel structural e.g. rods, channels, angels and flats generally as shown on drawings. Fasteners shall be shear type anchor fasteners in concrete walls and ceilings and wrought steel spikes of at least 75mm long in brick walls. All pipes supports shall be painted with 1 coats of red oxide primer and two coats of black enamel paint.

2.2.5 All low point loops in the piping shall be provided with 25mm Ball Valves with rising spindle for draining the system. All valves shall have screwed brass caps. Likewise 25mm gun metal air vents shall be provided at all high point loops to prevent air-locking.

2.2.6 All piping shall have flanged joints at about 25m intervals to facilitate easy maintenance.

3.0 Pipe Jointing

3.1 All pipes shall be provided with threaded joints up to 50mm diameter and welded joints for pipe above 50mm diameters. Hold titer shall be used for sealing.

3.2 All welded joints shall be tested by radiography test.

3.3 Joints between CI and GI pipes shall be made by providing a suitable flanged tail or socket piece and MS flange on the GI pipe. Flanges shall have appropriate number of holes and shall be fastened with nuts, bolts and 1.5mm thick compressed asbestos gasket.

4.0 Valves and other accessories

4.1 Gate Valves

4.1.1 Sluice / Gate valves shall be used for isolation of flow in pipe lines For sizes upto 65 mm, gate valves shall be outside screw rising spindle type and shall be as per IS: 778 Class-I and Class-II, as applicable. For sizes 80 mm to 300 mm, gate valve shall be as per IS: 780, PN=1.0 and shall be of inside screw and non rising type and cast iron double flanged.

4.1.2 Gate valves shall be provided with a hand wheel, draining arrangement of seat valve and locking facility (as required). Gate valves shall have back setting bush to facilitate gland renewal during full open condition.

4.1.3 The Body, bonnet, Stuffing Box, cap and hand wheel shall be of cast iron to IS:210/70, grade FG 200 / 260. The non rising spindle shall be of solid forged high tensile brass or

carbon steel to AISI 304 construction. The Body seating and wedge ring shall be of solid leaded gun metal. The Bonnet gasket shall be of high quality rubber.

4.1.4 The Valve shall be PN 1.0 rated but shall withstand tests of upto 20 kg / cm^2. The ends shall be flanged. The batch number of the valve shall be punched on the top of the flange. The spindle shall be removable type, and shall be easily rotated.

4.2 Pressure Switch

4.2.1 The Pressure switches shall be employed for starting and shutting down operation of pumps automatically, dictated by line pressure. The Pressure Switch shall be diaphragm type. It shall be suitable for line pressures upto 15 kg / cm2. The scale range for cut in and cut out shall be from 0 to 10 kg / cm2.

4.2.2 The Switch shall be suitable for consistent and repeated operations without change in values. It shall be provided with IP:66 water and environment protection.

4.2.3 The enclosure shall be of aluminium and pressure element and wetted parts shall be of stainless steel. The switch shall be snap acting type with 1 number N O / N C contact.

4.3 Air Vessel

4.3.1 Air vessel shall be fabricated from 6 mm thick, 300mm x 1000mm MS plate suitable for 7kg/cm^2 working pressure complete with air release valve, safety valve, pressure gauge etc. as required. The air vessel shall be continuous welded construction and painted with two coats of Postal red enamel outside over a coat of primer and epoxy paint inside.

4.4 Pressure Vessel

4.4.1 The Pressure Vessel shall be provided to compensate for slight loss of pressure in the system and to provide an air cushion for counter acting pressure surges whenever the pumping set comes into operation. It shall be normally partly full of water, the remaining being filled with air which will be under compression when the system is in normal operation.

4.4.2 Pressure vessel shall be fabricated from 8-10 mm thick MS plate with dished ends and suitable supporting legs. It shall be provided with a 50 mm dia flanged connections from pump, one 25 mm drain with ball valve, one water level gauge and 25 mm sockets for pressure switches. The pressure vessel shall be hydraulically tested as required.

4.4.3 The Pressure Vessel shall be for Hydrant Systems. The Pressure Switches shall be mounted on the drain end of each Vessel. The Vessel shall also be provided with an air release valve mounted at the top.

4.5 Pressure Gauge

4.5.1 The Pressure Gauge shall be constructed of die cast aluminum and stove enameled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourdon tube type Pressure Gauge with a scale range from 0 to 16 Kg / CM2 and shall be constructed as per IS: 3624. Each Pressure Gauge shall have a siphon tube connection. The Shut off arrangement shall be by Ball Valve.

4.6 Ball Valve

4.6.1 The Ball Valve shall be made from die cast brass and tested to 14 Kg/cm^2 pressure.

4.6.2 The valve shall be internally threaded to receive pipe connections.

4.6.3 The Ball shall be made from brass and machined to perfect round shape and subsequently chrome plated. The seat of the valve body- bonnet gasket and gland packing shall be of Teflon.

4.6.4 The handle shall be of chrome plated steel with PVC jacket. The handle shall also indicate the direction of `open' and `closed' situations. The gap between the ball and the Teflon packing shall be sealed to prevent water seeping up to 14 Kg / cm^2 pressure.

4.6.5 The handle shall also be provided with a lug to keep the movement of the ball valve within 90 degree. The lever shall be operated smoothly and without application of any unnecessary force.

4.7 Non Return Valve

4.7.1 No return valves shall be cast iron spring action swing check type. An arrow mark in the direction of flow shall be marked on the body of the valve. The valve shall bear IS:531 certification.

4.7.2 The Valve shall be of cast iron body and cover. The internal flap in the direction of water shall be of cast iron and hinged by a hinge pin of high tensile brass or stainless steel. Cast iron parts shall be conform to IS:210 / 70, grade 200 / 260 type.

4.7.3 The gasket shall be of high quality rubber and flap seat ring of leaded gun metal to BS 1400 LG 2C. At high pressure of water flow the flapper shall seat tightly to the seat. The Valve shall be capable of handling pressure up to 15 kg / cm^2.

4.8 Butterfly Valve

4.8.1 The Butterfly Valve shall be suitable for waterworks and tested to minimum of 16 kg / sq cm pressure. The Valves shall fulfill the requirements of AWWA (American Water Works Association) C 504, API 609 and MSS-SP-67.

4.8.2 The body shall be of cast iron to IS:210 in circular shape and of high strength to take the minimum water pressure of 10 kg / cm2. The disc shall be heavy duty cast iron with anti corrosive epoxy or nickel coating.

4.8.3 The valve seat shall be of high grade elastomeric or nitrile rubber. The Valve in closed position shall have complete contact between the seat and the disc throughout the perimeter. The elastomer rubber shall have a long life and shall not give away on continuous applied water pressure. The shaft shall be of EN 8 grade carbon steel.

4.8.4 The Valve shall be fitted between two flanges on either side of pipe flanges. The Valve edge rubber shall be projected outside such that they are wedged within the pipe flanges to prevent leakage.

4.8.5 The Valves shall be supplied with manual gear operated opening / closing system by lever.

5.0 Pipe supports

All pipes whether horizontal or vertical shall be suitably supported using galvanized mild steel clamps/clevis hanger manufactured by M/s Hitech Support (India) Pvt Ltd or equivalent product of good quality as approved by engineer in-charge.

5.1 Vertical Pipes

5.1.1 The pipes running vertical shaft shall be supported by galvanised mild steel rigid clamps fixed to wall with anchor bolts and studs.

5.1.2 When the horizontal distance between the centre line of two adjacent pipes is less than 300 mm a powder coated HITECH/or equivalent rail shall be fixed to wall the pipes independently clamped to the rail with `U' bolt clamps.

5.2 Horizontal Pipes

5.2.1 Pipes running horizontal shall be supported from structural beam/slab by using appropriate galvanised m.s. pipe clevis hangers.

5.2.2 The spacing of supports shall be as follows:

GI Pipes/MS Pipes		CI Spun Pipes	
Internal Dia (mm)	**Spacing (mm)**	**Internal dia (mm)**	**Spacing (mm)**
15	1800	75-150	2700
20,25	2400	200-250	3000
32	2700	300	3600
40-50	3000		
65-80	3600		
100	4000		
150	4500		

5.2.3 Supports for horizontal piping longer than 15m in a stretch shall be provided with swivel clamps. Otherwise, the clamps shall be universal clamps or rigid clamps as required by the project engineer.

5.3 Fixing of clamps/rails etc.

All clamps, rails and accessories shall be fixed to the structure (beam, slab, walls etc.) by using approved good quality anchor fasteners of appropriate size.

6.0 Painting

6.1 All exposed piping for fire fighting shall be distinctly painted `Fire red' shade 536 to IS:5-1978. Pipes shall first receive two coats of red oxide primer uniformly applied and two coats of oil paint applied thereafter. All pipes supports shall be painted black as specified for support & clamps.

6.2 Painting Schedule

6.2.1 All equipment and piping shall be painted in accordance with the following colour code:

Equipment	Colour	Distinguishing Mark
a) Pump motors	Fire Red Shade No.536 to IS: 5 -1978	
b) Internal piping	"	

c)	Landing valves & Hose reel cabinets	"
d)	External Hydrants	"
e)	Fire brigade connection	"
f)	Priming tank	"
g)	Air vessel	"
h)	Electric panels	Black & Red
i)	Fire Alarm Panel	Black & Red
j)	Repeater panel	Black & Red
k)	Break Glass Unit	Fire Red
l)	Hooters/Speakers	Fire Red
m)	Sprinkler pipes	Fire Red

6.2.2 All surfaces to be painted shall be thoroughly cleaned with wire brush to remove completely rust and other extraneous substances. Over the cleaned surfaces one coat of red oxide primer shall be applied completely covering the exposed surfaces. Finishing coat of enamel paint shall be applied one day after the prime coat, after ensuring that the paint is dry. The second coat shall be done before the installation is handed over and after approval to do so from the Engineer-in-charge.

7.0 Testing & commissioning

All piping after installation shall be tested for a hydrostatic test pressure of 10.5 kg/sqcm or 1.5 times the working pressure (whichever is less) maintained for 24 hours. All joints and valves shall be checked for leaks and rectified and retested. During testing all valves except drain & air valves shall be kept fully open.

8.0 Makes of materials

The makes of materials shall be got approved from Engineer-in-charge after concurrence from the client.

9.0 Mode of measurement

9.1 All external piping shall be measured along the centre line of the pipe and paid per unit length and shall include:

9.1.1 All pipes & fittings

9.1.2 Bituminous coating

9.2 All internal piping shall be measured similarly but shall include for the pipe supports and clamps.

9.3 All valves, air valves, drain valves together with flanges or tail pieces shall be measured per unit.

9.4 All excavation and concrete supports and thrust blocks shall be measured as per drawing and paid for per cum.

9.5 The cost of pipe supports described above form part of the rate quoted for piping and no extra shall be payable on the account.

All painting shall form part of the cost of equipment piping etc. No separate payment shall be admissible.

SECTION - III
SPRINKLER SYSTEM

1.0 **Pendant type Sprinkler Head**

1.1 Sprinkler heads shall be of quartzoid bulb type with bulb, valve assembly, yoke and the deflector. The sprinkler shall be of approved make and type with 15 mm nominal dia outlets.

1.2 The bulb shall be made of corrosion free material strong enough to withstand any water pressure likely to occur in the system. The bulb shall shatter when the temperature of the surrounding air reaches at 68° C / 79° C.

1.3 The nominal bore shall be 15 mm dia and colour of liquid shall be Red / Yellow.

1.4 The Sprinkler head shall be approved by UL / FM.

2.0 Upright type Sprinkler Head

2.1 Upright sprinkler heads shall be similar to Pendent type in material construction and performance but designed to throw water Droplets upwards in umbrella fashion, to cool the underside of ceiling and extinguish any fire involving combustibles on the floor below.

2.2 The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm dia and the colour of liquid shall be red.

2.3 Upright Sprinkler heads shall be use in lower and upper basement parking areas and above the false ceiling.

3.0 Side Wall type Sprinkler Head

3.1 Side wall sprinkler heads shall be similar to Pendent type in material construction and performance but designed to throw water Droplets horizontally.

3.2 The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm diameter and the colour of liquid shall be red.

3.3 Side wall sprinkler heads shall be use in staircase landing and along the ramp.

Water Curtain Sprinkler:-

For basement car parking, compartmentation can be achieved, with fire barrier or with water curtain nozzle (K-23) or with combination thereof. Automatic deluge system comprising deluge valve, piping, nozzles, etc shall be used to zone the compartment in case of water curtain system. In case of water curtain, existing water storage shall be supplemented by water demand for water curtain nozzles for 60 min considering the largest compartment' s perimeter out of all compartments of car parking in any of the basements. d) The water supply for the water curtain nozzles shall be through independent electric pump of adequate capacity (flow and head) with piping/riser for the water supply to the nozzles. e) The water curtain shall be operated by the actuation of flow switch actuating sprinkler system.

Installation

The spray nozzle must be handled with due care. For best results, the storage as well as any further shipment be made in original packing only. Nozzle which is visibly damaged should not be installed. Use Teflon tape or soft thread sealant on male thread of the nozzle. The nozzles must be tightened into the fitting. Excessive tightening torque may result into serious damage to nozzle arms and the deflector which may affect spray pattern of the nozzle and it's performance. Spray nozzles are to be installed in accordance with the latest published standards of NFPA or similar organizations and also with the provisional governmental code, ordinance and standards whenever applicable. The use of these nozzles may be limited due to occupancy and hazard, refer to Authority having jurisdiction prior to installation.

Inspection, tests & maintenance

It is recommended that window spray system be inspected regularly by authorised technical personnel. The nozzle must be checked for atmospheric effects, external and internal obstruction, blockage if any. The nozzles should be cleaned or replaced if required. The system must be operated with optimum water flow at least twice in a year or as per the provisions of NFPA or local authority having jurisdication. The owner is solely responsible for maintaining the water spray system and the components therein so that it performs properly when required

4.0 Powder coated Sprinkler with Powder coated Twin plate Rosette.

4.1 Most areas below false ceiling shall be provided with powder coated pendant sprinkler with twin plate sliding rosette. The sprinkler head shall be same as Pendent type above but powder coated white. The sprinkler head shall be provided with a double plate powder coated rosette that shall seal the gap between the false ceiling and he sprinkler head.

4.2 The adjustment allowable shall be 12 mm. The lower part shall have flared ends that shall fit tightly into the upper piece.

4.3 The Sprinkler head shall be approved by UL / FM. The nominal bore shall be 15 mm diameter and the colour of liquid shall be red.

5.0 Installation Control Valve for Sprinkler

4.1 The Installation Control Valve shall be double seated clapper type check valve. The Body and cover shall be made from Cast Iron to IS:210 Grade FG 200. The seat and seat clamp shall be made from bronze to IS: 318, LTB II grade. The sealing to the seat shall be neoprene gasket. The hinges pin and ball shall be from stainless steel.

4.2 It shall be vertically mounted and the direction of water travel shall be indicated on the surface. It shall be rated to 12 Kg / cm^2 and tested to 25 Kg / cm^2 pressure.

4.3 A By-pass check valve shall be fitted to adjust minor and slow variations in water pressure for balancing so as to avoid any false alarm.

4.4 The valve shall also be provided with a Test Control Box. The Box shall house a lever to test and operate the ICV. A brass strainer shall also be provided at the point of water supply to the Alarm gong. A Retarding Chamber shall also be provided.

4.5 The Chamber shall be able to balance the water pressure in case of water line surges.

4.6 Each Installation Control Valve shall have two sets of Pressure Gauges with brass ball valve type shut off.

4.7 A Water Motor Alarm. shall also be provided. This shall be mechanically operated by discharge of water through an impeller. The drive bearing shall be weather resistant. A strainer shall be provided on line before the nozzle. The Gong piece shall be constructed from bronze to IS 318, 2 TB II Grade, and base of cast iron. The Motor Housing, Rotor and Housing Cover shall be pressure die cast aluminium.

6.0 Flow Switch

6.1 Flow switch shall have a paddle made of flexible material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle / pipe through a connecting socket. The Switch shall be potential free in either N O or N C position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The seat shall be of stainless steel. The Flow Switch shall have IP:55 protection.

6.2 The Flow Switch shall work at a minimum flow rate of 100 LPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

7.0 Makes of materials

The makes of materials shall be got approved from Engineer-in-charge after concurrence from the client.

8.0 Mode of measurement

8.1 Sprinkler head including supports and clamps for fixing shall be measured as unit.

8.2 All alarm control valves including drain valves, butterfly valve and all other accessories together with flanges or tail pieces shall be measured per unit.

8.3 All floor control valves including drain valves, butterfly valve, sight glass and all other accessories together with flanges or tail pieces shall be measured per unit.

SECTION - IV
PORTABLE FIRE EXTINGUISHERS & EXIT SIGNAGES

1.0 Scope

The scope of work covers the supply and installation of portable fire extinguishers. The following types are envisaged in these specifications and provided as shown in the schedule of portable fire extinguishers.

- Dry powder extinguisher
- Carbon-dioxide extinguisher
- Mono ammonia phosphate extinguisher
- Water expelling type.

2.0 Standards

The following standards and rules and regulations shall be applicable:

Fire protection manual of the tariff advisory committee, Fire Insurance Association of India

- IS:2176:Portable fire extinguisher Dry power type
- IS:2878:Portable fire extinguisher carbon-dioxide type
- Local Fire Brigade/Authority

All standards mean the latest.

3.0 Extinguishers

Dry powder type

The extinguishers shall be 2, 5, 10 kg capacity and cartridge type unless specified otherwise.

The body shall be of cold rolled carbon steel grade D and 1.5mm thick upto 5 kg and 2mm for 10 kg. The construction shall be similar to `Soda Acid type' but of the following dimensions.

Capacity (kg)	Outside dia (mm)	Filler opening (mm)
2.00	100	45
5.00	150	45
10.00	175	45

The discharge fitting shall be with 500mm 10mm dia hose upto 5 kg and 750 mm 12.5 mm dia for 10 kg with a trigger controlled nozzle capable of discharging 85% of the contents as follows:

Capacity (kg)	Time (sec)	Throw (m)
2.00	8 - 10	2
5.00	15 - 20	4
10.00	23 - 30	6

A carbon dioxide cartridge conforming to IS:4947 shall be fitted in a cartridge holder with an inner shell. A spring loaded piercing device shall be provided in the cap for piercing the seal of the gas cartridge. A syphon tube of copper or PVC shall be provided for upright operation. The cap and neck ring shall be similar to Soda Acid type extinguisher.

All internal and external components and surfaces shall receive anti-corrosive coating of not less than 12 microns shall be applied uniformly as indicated below:

a)	Body	Mild steel	Tin alloy
b)	Cage for acid	Brass sheets	Lead or tin alloybottle and spring
c)	Discharge fittings	Leaded - Tin	Tin alloy
Bronze			
d)	Strainer	Brass sheets	Lead or Tin alloy

3.2 Carbon dioxide type

The extinguishers shall be rated for 2.0 and 4.5 kg by weight or carbon dioxide, unless stated otherwise. The contents shall be with a filling ratio not exceeding 0.667.

The body shall be steel cylinder made according to IS:2872 and approved by the chief controller of explosives.

The discharge head shall be simple and safe to operate conforming to IS:3224 with a safety release to IS:5903 set to 18.0 to 20.0 N/sqmm. A syphon tube of copper or PVC shall be fitted. A non-conducting discharge horn and a high pressure hose (27.5 N/sqmm pressure) shall be fitted with each extinguisher.

The discharge system shall be designed to expel 95% of the contents in continuous discharge as follows:

Capacity (kg)	**Time (Sec.)**
2.0	8 - 18
3.0	10 - 20
4.5	10 – 24

3.3 Mono ammonium phosphate type

The capacities envisaged are 2 kg & 5 kg. The filling pressure shall be 0.95 +/- 0.055 N/sqmm.

The body shall be cylindrical in shape and made of cold rolled carbon steel grade D/DD or hot rolled steel plate with radiographically tested welded construction. Plate thickness shall conform to IS:11108.

Discharge valve mechanism shall be a simple and safe squeeze grip valve. 4.5 kg and above capacity shall have a high pressure (0.5 N/sqmm) hose and non-conducting horn and shall also be provided with a pressure gauge. 95% of the contents shall be discharged as follows:

Capacity (kg)	**Time (sec)**	**Throw (m)**
2.00	8 - 16	2
6.00	15 - 24	4

The internal and external components and surface shall be treated for anti-corrosion as for dry powder type extinguishers.

3.4 Water CO2 Fire Extinguisher

The extinguishing medium shall be primarily water stored under normal pressure, the discharge being effected by release of carbon dioxide gas from a 60 gms cylinder.

The capacity of the cylinder when filled shall be 9 litres +/- 5 %.
The cylinder shall be fabricated from MS sheet, welded at seams, with dish and dome, being of same thickness and of size not exceeding the diameter of the body. The neck shall be externally threaded with leaded tin bronze.

The cap shall be of leaded tin bronze. The siphon tube shall of brass or GI. The cartridge holder, knob, discharge fittings and plunger shall be of leaded tin bronze and plunger of stainless steel with spring also of stainless steel. The discharge tube shall be of braided nylon, of 10 mm dia and 600 mm length with a brass nozzle.

The extinguisher shall be treated for anti corrosion internally and externally and painted fire red externally. The cartridge shall be IS marked. The Extinguisher body shall be tested to 25 bar pressure for 2 minutes. The Extinguisher shall be IS:940 marked.

3.5 General requirements

All extinguishers shall be standard products approved by the Tariff Advisory Committee and Local Fire Authority and manufactured and tested strictly in accordance with the relevant Indian Standard. All markings and test results shall be stamped in the appropriate colour markings accordingly to the Indian Standards.

All extinguishers shall have a structurally designed galvanised steel handle and also a suitable wall mounting bracket.

4.0 Illumination signs/EXIT signage

The illuminated signs shall have the letters 'FIRE EXIT" or "NO FIRE EXIT" painted in red on a 6mm thick white perspex sheet as the front face of a sheet steel enclosure constructed with minimum 1.5mm thick sheet. The MS box shall be powder coated finished in white colour. The perspex sheet shall be back lit with a rechargeable maintenance free sealed battery integral with a battery charging circuit. The battery backup facility shall operate independent of the mains supply in the event of a mains failure. The batteries shall be of adequate rating so as to support the illumination of the signage for a minimum period of 1 hour without mains power. The preferred dimensions of the illuminated signs shall be 450 mm length and 225mm height with 100 mm high lettering. They shall be suitable for surface or recessed mounting or ceiling hung type as required including all arrangements for suspension, cutting/chasing and making good the defects etc. complete as approved.

5.0 Mode of measurement

Each extinguisher with its mounting bracket shall be measured per unit and paid for.
Exit signages with mounting plate shall be measured per sq.inch and paid for.

6.0 Makes of Equipment and materials

The makes of materials shall be got approved from Engineer-in-charge after concurrence from the client.

SECTION - V

ELECTRICAL WORK

1.0 Scope

1.1 The scope of this section comprises of fabrication, supply, erection, testing and commissioning of electric panels, wiring and earthing of all equipment components and accessories, including supply, installation and wiring of remote mounted push button stations.

1.2 All the electrical cables, termination, wires and accessories are also including in the Scope of Work. The main cable from the main distribution board will be supplied and erected by other Agency.

2.0 General

2.1 Work shall be carried out in accordance with the specifications of CPWD specifications, Indian Electricity Act 1910 and Indian Electricity Rules 1956 as amended up to date.

3.0 Construction Features

3.1 The control panel shall be metal enclosed sheet steel cubical, indoor type, floor mounting/wall mounting type as per BS 5486 Part 1, 190 & IEC 439-1. The control panel shall be totally enclosed, completely dust and vermin proof, Gaskets between all adjacent units and beneath, covers shall be provided to render the joints dust proof. Control panels shall be arranged in multitier formations. All doors and covers shall also have sealing & pad locking arrangement. All mild steel sheets used in the construction of control panels shall be minimum 2mm. thick or as specified and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet metal shall be seam welded, all slag grounded off and welding pits wiped smooth with plumber metal.

3.2 All panels and covers shall be properly fitted and square with the frame, and holes in the panel correctly positioned. Fixing screws shall enter into holes tapped into an adequate thickness of metal provided with hank nuts. Self threading screws shall not be used in the construction of control panels. Base channel shall be of 75mm x 40mm x 5mm thick shall be provided at the bottom. Minimum clear space of 250 mm between top of channel of control panel and bottom most unit shall be provided.

3.3 The control panels shall be of adequate size with a provision of 10% spare space to accommodate possible future additional switchgear. Knockout holes of appropriate size and number of cables shall be provided in the control panels in conformity with the location of incoming and outgoing conduits/cables. All equipment such as meters and indicating lamps, etc shall be located adjacent to the unit with which it is associated and care shall be taken to achieve a neat and symmetrical arrangement. Facility shall be provided for termination of cables from both above and below the control panel. Where cables enter below, cables boxes shall be fitted at the rear and arranged in tiers to facilitate making connections to the upper and lower units. Clamps shall be provided to support the weight of the cables. All incoming and outgoing feeders shall be brought out to a terminal block of adequate size at suitable location inside the control panel. All wiring inside the control panel shall be color coded and labeled with approved plastic beads for identification. Circuit diagrams

showing the arrangement of circuits shall be pasted on the inside of the panel door and covered with transparent plastic sheet and all labeling shall be provided on the front face of the panel board.

4.0 Circuit Compartments

4.1 Each circuit breaker, contactor and relay shall be housed in a separate compartment and shall be enclosed on all sides. Sheet steel hinged lockable door shall be duly interlocked with the breaker in the `ON' position. Safety interlocks shall be provided to prevent the breaker or Contactor from being drawn out when the breaker is in the draw out position of the panel. Instruments and indicating lamps shall not be mounted on the panel compartment door. Sheet steel barriers shall be provided between the tiers in a vertical section.

5.0 Instrument Accommodation

5.1 Separate and adequate compartments shall be provided to accommodate instruments, indicating lamps, control contactors and control fuses etc. These shall be accessible for testing and maintenance without any danger of accident contact with live parts of the circuit breaker and bus bar.

6.0 Bus Bars and Bus bar Connection

6.1 The bus bar and interconnections shall be of aluminum and of rectangular cross sections suitable for full load current for phase bus bars and half rated current for neutral bus bars and shall be extensible on either side. The bars and inter-connections shall be insulated with PVC heat shrinkable sleeve and color coded. All bus bars shall be supported on unbreakable, non-hygroscopic insulated SMC/DMC type supports at regular intervals not more than 400 mm, to withstand the forces arising in case of short circuit in the system. Bus bars shall be provided in separate chamber of main control panels shall be connected by clamping, no holes shall be drilled in bus bars. If holes have to be drilled for making connections, extra cross section of bus bars shall be provided.

6.2 All bus bar connections in smaller control panels shall be done by drilling hole and connecting by brass bolts and nuts. Additional cross section of bus bars shall be provided in small control panels to cover up the holes drilled in the bus bars.

6.3 All connections between the bus bar and breaker and between breaker and contactor shall be through copper strips of proper size to carry full rated current and shall be insulated with coloured PVC heat shrinkable sleeve.

7.0 Terminals

7.1 The outgoing terminals and neutral links shall be brought out to a terminal block suitably located in the control panels. The current transformer for instruments, metering and for protection shall be mounted on the terminal blocks. Separate cable compartment shall be provided for incoming and outgoing cables.

8.0 Wire ways

8.1 A horizontal wire way screwed covers shall be provided at the top to take in the connecting control wiring of different vertical sections.

9.0 Cable Compartments

9.1 Cable compartments/alley of adequate size shall be provided in the control panels for easy termination of all incoming and outgoing cables entering from bottom or top using detachable gland plates with proper knockouts. Adequate and proper DMC supports shall be provided in cable compartments to support cables. All incoming and outgoing terminals shall be brought out on terminal blocks in the cable compartment.

10.0 Materials

a) Rotary Switches

Switches up to 60 amps shall be rotary type with compact and robust construction, built up from one or more stacks with contacts and a positioning mechanism, with stop as required. The terminals shall be shrouded with insulation to prevent accidental contact with live parts. Rotary switches shall be backed up with moulded type HRC fuse fittings of appropriate rating.

b) Selector Switch

When called for, selector switches of rated capacity shall be provided in control panels, to give the choice of operating equipment in selective mode.

c) Molded Case Circuit Breakers (MCCB)

MCCBs shall be quick make, quick break, and preferably double break contact system, arc extinguishing device, independent manual type with trip free feature with mechanical ON, OFF, and TRIP indications as called for in BOQ. A trip button shall be provided for tripping the breaker.

MCCB shall be a compact high strength, heat resistant, flame retardant; insulating molded case with high withstands capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload adjustment

d) Switches

Switches beyond 60 amps shall be panel mounted double break type and suitable for load break duty, quick make and break action. Switch contacts shall be silver plated and shall be back-up with HRC fuses of appropriate rating. The switch handles shall be located at the front.

e) HRC Fuses

Fuses shall be high Rupturing capacity of not less than 20 MVA at 415 volts. The backup fuse rating of each motor/heater/equipment shall be so chosen that the fuse does not operate on starting of motor/heater/equipment. Fuses shall be of the same make as the switches.

f) Starters

Each motor shall be provided with a starter of suitable rating. Direct on line starters shall be provided for motors up to 10 HP.

Operating coils of contactors shall be suit able for 220/415 +/- 10% volts AC, 50 cycles supply system. The contactor shall drip out when voltage drops to 90% of the rated voltage.

g) Over Load Relays

Contactors shall be provided with a three element, positive acting ambient temperature compensated time lagged hand-reset type thermal over load relay with adjustable setting.

h) Current Transformers

Current Transformer shall be of accuracy class - I and suitable VA burden for operation for the connected meters and relays.

i) Single Phase Preventor

Single phase preventor shall be provided for all the starters. Single phase preventor shall act when the supply voltage drops down to 90% of the rated voltage or on failure of one or more phases.

j) Indicating Lamp and Metering

The meters shall be flush mounted and draw-out type. The indicating lamp shall be neon type and of low burden. Each phase indicating lamp shall be backed up with 2 amps fuse.

k) Push Button Stations

Push button station shall be for manual starting and stopping of motors/equipment as called for. Red and Green colour push buttons shall be provided for starting and stopping operations. Push buttons shall be suitable for panel mounting and accessible from front without opening door.

m) Cables

M.V. cables shall be PVC insulated aluminium conductor armoured cables suitable for laying in trenches, duct, and on cable trays as required.

n) Wires

650/1100 volts grade PVC insulated copper conductor wires in conduit shall be used.

11.0 Cable Laying

11.1 Easy access to all cables shall be provided to allow cable withdrawal/replacement in the future. Where more than one cable is running, proper spacing shall be provided to minimize the loss in current carrying capacity with necessary saddling/clamps.

12.0 Earthing

12.1 The earthing of MCC and equipment shall be as per BIS Specification and considered in the main electrical panel. The loop earthing shall be carried out with G.I/Copper Strips/wires.

13.0 Painting for Panel

13.1 All sheet steel work shall undergo a process of seven tank treatment and painting with powder coating paint of approved shade.

14.0 Cable Work

This section covers detailed requirements for supply, laying, testing and commissioning of

cables.

14.1 General

MV cable shall be supplied inspected, laid, tested and commissioned in accordance with drawings, specifications, relevant Indian Standards Specifications and cable manufacturer's instructions. The cable shall be delivered at site in original drums with manufacturer's name clearly written on the drum.

14.2 Material

14.2.1 The MV power cable of 660/1100 V. grade shall be PVC insulated Aluminium conductor armoured cable conforming to IS : 1554 (part - I). MV cable shall be 3.5/4 core of size and type as specified.

14.2.2 The MV control cables shall be PVC insulated copper conductor armoured cable.

14.3 Storage And Handling

14.3.1 All cables shall be inspected upon receipt at site and checked for any damage during transit.

14.3.2 Cable drums shall be stored on a well drained, hard surface, preferably of concrete, so that the drums do not sink in the ground causing rot and damage to the cable drums.

14.3.3 During storage periodical rolling of drums once in 3 months through 90° shall be done. Rolling shall be done in the direction of the arrow marked on the drum.

14.3.4 It should be ensured that both ends of the cable are properly sealed to prevent ingress/absorption of moisture by the insulation.

14.3.5 Protection from rain and sun shall be ensured. Sufficient ventilation between cable drums, should be ensured during storage.

14.3.6 The drums shall always be rested on the flanges and not on the flat sides.

14.3.7 Damaged battens of drums etc. should be replaced, if necessary.

14.3.8 When cable drums have to be moved over short distances, they should be rolled in the direction of the arrow, marked on the drum.

14.3.9 For transportation over long distances, the drum should be mounted on cable drum wheels strong enough to carry the weight of the drum and pulled by means of ropes. Alternatively, they may be mounted on a trailer or on a suitable mechanical transport.

14.3.10 When unloading cable drums from vehicles, a crane shall preferably be used. Otherwise the drum shall be rolled down carefully on a suitable ramp or rails, where necessary.

14.3.11 While transferring cable from one drum to another, the barrel of the new drum shall have a diameter not less than that of the original drum.

14.3.12 The cables shall not be bent sharp to a small radius. The minimum safe bending radius for all types of PVC cables shall be taken as 12 times the overall diameter of the cable. Wherever practicable, larger radius should be adopted. At joints and terminations, the bending radius of individual cores of a multi core cable shall not be less than 15 times its overall diameter.

14.3.13 Cable with kinks and straightened kinks or with similar apparent defects like defective armouring etc. shall be rejected.

14.3.14 Cables from the stores shall be supplied by the contractor as per the site requirement in pieces cut in the stores.

14.4 INSTALLATION

14.4.1 General

The cable installation including necessary joints shall be carried out in accordance with the specifications given herein. For details not covered in these specifications, I.S.:1255 shall be followed. No straight through joint shall be permitted in the system. The cables shall be supplied as per cable schedule submitted by the contractor & approved by Engineer-in-Charge.

14.4.2 Route

14.4.2.1 Before the cable laying work is undertaken, the route of the cable shall be decided by the Architect in consultation with Owner representative.

14.4.2.2 While shortest practicable route shall be preferred, cable runs shall generally follow fixed developments such as roads, foot-paths etc. with proper offsets so that future maintenance, identification etc. are rendered easy. Cross country run to shorten the route length is not desirable as it would lead to route identification and maintenance problems, besides posing difficulties during later development of open areas etc.

14.4.2.3 While selecting cable routes, corrosive soils, ground surrounding sewage and effluent etc. shall be avoided. Where this is not feasible, special precautions as approved by the Architect shall be taken.

14.4.2.4 As far as possible, the alignment of the cable route shall be decided taking into consideration the present and future requirements of other agencies and utility services affected by it, the existence of any cable in the vicinity as may be indicated by cable markers or cable schedules or drawing maintained for that area, possibilities of widening of roads/lanes, storm water drains etc. Cable routes shall be planned away from the drains and should be within the property.

14.4.2.5 Whenever cables are laid along well demarcated or established roads, the MV cables shall be laid further from the kerb line than HV cables.

14.4.2.6 Cables of different voltages and also power and control cables shall be kept in different trenches with adequate separation. Where available space is restricted, MV cables shall be laid above HV cables.

14.4.2.7 Where cables cross one another the cable of higher voltage shall be laid at a lower level than the cable of lower voltage.

14.5 WAY LEAVE

14.5.1 It may be necessary to obtain way leave for the cable route from the appropriate authorities some of whom are listed below:

a) Drainage, Public Health and Water Works.
b) Telephones and Telegraphs.
c) Gas works.
d) Other Undertakings.
e) Owners of properties.

14.5.2 Where necessary, joint inspection with representatives of other authorities may be arranged so that mutual interests are safeguarded. In case of private property, Section 12/51 of the Indian Electricity Act shall be complied with.

14.6 PROXIMITY TO COMMUNICATION CABLES

Power and communication cables shall as far possible cross at right angles. Where power cables are laid in proximity communication cables the horizontal and vertical clearances shall not normally be less than 60 cms.

14.6.1 LAYING METHODS

14.6.1.1 Cables shall be laid direct in ground or in pipes/closed ducts, in open ducts or on cable trays suspended from slab depending on site conditions.

14.6.2 Laying in Pipes/Closed ducts:

14.6.2.1 In location such as road crossing, entry to building, on poles, in paved areas etc. cables shall be laid in pipes or closed ducts.

14.6.2.2 GI or Hume Pipes (spun reinforced concrete pipes) shall be used for such purposes. In the case of new construction, pipes as required shall be laid along with the civil works and jointed according to the instructions of the Engineer-in-Charge as the case may be. The size of pipe shall be as indicated in the electrical drawings. GI pipe shall be laid directly in ground without any special bed. Hume pipe (Spun reinforced concrete pipe) shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate of 40mm nominal size) bed, after which it shall be completely embedded in concrete. No sand cushioning or tiles need be used in such situations. Unless otherwise specified, the top surface of pipes shall be at a minimum depth of 1mtr. From the ground level when laid under roads, pavement etc.

14.6.2.3 Where steel pipes are employed for protection of single core cables feeding AC load, the pipe should be large enough to contain both cables in the case of single phase system and all cables in the case of polyphase system.

14.6.2.4 The pipes on road crossing shall preferably be on the skew to reduce the angle of bends as the cable enters and leaves the crossings. This is particularly important for high voltage cables.

14.6.2.5 Manholes of adequate size as decided by the Engineer-in-Charge shall be provided to facilitate feeding/drawing in of cables and to provide working space for persons.

They shall be covered by suitable manhole covers with frame of proper design. The construction of manholes and providing the cover is not in the scope of this Contract and shall be got executed and paid for by the Engineer-in-Charge through another agency.

14.6.2.6 Pipes shall be continuous and clear of debris or concrete before cable is drawn. Sharp edges at ends shall be smoothened to prevent injury to cable insulation or sheathing.

14.6.2.7 Pipes for cable entries to the building shall slope downwards from the building and suitably sealed to prevent entry of water inside the building. Further the mouth of the pipes at the building end shall be suitably sealed to avoid entry of water. This seal in addition to being waterproof shall also be fireproof.

14.6.2.8 All chases and passages necessary for lying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Engineer-in-Charge.

14.6.2.9 Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

14.6.3 Laying on Cable Trays

14.6.3.1 Cables, where indicated in approved shop drawings, shall be laid on overhead cable trays which are suspended from ceiling or supported from wall, by anchor fasteners as required.

14.6.3.2 The Contractor shall provided for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trifoil clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

14.6.4 Termination

Brass single compression glands shall be provided for MV cables termination

14.6.5 Testing

14.6.5.1 All 650/1100 Volt grade cables before laying shall be tested with a 500 V megger or with a 2,500/5,000 V megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armour and insulation resistance between conductors.

14.6.5.2 All cables shall be subject to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

15.0 CABLE TRAYS

15.1 Prefabricated Cable trays of ladder type and associated accessories, tees, bends, elbows & reducers shall be fabricated from 12 gauge (2.6 mm thick) mild steel. Perforated cable trays and associated accessories tees, elbows, and reducers shall be fabricated from 14 guage (2 mm thick) MS steel.

15.2 Cable trays and accessories and covers shall be painted with one shop coat of red oxide zinc chromate primer and two coats of Aluminium alkyd paint.

15.3 The Contractor shall provide for all accessories for the installation of the cable trays, such as bends, tees, reducers coupler plates, trifoil clamps and structural steel members (comprising of channels, angles, flats, rods) to be fabricated at site for structural supports for cable trays racks etc.

16.0 EARTHING

This section covers detailed requirements for earthing.

16.1 GENERAL

16.1.1 The non-current carrying metal parts of electrical installation shall be earthed properly. All metallic structure, enclosures, junction boxes, outlet boxes, cabinets, machine frame, portable equipments, metal conduits, trunking, cable armour, switchgear, distribution boards, lighting fittings and all other parts made of metal in close proximity with electrical circuits shall be bonded together and connected by means of specified earthing conductors to an efficient earthing system. All earthing will be in conformity with the relevant Indian Electricity Rules 1956 and Indian Standard Specification IS : 3043. Every item of equipment served by the electrical system shall be bonded to earthing system.

16.1.2 Every switch, lighting fixture and 5 Amp outlets shall be provided with insulated copper conductor of 1.5 sq. mm for earthing. The computer workstations shall be earthed with 2.5 sq.mm. insulated copper conductor wire.

16.1.3 Separate copper earth pits shall be provided for UPS, EPABX & Networking equipment.

16.1.4 The raceways shall not be used as a grounding conductor.

16.2 CONNECTION OF EARTHING CONDUCTORS

16.2.1 Main earthing conductor shall be taken from the earth connections at the PDB to the earthing pit. Circuit earthing conductor shall run from the exposed metal of equipment and shall be connected to any point on the main earthing conductor, or its distribution boards or to an earth leakage circuit breaker. Metal conduits, cable sheathing and armouring shall be earthed at the ends adjacent to switch boards at which they originate, or otherwise at the commencement of the run by an earthing conductor in effective electrical contact with cable sheathing. Where equipment is connected by flexible cord, all exposed metal parts of equipment shall be earthed with 2 no. G.I. strips/wires and non-current carrying metallic parts with, 1 no. G.I. strips/wires.

16.2.2 Neutral conductor, sprinkler pipes, or pipes conveying gas, water or inflammable liquid, structural steel work, metallic enclosures cables and conductors, metallic conduits and lightning protection system conductors shall not be used as a means of earthing an installation or even as a link in earthing system. The Electrical resistance of metallic enclosures for cables and conductors measured between earth connections at the main switch boards and any other point on the completed installation shall be low enough to permit the passage of current necessary to operate circuit breakers and shall not exceed 1 OHM.

16.3 EARTH CONNECTIONS

All metal clad switches and other equipment carrying single phase circuit, shall be connected to earth by a single connection. All metal clad switches carrying 3 phase shall be connected with earth by two separate and distinct connections. The earthing conductor inside the building wherever exposed shall be properly protected from mechanical injury by running the same in GI pipe of adequate size. The earthing conductor shall be painted to protect it against corrosion. Earthing conductor outside the building shall be laid 600 mm below finished ground level. The over lapping in **G.I.** strips in joints shall be welded. Lugs of adequate capacity and size shall be used for all termination of conductor wires. Lugs shall be bolted to the equipment body to be earthed after the metal is cleaned of paint and other oily substance and properly tinned.

16.4 PROTECTION FROM CORROSION

Connection between copper and galavanised equipment shall be made on vertical face and protected with paint and grease. Galvanised fixing clamps shall not be used for fixing earth conductors. Only copper fixing clamp shall be used for fixing earth conductors. When there is evidence that the soil is aggresive to copper, buried earthing conductors shall be protected by suitable serving and sheathing.

16.5 EARTHING STATION

16.5.1 PLATE ELECTRODE EARTHING

16.5.1.1 Earthing electrode shall consist of a Copper plate of 600 mm X 600 mm X 3 mm or G.I. plate of 600mm x 600mm x 6.3 mm as called for in the Schedule of Quantity. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 meters below ground level. Wherever possible, earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the wall.

16.5.1.2 The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 20 mm dia GI pipe shall run from the top edge of the plate to the ground level. The top of the pipe shall be provided with a funnel and a mesh for watering the earth through the pipe. The funnel over the GI pipe shall be housed in a masonry chamber approximately 300 mm x 300 mm x 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. Test facility shall be provided with test links for the earthing station.

16.5.2 PIPE ELECTRODE EARTHING

Earthing Electrode shall consist of G.I. medium class. 40 mm dia 4.5 m long pipe (without any joint) G.I. pipe Electrode shall be cut, tapered at the bottom and provided with holes of 12 mm dia drilled not, less than 7.5 cm from each other upto 2 M of length from the bottom. Pipe electrode shall be buried in the ground vertically with its top at not less than 200 mm below the ground level. When more than one pipe is to be installed a separation of not less than 2 M shall be maintained between two adjacent electrodes as called for in the drawings. Wherever possible, earth electrode shall be located as near the water tap, water drain or a down take pipe as possible. Earth electrode shall be kept clear of the building foundations and in no case shall it be nearer than 2 meters from the outer surface of the walls. The pipe electrode shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. A 40 mm x 20 mm reducer shall be used for fixing of funnel

with mesh. The funnel and mesh have been provided for watering the earth through the pipe. The funnel over the G.I. Pipe shall be housed in a masonry chamber 300mm x 300mm x 300mm. deep. The masonry chamber shall be provided with a cast iron cover resting over a CI frame. The breaked earth pit will be provided with test links in suitable enclosures.

16.5.3 ARTIFICIAL TREATMENT OF SOIL

If the earth resistance is too high and the multiple electrode earthing does not give adequate low resistance to earth, as specified in Clause no. 7 then the soil resistivity immediately surrounding the earth electrodes shall be reduced by adding sodium chloride, Calcium chloride, sodium carbonate, copper sulphate, salt and soft coke or charcoal in suitable proportions.

16.5.4 RESISTANCE TO EARTH

The resistance to each earthing system shall not exceed 1.0 ohm.

COMMISSIONING & GUARANTEE

1. SCOPE OF WORK

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rotameters. Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Project Manager.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

2 PRECOMMISSIONNIG

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

2.1 Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

a) All strainers shall be inspected and cleaned out or replaced.
b) Check all clamps, supports and hangers provided for the pipes.
c) Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. Thereafter conduct & hydro test of the system as for (b) above.
d) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

3 FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Architect.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

4 REJECTION OF INSTALLATION / PLANT

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Architect either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/Architect.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Employer.

5. WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

6. HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner's site representative and all testing and commissioning documents shall be handed over to the Owner's site representative.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Owner's site representative.

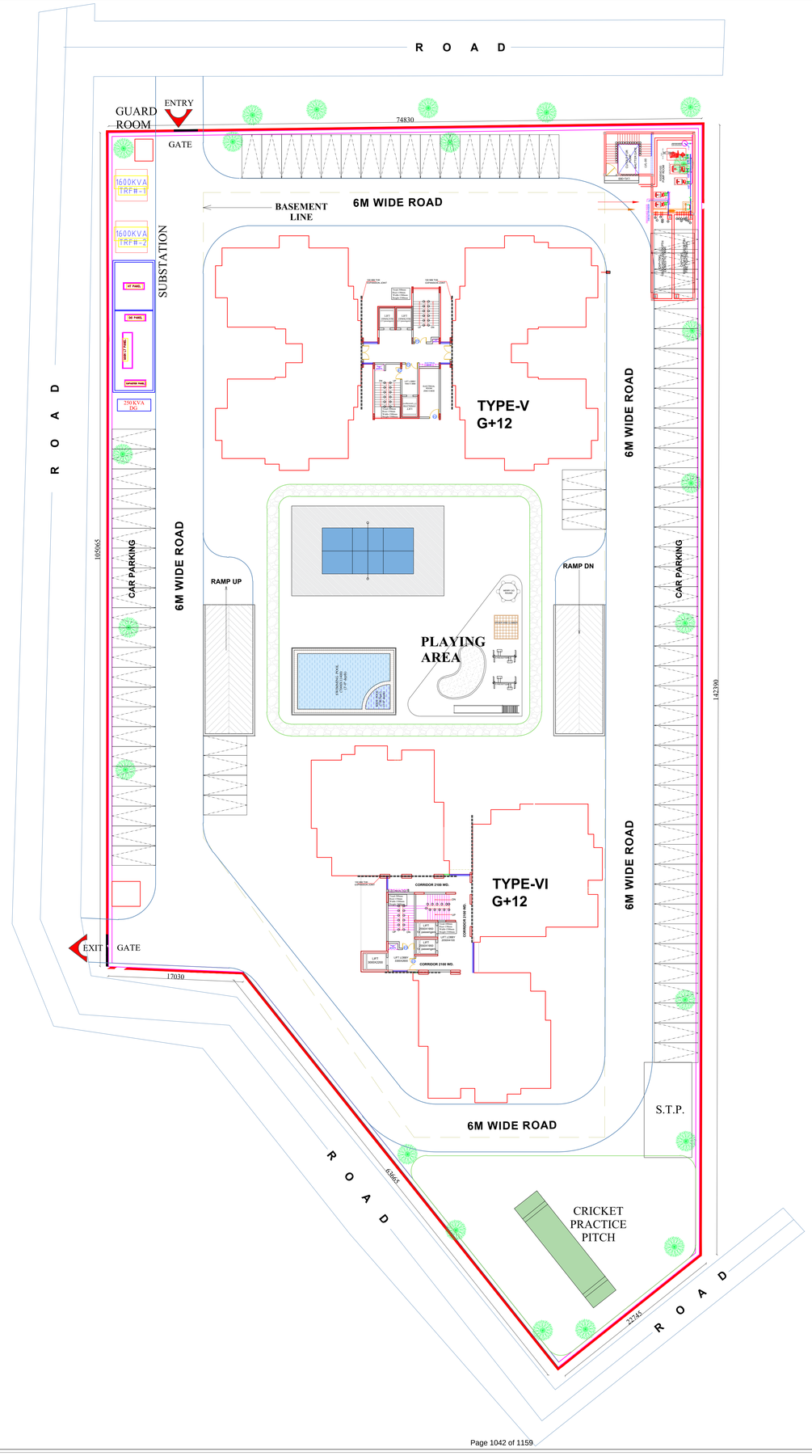
LIST OF STANDARD CODES

S.No.	IS Code No.	Description
1.	IS:780:1984	Specification for sluice valve for water works purposes (6th rev.) (50 to 300 mm size) (amendment 3)
2.	IS:13095:1991	Butterfly valves for general purposes
3.	IS:5312 (part 1) :1984	Swing heck type reflux valves (non-return valve): part 1 single door pattern (1st rev.)(amendment 1)
4.	IS:884:1985	Fire aid hose reel for fire fighting
5.	IS:901:1988	Coupling double male and female instantaneous pattern for fire fighting
6.	IS:903:1984	Fire hose delivery coupling, branch pipe, nozzles and nozzles spanner
7.	NBC-SP-7-1983 Part IV	National building code of India 1983, amendment No. 3
8.		Central public works division (CPWD) Part-V, wet riser system for fire fighting 1985, Govt. of India
9.	IS:3844-1989	Code of practice for installation and maintenance of internal fire hydrants and hose reels on premises
10.	IS:2190:1992	Code of practice for selection and maintenance of first-aid fire extinguisher
11	IS:6382:1984	Code of practice for design and installation of fixed system carbon dioxide fire extinguishing system
12.	SP:35 (s&t)-1987	Hand book on water supply & drainage by bureau of Indian standards
13.		National Building code (sec-ix)
14.	IS:933-1989	Specifications for portable chemical from fire extinguisher
15.	IS:2171-1985	Specifications for portable fire extinguishers, dry power

Volume-II

Part D

TENDER DRAWINGS



LEGEND

SL. NO.	DESCRIPTION	SYMBOL
1.	ROAD	
2.	NORTH DIRECTION	
3.	BOUNDARY	
4.	TREE	
5.	PLAIN AREA	
6.	DIGGING AREA	
7.	GRID	

DWARKA SECTOR-19,DELHI
DWG AREA=0.9680 Hact.=2.3920 Acr

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

DRAWING TITLE :
SITE PLAN

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

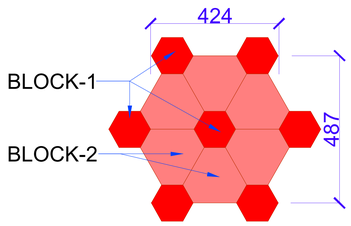
RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
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APPROVED BY		

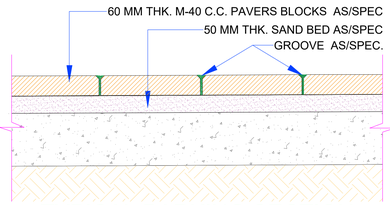
TENDER PURPOSE ONLY

LEGEND OF MATERIALS

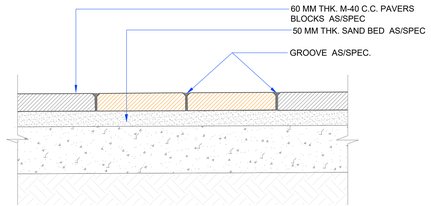
	C.C. FINISH
	ROAD
	INTERLOCKING TILES IN PARKING
	PEDESTRIAN WALKWAY
	GRASS/ GROUND COVER
	WATER BODY



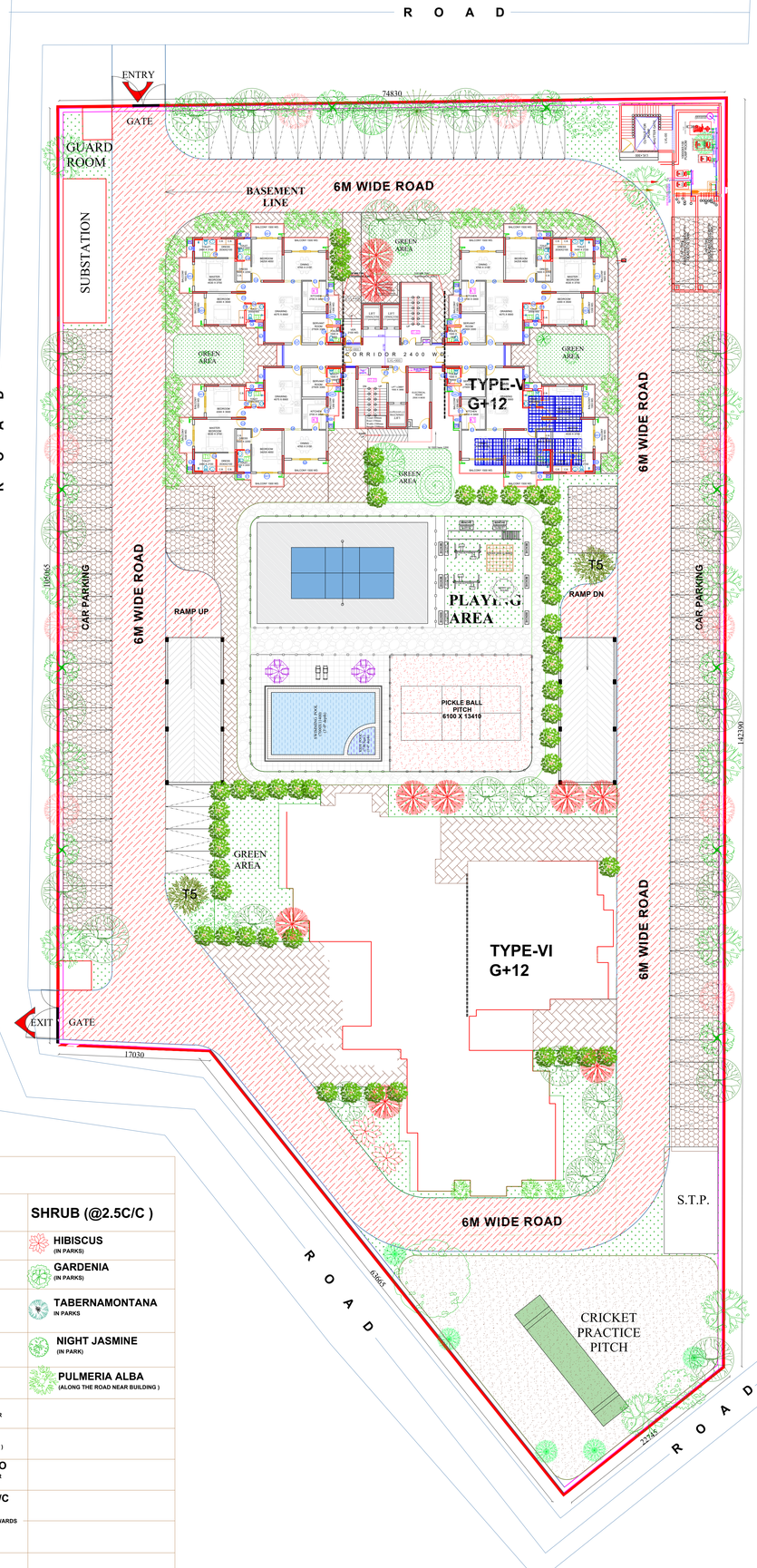
DETAIL-A



TYPICAL PARKING SECTION

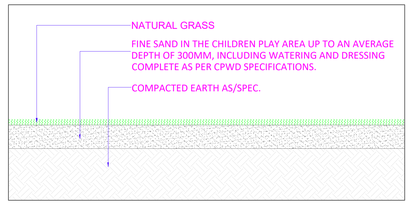


TYPICAL PATHWAY SECTION

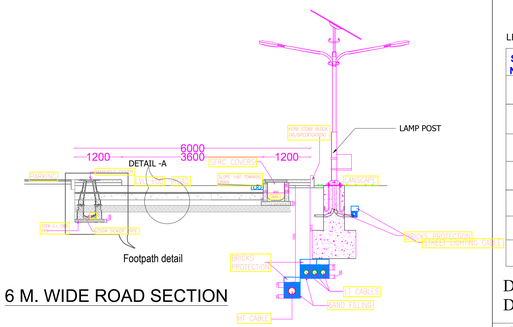


LIST OF PLANTS FOR LOCAL ENVIRONMENT FOR DELHI

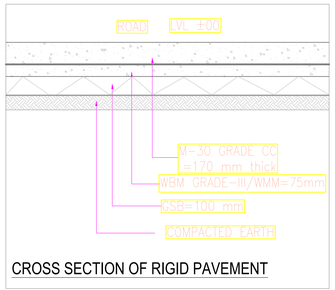
ORNAMENTAL PLANTS	MEDICINAL PLANTS (NEAR RESIDENCE)	CLIMBERS (ALONG BOUNDARY WALL)	FRUITS TREES (@4.5 MT C/C)	TREES (@4.5 MT C/C)	SHRUB (@2.5C/C)
FICUS BENJAMINA (HEDGE)	ALOEVERA (IN PARKS)	BOUGAINVILLEA (IN PARKING)	MANGO BOUNDARY WALL & PARKS	GULMOHAR (IN FRONT OF ENTRANCES ROAD)	HIBISCUS (IN PARKS)
FURCARIA	STEVIA (IN PARKS)	FLAME VINE (IN FRONT OF BUILDING ENTRANCES)	JAMUN BOUNDARY WALL & PARKS	MOLSARI (ALONG THE ROAD,BOUNDARY & PARKS)	GARDENIA (IN PARKS)
NERIUM OLEANDER	TULSI (IN PARKS)	VINE (MAIN GATE)	GUAVA IN PARKS	ASHOKA SARACA ASOCA (IN FRONT OF ENTRANCES ROAD)	TABERNAMONTANA IN PARKS
ARECA PALM	CINNAMOMUM (IN PARKS)		INDIAN BAEL (IN PARKS & BOUNDARY WALL)	CRIMSON (IN FRONT OF ENTRANCES ROAD)	NIGHT JASMINE (IN PARK)
LAGERSTROMIA	CAMPHORA (IN PARKS)		JACKFRUIT IN PARKS	NEEM (ALONG THE ROAD,BOUNDARY & PARKS)	PULMERIA ALBA (ALONG THE ROAD NEAR BUILDING)
PHOENIX PALM	HAR SINGAR (IN PARKS)			BANYAN (AS A FOCUS TREE WITH CIRCULAR BOUNDARY)	
FOXTAIL PALM	CITRUS IN PARKS			FICUS RELIGIOSA (ALONG BOUNDARY WALL & ROAD)	
	PAPAYA (IN PARKS)			DALBERGIA SISSOO (AS A FOCUS TREE WITH CIRCULAR BOUNDARY)	
	AMLA (IN PARKS)			BAMBOO (@2 MT C/C APPX) (ALONG THE BOUNDARY WALL TOWARDS NALA)	
	LIMETTA (IN PARKS)				
TOTAL NOS.					



CHILDREN PARK DETAIL

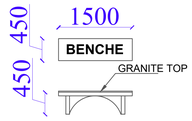


6 M. WIDE ROAD SECTION

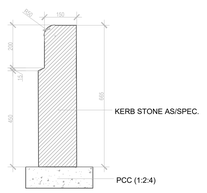


CROSS SECTION OF RIGID PAVEMENT

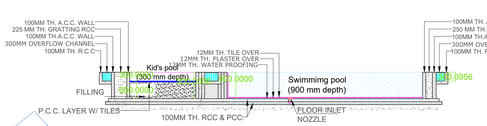
DETAIL -A



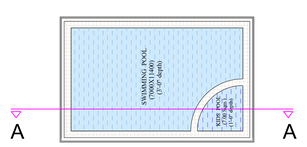
SITTING DETAIL



KERB STONE DETAIL



SECTION AT AA'



SWIMMING POOL DETAIL

TENDER PURPOSE ONLY

LEGEND

SL. NO.	DESCRIPTION	SYMBOL
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2.	NORTH DIRECTION	
3.	BOUNDARY	
4.	TREE	
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R0						

REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
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A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

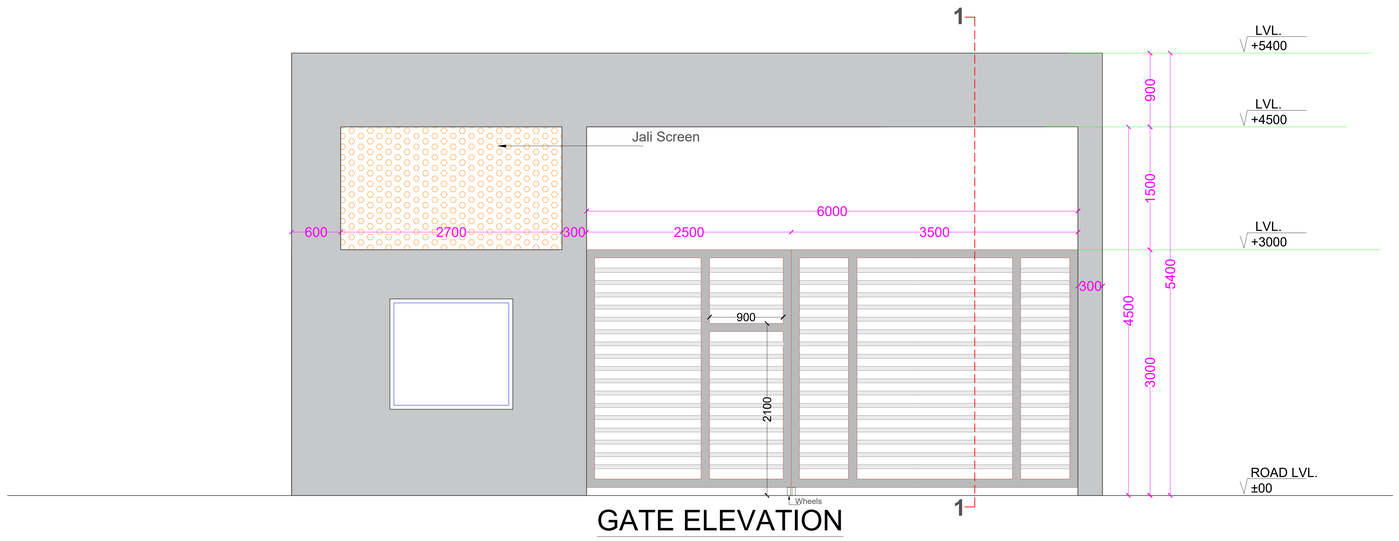
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LANDSCAPING PLAN

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

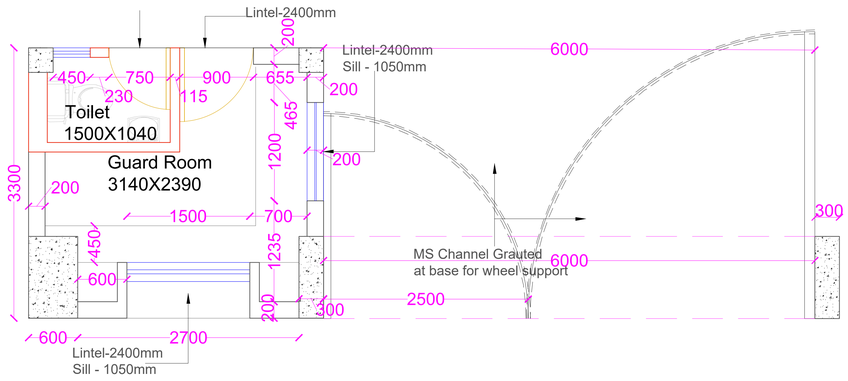
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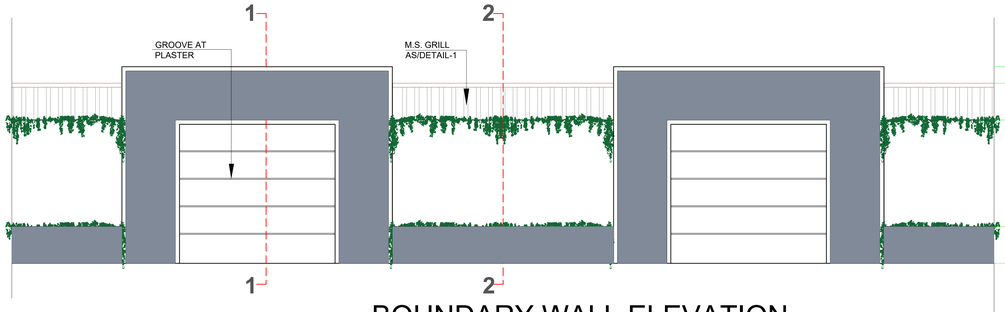
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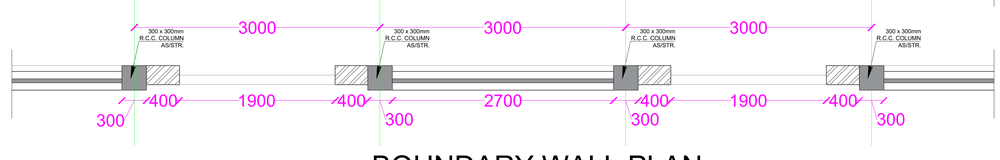
GATE ELEVATION



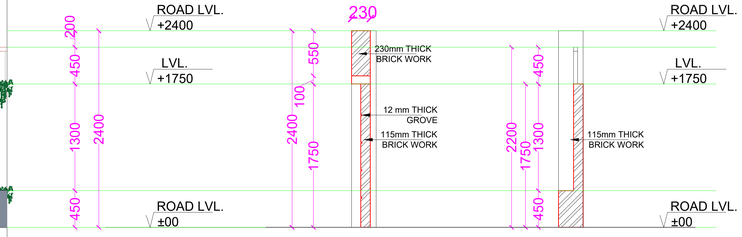
GUARD ROOM & GATE PLAN



BOUNDARY WALL ELEVATION



BOUNDARY WALL PLAN



SECTION 1-1 SECTION 2-2

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DWARKA SECTOR-19,DELHI
DWG AREA=0.9680 Hact.=2.3920 Acr

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Job No:

BUILDING NAME :

DRAWING TITLE :
GATE GUARD ROOM & BOUNDARY WALL DETAIL

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

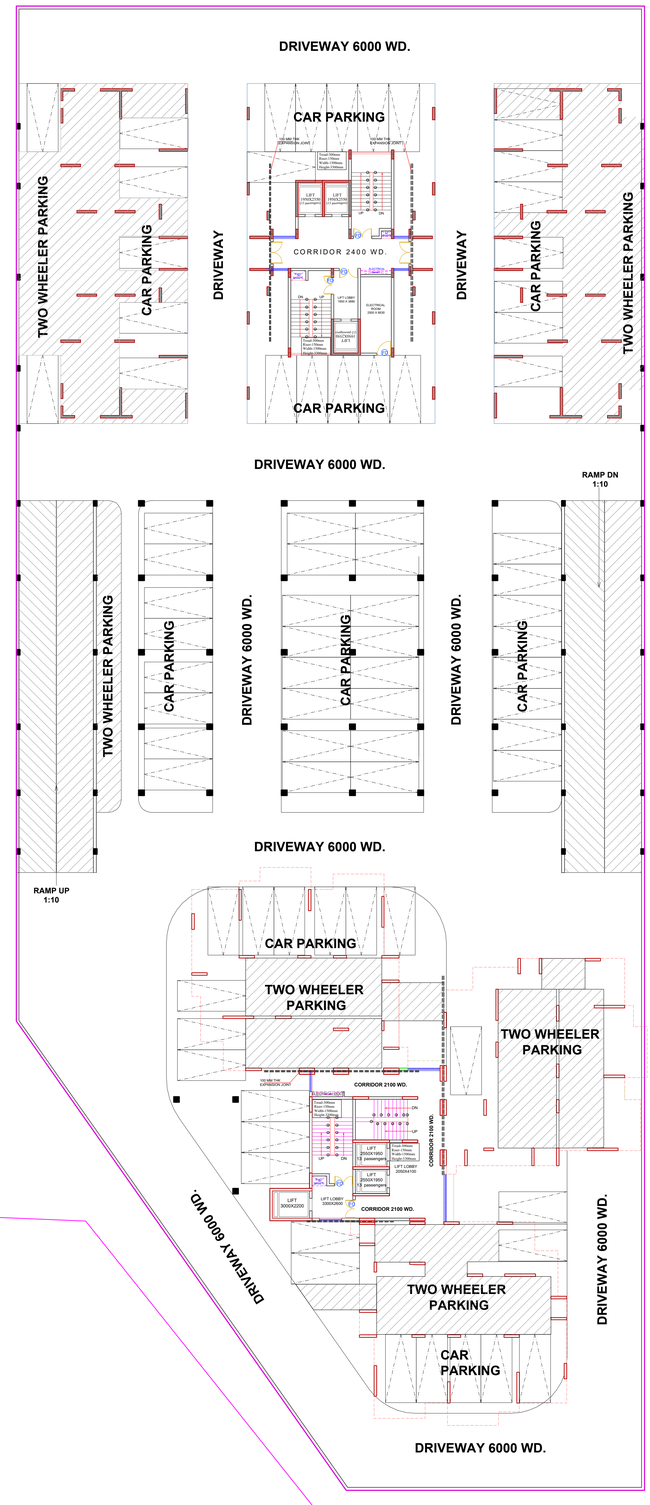
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DESIGNED / DRAWN BY		
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APPROVED BY		



BASEMENT PLAN -01



BASEMENT PLAN -02

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Job No:

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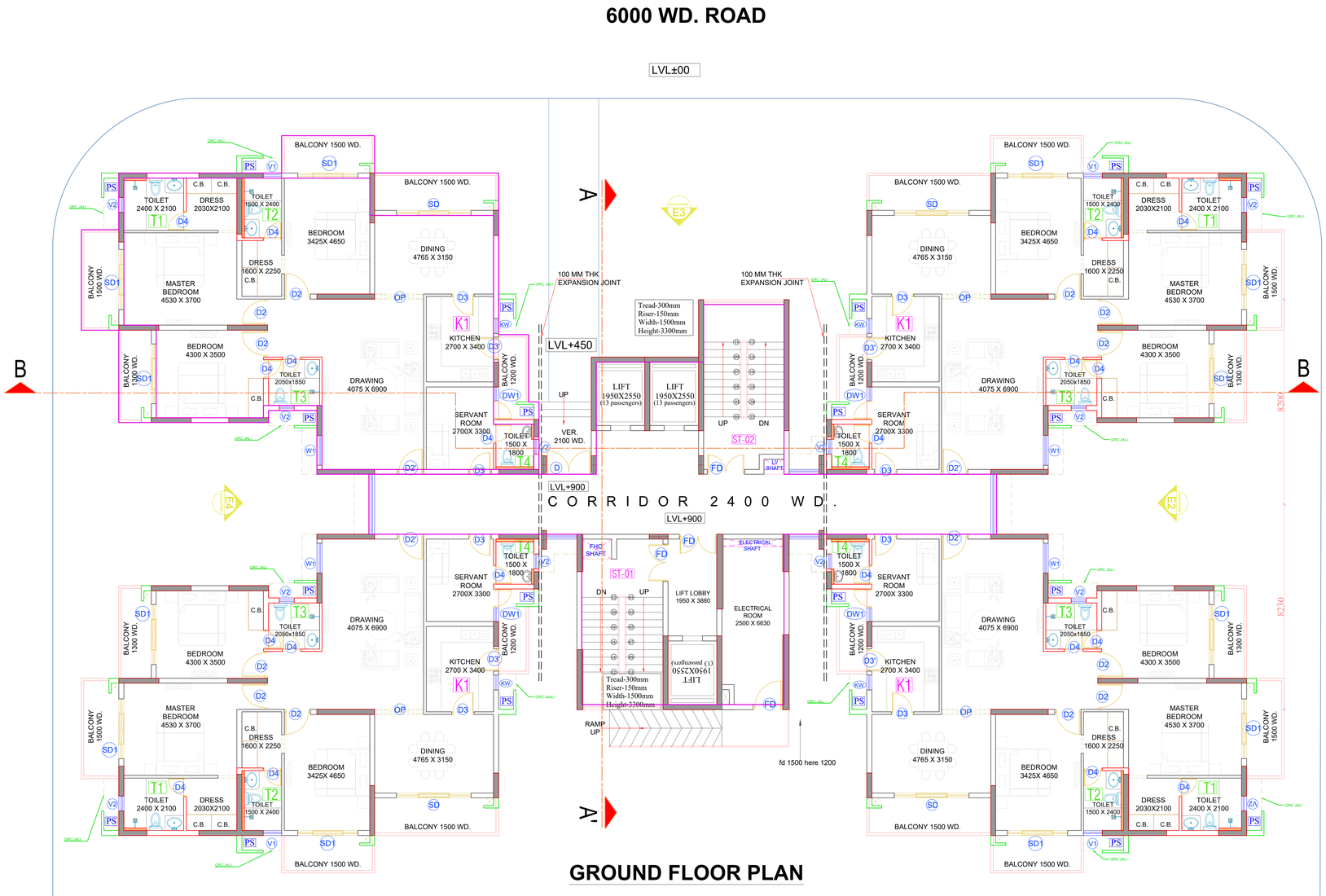
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BASEMENT PLAN

DRAWING TYPE :
TENDER DRAWINGS

SCALE: | SHEET SIZE: A1 | DATE: 09-02-26 | REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



GROUND FLOOR PLAN

TENDER PURPOSE ONLY

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS

S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL	NOs.
DOORS :						
1	FD	1500	2550	00	2550	03
2	SD	3000	2550	00	2550	04
3	SD1	2400	2550	00	2550	12
4	D	1800	2550	00	2550	00
5	D2'	1050	2550	00	2550	04
6	D2	1050	2100	00	2100	12
7	D3'	900	2550	00	2550	04
8	D3	900	2100	00	2100	09
9	D4	750	2100	00	2100	20
10	DW1	1300	2100	00	2100	04
WINDOWS :						
1	W1	1200	1800	750	2550	04
2	KW	600	1800	750	2550	04
VENTILATOR :						
1	V1	750	1050	1500	2550	12
2	V2	600	1050	1500	2550	04

GENERAL NOTES:

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7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
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12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

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ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

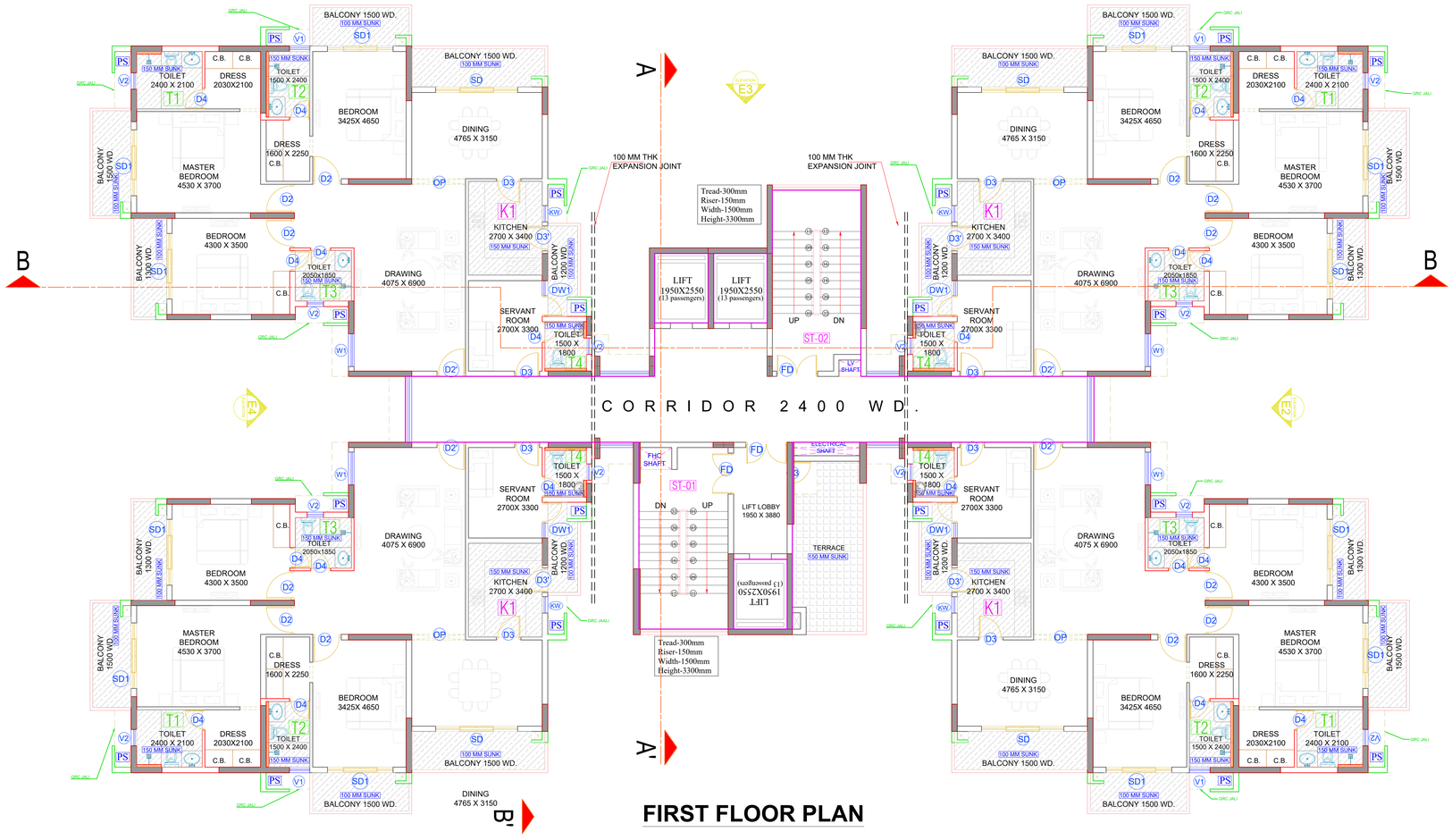
DRAWING TITLE :
GROUND FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

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APPROVED BY		



FIRST FLOOR PLAN

TENDER PURPOSE ONLY

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS

S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL	NOs.
DOORS :						
1	FD	1500	2550	00	2550	03
2	SD	3000	2550	00	2550	04
3	SD1	2400	2550	00	2550	12
4	D	1800	2550	00	2550	00
5	D2'	1050	2550	00	2550	04
6	D2	1050	2100	00	2100	12
7	D3'	900	2550	00	2550	04
8	D3	900	2100	00	2100	09
9	D4	750	2100	00	2100	20
10	DW1	1300	2100	00	2100	04
WINDOWS :						
1	W1	1200	1800	750	2550	04
2	KW	600	1800	750	2550	04
VENTILATOR :						
1	V1	750	1050	1500	2550	12
2	V2	600	1050	1500	2550	04

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14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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A-3/269 , vibhav khand , gomti nagar , lucknow
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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

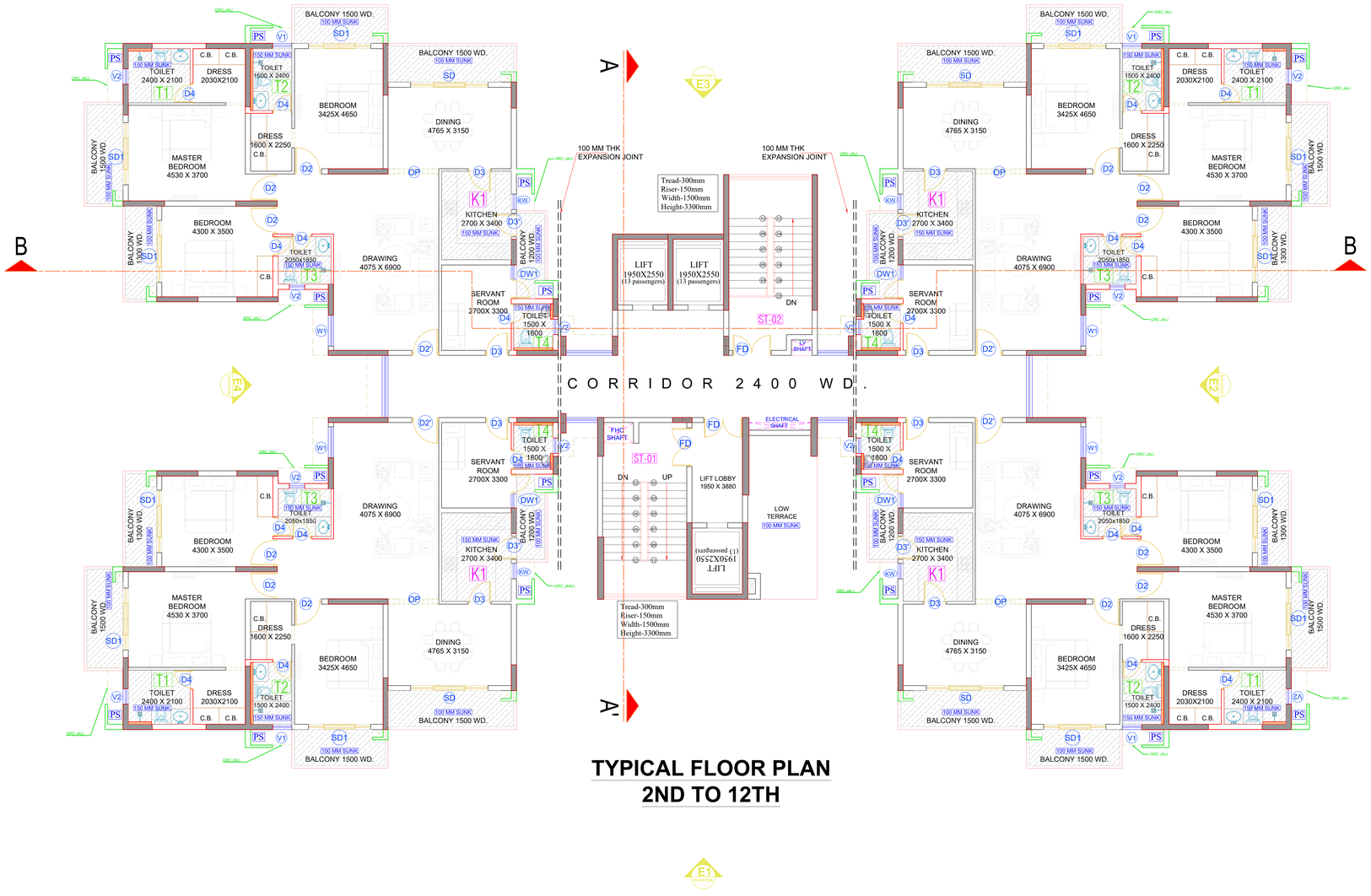
DRAWING TITLE :
FIRST FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

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TYPICAL FLOOR PLAN
2ND TO 12TH

TENDER PURPOSE ONLY

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS

S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL	NOs.
DOORS :						
1	FD	1500	2550	00	2550	03
2	SD	3000	2550	00	2550	04
3	SD1	2400	2550	00	2550	12
4	D	1800	2550	00	2550	00
5	D2'	1050	2550	00	2550	04
6	D2	1050	2100	00	2100	12
7	D3'	900	2550	00	2550	04
8	D3	900	2100	00	2100	09
9	D4	750	2100	00	2100	20
10	DW1	1300	2100	00	2100	04
WINDOWS :						
1	W1	1200	1800	750	2550	04
2	KW	600	1800	750	2550	04
VENTILATOR :						
1	V1	750	1050	1500	2550	12
2	V2	600	1050	1500	2550	04

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7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
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13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

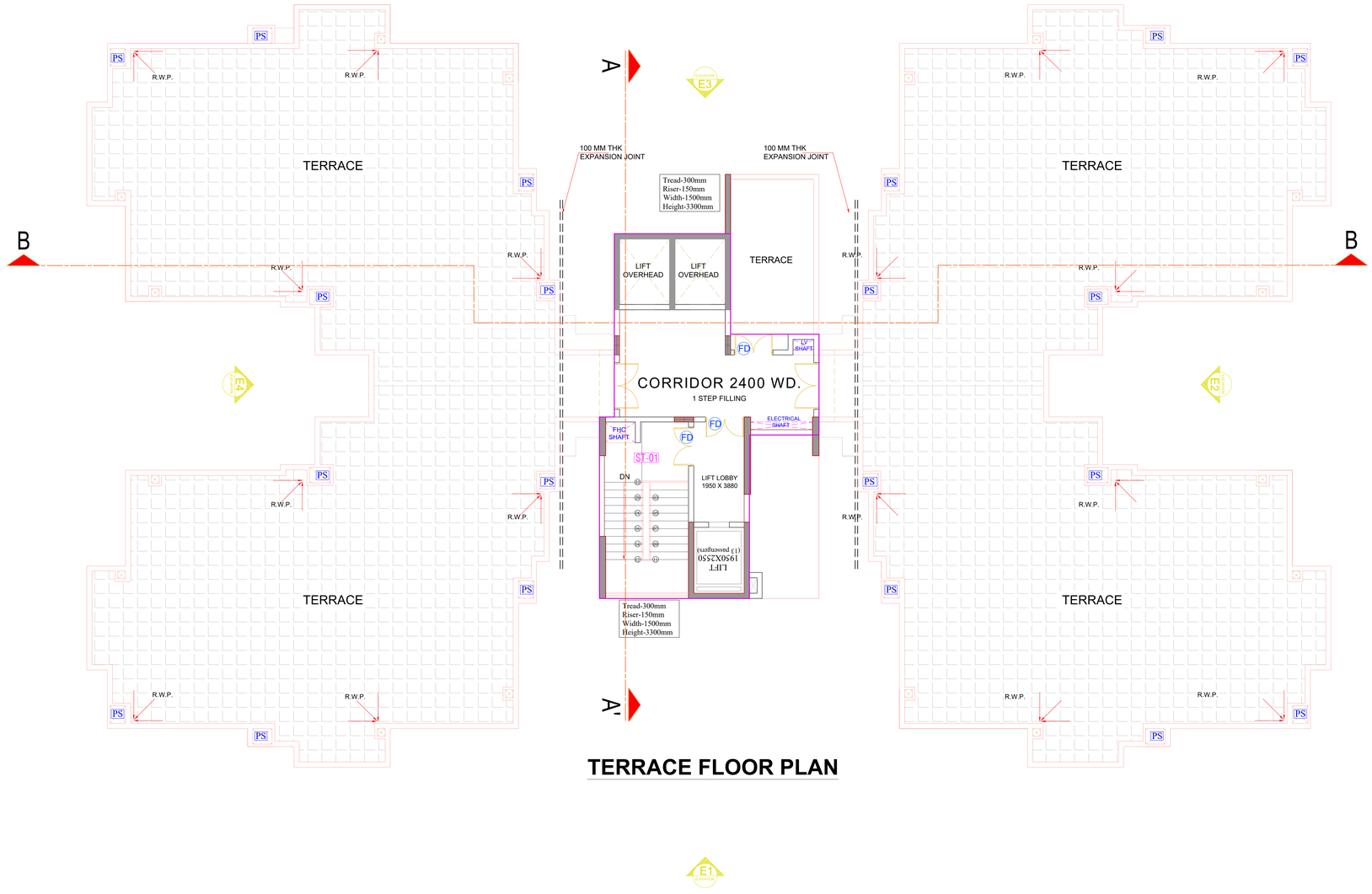
DRAWING TITLE :
TYPICAL FLOOR PLAN (2nd to 12th)

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

RELEASED FOR ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

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DESIGNED / DRAWN BY		
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APPROVED BY		



TERRACE FLOOR PLAN

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS						
S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL	NOs.
DOORS :						
1	FD	1500	2550	00	2550	03
2	SD	3000	2550	00	2550	04
3	SD1	2400	2550	00	2550	12
4	D	1800	2550	00	2550	00
5	D2'	1050	2550	00	2550	04
6	D2	1050	2100	00	2100	12
7	D3'	900	2550	00	2550	04
8	D3	900	2100	00	2100	09
9	D4	750	2100	00	2100	20
10	DW1	1300	2100	00	2100	04
WINDOWS :						
1	W1	1200	1800	750	2550	04
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15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
TERRACE FLOOR PLAN

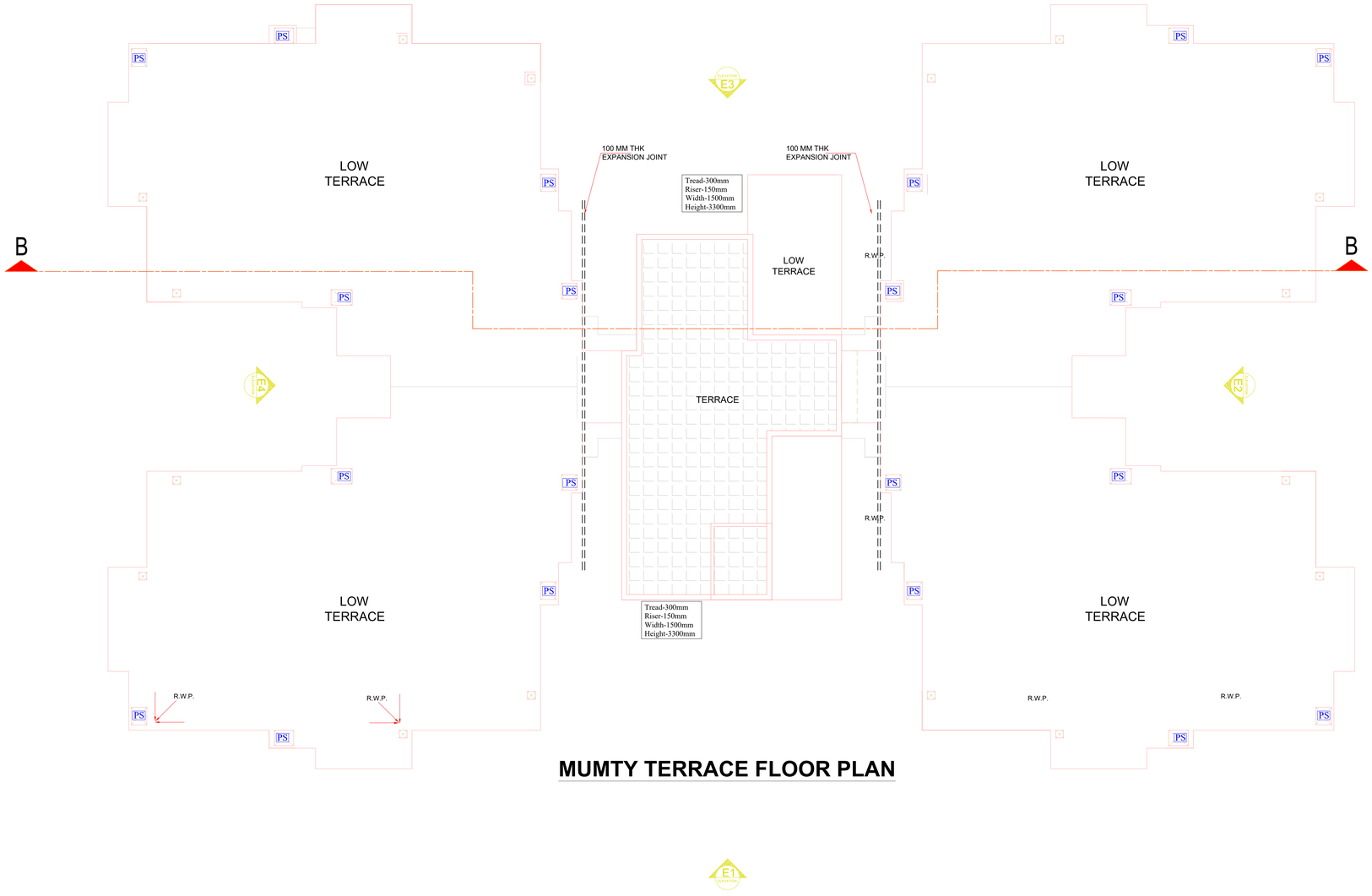
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

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APPROVED BY		

TENDER PURPOSE ONLY



MUMTY TERRACE FLOOR PLAN

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CIVIL & STRUCTURAL			FPS		
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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
MUMTY TERRACE FLOOR PLAN

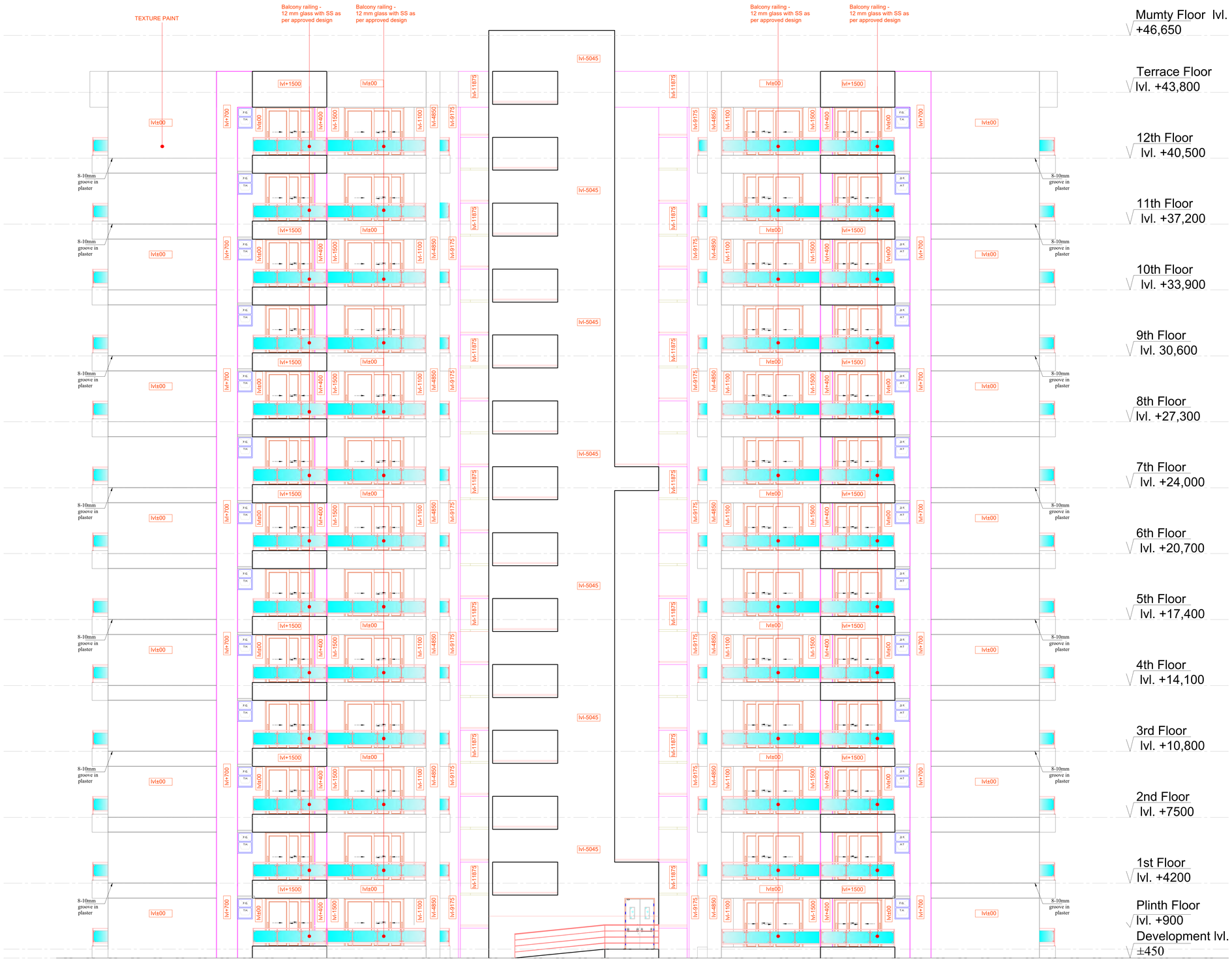
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

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TENDER PURPOSE ONLY



ELEVATION-1

TENDER PURPOSE ONLY

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
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BUILDING NAME :
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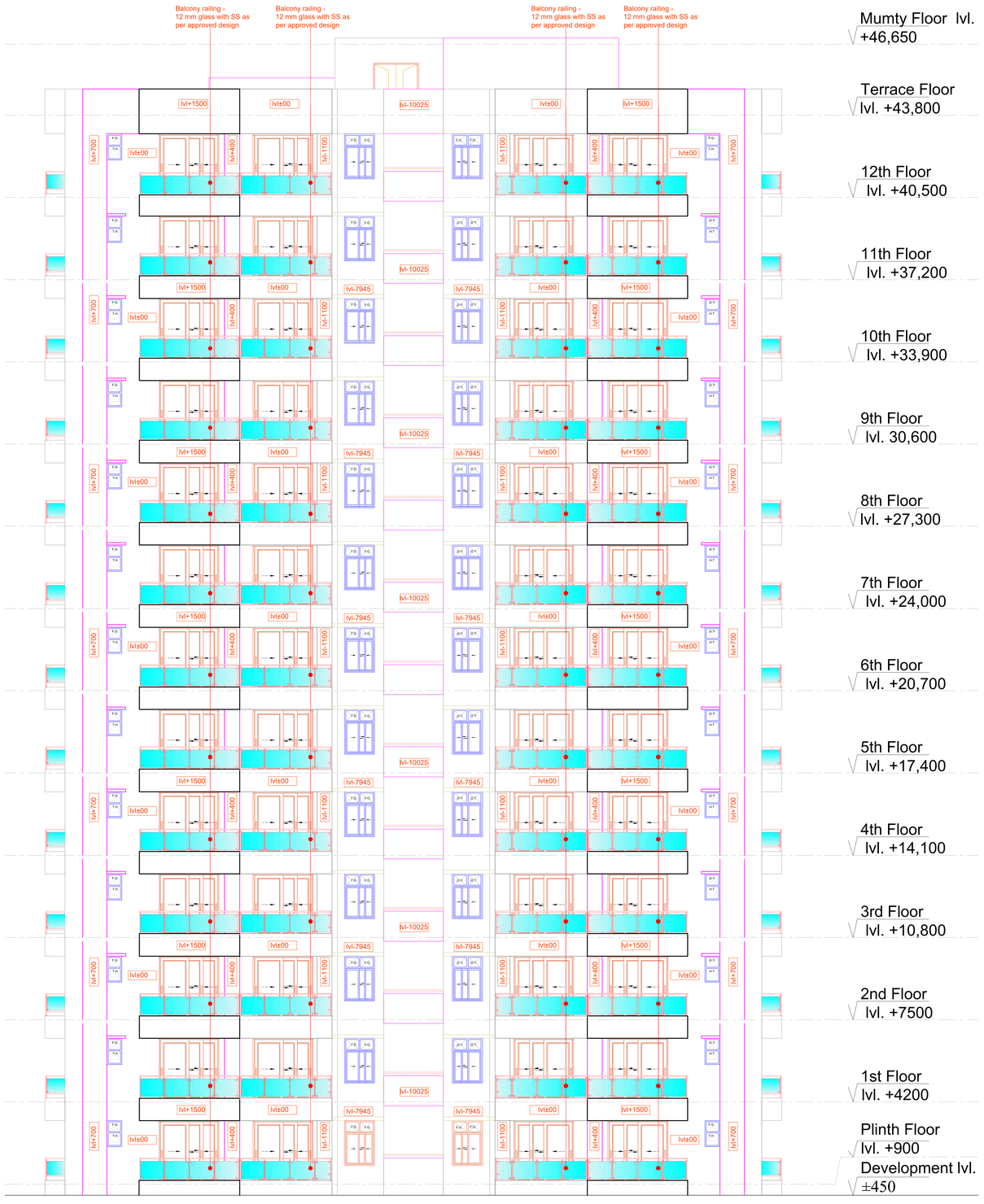
DRAWING TITLE :
ELEVATION -1

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

RELEASED FOR ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



ELEVATION-2

TENDER PURPOSE ONLY

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7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

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ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

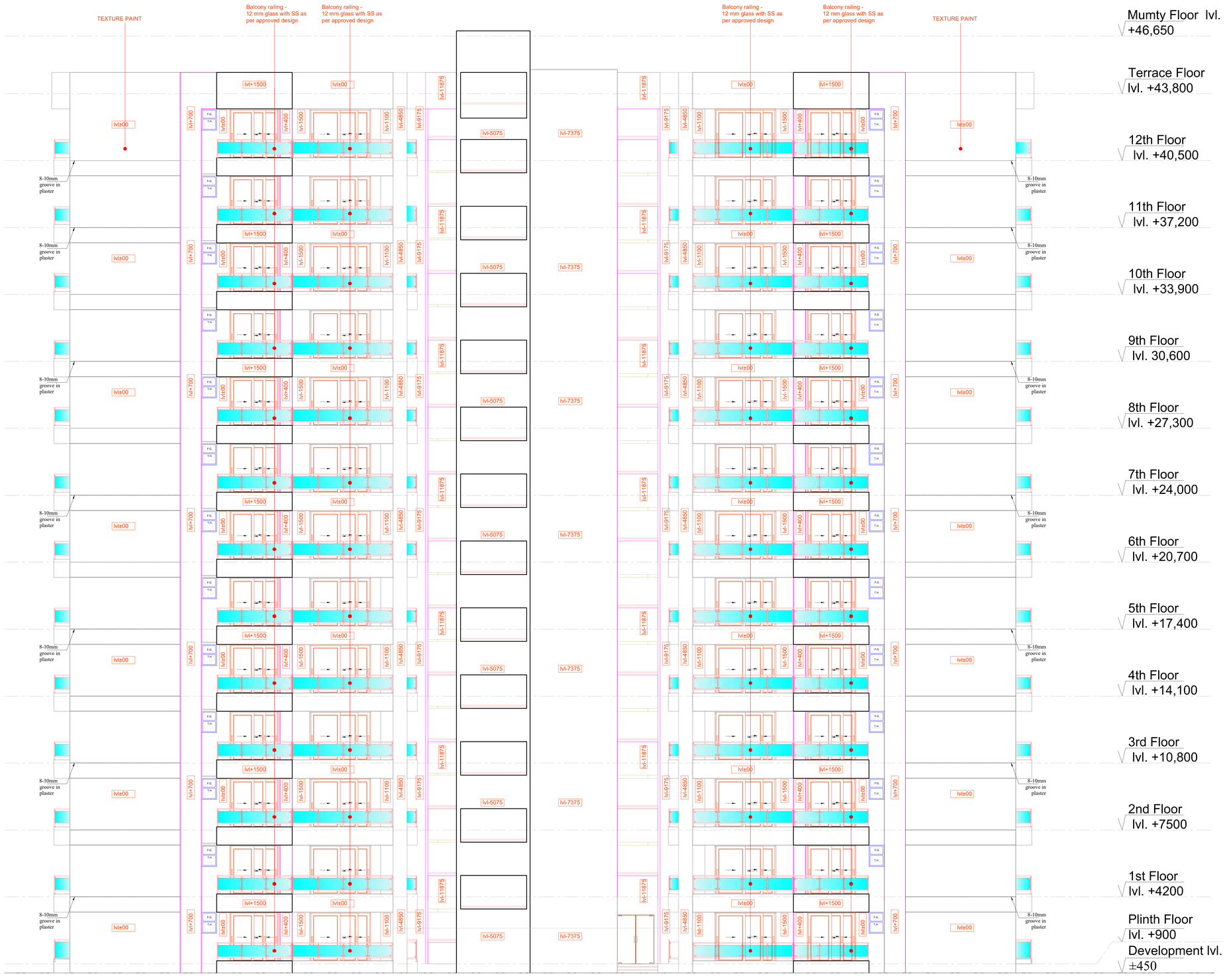
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ELEVATION -4

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

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ELEVATION-3

TENDER PURPOSE ONLY

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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME : TYPE - V RESIDENTIAL FLAT

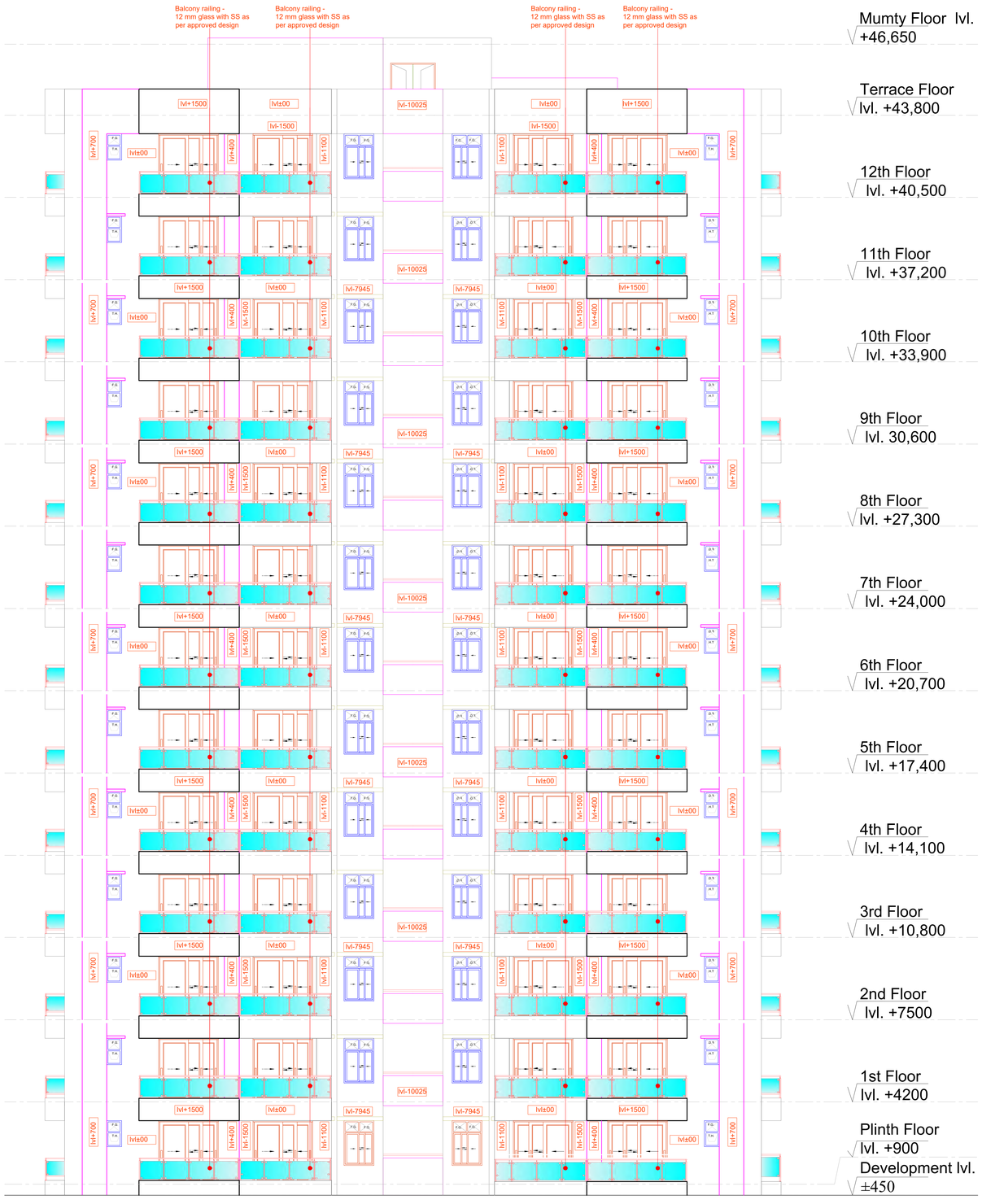
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SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

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ELEVATION-4

TENDER PURPOSE ONLY

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

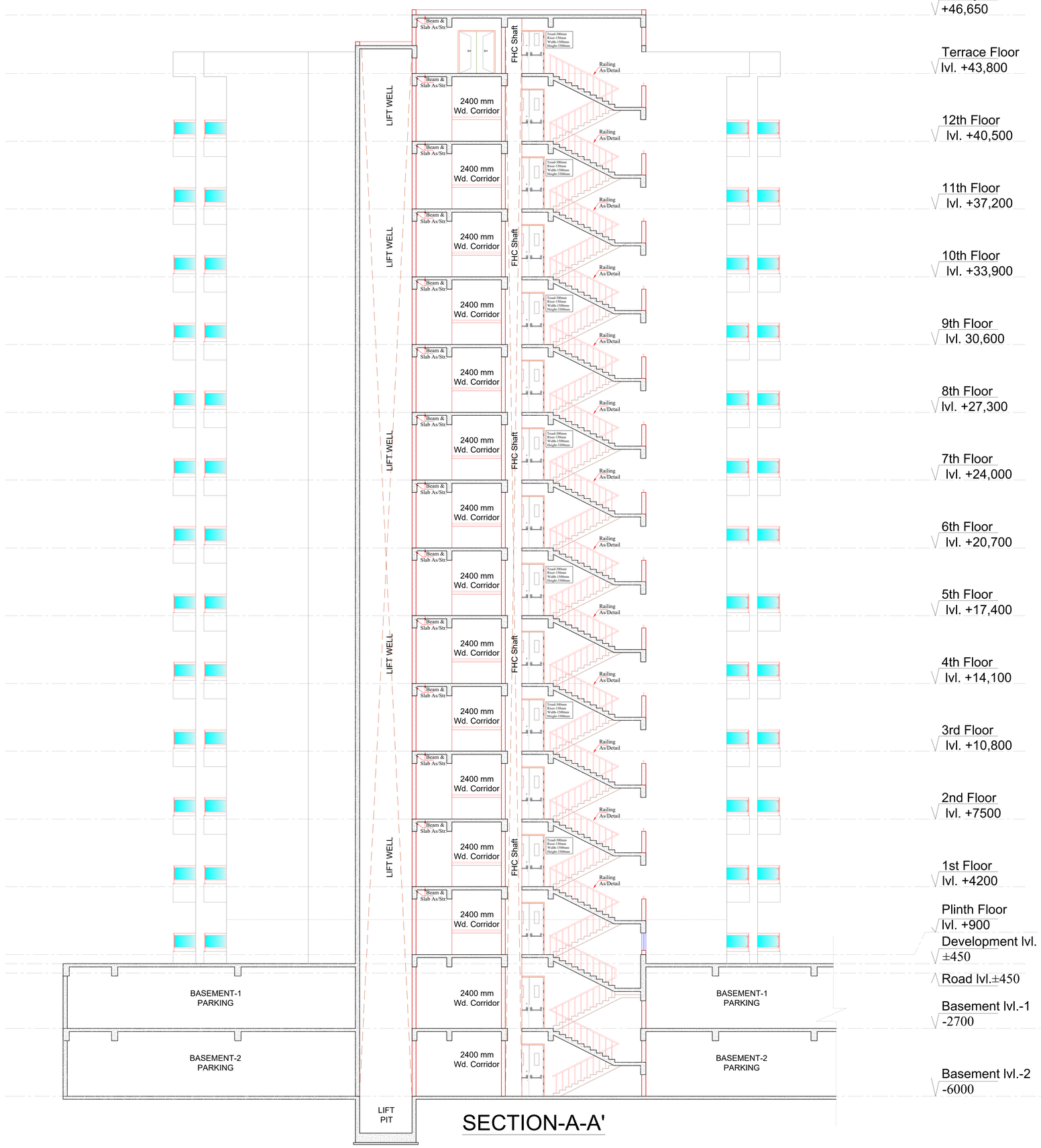
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ELEVATION-2

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

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SECTION-A-A'

TENDER PURPOSE ONLY

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CIVIL & STRUCTURAL			FPS		
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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME : TYPE - V RESIDENTIAL FLAT

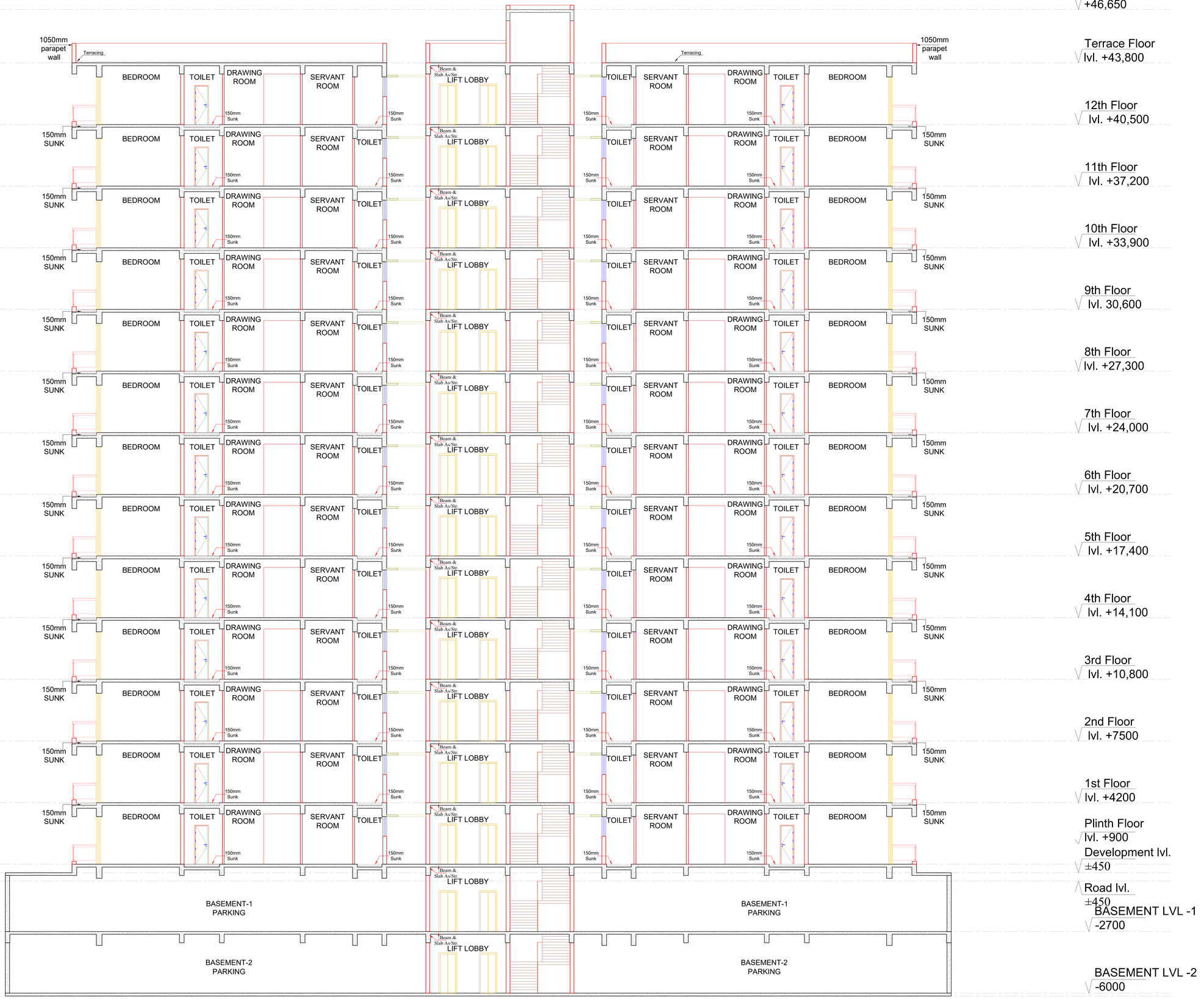
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DRAWING TYPE : **TENDER DRAWINGS ARCHITECTURE**

SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

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SECTION: B-B'

TENDER PURPOSE ONLY

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
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A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

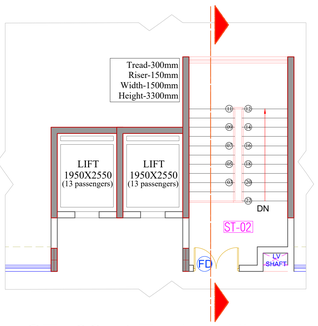
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SECTION B-B'

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

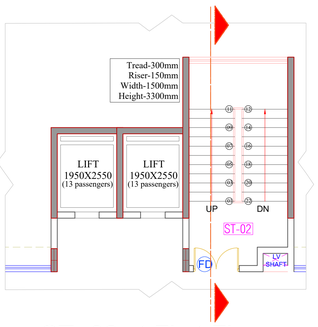
SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

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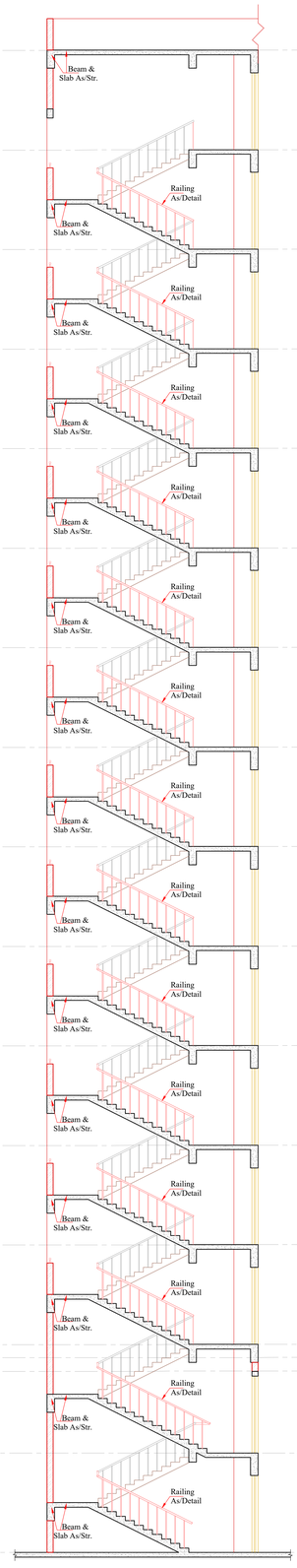
ST- 02 at Typical Floor (2ND TO 12TH)



ST- 02 at First Floor



ST- 02 at Ground Floor



Mumty Floor lvl. +46,650

Terrace Floor lvl. +43,800

12th Floor lvl. +40,500

11th Floor lvl. +37,200

10th Floor lvl. +33,900

9th Floor lvl. 30,600

8th Floor lvl. +27,300

7th Floor lvl. +24,000

6th Floor lvl. +20,700

5th Floor lvl. +17,400

4th Floor lvl. +14,100

3rd Floor lvl. +10,800

2nd Floor lvl. +7500

1st Floor lvl. +4200

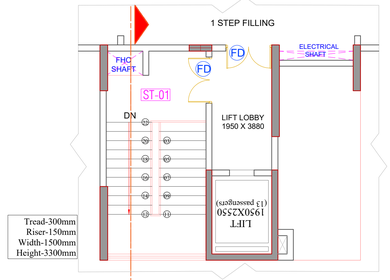
Plinth Floor lvl. +900

Development lvl. ±450

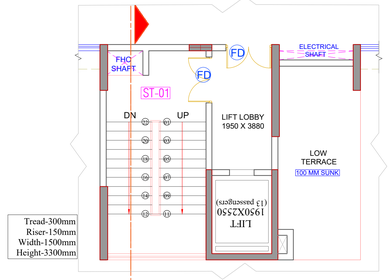
Road lvl.±450

Basement lvl.-1 -2700

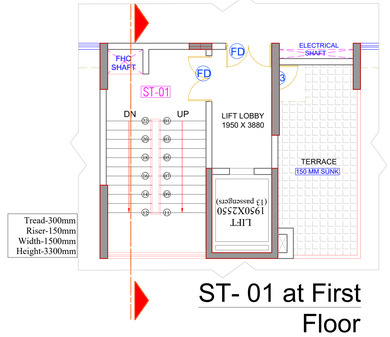
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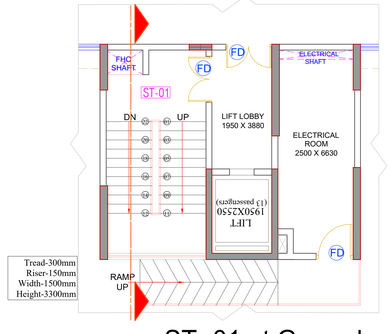
ST- 01 at Terrace Floor



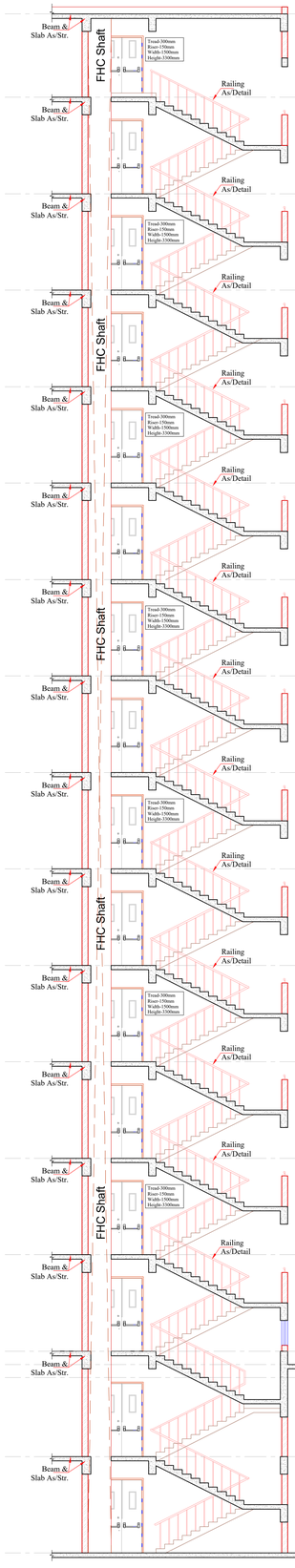
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5th Floor lvl. +17,400

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3rd Floor lvl. +10,800

2nd Floor lvl. +7500

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Development lvl. ±450

Road lvl.±450

Basement lvl.-1 -2700

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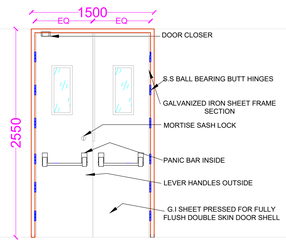
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DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: | SHEET SIZE: A1 | DATE: 18-03-26 | REV. NO: R0

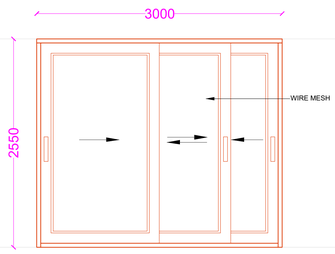
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CHECKED BY		
APPROVED BY		



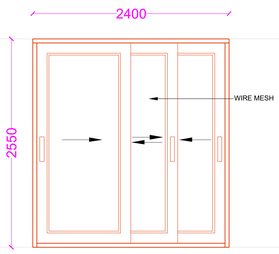


FD(1500X2550)



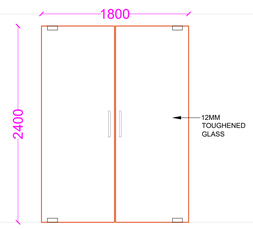
SD (3000X2550)

UPVC 3track sliding door with 12mm toughend glass

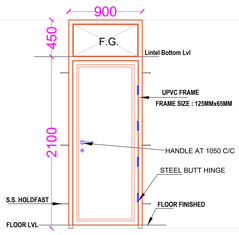


SD1 (2400X2550)

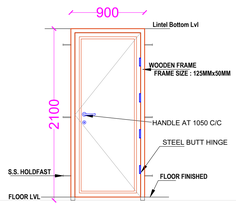
UPVC 3track sliding door with 12mm toughend glass



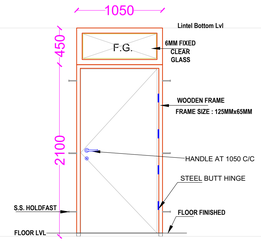
D(1800X2550)



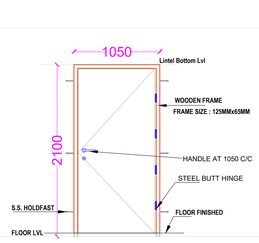
D3' (900X2550)



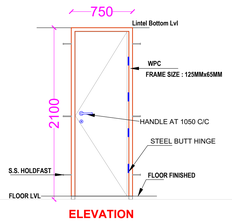
D3 (900X2100)

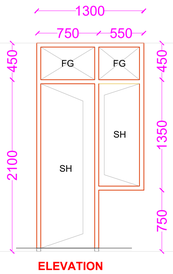


D2'(1050X2550)

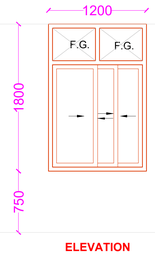


D2 (1050X2100)

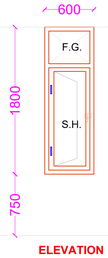




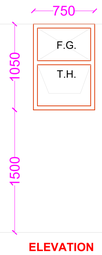
DW1 (1300X2550)



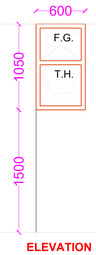
W1 (1200X1800)



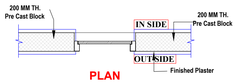
KW (600X1800)



V1(750X1050)



V2(600X1050)



D4 (750X2100)

TENDER PURPOSE ONLY

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS

S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL	NOs.
DOORS :						
1	FD	1500	2550	00	2550	03
2	SD	3000	2550	00	2550	04
3	SD1	2400	2550	00	2550	12
4	D	1800	2550	00	2550	00
5	D2'	1050	2550	00	2550	04
6	D2	1050	2100	00	2100	12
7	D3'	900	2550	00	2550	04
8	D3	900	2100	00	2100	09
9	D4	750	2100	00	2100	20
10	DW1	1300	2100	00	2100	04
WINDOWS :						
1	W1	1200	1800	750	2550	04
2	KW	600	1800	750	2550	04
VENTILATOR :						
1	V1	750	1050	1500	2550	12
2	V2	600	1050	1500	2550	04

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12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

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(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

muralage
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

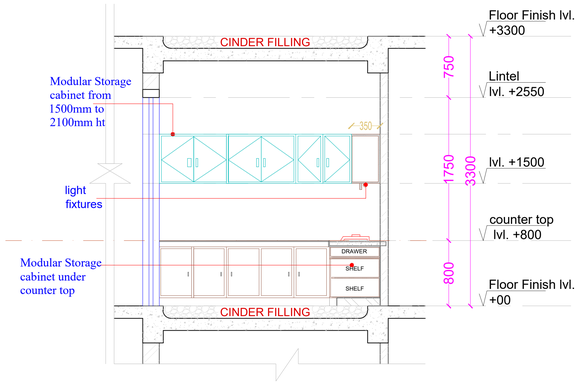
DRAWING TITLE :
DOOR WINDOW DETAIL

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

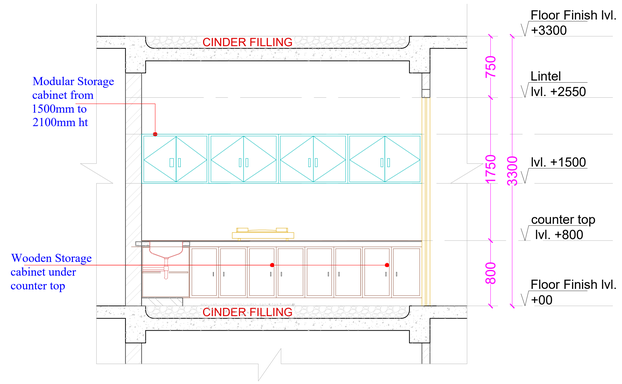
SCALE:	SHEET SIZE: A1	DATE: 18-03-26	REV. NO: R0

RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



SECTION 3-3

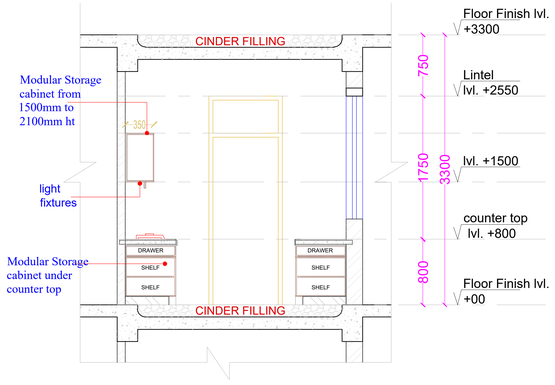


SECTION 4-4

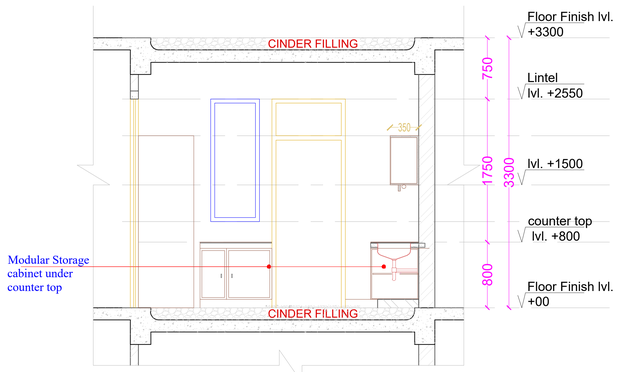
Modular kitchen , cabinabtery Hdhmr with laminate with minifix, wooden dowel joinery & EBT , front shutters make in HDHMR with 1.0mm laminate(marino, green,century or equvilient) . All hardware in soft close (make hettich,haffele or eql) kitchen necessary accessories should be branded like hettich , haffele or eql)

TENDER PURPOSE ONLY

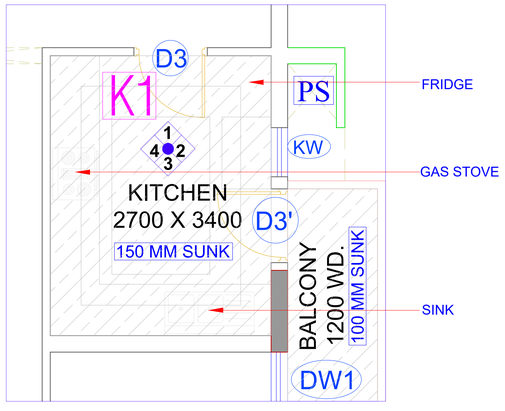
NOTE:
SHOP DRAWINGS TO BE APPROVED FROM THE CLIENT



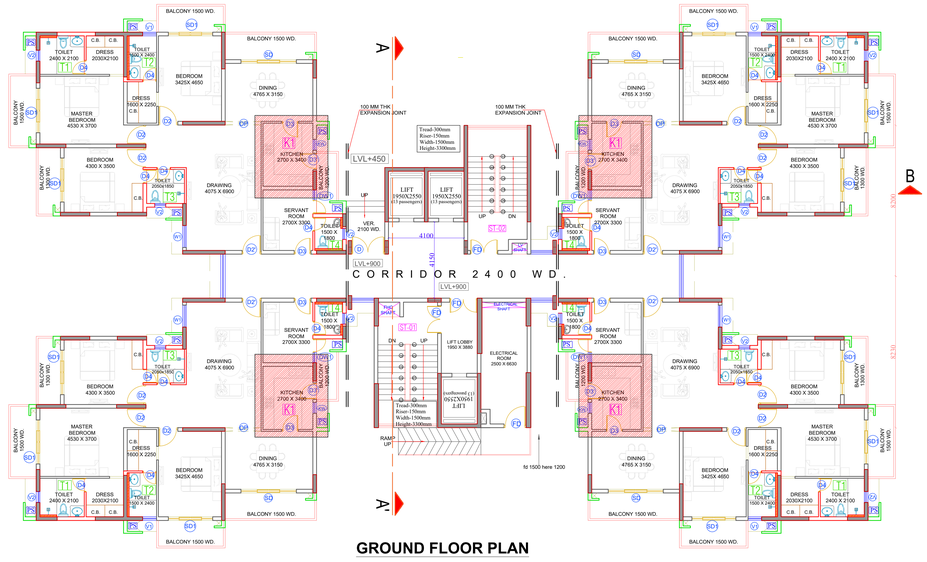
SECTION 1-1



SECTION 2-2



KITCHEN
2700X3400



GROUND FLOOR PLAN

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

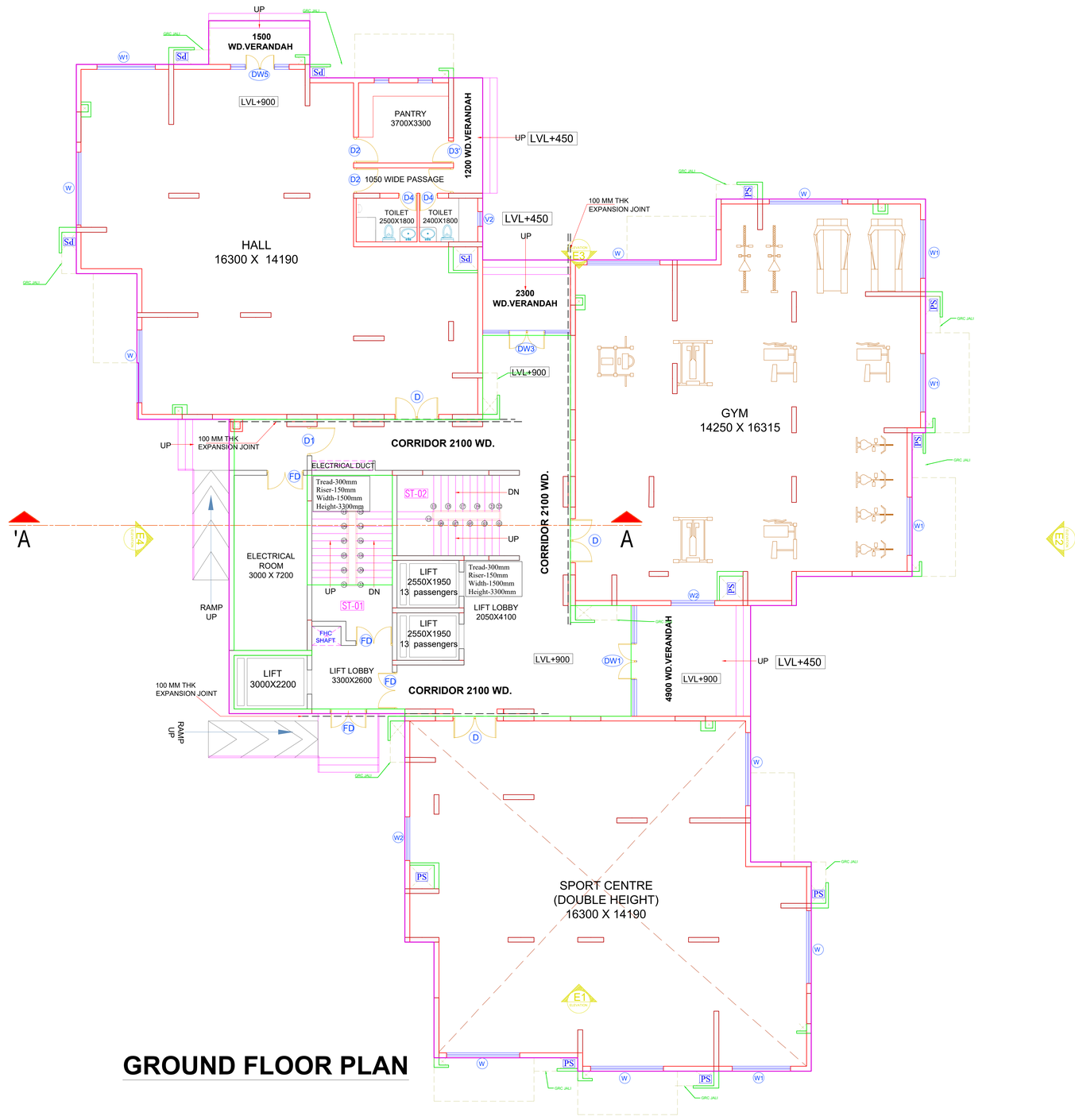
DRAWING TITLE :
KITCHEN DETAIL FOR SHOP DRAWING

DRAWING TYPE :
TENDER DRAWINGS - ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 29-05-26	REV. NO: R0

RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



GROUND FLOOR PLAN

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS					
S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL
DOORS :					
1	FD	1500	2550	00	2550
2	SD	3000	2550	00	2550
3	SD1	2400	2550	00	2550
4	D	1800	2550	00	2550
5	D1	1200	2550	00	2550
6	D2'	1050	2550	00	2550
7	D2	1050	2100	00	2100
8	D3'	900	2550	00	2550
9	D3	900	2100	00	2100
10	D4	750	2100	00	2100
11	DW1	4550	2550	00	2550
12	DW2	3850	2550	00	2550
13	DW3	3600	2550	00	2550
14	DW4	2600	2550	00	2550
15	DW5	2400	2550	00	2550
16	DW6	1800	2550	00	2550
17	DW7	1600	2550	00	2550
18	DW8	1400	2550	00	2550
19	DW9	1330	2550	00	2550
WINDOWS :					
1	W	3000	1800	750	2550
2	W1	2400	1800	750	2550
3	W2	1800	1800	750	2550
4	W3	700	1800	750	2550
5	W4	600	1350	1200	2550
VENTILATOR :					
1	V1	750	1050	1500	2550
2	V2	600	1050	1500	2550

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
GROUND FLOOR PLAN

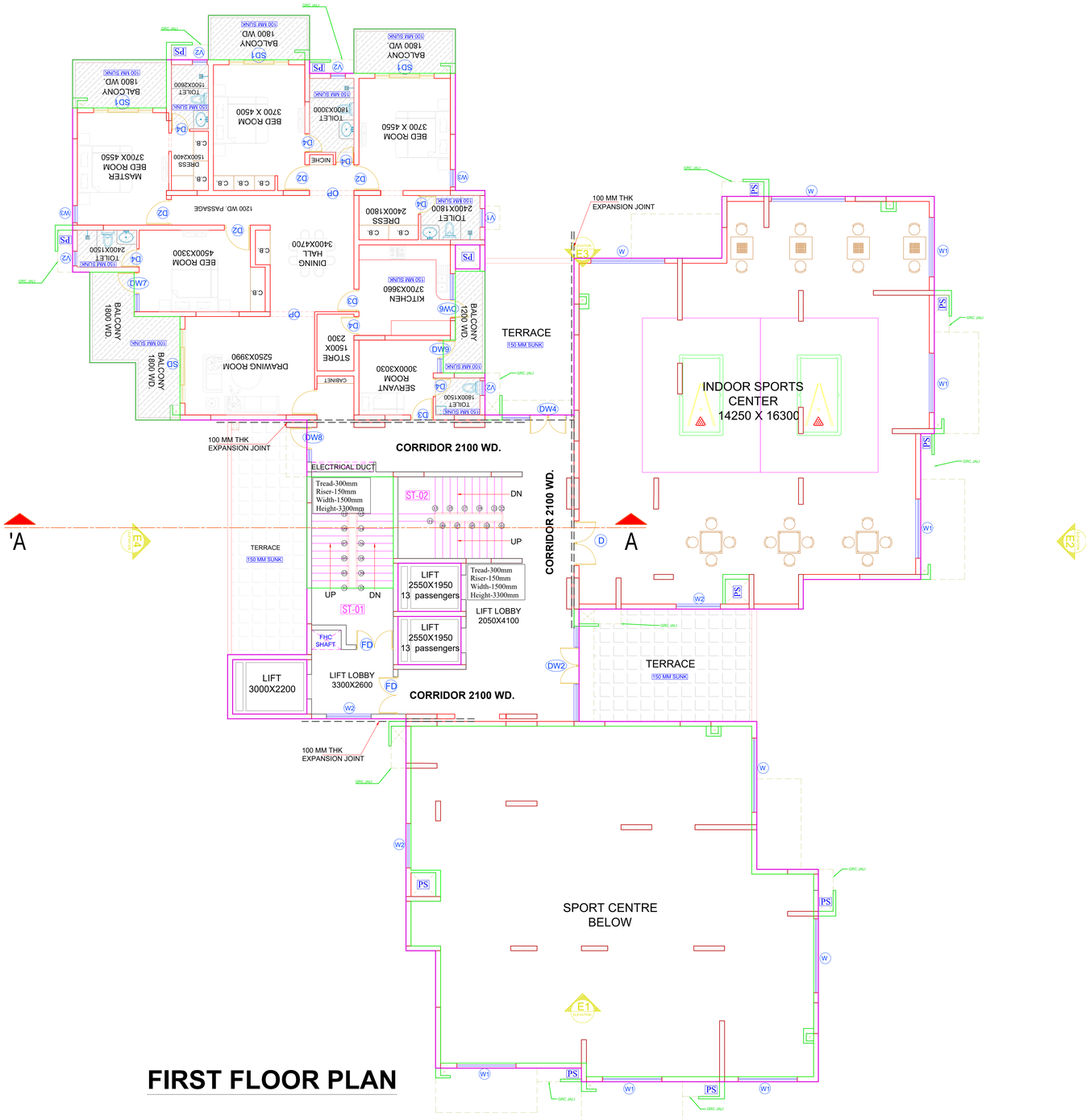
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		

TENDER PURPOSE ONLY



FIRST FLOOR PLAN

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS

S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL
DOORS :					
1	FD	1500	2550	00	2550
2	SD	3000	2550	00	2550
3	SD1	2400	2550	00	2550
4	D	1800	2550	00	2550
5	D1	1200	2550	00	2550
6	D2'	1050	2550	00	2550
7	D2	1050	2100	00	2100
8	D3'	900	2550	00	2550
9	D3	900	2100	00	2100
10	D4	750	2100	00	2100
11	DW1	4550	2550	00	2550
12	DW2	3850	2550	00	2550
13	DW3	3600	2550	00	2550
14	DW4	2600	2550	00	2550
15	DW5	2400	2550	00	2550
16	DW6	1800	2550	00	2550
17	DW7	1600	2550	00	2550
18	DW8	1400	2550	00	2550
19	DW9	1330	2550	00	2550
WINDOWS :					
1	W	3000	1800	750	2550
2	W1	2400	1800	750	2550
3	W2	1800	1800	750	2550
4	W3	700	1800	750	2550
5	W4	600	1350	1200	2550
VENTILATOR :					
1	V1	750	1050	1500	2550
2	V2	600	1050	1500	2550

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
FIRST FLOOR PLAN

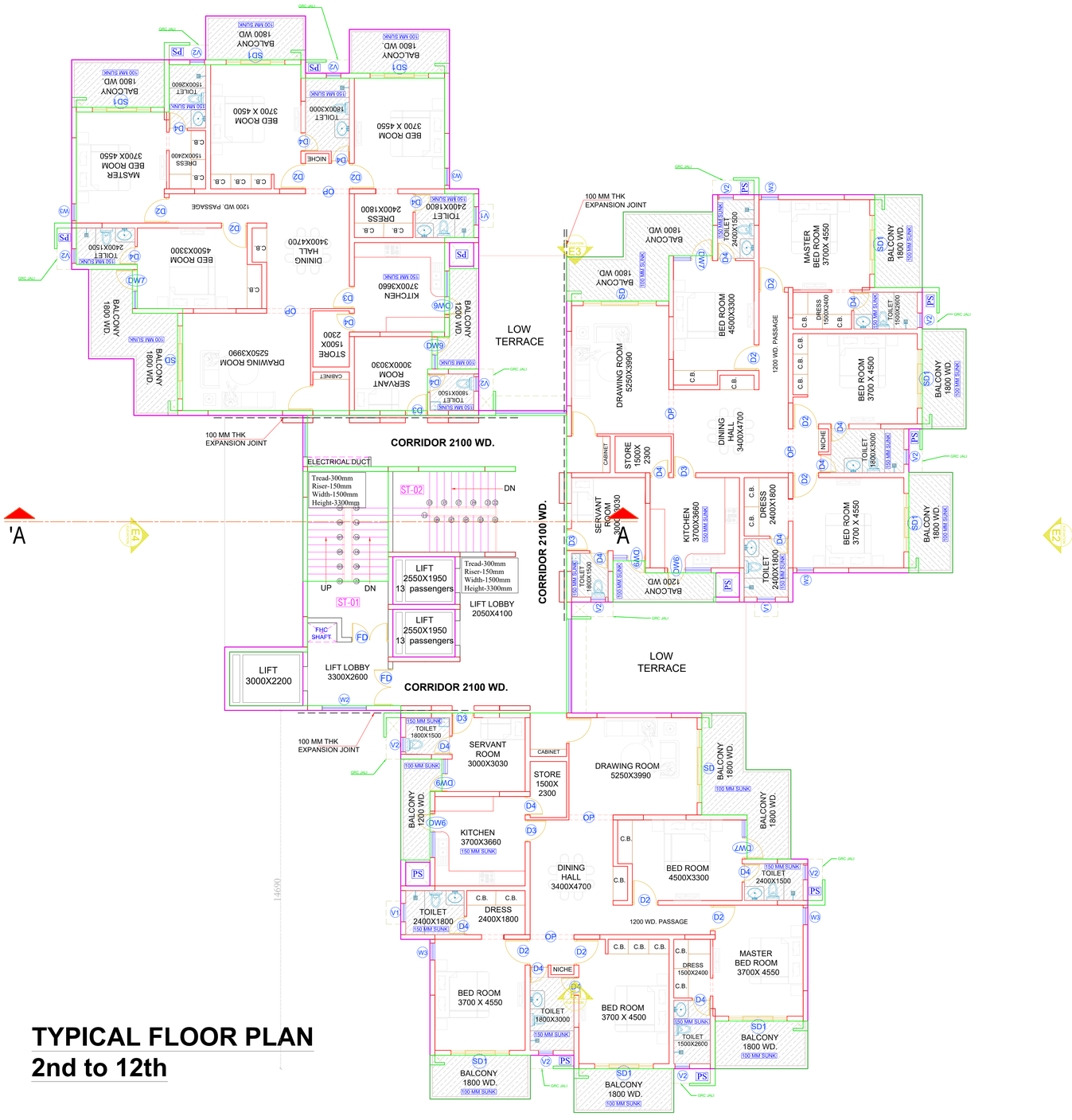
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

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CHECKED BY		
APPROVED BY		

TENDER PURPOSE ONLY



TYPICAL FLOOR PLAN
2nd to 12th

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS					
S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL
DOORS :					
1	FD	1500	2550	00	2550
2	SD	3000	2550	00	2550
3	SD1	2400	2550	00	2550
4	D	1800	2550	00	2550
5	D1	1200	2550	00	2550
6	D2'	1050	2550	00	2550
7	D2	1050	2100	00	2100
8	D3'	900	2550	00	2550
9	D3	900	2100	00	2100
10	D4	750	2100	00	2100
11	DW1	4550	2550	00	2550
12	DW2	3850	2550	00	2550
13	DW3	3600	2550	00	2550
14	DW4	2600	2550	00	2550
15	DW5	2400	2550	00	2550
16	DW6	1800	2550	00	2550
17	DW7	1600	2550	00	2550
18	DW8	1400	2550	00	2550
19	DW9	1330	2550	00	2550
WINDOWS :					
1	W	3000	1800	750	2550
2	W1	2400	1800	750	2550
3	W2	1800	1800	750	2550
4	W3	700	1800	750	2550
5	W4	600	1350	1200	2550
VENTILATOR :					
1	V1	750	1050	1500	2550
2	V2	600	1050	1500	2550

GENERAL NOTES:

1.DRAWINGS & ACCOMPANYING SPECIFICATIONS AS INSTRUMENTS OF SERVICE ARE EXCLUSIVE PROPERTY OF WAPCOS.
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5.ALL DIMENSIONS & LEVELS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
6.DRAWING NOT TO BE SCALED, WRITTEN DIMENSIONS TO BE FOLLOWED.
7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
TYPICAL FLOOR PLAN

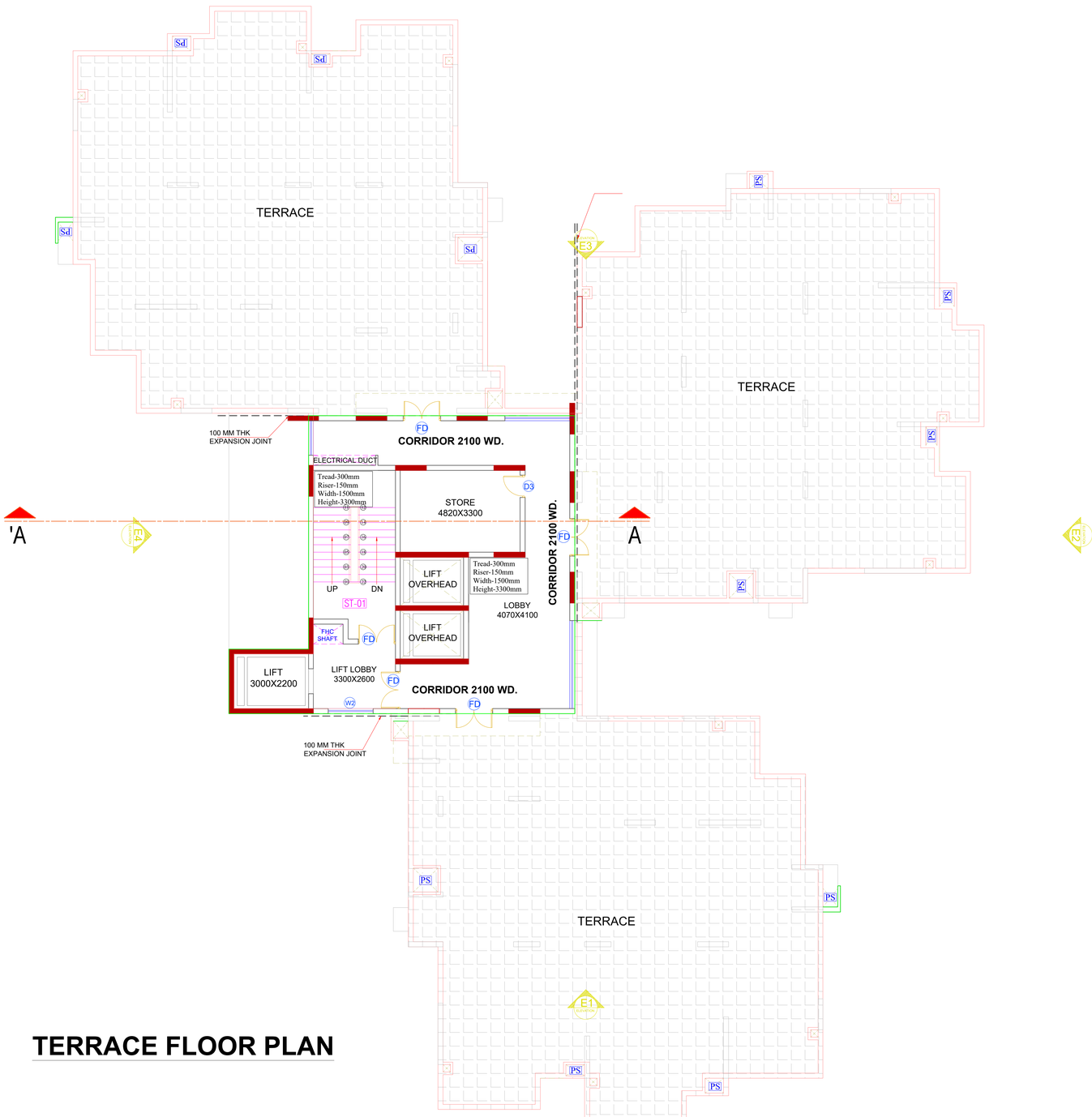
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100	SHEET SIZE: A1	DATE: 18-03-2026	REV. NO: R0

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	SIGN	DATE
DESIGNED / DRAWN BY		
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APPROVED BY		

TENDER PURPOSE ONLY



TERRACE FLOOR PLAN

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS

S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL
DOORS :					
1	FD	1500	2550	00	2550
2	SD	3000	2550	00	2550
3	SD1	2400	2550	00	2550
4	D	1800	2550	00	2550
5	D1	1200	2550	00	2550
6	D2'	1050	2550	00	2550
7	D2	1050	2100	00	2100
8	D3'	900	2550	00	2550
9	D3	900	2100	00	2100
10	D4	750	2100	00	2100
11	DW1	4550	2550	00	2550
12	DW2	3850	2550	00	2550
13	DW3	3600	2550	00	2550
14	DW4	2600	2550	00	2550
15	DW5	2400	2550	00	2550
16	DW6	1800	2550	00	2550
17	DW7	1600	2550	00	2550
18	DW8	1400	2550	00	2550
19	DW9	1330	2550	00	2550
WINDOWS :					
1	W	3000	1800	750	2550
2	W1	2400	1800	750	2550
3	W2	1800	1800	750	2550
4	W3	700	1800	750	2550
5	W4	600	1350	1200	2550
VENTILATOR :					
1	V1	750	1050	1500	2550
2	V2	600	1050	1500	2550

GENERAL NOTES:

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6.DRAWING NOT TO BE SCALED, WRITTEN DIMENSIONS TO BE FOLLOWED.
7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
TERRACE FLOOR PLAN

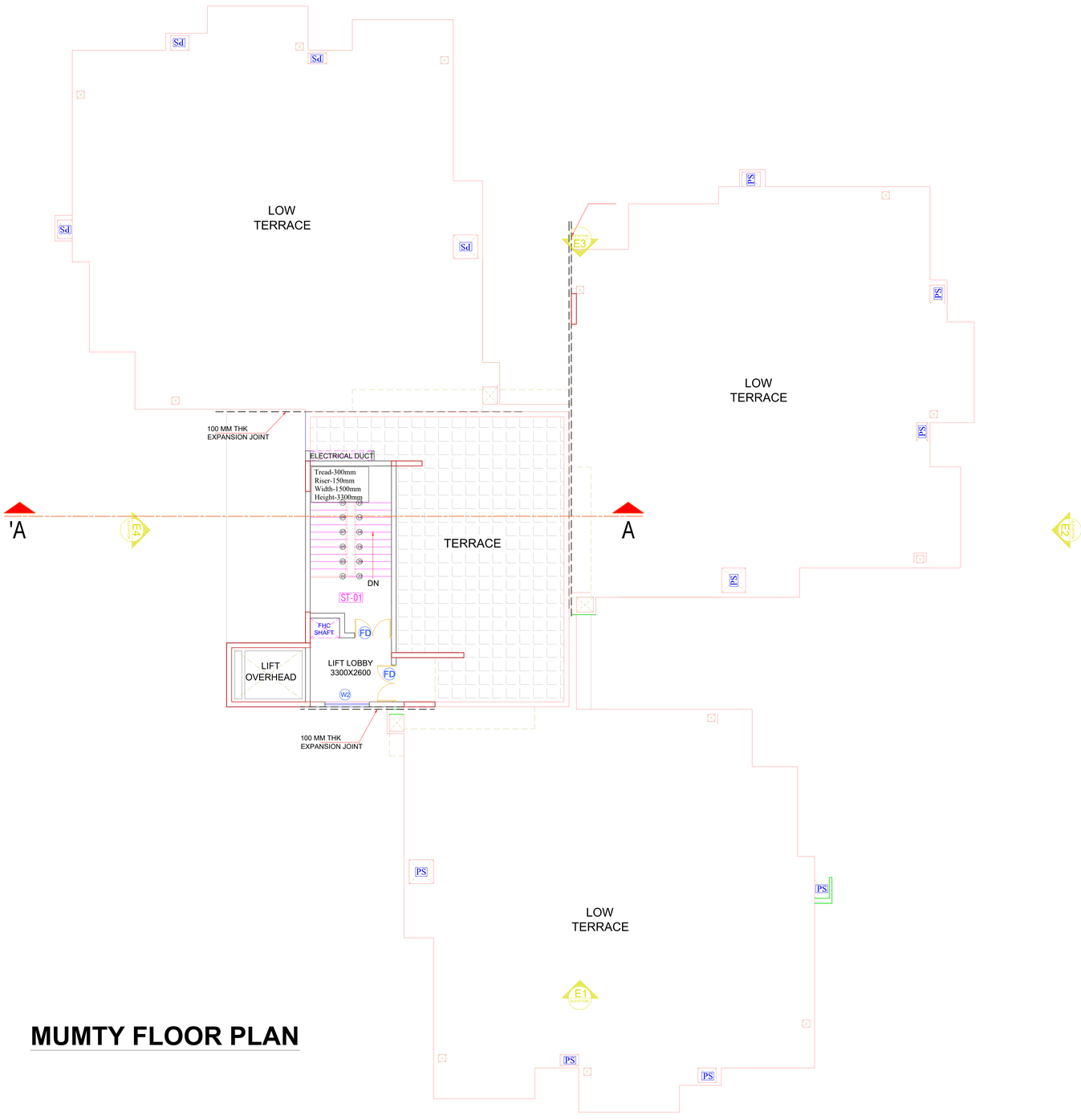
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

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TENDER PURPOSE ONLY



MUMTY FLOOR PLAN

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS					
S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL
DOORS :					
1	FD	1500	2550	00	2550
2	SD	3000	2550	00	2550
3	SD1	2400	2550	00	2550
4	D	1800	2550	00	2550
5	D1	1200	2550	00	2550
6	D2'	1050	2550	00	2550
7	D2	1050	2100	00	2100
8	D3'	900	2550	00	2550
9	D3	900	2100	00	2100
10	D4	750	2100	00	2100
11	DW1	4550	2550	00	2550
12	DW2	3850	2550	00	2550
13	DW3	3600	2550	00	2550
14	DW4	2600	2550	00	2550
15	DW5	2400	2550	00	2550
16	DW6	1800	2550	00	2550
17	DW7	1600	2550	00	2550
18	DW8	1400	2550	00	2550
19	DW9	1330	2550	00	2550
WINDOWS :					
1	W	3000	1800	750	2550
2	W1	2400	1800	750	2550
3	W2	1800	1800	750	2550
4	W3	700	1800	750	2550
5	W4	600	1350	1200	2550
VENTILATOR :					
1	V1	750	1050	1500	2550
2	V2	600	1050	1500	2550

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8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
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14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

WAPCOS

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(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
MUMTY FLOOR PLAN

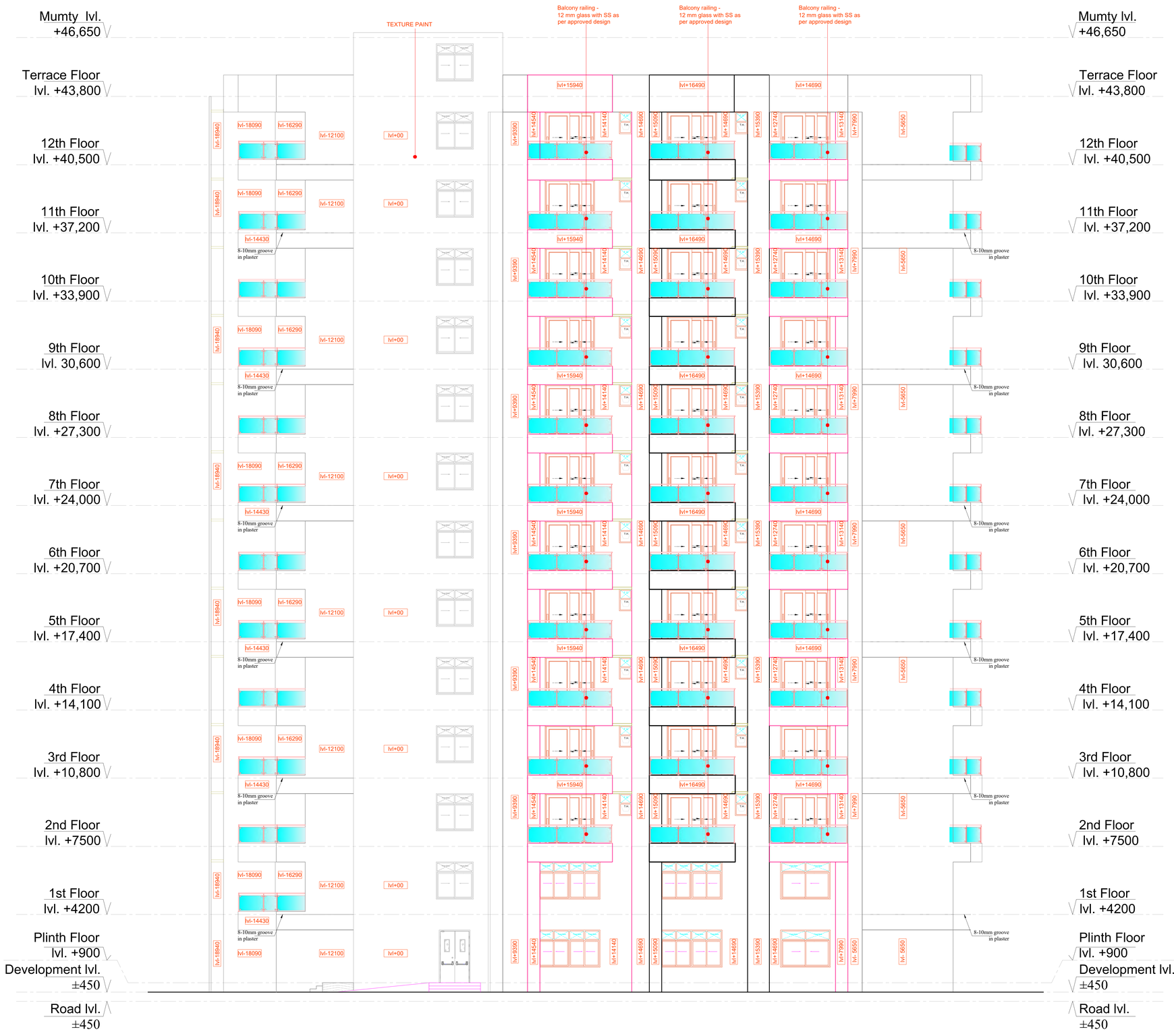
DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

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TENDER PURPOSE ONLY



ELEVATION 01

TENDER PURPOSE ONLY

GENERAL NOTES:

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

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A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

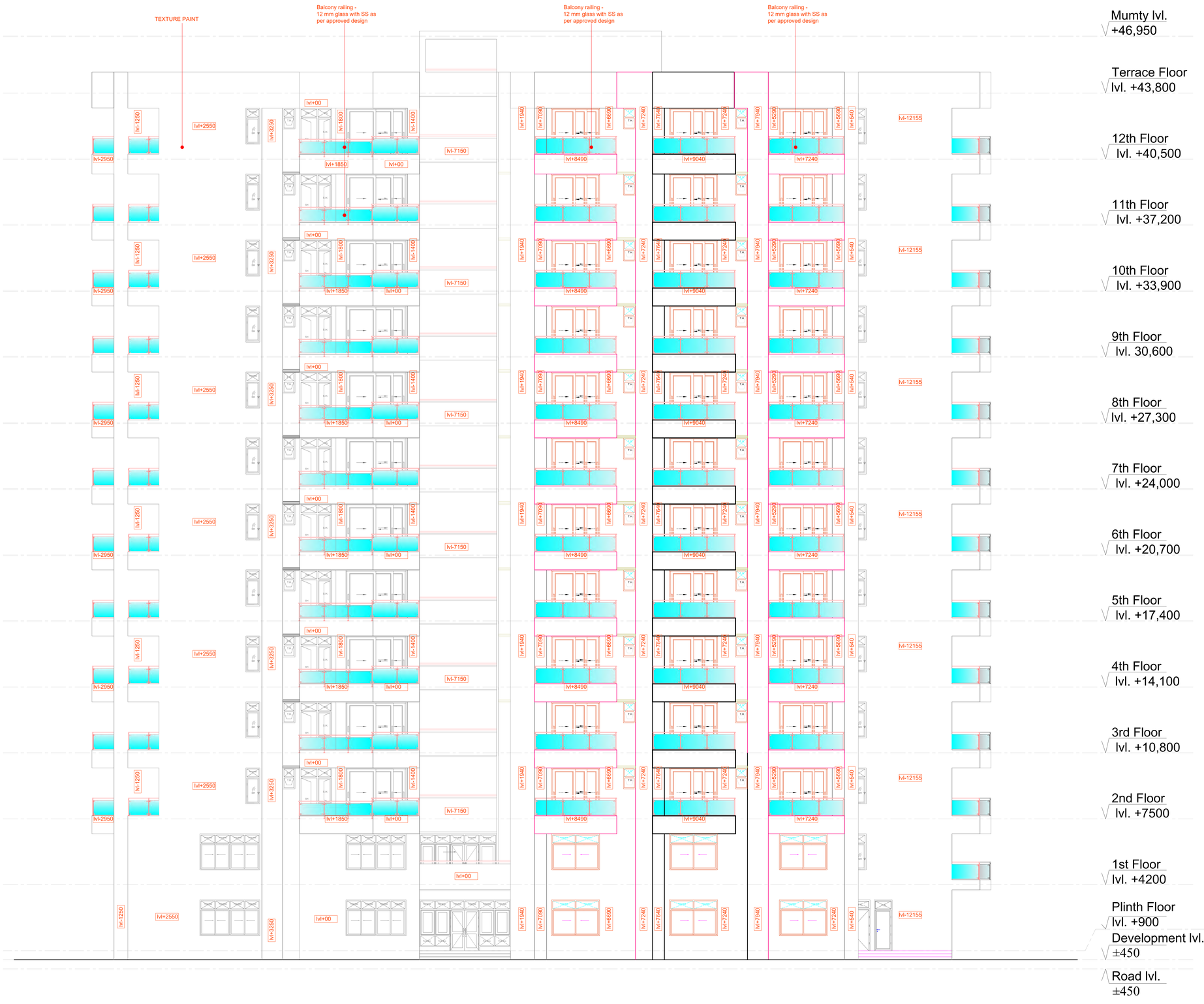
DRAWING TITLE :
ELEVATION-01

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



ELEVATION 02

TENDER PURPOSE ONLY

GENERAL NOTES:

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7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
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ARCHITECTURAL CONSULTANTS:

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architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
ELEVATION-02

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
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ELEVATION 03

TENDER PURPOSE ONLY

GENERAL NOTES:

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10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
ELEVATION-03

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

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	SIGN	DATE
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ELEVATION 04

TENDER PURPOSE ONLY

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5.ALL DIMENSIONS & LEVELS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
6.DRAWING NOT TO BE SCALED, WRITTEN DIMENSIONS TO BE FOLLOWED.
7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

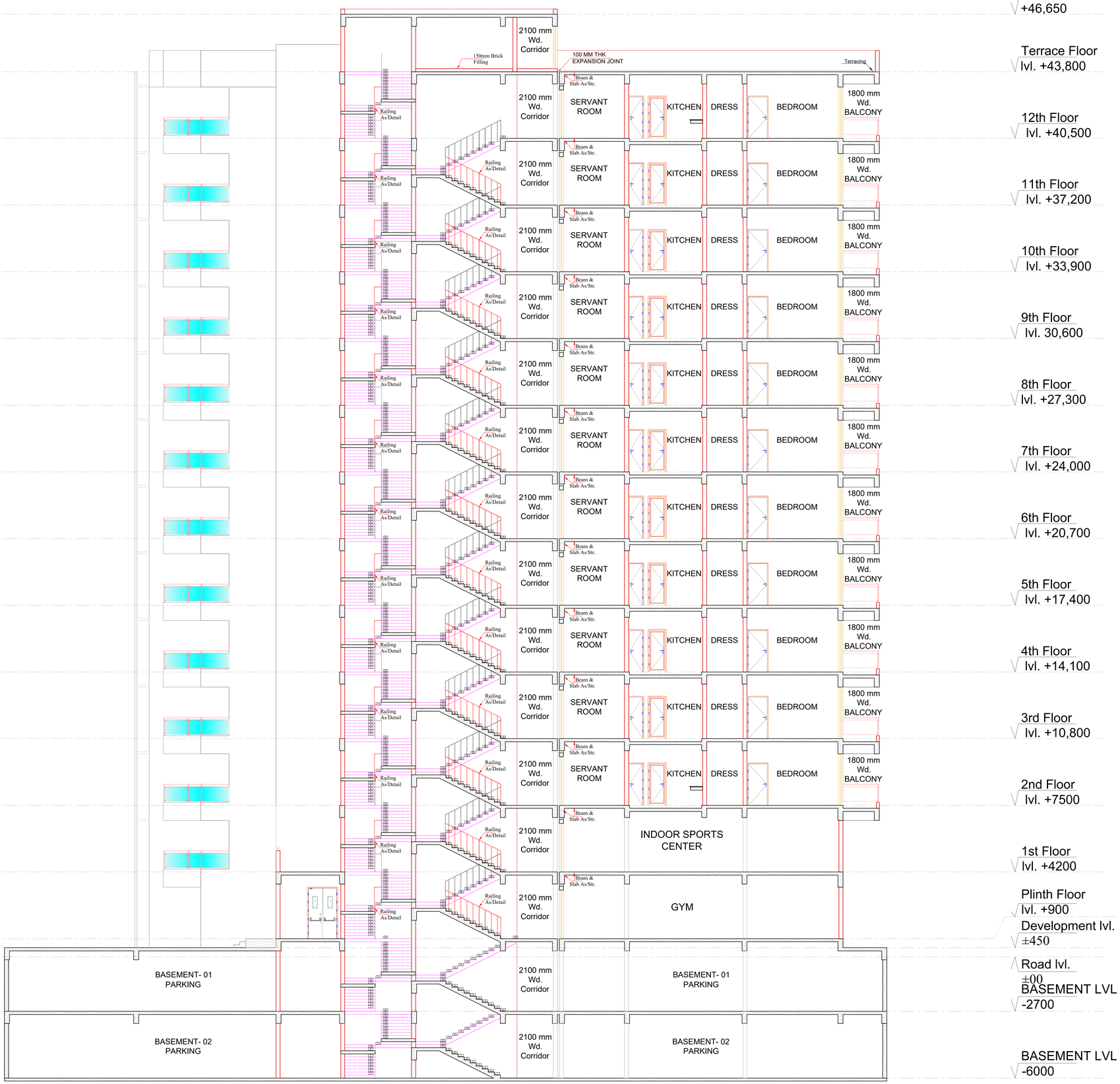
DRAWING TITLE :
ELEVATION-04

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100	SHEET SIZE: A1	DATE: 18-03-2026	REV. NO: R0

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SECTION A-A

TENDER PURPOSE ONLY

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REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

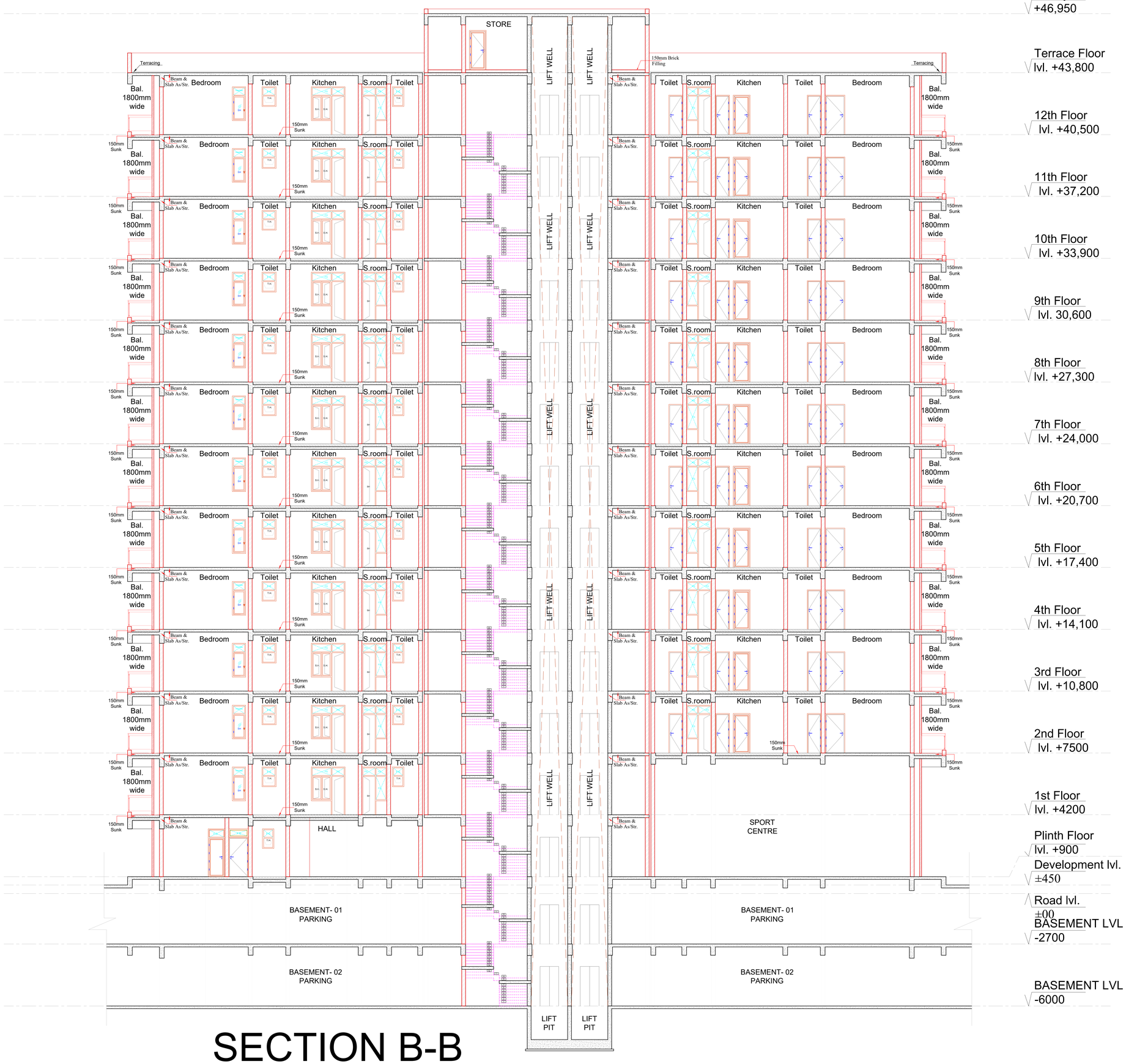
DRAWING TITLE :
SECTION A-A

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

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SECTION B-B

TENDER PURPOSE ONLY

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REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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phone no.. : 2980139, 2320715

PROJECT:

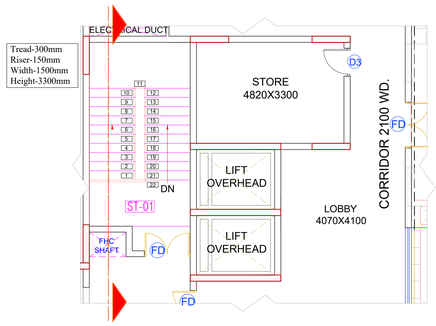
Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:	BUILDING NAME : TYPE - VI RESIDENTIAL FLAT
	DRAWING TITLE : SECTION B-B
	DRAWING TYPE : **TENDER DRAWINGS ARCHITECTURE**

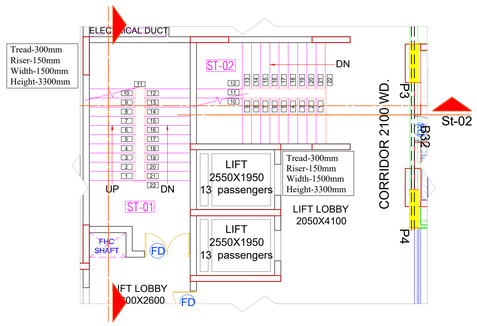
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RELEASED FOR ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

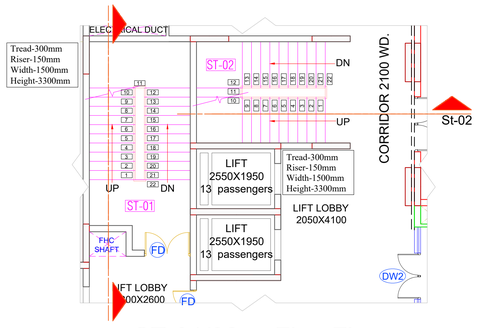
	SIGN	DATE
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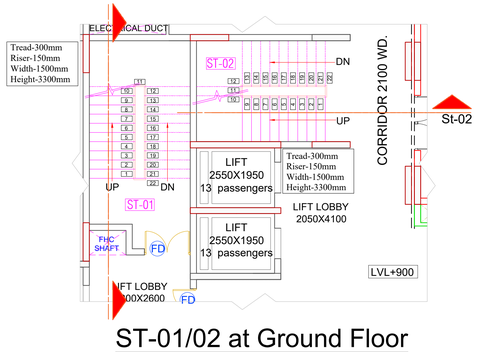
ST-01 at Terrace Floor



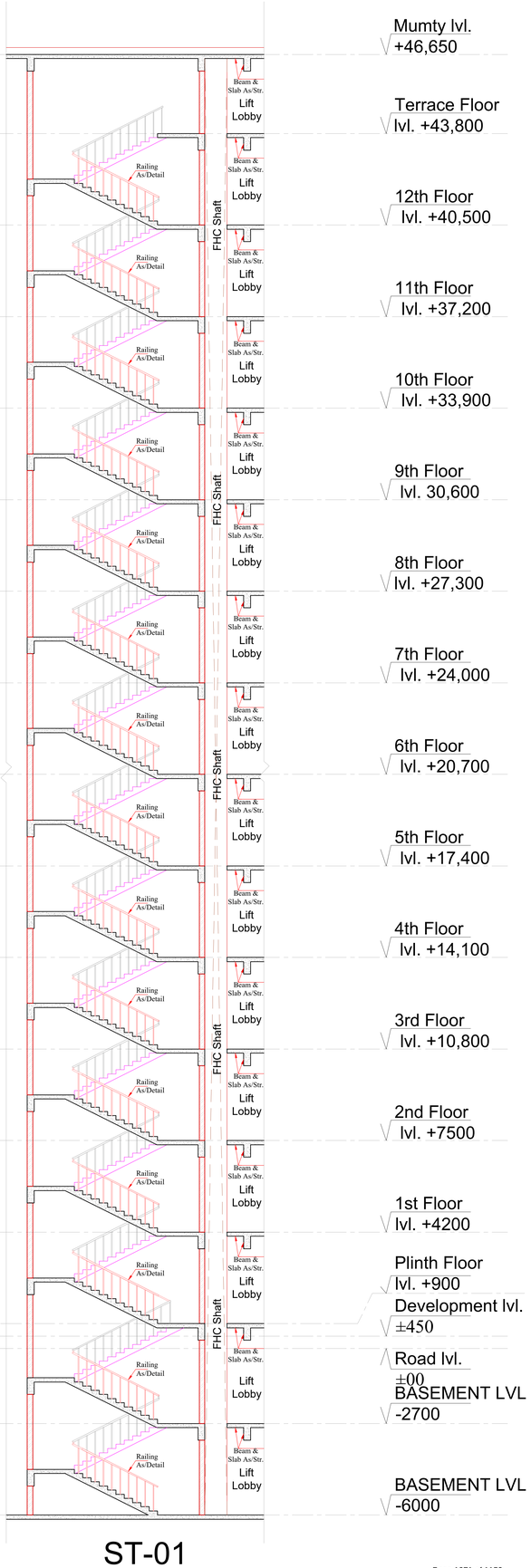
ST-01/02 at Typical Floor



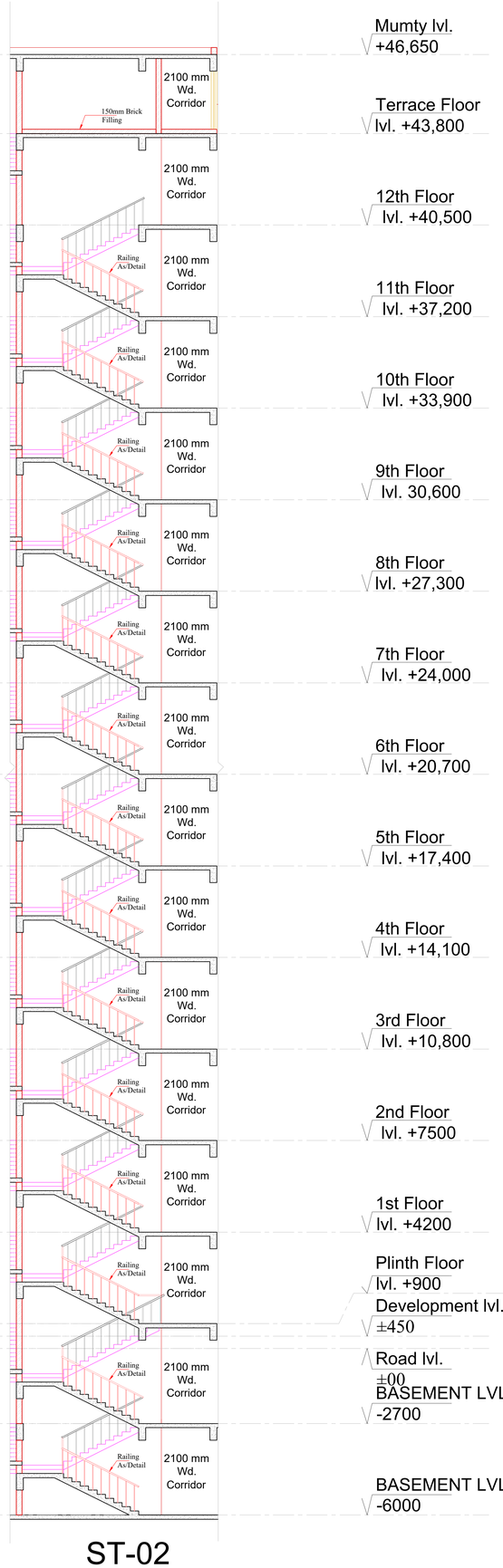
ST-01/02 at First Floor



ST-01/02 at Ground Floor



ST-01



ST-02

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A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

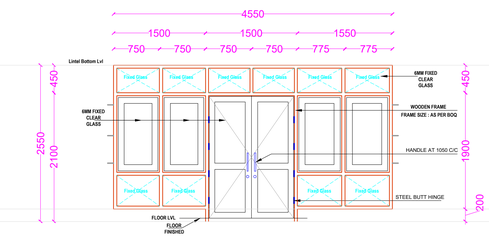
DRAWING TITLE :
Staircase Detail

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

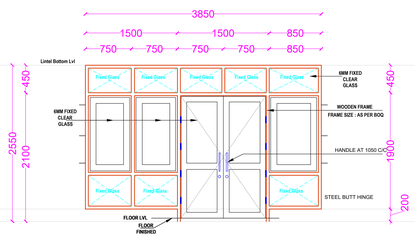
SCALE: 1:100 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

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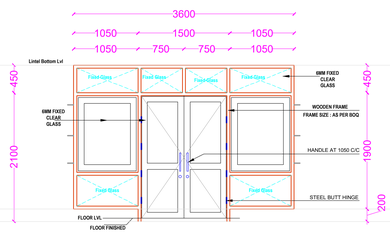
	SIGN	DATE
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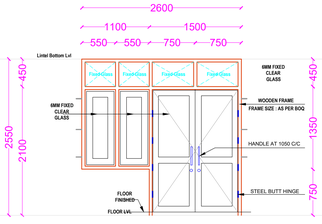
DW1(4550X2550)



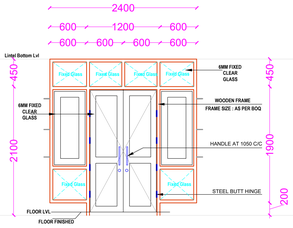
DW2(3850X2550)



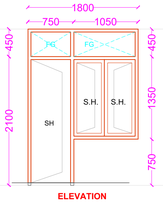
DW3(3600X2550)



DW4 (2600X2550)

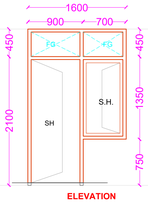


DW5(2400X2550)



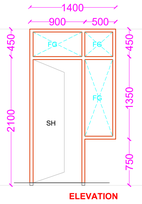
ELEVATION

DW6 (1800X2550)



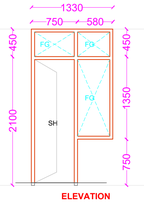
ELEVATION

DW7 (1600X2550)



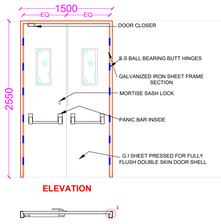
ELEVATION

DW8 (1400X2550)



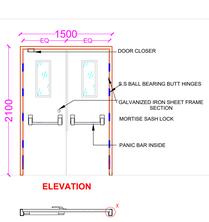
ELEVATION

DW9 (1330X2550)



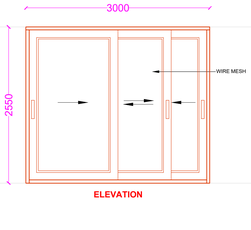
ELEVATION

FD(1500X2550)



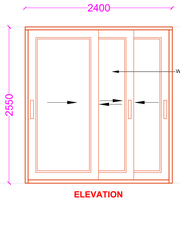
ELEVATION

FD' (1500X2100)



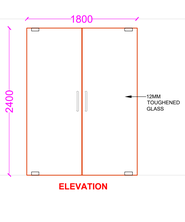
ELEVATION

SD (3000X2550)
UPVC 3track sliding door with 12mm toughend glass



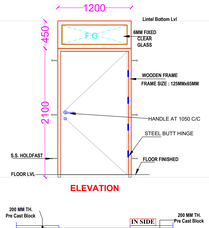
ELEVATION

SD1 (2400X2550)
UPVC 3track sliding door with 12mm toughend glass

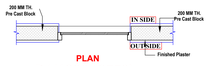


ELEVATION

D(1800X2550)

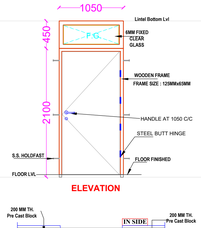


ELEVATION

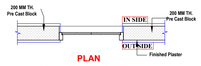


PLAN

D1(1200X2550)

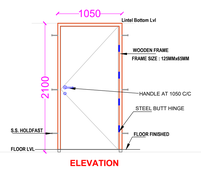


ELEVATION

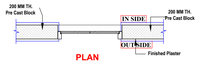


PLAN

D2'(1050X2550)

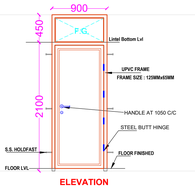


ELEVATION



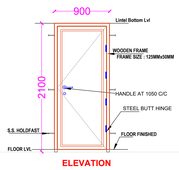
PLAN

D2 (1050X2100)



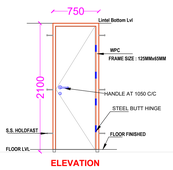
ELEVATION

D3' (900X2550)

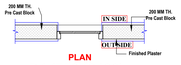


ELEVATION

D3 (900X2100)

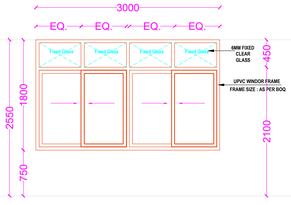


ELEVATION

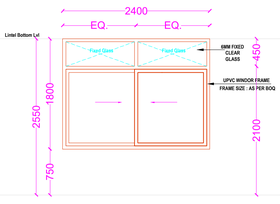


PLAN

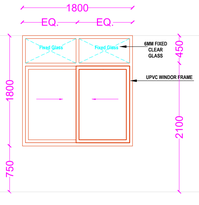
D4 (750X2100)



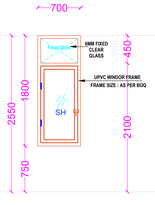
W (3000X1800)
2 TRACK UPVC FRAME SLIDING WINDOW



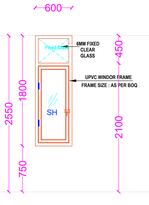
W1 (2400X1800)
2 TRACK UPVC FRAME SLIDING WINDOW



W2 (1800X1800)
2 TRACK UPVC FRAME SLIDING WINDOW



W3 (700X1800)
SIDE HUNG UPVC FRAME OPENABLE WINDOW

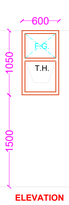


W4 (600X1800)
SIDE HUNG UPVC FRAME OPENABLE WINDOW



ELEVATION

V1(750X1050)



ELEVATION

V2(600X1050)

TENDER PURPOSE ONLY

GENERAL NOTES:

1.DRAWINGS & ACCOMPANYING SPECIFICATIONS AS INSTRUMENTS OF SERVICE ARE EXCLUSIVE PROPERTY OF WAPCOS.
2.REUSE, REPRODUCTION OR PUBLICATION BY ANY METHOD WHOLE OR IN PART IS PROHIBITED.
3.TITLE TO THESE DRAWINGS & SPECIFICATIONS SHALL REMAIN WITH WAPCOS WITHOUT PREJUDICE & VISUAL CONTACT WITH THEM SHALL CONSTITUTE PRIMA FACIE EVIDENCE OF ACCEPTANCE OF THESE CONDITIONS.
4.ANY DISCREPANCIES &/OR SPECIFICATIONS MUST BE BROUGHT TO THE NOTICE OF WAPCOS BEFORE THE START OF CONSTRUCTION.
5.ALL DIMENSIONS & LEVELS ARE IN MILLIMETERS UNLESS OTHERWISE SPECIFIED.
6.DRAWING NOT TO BE SCALED, WRITTEN DIMENSIONS TO BE FOLLOWED.
7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

CLIENT

सत्यमेव जयते

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

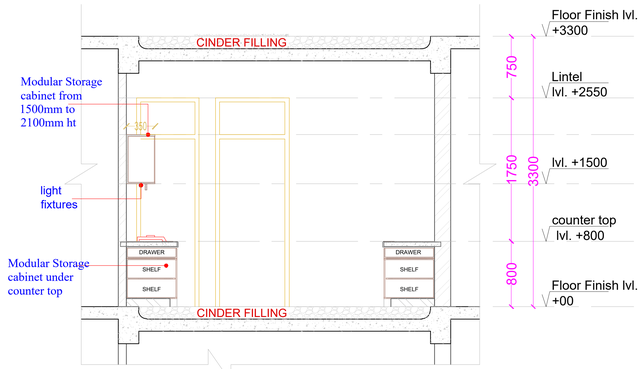
DRAWING TITLE :
DOOR WINDOW DETAIL

DRAWING TYPE :
TENDER DRAWINGS ARCHITECTURE

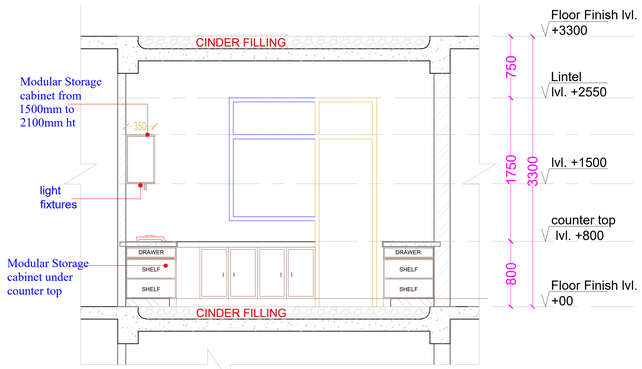
SCALE: 1:50 | SHEET SIZE: A1 | DATE: 18-03-2026 | REV. NO: R0

RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

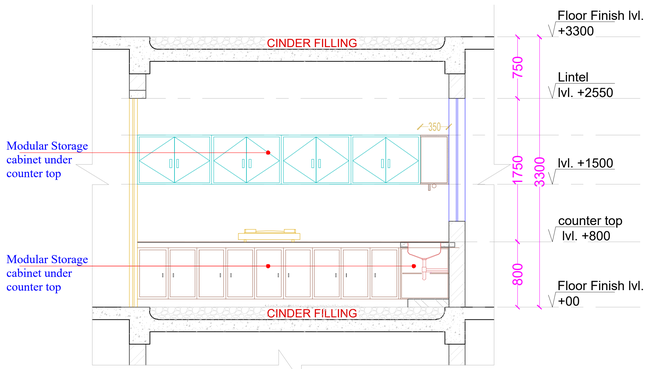
	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



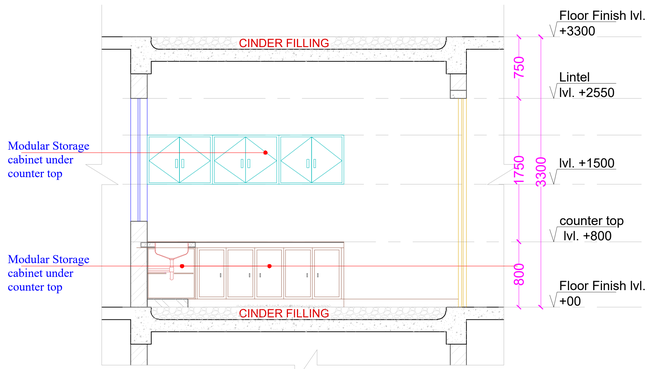
SECTION 4-4



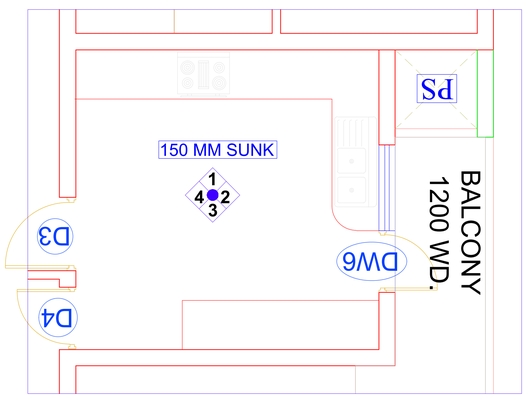
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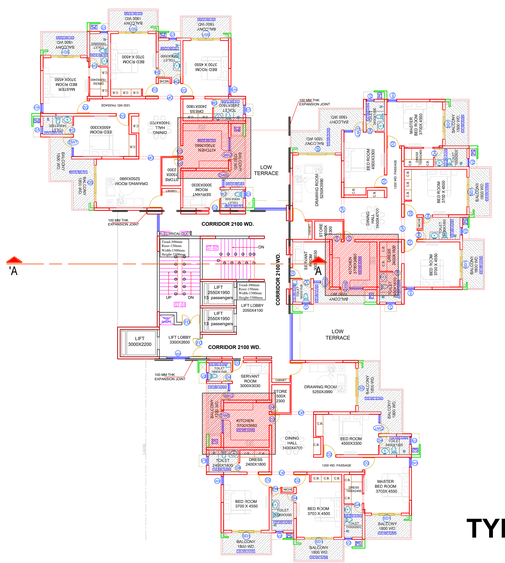
SECTION 1-1

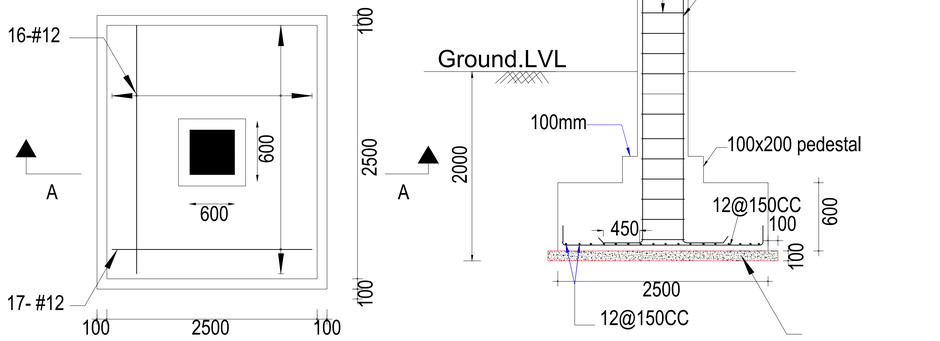


SECTION 3-3



KITCHEN
3700X3660
K1


'A'
'A'
CORRIDOR 2100 WD.
CORRIDOR 2100 WD.
CORRIDOR 2100 WD.
LOW TERRACE
LOW TERRACE
LOW TERRACE
DRAWING ROOM 5250X3990
DINING HALL 7400X4700
KITCHEN 3700X3660
SERVANT ROOM 3000X3000
BED ROOM 4500X3300
MASTER BED ROOM 3700X4500
BED ROOM 3700 X 4500
BED ROOM 3700 X 4500
BALCONY 1800 WD.
BALCONY 1800 WD.
BALCONY 1800 WD.
LIFT 3000X3200
LIFT LOBBY 3300X3000
LIFT 2000X1650 13 passengers
LIFT LOBBY 2000X4100
LIFT 2000X1650 13 passengers
LIFT LOBBY 2000X3000
LIFT LOBBY 2000X4100
DRESS 2400X1800
DRESS 2400X1800
SOFA 3300X1000
SOFA 3300X1000
SOFA 3300X1000

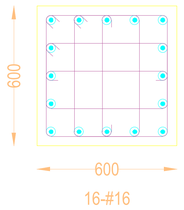


TYP-ISOLATED FOOTING PLAN (FOR BASEMENT COLUMN)

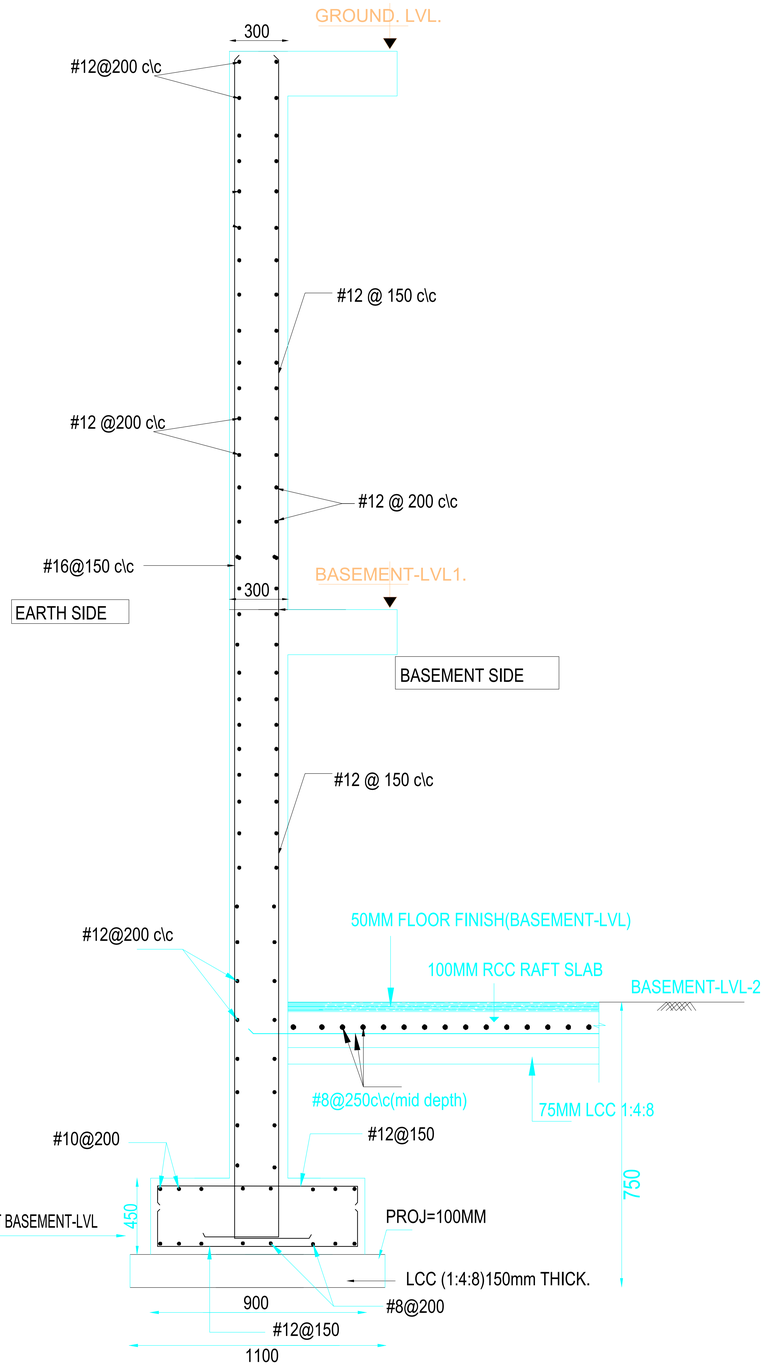
Spacing of bar c\c=(L-2*cover)\(no of bar-1)

100MM TH PCC (1:4:8)

SECTION AT A-A(FOR BASEMENT COLUMN)



TYP SECTION BASEMENT COLUMN



TYP R\FT DETAILS OF RETAINING WALL.

GENERAL NOTES:

NOTES:-

[GENERAL]

[1] ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE MENTIONED.
[2] ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED NEITHER THE BARS SHALL BE COUNTED NOR THE DIMENSIONS SCALED FROM THE DRG.
[3] ANY DISCREPANCY IN THE DRGS. SHALL BE BROUGHT TO THE NOTICE OF ARCHITECT / CONSULTANT. AND CLARIFICATION OBTAINED IN WRITING PRIOR TO EXECUTION OF WORK.
[4] HIGH YIELD STRENGTH DEFORMED BARS OF YIELD STRESS 550 N/MM2 WHICH SHALL CONFORM TO 1786-2008 SHALL BE USED AS REINFORCEMENT
[5] CLEAR COVER OF OUTER LAYER REINF. SHALL BE AS FOLLOWS.
(a) FOUNDATION = 50 M.M. (b) COLUMN = 40 M.M. (c) BEAM = 25 M.M.
(d) SLAB = 20 M.M. (e) WAIST SLAB = 20 M.M. (f) WALL 25MM
[6] LAP / DEVELOPMENT LENGTH 'Ld ' FOR DIFFERENT DIA. OF BARS FOR M - 40 SHALL BE AS 50*DIA OF BAR.
[7] CONC. MIX FOR R.C.C. WORK SHALL BE OF GRADE M - 40 CONFIRMING TO I.S. 456 - 2000.
[8] NECESSARY FIXTURE FOR ELECTRICAL, PLUMBING, ETC. SHALL BE PROVIDED IN SLAB, BEAMS BEFORE EXECUTION AS PER RELEVANT DRGS.

LOAD BEARING WALL

[1] ALL THE WALL LOAD BEARING AS PER SPANNING OF SLAB AS SHOWN IN DRG
[2] MUST BE ONE BRICK WALL THICKNES 1:6 CEMENT SAND MORTOR EXCEPT HATCHED WALL 1:3 CEMENT SAND MORTOR AS PER P.W.D SPECIFICATION. 1\2 BRICK WALL OR PARTION WALL MUST BE 1:3 CEMENT SAND MORTOR.
[3] DOTTED LINE WITH NAME STARTING WITH PRIFIX "B" IS R.C.C BEAM.
[4] BED BLOCK OF CONCRETE M-20 GRADE MUST BE PROVIDED BELOW BEAM.
[5] AT JOINT ,CORNER& AT JAMB OF OPENING IN WALL SINGLE BAR #12 PROVIDED AS VERTICAL STEEL.

[FOUNDATION]

[1] THE LAYOUT OF BUILDING SHALL BE GIVEN FROM THE LATEST ARCH. DRG.
[2] THE DESIGN DATA FOR FOUNDATION HAS BEEN TAKEN FROM SOIL TEST REPORT PROVIDED BY THE DEPT./ CLIENT NET SBC =21.15 T\M2 AT DEPTH 9.0M BELOW GROUND-LVL FOR ISOLATED SQUARE FOOTING FOR FRAME TYPE STRUCTURE.
[3] THE DEPTH OF FOUNDATION SHALL BE 9000MM BELOW GENERAL GROUND-LVL

[BEAMS]

[1] FOR LOCATION OF BEAMS REFER GRID PLAN.
[2] WHERE TWO LAYERS OF REINF. BARS ARE TO BE PROVIDED, SPACER BAR ARE TO BE PROVIDED AT SPACING OF 1000 MM. MAX. AND THE DIA OF THE SPACER BAR SHALL BE HIGHER OF DIA OF LONGITUDINAL BARS OR 25 MM.
[3] MAX. 3 NOS. OF BARS SHALL BE PROVIDED IN A LAYER OF 230 WIDE BEAM.

[SLABS]

[1] CRANKING & CURTAILMENT OF BOTTOM REINF. SHALL BE DONE AS PER TYP DETAIL OF SLAB.
[2] THE CROSS REINF. / TEMP. REINF. BELOW TOP REINF.i.e. #8@300 c/c IS TO BE PROV. JUST BELOW THE MAIN TOP STEEL WHICH HAS NOT BEEN SHOWN IN THE DRG.

S.No.	R.No.	Date	Description	By

REVISION

CLIENT

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT:

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

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architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

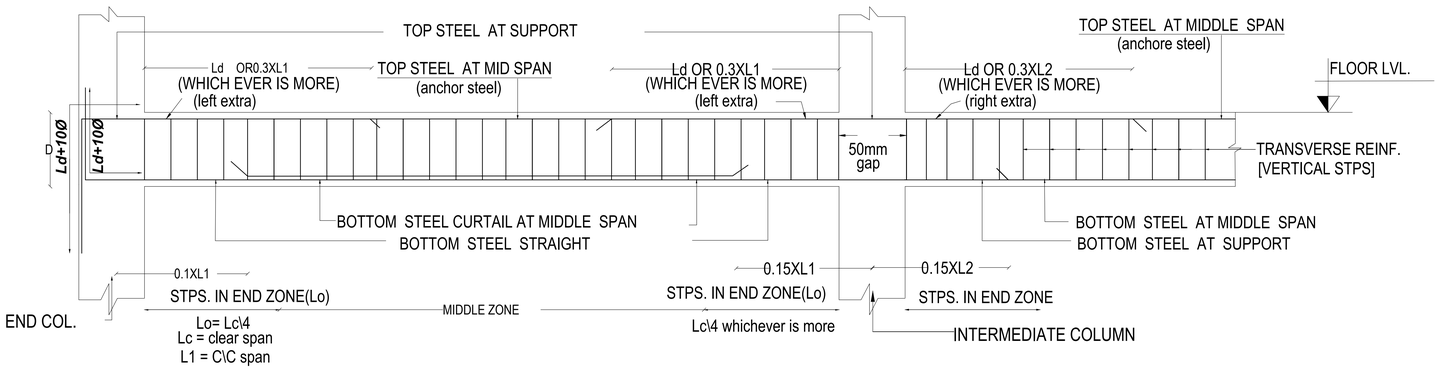
BASEMENT DETAIL

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\02
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

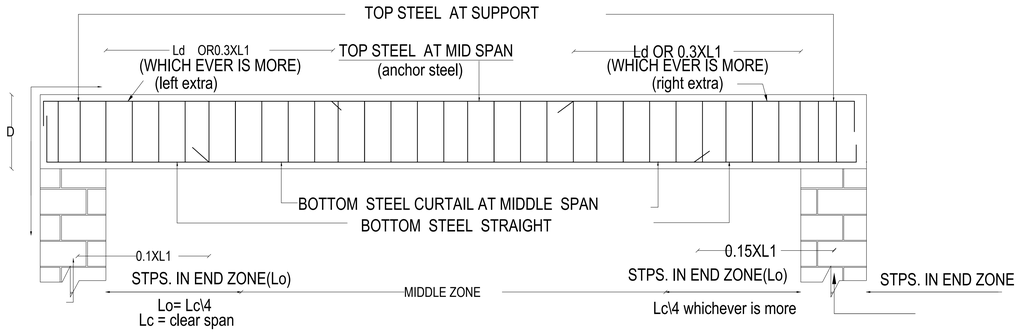
DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

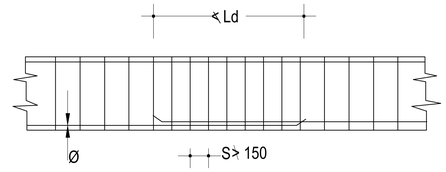
TENDER PURPOSE ONLY



TYP.REINF. DETAILS IN THE SLAB BEAMS SPANNING BETWEEN SUPPORT TO SUPPORT(COLUMNS)

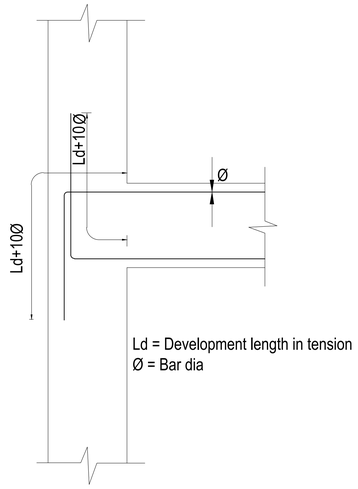


TYP.REINF. DETAILS IN THE SLAB BEAMS SPANNING BETWEEN WALL SUPPORT



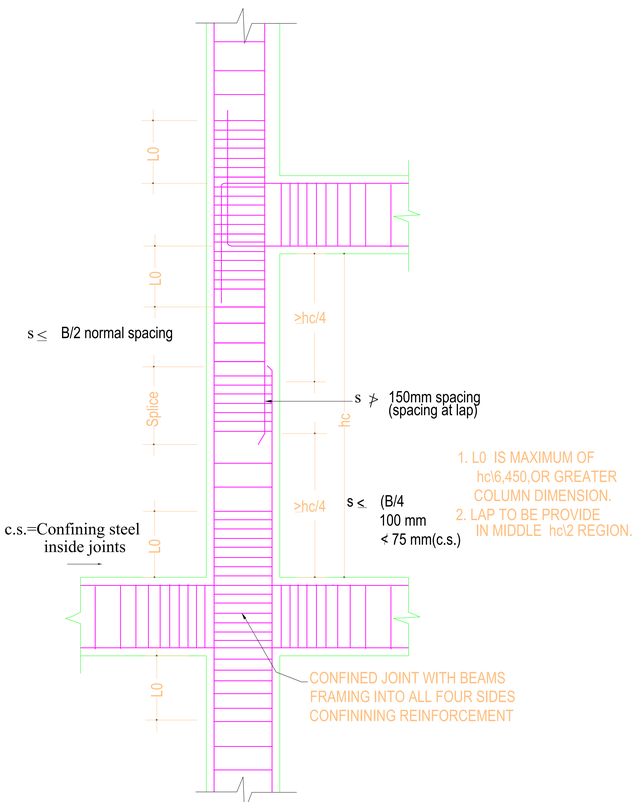
Ld = Development length in tension
Ø = Bar dia

Lap splice in beam



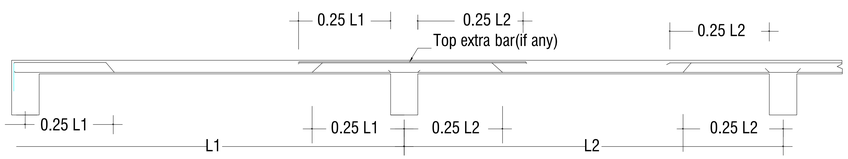
Ld = Development length in tension
Ø = Bar dia

(Anchorage of Beam Bars in an External Joint

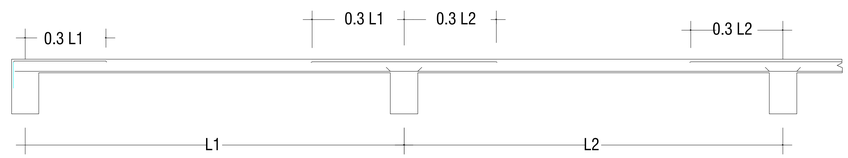


1. L0 IS MAXIMUM OF hc\6,450,OR GREATER COLUMN DIMENSION.
2. LAP TO BE PROVIDE IN MIDDLE hc\2 REGION.

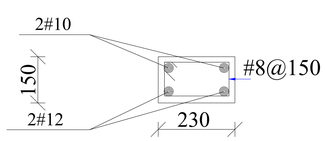
Ducutile detailing of beam Column and joint detailing



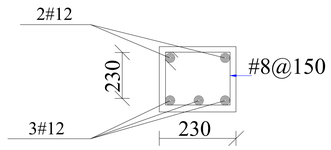
TYPICAL DETAILING OF SLAB(with bentup bar)



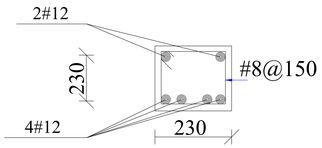
TYPICAL DETAILING OF SLAB(with straight bars)



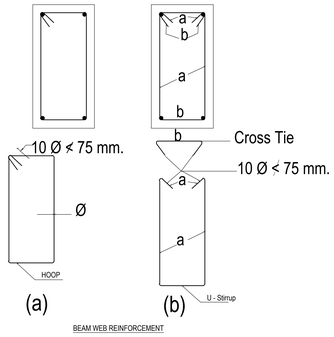
LINTEL BEAM UPTO 1.0M SPAN

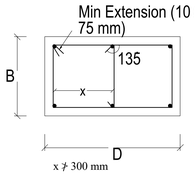


LINTEL BEAM UPTO 1.50M TO 2.0 M SPAN

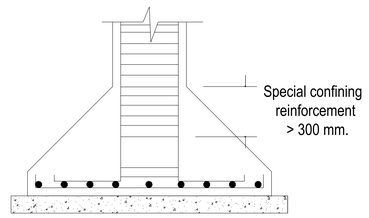


LINTEL BEAM UPTO 2.0M TO 2.5 M SPAN





(Details of ties in columns)



Provision of special confining reinforcement in footing

GENERAL NOTES:

ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE MENTIONED.
ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED NEITHER THE BARS SHALL BE COUNTED NOR THE DIMENSIONS SCALED FROM THE DRG.
ANY DISCREPANCY IN THE DRGS. SHALL BE BROUGHT TO THE NOTICE OF ARCHITECT / CONSULTANT. AND CLARIFICATION OBTAINED IN WRITING PRIOR TO EXECUTION OF WORK.
HIGH YIELD STRENGTH DEFORMED BARS OF YIELD STRESS 550 N/MM2 WHICH SHALL CONFORM TO 1786-2008 SHALL BE USED AS REINFORCEMENT
CLEAR COVER OF OUTER LAYER REINF. SHALL BE AS FOLLOWS.
(a) FOUNDATION = 50 M.M. (b) COLUMN = 40 M.M. (c) BEAM = 25 M.M.
(d) SLAB = 20 M.M. (e) WAIST SLAB = 20 M.M. (f) WALL 25MM
LAP / DEVELOPMENT LENGTH 'Ld ' FOR DIFFERENT DIA. OF BARS FOR M - 40 SHALL BE AS 50*DIA OF BAR.
CONC. MIX FOR R.C.C. WORK SHALL BE OF GRADE M - 40 CONFIRMING TO I.S. 456 - 2000.
NECESSARY FIXTURE FOR ELECTRICAL, PLUMBING, ETC. SHALL BE PROVIDED IN SLAB, BEAMS BEFORE EXECUTION AS PER RELEVANT DRGS.
LOAD BEARING WALL
ALL THE WALL LOAD BEARING AS PER SPANNING OF SLAB AS SHOWN IN DRG MUST BE ONE BRICK WALL THICKNES 1:6 CEMENT SAND MORTOR EXCEPT HATCHED WALL 1:3 CEMENT SAND MORTOR AS PER P.W.D SPECIFICATION.
1\2 BRICK WALL OR PARTION WALL MUST BE 1:3 CEMENT SAND MORTOR.
DOTTED LINE WITH NAME STARTING WITH PRIFIX "B" IS R.C.C BEAM.
BED BLOCK OF CONCRETE M-20 GRADE MUST BE PROVIDED BELOW BEAM.
[5] AT JOINT ,CORNER& AT JAMB OF OPENING IN WALL SINGLE BAR #12 PROVIDED AS VERTICAL STEEL.

[FOUNDATION]
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Date	Description	By

REVISION

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

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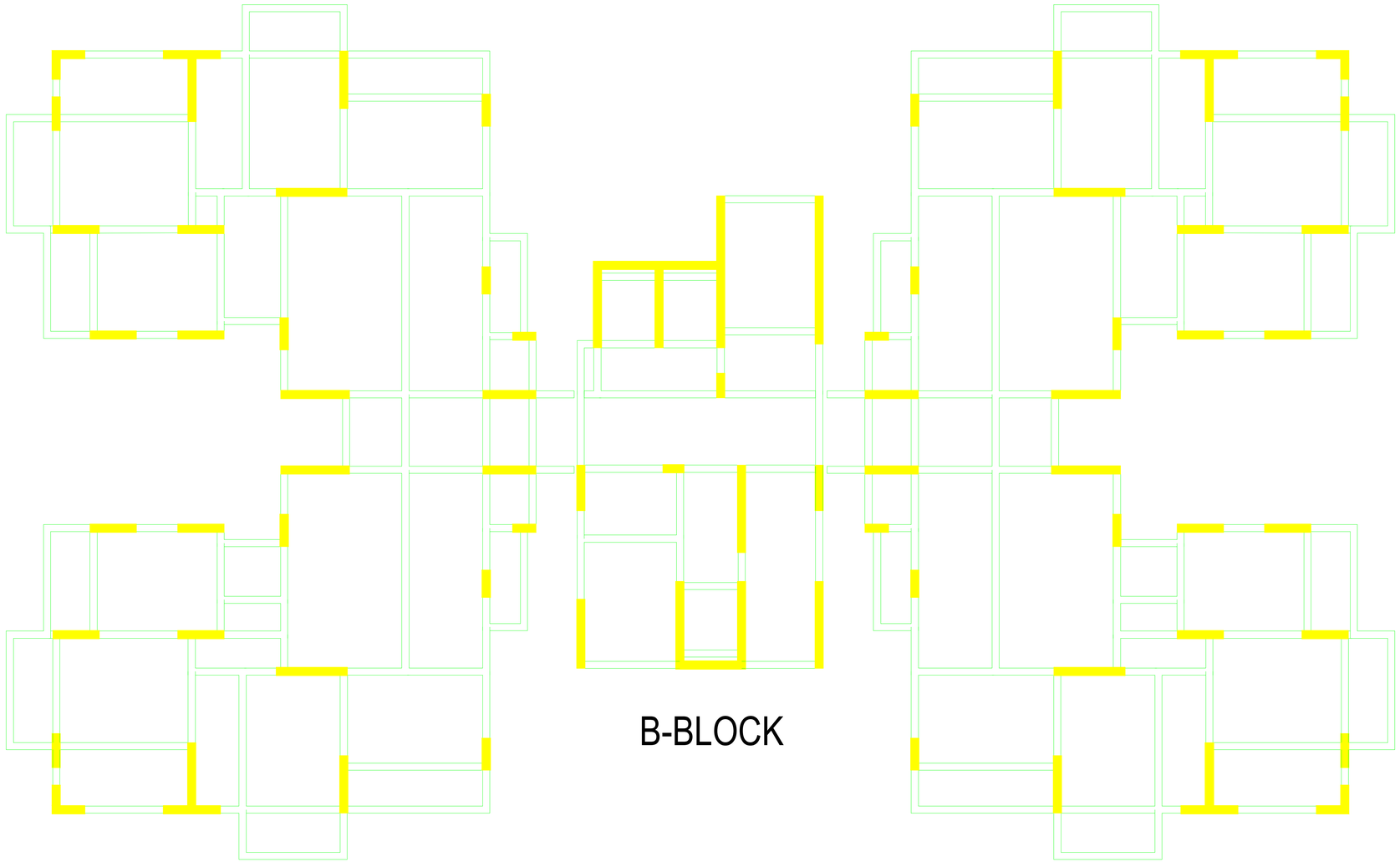
Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

TYP DETAILS OF BEAM,COLUMN&SLAB IS PER IS-456(2000) & IS-13920

nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\01
	DRG. NO.	REVISION NO. 01	

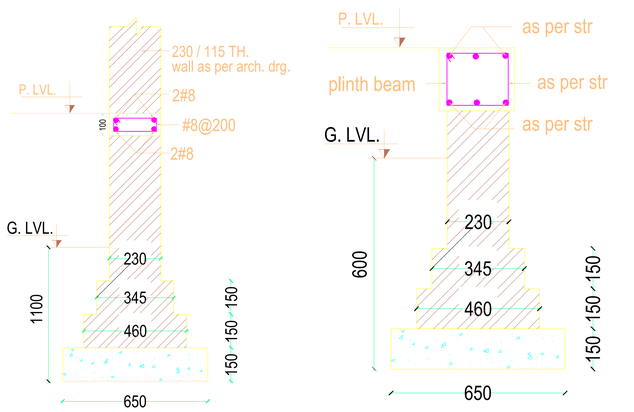
TENDER DRAWINGS -STRUCTURE

TENDER PURPOSE ONLY



RCC GRID PLAN AT TYPICAL FLOOR-LVL

TYPE - V RESIDENTIAL FLAT



DETAILS OF OUTER PLINTH BEAM

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

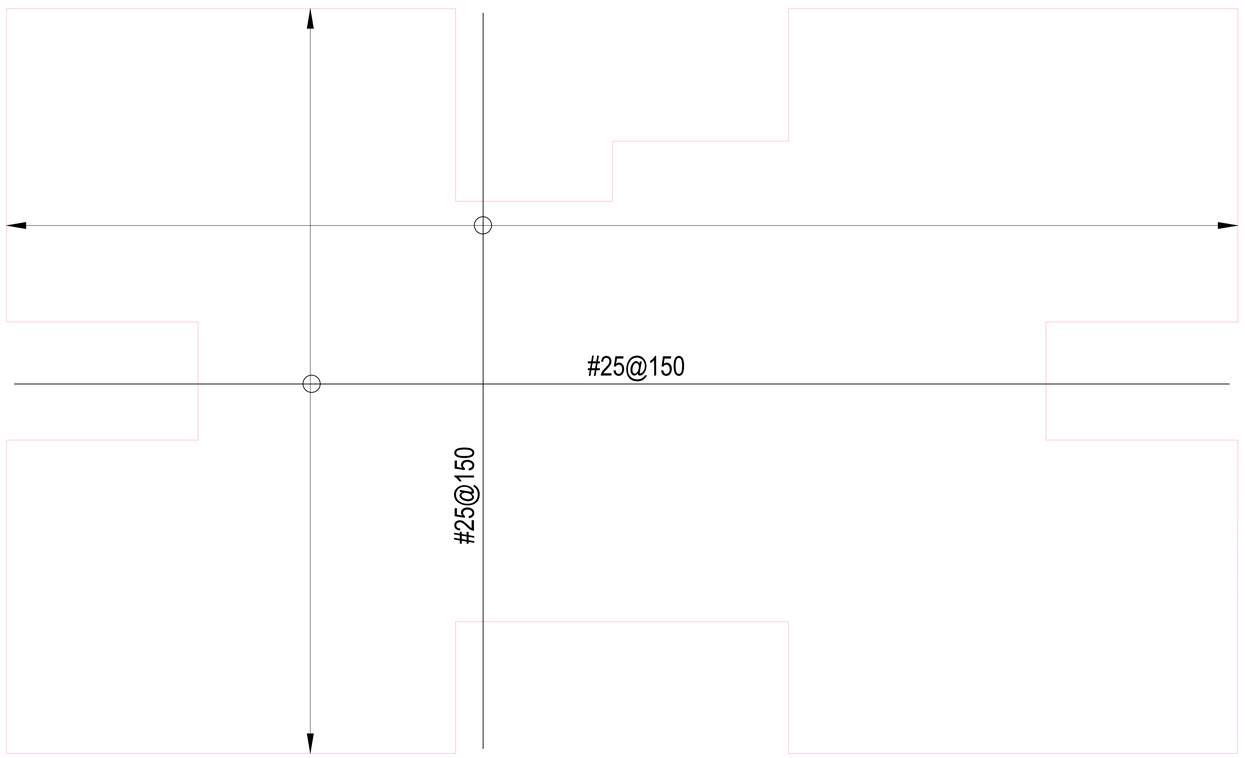
RCC GRID PLAN AT TYPICAL FLOOR-LVL
TYPE - V RESIDENTIAL FLAT

DEALT BY:	DATE:	SCALE:	SHEET NO.
nidhi	17-3-26	1:100	STRT\02
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:
TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY

FOUNDATION PLAN



RAFT BOTTOM STEEL& TOP STEEL

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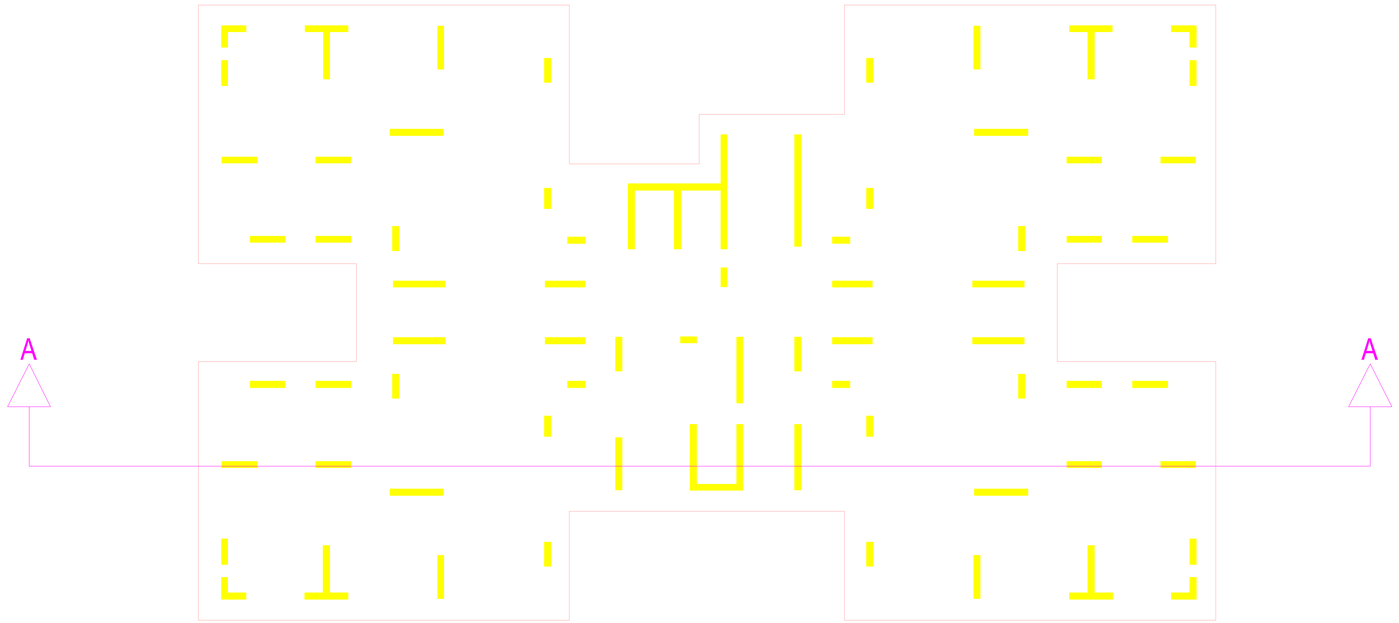
DRG. TITLE: FOUNDATION PLAN

TYPE - V RESIDENTIAL FLAT

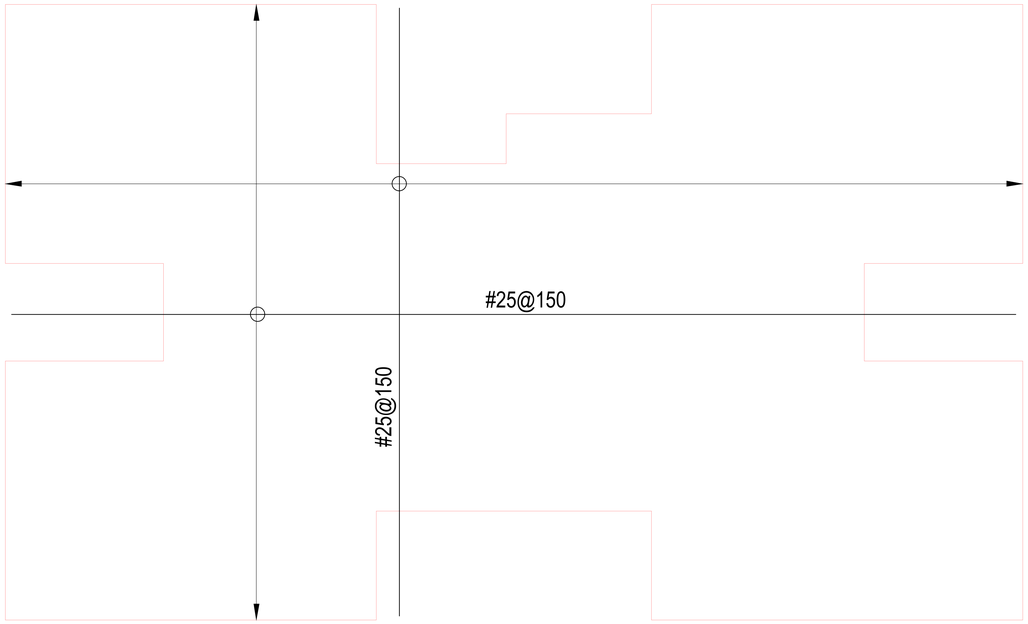
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CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE: **TENDER DRAWINGS - STRUCTURE**

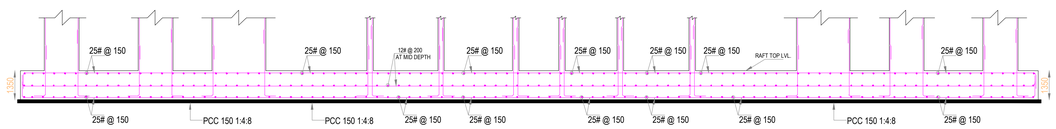
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FOUNDATION PLAN



RAFT BOTTOM STEEL& TOP STEEL



SECTION AT AA

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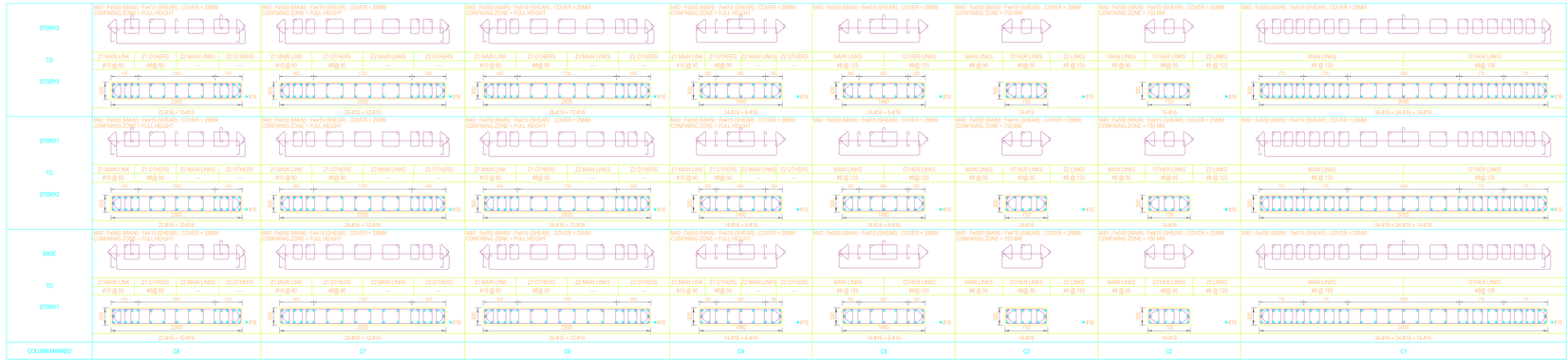
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CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

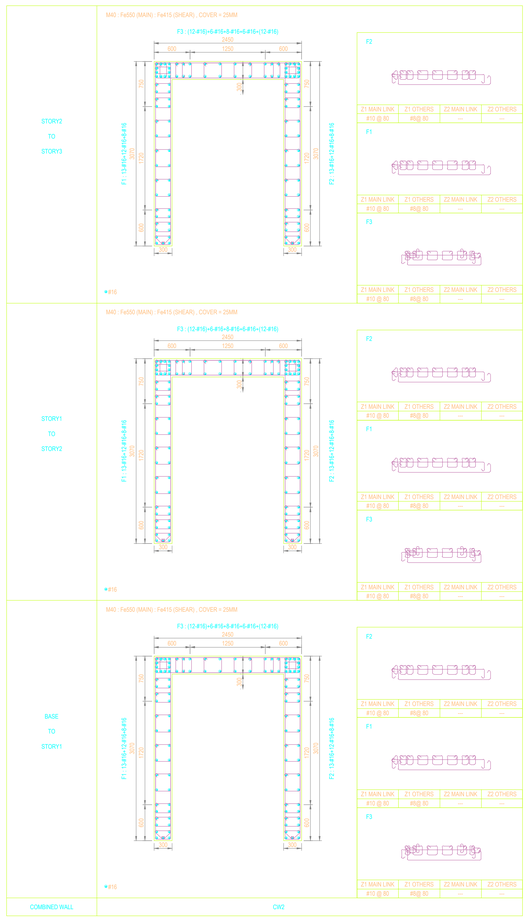
TENDER PURPOSE ONLY

COLUMN\ SHEARWALL SCHEDULE:

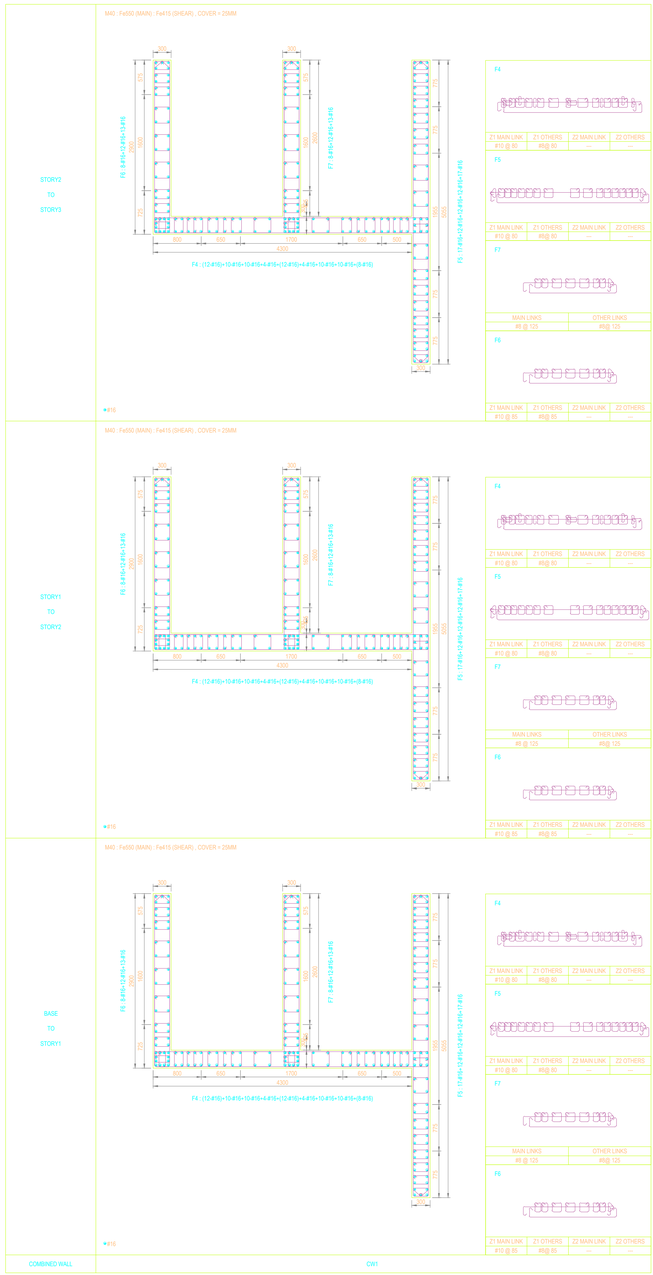


COLUMN AND WALL SCHEDULE
(SCALE 1:25)
NOTES:
1. Z1 = SPECIAL CONFINING ZONE As PER IS 456 : 2000 + IS 13920 : 2016, Z2 = REMAINING ZONES As PER IS 456 : 2000 + IS 13920 : 2016

2. (bt) – STEEL GRADE For MAIN REINFORCEMENT
3. (S) – STEEL GRADE FOR SHEAR REINFORCEMENT/LINKS



COMBINED WALL SCHEDULE
(SCALE 1:25)
NOTES:
(Z1 = SPECIAL CONFINING ZONE AS PER IS 456 : 2000 + IS 13920 : 2016, Z2 = REMAINING ZONES AS PER IS 456 : 2000 + IS 13920 : 2016
(x-Tnx) DENOTES BARS WITHIN INTERSECTION



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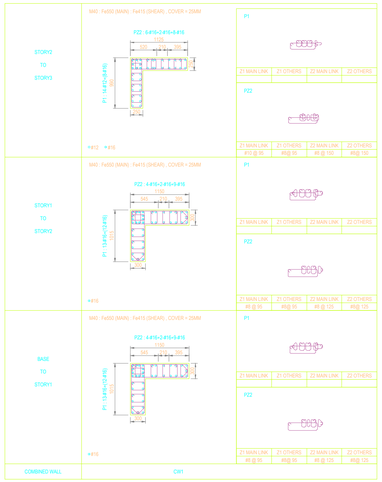
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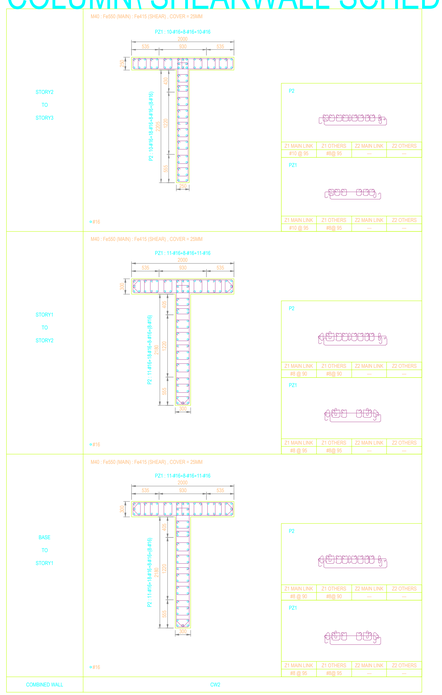
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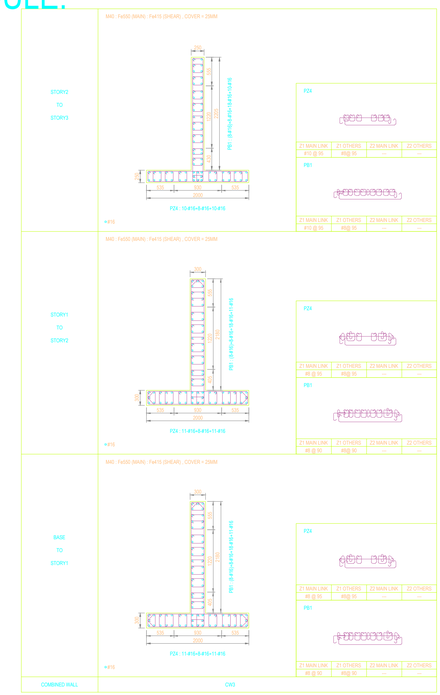
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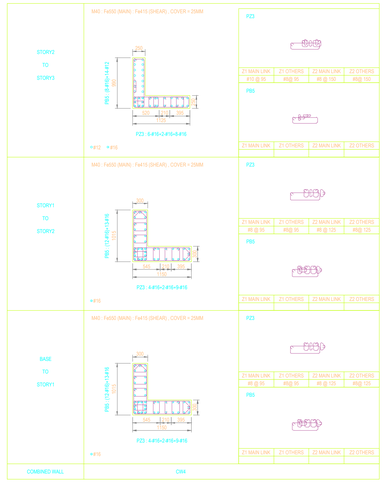
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COLUMN\ SHEARWALL SCHEDULE:

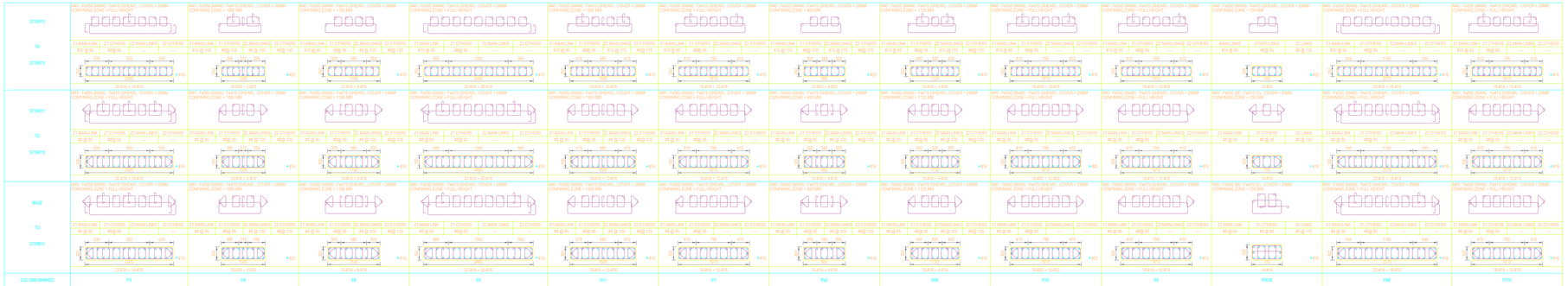


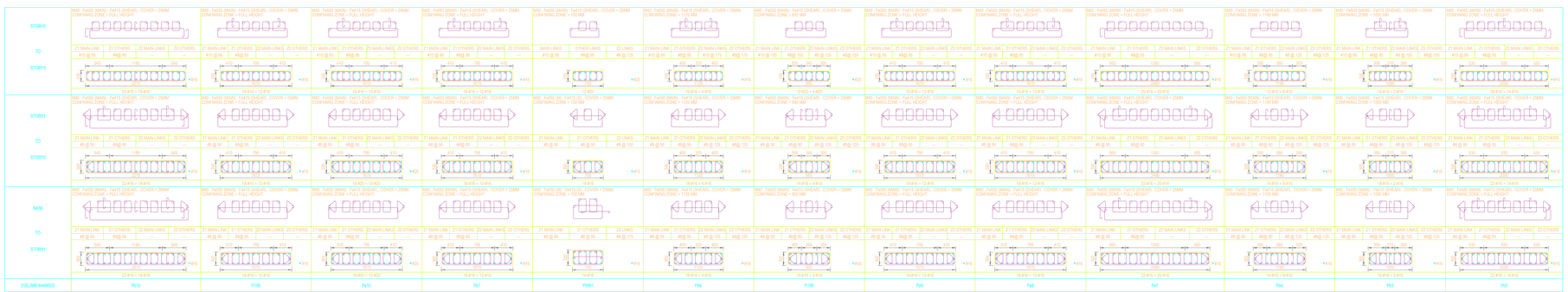






COMBINED WALL SCHEDULE
SCALE 1:25
NOTES:
Z1 = SPECIAL CONFINING ZONE AS PER IS 456 : 2000 + IS 13920 : 2016, Z2 = REMAINING ZONES AS PER IS 456 : 2000 + IS 13920 : 2016
(x-Yxx) DENOTES BARS WITHIN INTERSECTION





COLUMN AND WALL SCHEDULE
SCALE 1:25)

1. Z1 = SPECIAL CONFINING ZONE As PER IS 456 : 2000 + IS 13920 : 2016, Z2 = REMAINING ZONES As PER IS 456 : 2000 + IS 13920 : 2016
2. (M) – STEEL GRADE For MAIN REINFORCEMENT
3. (S) – STEEL GRADE FOR SHEAR REINFORCEMENT(LINKS)

GENERAL NOTES:

NOTES:-
[GENERAL]

[1] ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE MENTIONED.
[2] ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED NEITHER THE BARS SHALL BE COUNTED NOR THE DIMENSIONS SCALED FROM THE DRG.
[3] ANY DISCREPANCY IN THE DRGS. SHALL BE BROUGHT TO THE NOTICE OF ARCHITECT / CONSULTANT. AND CLARIFICATION OBTAINED IN WRITING PRIOR TO EXECUTION OF WORK.
[4] HIGH YIELD STRENGTH DEFORMED BARS OF YIELD STRESS 550 N/MM2 WHICH SHALL CONFORM TO 1786-2008 SHALL BE USED AS REINFORCEMENT
[5] CLEAR COVER OF OUTER LAYER REINF. SHALL BE AS FOLLOWS.
(a) FOUNDATION = 50 M.M. (b) COLUMN = 40 M.M. (c) BEAM = 25 M.M.
(d) SLAB = 20 M.M. (e) WAIST SLAB = 20 M.M. (f) WALL 25MM
[6] LAP / DEVELOPMENT LENGTH 'Ld' FOR DIFFERENT DIA. OF BARS FOR M - 40 SHALL BE AS 50*DIA OF BAR.
[7] CONC. MIX FOR R.C.C. WORK SHALL BE OF GRADE M - 40 CONFIRMING TO I.S. 456 - 2000.
[8] NECESSARY FIXTURE FOR ELECTRICAL, PLUMBING, ETC. SHALL BE PROVIDED IN SLAB, BEAMS BEFORE EXECUTION AS PER RELEVANT DRGS.

LOAD BEARING WALL

[1] ALL THE WALL LOAD BEARING AS PER SPANNING OF SLAB AS SHOWN IN DRG
[2] MUST BE ONE BRICK WALL THICKNES 1:6 CEMENT SAND MORTOR EXCEPT HATCHED WALL 1:3 CEMENT SAND MORTOR AS PER P.W.D SPECIFICATION. 1\2 BRICK WALL OR PARTION WALL MUST BE 1:3 CEMENT SAND MORTOR.
[3] DOTTED LINE WITH NAME STARTING WITH PRIFIX "B" IS R.C.C BEAM.
[4] BED BLOCK OF CONCRETE M-20 GRADE MUST BE PROVIDED BELOW BEAM.
[5] AT JOINT ,CORNER& AT JAMB OF OPENING IN WALL SINGLE BAR #12 PROVIDED AS VERTICAL STEEL.

[FOUNDATION]

[1] THE LAYOUT OF BUILDING SHALL BE GIVEN FROM THE LATEST ARCH. DRG.
[2] THE DESIGN DATA FOR FOUNDATION HAS BEEN TAKEN FROM SOIL TEST REPORT PROVIDED BY THE DEPT./ CLIENT NET SBC =21.15 TIM2 AT DEPTH 9.0M BELOW GROUND-LVL FOR ISOLATED SQUARE FOOTING FOR FRAME TYPE STRUCTURE.
[3] THE DEPTH OF FOUNDATION SHALL BE 9000MM BELOW GENERAL GROUND-LVL

[BEAMS]

[1] FOR LOCATION OF BEAMS REFER GRID PLAN.
[2] WHERE TWO LAYERS OF REINF. BARS ARE TO BE PROVIDED, SPACER BAR ARE TO BE PROVIDED AT SPACING OF 1000 MM. MAX. AND THE DIA OF THE SPACER BAR SHALL BE HIGHER OF DIA OF LONGITUDINAL BARS OR 25 MM.
[3] MAX. 3 NOS. OF BARS SHALL BE PROVIDED IN A LAYER OF 230 WIDE BEAM.

[SLABS]

[1] CRANKING & CURTAILMENT OF BOTTOM REINF. SHALL BE DONE AS PER TYP DETAIL OF SLAB.
[2] THE CROSS REINF. / TEMP. REINF. BELOW TOP REINF i.e. #8@300 c/c IS TO BE PROV. JUST BELOW THE MAIN TOP STEEL WHICH HAS NOT BEEN SHOWN IN THE DRG.

S.No.	R.No.	Date	Description	By

REVISION

CLIENT

सत्यमेव जयते

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

TYPE - V RESIDENTIAL FLAT

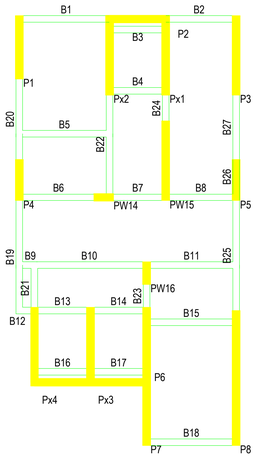
COLUMN\ SHEARWALL SCHEDULE:

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\05
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY

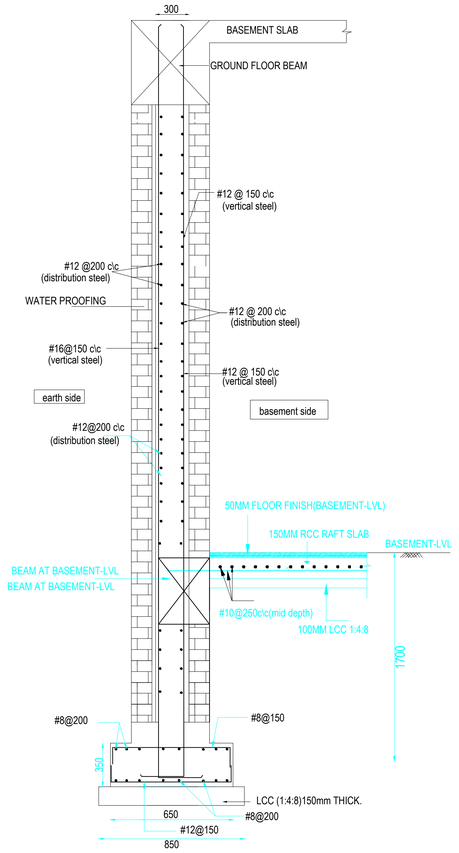


BEAM SCHEDULE (M40 : Fe550 (MAIN) : Fe415 (SHEAR)) (LEVEL: Story2)

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR	DIAGONAL	REMARKS
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT			
B1	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B2	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	-	2L-#8@120	-	-	-
B3	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@110	-	2L-#8@110	-	-	-
B4	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@110	-	2L-#8@110	-	-	-
B5	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B6	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	-	2L-#8@120	-	-	-
B7	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#10@120	-	2L-#10@120	-	-	-
B8	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	-	2L-#8@120	-	-	-
B9	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B10	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B11	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B12	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B13	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@110	-	2L-#8@110	-	-	-
B14	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@110	-	2L-#8@110	-	-	-
B15	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B16	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@110	-	2L-#8@110	-	-	-
B17	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@110	-	2L-#8@110	-	-	-
B18	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B19	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B20	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B21	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B22	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B23	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@130	2L-#8@130	-	-	-
B24	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#12@100	-	2L-#12@100	-	-	-
B25	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B26	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#10@120	-	2L-#10@120	-	-	-
B27	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	-	2L-#8@120	-	-	-

RCC GRID PLAN AT TYP FLOOR-LVL

B-BLOCK



TYP RIFT DETAILS OF RETAINING WALL.

Section at A-A

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REVISION

S.No.	R.No.	Date	Description	By

CLIENT

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT:

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

muralage
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

FOUNDATION PLAN

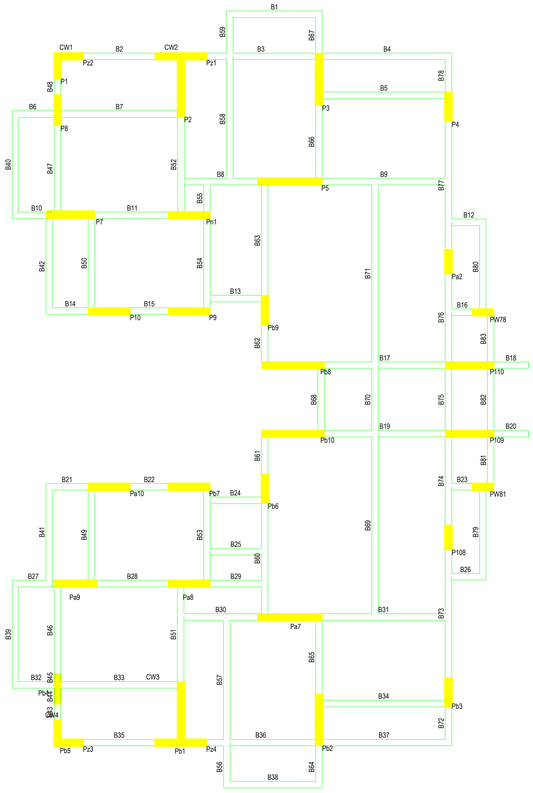
TYPE - V RESIDENTIAL FLAT

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\03
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

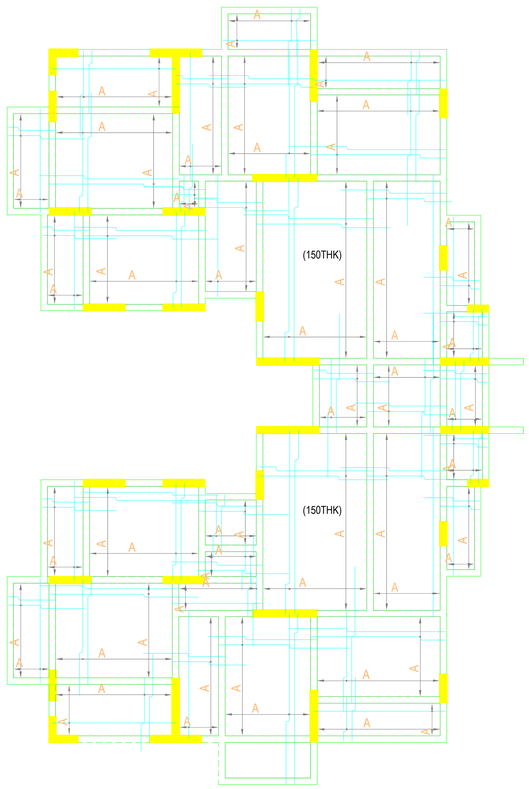
TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY



RCC GRID PLAN AT TYPICAL FLOOR-LVL

A-BLOCK



BENTUP REINFORCEMENT LAYOUT - STORY2
(SCALE: H = 1:100 / V = 1:100)
ALL SLABS 125MM UNLESS SPECIFIED

BEAM SCHEDULE (M40 : Fe550 (MAIN) : Fe415 (SHEAR)) (LEVEL: Story2)

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR	DIAGONAL	REMARKS
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT			
B1	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B2	250	750	3-#16 +3-#16	3-#16	3-#16 +2-#16	3-#16 +3-#16	3-#16	3-#16 +3-#16	2L-#10@120	2L-#10@200	2L-#10@120	-	-	-
B3	250	750	3-#16	3-#16	3-#16	3-#16 +3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B4	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B5	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B6	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B7	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B8	250	600	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@200	2L-#8@180	2L-#8@160	-	-	-
B9	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B10	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B11	250	600	3-#16 +2-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B12	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B13	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B14	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B15	250	750	3-#16 +2-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16	3-#16 +2-#16	2L-#10@140	2L-#10@130	2L-#10@140	-	-	-
B16	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B17	250	750	3-#16	3-#16	3-#16	3-#16 +3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B18	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B19	250	750	3-#16	3-#16	3-#16	3-#16 +3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B20	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B21	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B22	250	750	3-#16 +2-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16	3-#16 +2-#16	2L-#10@130	2L-#10@120	2L-#10@130	-	-	-
B23	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B24	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B25	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B26	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B27	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B28	250	600	3-#16 +2-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@100	-	-	-
B29	250	600	3-#16 +2-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16	3-#16	2L-#8@190	2L-#8@180	2L-#8@200	-	-	-
B30	250	600	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@200	2L-#8@170	2L-#8@170	-	-	-
B31	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B32	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B33	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B34	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B35	250	750	3-#16 +3-#16	3-#16	3-#16 +3-#16	3-#16 +3-#16	3-#16	3-#16 +3-#16	2L-#10@120	2L-#10@200	2L-#10@120	-	-	-
B36	250	750	3-#16	3-#16	3-#16	3-#16 +3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B37	250	750	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B38	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B39	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B40	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B41	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B42	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B43	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#10@100	2L-#10@100	2L-#10@110	-	-	-
B44	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B45	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B46	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B47	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B48	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	2L-#10@110	2L-#10@100	2L-#10@100	-	-	-
B49	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B50	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B51	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B52	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B53	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B54	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B55	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B56	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B57	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B58	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B59	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B60	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B61	250	600	3-#16	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	2L-#12@120	2L-#12@200	2L-#12@120	-	-	-
B62	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#10@110	2L-#10@200	2L-#10@120	-	-	-
B63	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B64	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B65	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B66	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B67	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B68	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B69	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B70	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B71	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	-
B72	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B73	250	750	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B74	250	750	3-#16 +2-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B75	250	750	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B76	250	750	3-#16	3-#16	3-#16 +2-#16	3-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B77	250	750	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16	3-#16 +2-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B78	250	600	3-#16	3-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	3-#16 +2-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B79	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B80	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@200	2L-#8@200	2L-#8@200	-	-	CANTILEVERED
B81	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@100	2L-#8@200	2L-#8@100	-	-	-
B82	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@120	2L-#8@200	2L-#8@120	-	-	-
B83	250	600	3-#16	3-#16	3-#16	3-#16	3-#16	3-#16	2L-#8@100	2L-#8@200	2L-#8@100	-	-	-

GENERAL NOTES:

NOTES:-
[GENERAL]

[1] ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE MENTIONED.
[2] ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED NEITHER THE BARS SHALL BE COUNTED NOR THE DIMENSIONS SCALED FROM THE DRG.
[3] ANY DISCREPANCY IN THE DRGS. SHALL BE BROUGHT TO THE NOTICE OF ARCHITECT / CONSULTANT. AND CLARIFICATION OBTAINED IN WRITING PRIOR TO EXECUTION OF WORK.
[4] HIGH YIELD STRENGTH DEFORMED BARS OF YIELD STRESS 550 N/MM2 WHICH SHALL CONFORM TO 1786-2008 SHALL BE USED AS REINFORCEMENT
[5] CLEAR COVER OF OUTER LAYER REINF. SHALL BE AS FOLLOWS.
(a) FOUNDATION = 50 M.M. (b) COLUMN = 40 M.M. (c) BEAM = 25 M.M.
(d) SLAB = 20 M.M. (e) WAIST SLAB = 20 M.M. (f) WALL 25MM
[6] LAP / DEVELOPMENT LENGTH 'Ld ' FOR DIFFERENT DIA. OF BARS FOR M - 40 SHALL BE AS 50*DIA OF BAR.
[7] CONC. MIX FOR R.C.C. WORK SHALL BE OF GRADE M - 40 CONFIRMING TO I.S. 456 - 2000.
[8] NECESSARY FIXTURE FOR ELECTRICAL, PLUMBING, ETC. SHALL BE PROVIDED IN SLAB, BEAMS BEFORE EXECUTION AS PER RELEVANT DRGS.

LOAD BEARING WALL

[1] ALL THE WALL LOAD BEARING AS PER SPANNING OF SLAB AS SHOWN IN DRG
[2] MUST BE ONE BRICK WALL THICKNES 1:6 CEMENT SAND MORTOR EXCEPT HATCHED WALL 1:3 CEMENT SAND MORTOR AS PER P.W.D SPECIFICATION. 1\2 BRICK WALL OR PARTION WALL MUST BE 1:3 CEMENT SAND MORTOR.
[3] DOTTED LINE WITH NAME STARTING WITH PRIFIX "B" IS R.C.C BEAM.
[4] BED BLOCK OF CONCRETE M-20 GRADE MUST BE PROVIDED BELOW BEAM.
[5] AT JOINT ,CORNER& AT JAMB OF OPENING IN WALL SINGLE BAR #12 PROVIDED AS VERTICAL STEEL.

[FOUNDATION]

[1] THE LAYOUT OF BUILDING SHALL BE GIVEN FROM THE LATEST ARCH. DRG.
[2] THE DESIGN DATA FOR FOUNDATION HAS BEEN TAKEN FROM SOIL TEST REPORT PROVIDED BY THE DEPT./ CLIENT NET SBC =21.15 TIM2 AT DEPTH 9.0M BELOW GROUND-LVL FOR ISOLATED SQUARE FOOTING FOR FRAME TYPE STRUCTURE.
[3] THE DEPTH OF FOUNDATION SHALL BE 9000MM BELOW GENERAL GROUND-LVL

[BEAMS]

[1] FOR LOCATION OF BEAMS REFER GRID PLAN.
[2] WHERE TWO LAYERS OF REINF. BARS ARE TO BE PROVIDED, SPACER BAR ARE TO BE PROVIDED AT SPACING OF 1000 MM. MAX. AND THE DIA OF THE SPACER BAR SHALL BE HIGHER OF DIA OF LONGITUDINAL BARS OR 25 MM.
[3] MAX. 3 NOS. OF BARS SHALL BE PROVIDED IN A LAYER OF 230 WIDE BEAM.

[SLABS]

[1] CRANKING & CURTAILMENT OF BOTTOM REINF. SHALL BE DONE AS PER TYP DETAIL OF SLAB.
[2] THE CROSS REINF. / TEMP. REINF. BELOW TOP REINF.i.e. #8@300 c/c IS TO BE PROV. JUST BELOW THE MAIN TOP STEEL WHICH HAS NOT BEEN SHOWN IN THE DRG.

S.No.	R.No.	Date	Description	By

REVISION

CLIENT

सत्यमेव जयते

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

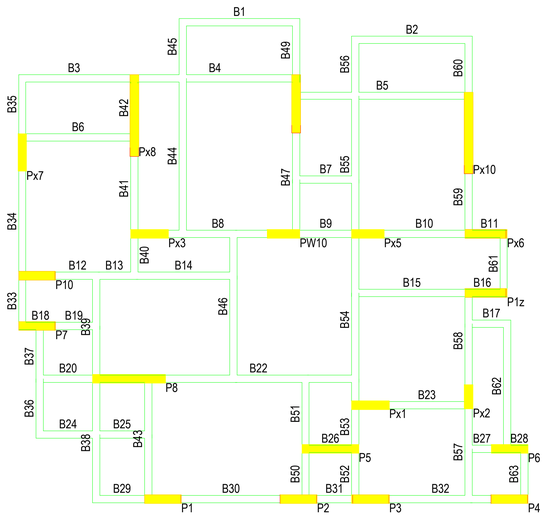
TYPE - V RESIDENTIAL FLAT
RCC GRID PLAN AT TYPICAL FLOOR-LVL

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\07
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY



RCC GRID PLAN AT TYP FLOOR-LVL

TYPE - VI RESIDENTIAL FLAT

BEAM SCHEDULE (M40 : Fe550 (MAIN) : Fe415 (SHEAR)) (LEVEL: Story2)

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR	DIAGONAL	REMARKS
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT			
B1	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	8-2L-T8@200 C/C	6-2L-T8@200 C/C	8-2L-T8@200 C/C	-	-	-
B2	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	8-2L-T8@200 C/C	6-2L-T8@200 C/C	8-2L-T8@200 C/C	-	-	-
B3	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	7-2L-T8@200 C/C	5-2L-T8@200 C/C	7-2L-T8@200 C/C	-	-	-
B4	250	600	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16	3-T16	11-2L-T8@120 C/C	14-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B5	250	600	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16	3-T16 +2-T16	11-2L-T8@120 C/C	16-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B6	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	5-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B7	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B8	250	600	2-T25	2-T25 +2-T20	2-T25 +2-T20	2-T25 +2-T20	2-T25 +2-T20	2-T25 +2-T20	11-2L-T10@130 C/C	7-2L-T10@130 C/C	11-2L-T10@130 C/C	-	-	-
B9	250	600	2-T25 +2-T16	2-T25	2-T25 +2-T20	2-T25 +2-T20	2-T25	2-T25 +2-T20	7-2L-T10@120 C/C	5-2L-T10@120 C/C	6-2L-T10@140 C/C	-	-	-
B10	250	600	2-T25	2-T25 +2-T20	2-T25 +2-T20	2-T25 +2-T20	2-T25 +2-T20	2-T25 +2-T20	12-2L-T10@110 C/C	2-2L-T10@180 C/C	13-2L-T10@100 C/C	-	-	-
B11	250	600	2-T25	2-T25	2-T25	2-T25 +2-T20	2-T25	2-T25	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B12	250	600	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B13	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B14	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T8@200 C/C	5-2L-T8@200 C/C	7-2L-T8@200 C/C	-	-	-
B15	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	8-2L-T8@200 C/C	6-2L-T8@200 C/C	8-2L-T8@200 C/C	-	-	-
B16	250	600	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16	3-T16	6-2L-T12@120 C/C	-	7-2L-T12@110 C/C	-	-	-
B17	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B18	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	2-2L-T8@200 C/C	2-2L-T8@200 C/C	2-2L-T8@200 C/C	-	-	-
B19	250	600	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B20	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	5-2L-T8@200 C/C	3-2L-T8@200 C/C	5-2L-T8@200 C/C	-	-	CANTILEVERED
B21	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 +3-T16	10-2L-T10@110 C/C	-	9-2L-T10@120 C/C	-	-	-
B22	250	600	3-T16	3-T16	3-T16	3-T16 +3-T16	3-T16	3-T16	12-2L-T8@200 C/C	10-2L-T8@200 C/C	12-2L-T8@200 C/C	-	-	-
B23	250	600	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16	11-2L-T8@120 C/C	6-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B24	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B25	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B26	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	10-2L-T8@100 C/C	-	10-2L-T8@100 C/C	-	-	-
B27	250	600	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B28	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B29	250	600	3-T16	3-T16	3-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	CANTILEVERED
B30	250	600	3-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16	3-T16 +2-T16	11-2L-T8@120 C/C	4-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B31	250	600	3-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16	3-T16 +2-T16	8-2L-T12@100 C/C	-	8-2L-T12@100 C/C	-	-	-
B32	250	600	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	11-2L-T8@120 C/C	16-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B33	250	750	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B34	250	750	3-T16	3-T16 +2-T16	3-T16	3-T16	3-T16 +2-T16	3-T16 +2-T16	7-2L-T8@200 C/C	5-2L-T8@200 C/C	7-2L-T8@200 C/C	-	-	-
B35	250	750	3-T16 +2-T16	3-T16	3-T16	3-T16 +2-T16	3-T16 +2-T16	3-T16 +2-T16	7-2L-T12@120 C/C	3-2L-T12@200 C/C	5-2L-T12@200 C/C	2-T8EF	-	CANTILEVERED
B36	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	CANTILEVERED
B37	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	-
B38	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	8-2L-T8@200 C/C	6-2L-T8@200 C/C	8-2L-T8@200 C/C	-	-	-
B39	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T8@200 C/C	5-2L-T8@200 C/C	7-2L-T8@200 C/C	-	-	CANTILEVERED
B40	250	600	2-T25	2-T25	2-T25	2-T25	2-T25	2-T25	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	CANTILEVERED
B41	250	600	2-T25	2-T25	2-T25 +2-T16	2-T25	2-T25 +2-T25	2-T25 +2-T25	11-2L-T10@120 C/C	2-2L-T10@200 C/C	11-2L-T10@120 C/C	-	-	-
B42	250	600	2-T25	2-T25	2-T25	2-T25 +2-T25	2-T25	2-T25	9-2L-T12@130 C/C	-	11-2L-T12@110 C/C	-	-	-
B43	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	7-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B44	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	10-2L-T8@200 C/C	8-2L-T8@200 C/C	10-2L-T8@200 C/C	-	-	-
B45	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	CANTILEVERED
B46	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	9-2L-T8@200 C/C	7-2L-T8@200 C/C	9-2L-T8@200 C/C	-	-	-
B47	250	600	3-T16	3-T16 +2-T16	3-T16 +2-T16	2-T25	2-T25 +2-T16	2-T25 +2-T16	11-2L-T8@120 C/C	5-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B48	250	600	3-T16	3-T16	3-T16	2-T25 +2-T16	2-T25	2-T25	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B49	250	600	3-T16	3-T16	3-T16	2-T25	2-T25	2-T25	5-2L-T8@200 C/C	3-2L-T8@200 C/C	5-2L-T8@200 C/C	-	-	CANTILEVERED
B50	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T10@120 C/C	-	8-2L-T10@110 C/C	-	-	-
B51	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	5-2L-T8@200 C/C	3-2L-T8@200 C/C	5-2L-T8@200 C/C	-	-	-
B52	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T10@120 C/C	-	7-2L-T10@120 C/C	-	-	-
B53	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T10@100 C/C	-	7-2L-T10@100 C/C	-	-	-
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B55	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	9-2L-T8@200 C/C	7-2L-T8@200 C/C	9-2L-T8@200 C/C	-	-	-
B56	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	4-2L-T8@200 C/C	2-2L-T8@200 C/C	4-2L-T8@200 C/C	-	-	CANTILEVERED
B57	250	600	3-T16	3-T16	3-T16 +2-T16	3-T16	3-T16	3-T16 +2-T16	7-2L-T8@200 C/C	5-2L-T8@200 C/C	9-2L-T8@130 C/C	-	-	-
B58	250	600	3-T16 +2-T16	3-T16 +2-T16	3-T16	3-T16 +2-T16	3-T16	3-T16 +2-T16	11-2L-T8@120 C/C	2-2L-T8@200 C/C	12-2L-T8@110 C/C	-	-	-
B59	250	600	2-T25 +2-T20	2-T25 +2-T20	2-T25	2-T25 +2-T25	2-T25 +2-T25	2-T25	11-2L-T12@130 C/C	2-2L-T12@200 C/C	11-2L-T12@120 C/C	-	-	-
B60	250	600	2-T25	2-T25	2-T25	2-T25	2-T25	2-T25	7-2L-T12@110 C/C	5-2L-T12@120 C/C	5-2L-T12@200 C/C	2-T8EF	-	CANTILEVERED
B61	250	600	3-T16 +2-T16	3-T16	3-T16	3-T16	3-T16	3-T16 +2-T16	9-2L-T10@110 C/C	-	9-2L-T10@120 C/C	-	-	-
B62	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	8-2L-T8@200 C/C	6-2L-T8@200 C/C	8-2L-T8@200 C/C	-	-	CANTILEVERED
B63	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T10@120 C/C	-	7-2L-T10@120 C/C	-	-	-

GENERAL NOTES:

NOTES:-

[GENERAL]

[1] ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE MENTIONED.
[2] ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED NEITHER THE BARS SHALL BE COUNTED NOR THE DIMENSIONS SCALED FROM THE DRG.
[3] ANY DISCREPANCY IN THE DRGS. SHALL BE BROUGHT TO THE NOTICE OF ARCHITECT / CONSULTANT. AND CLARIFICATION OBTAINED IN WRITING PRIOR TO EXECUTION OF WORK.
[4] HIGH YIELD STRENGTH DEFORMED BARS OF YIELD STRESS 550 N/MM2 WHICH SHALL CONFORM TO 1786-2008 SHALL BE USED AS REINFORCEMENT
[5] CLEAR COVER OF OUTER LAYER REINF. SHALL BE AS FOLLOWS.
(a) FOUNDATION = 50 M.M. (b) COLUMN = 40 M.M. (c) BEAM = 25 M.M.
(d) SLAB = 20 M.M. (e) WAIST SLAB = 20 M.M. (f) WALL 25MM
[6] LAP / DEVELOPMENT LENGTH 'Ld ' FOR DIFFERENT DIA. OF BARS FOR M - 40 SHALL BE AS 50*DIA OF BAR.
[7] CONC. MIX FOR R.C.C. WORK SHALL BE OF GRADE M - 40 CONFIRMING TO I.S. 456 - 2000.
[8] NECESSARY FIXTURE FOR ELECTRICAL, PLUMBING, ETC. SHALL BE PROVIDED IN SLAB, BEAMS BEFORE EXECUTION AS PER RELEVANT DRGS.

LOAD BEARING WALL

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[4] BED BLOCK OF CONCRETE M-20 GRADE MUST BE PROVIDED BELOW BEAM.
[5] AT JOINT ,CORNER& AT JAMB OF OPENING IN WALL SINGLE BAR #12 PROVIDED AS VERTICAL STEEL.

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S.No.	R.No.	Date	Description	By

REVISION

CLIENT

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT:

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

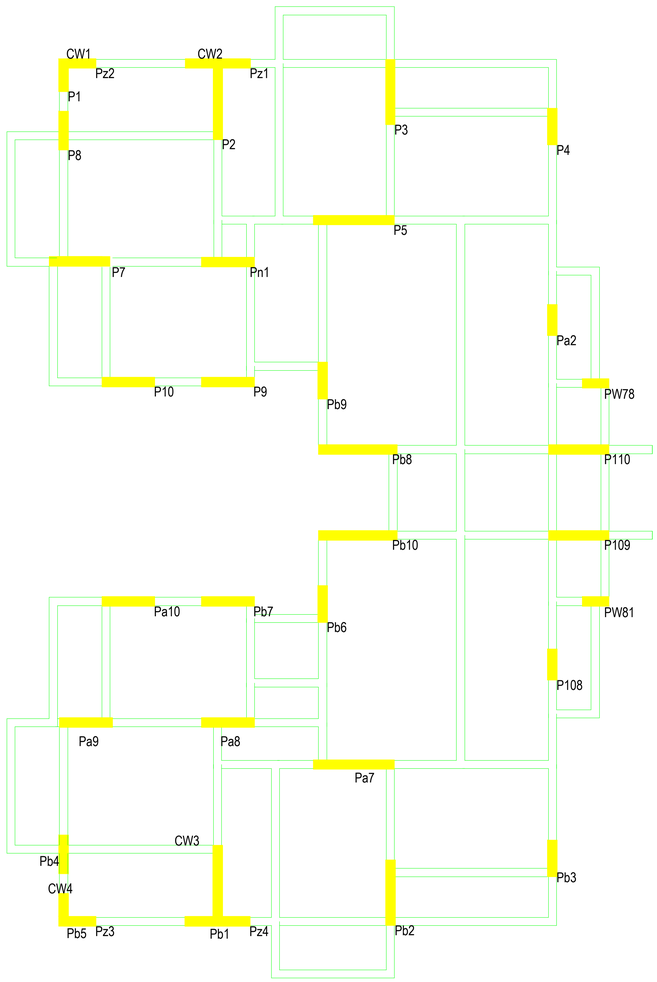
RCC GRID PLAN AT TYP FLOOR-LVL

TYPE - VI RESIDENTIAL FLAT

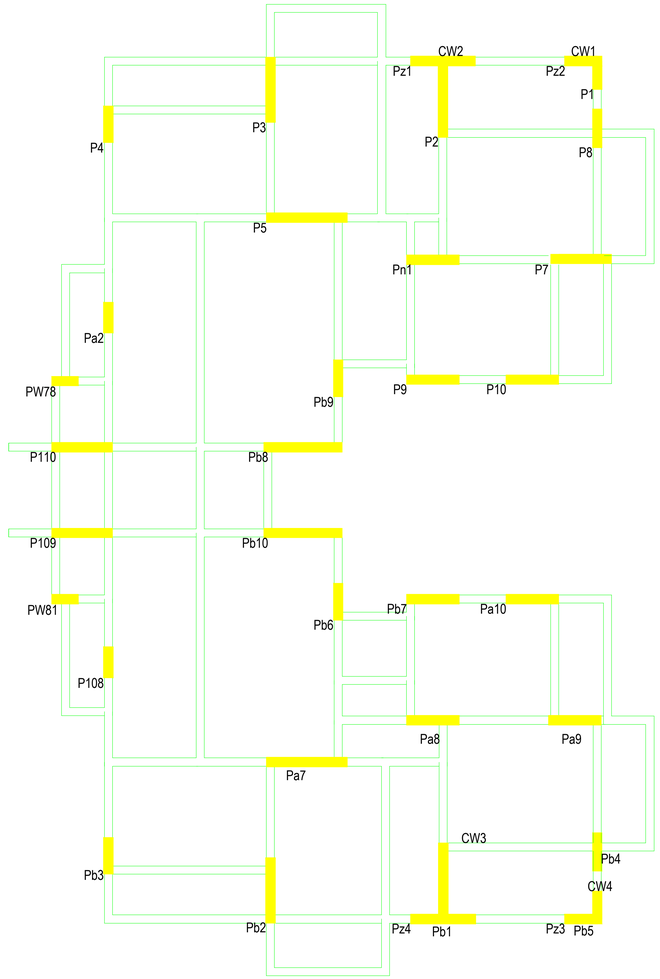
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CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE: **TENDER DRAWINGS - STRUCTURE**

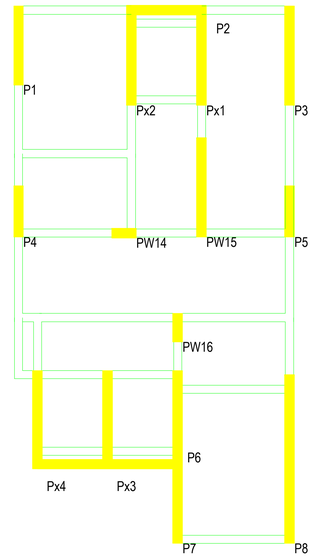
TENDER PURPOSE ONLY



A-BLOCK



A-BLOCK
mirror



B-BLOCK

RCC GRID PLAN AT TYPICAL FLOOR-LVL SHOWING COLUMNS

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S.No.	R.No.	Date	Description	By

REVISION

CLIENT

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT

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architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

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Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

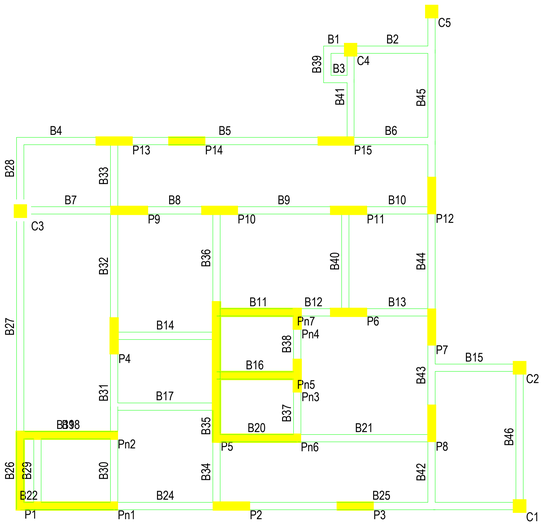
TYP DETAILS OF BEAM,COLUMN&SLAB IS PER IS-456(2000) & IS-13920

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\09
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

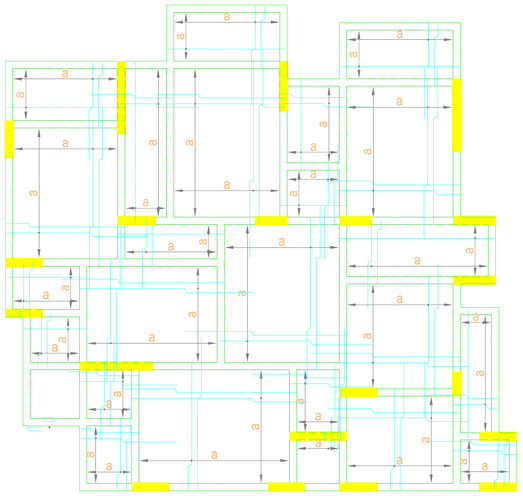
TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY



TYPE - VI RESIDENTIAL FLAT

Bar Mark	Reinforcement
a	T10 @ 200



BENTUP REINFORCEMENT LAYOUT - TYP FLOOR
(SCALE: H = 1:100 / V = 1:100)
ALL SLABS 125MM UNLESS SPECIFIED

BEAM SCHEDULE (M40 : Fe550 (MAIN) : Fe415 (SHEAR)) (LEVEL: Story2)

BEAM NUMBERS	SIZE		BOTTOM REINFORCEMENT			TOP REINFORCEMENT			SHEAR STIRRUPS			SFR	DIAGONAL	REMARKS
	B	D	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT	LEFT	MID SPAN	RIGHT			
B1	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	2-2L-T8@200 C/C	2-2L-T8@200 C/C	2-2L-T8@200 C/C	-	-	CANTILEVERED
B2	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	6-2L-T8@200 C/C	4-2L-T8@200 C/C	6-2L-T8@200 C/C	-	-	-
B3	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	CANTILEVERED
B4	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 + 2-T16	6-2L-T8@200 C/C	4-2L-T8@200 C/C	6-2L-T8@200 C/C	-	-	-
B5	250	600	3-T16 + 2-T16	3-T16	3-T16	3-T16 + 2-T16	3-T16 + 2-T16	3-T16 + 2-T16	12-2L-T10@110 C/C	35-2L-T10@110 C/C	11-2L-T10@120 C/C	-	-	-
B6	250	600	3-T16	3-T16	3-T16	3-T16 + 2-T16	3-T16	3-T16	6-2L-T8@200 C/C	4-2L-T8@200 C/C	6-2L-T8@200 C/C	-	-	-
B7	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 + 2-T16	14-2L-T8@110 C/C	-	13-2L-T8@120 C/C	-	-	-
B8	250	600	3-T16	3-T16 + 2-T16	3-T16 + 2-T16	3-T16 + 2-T16	3-T16 + 2-T16	3-T16 + 2-T16	12-2L-T10@110 C/C	3-2L-T10@180 C/C	13-2L-T10@100 C/C	-	-	-
B9	250	600	3-T16	3-T16	3-T16	3-T16 + 2-T16	3-T16	3-T16 + 2-T16	11-2L-T8@120 C/C	3-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B10	250	600	3-T16	3-T16	3-T16	3-T16 + 2-T16	3-T16	3-T16	11-2L-T10@120 C/C	1-2L-T10@200 C/C	11-2L-T10@120 C/C	-	-	-
B11	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 + 3-T16	13-2L-T8@120 C/C	-	13-2L-T8@120 C/C	-	-	-
B12	250	600	3-T16 + 2-T16	3-T16 + 3-T16	3-T16	3-T16 + 3-T16	3-T16 + 2-T16	3-T16 + 2-T16	5-2L-T12@110 C/C	3-2L-T12@110 C/C	5-2L-T12@120 C/C	-	-	-
B13	250	600	3-T16	3-T16 + 2-T16	3-T16	3-T16 + 2-T16	3-T16 + 2-T16	3-T16	11-2L-T10@120 C/C	1-2L-T10@200 C/C	11-2L-T10@120 C/C	-	-	-
B14	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	3-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B15	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	6-2L-T8@200 C/C	4-2L-T8@200 C/C	6-2L-T8@200 C/C	-	-	-
B16	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	13-2L-T8@120 C/C	-	13-2L-T8@120 C/C	-	-	-
B17	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	7-2L-T8@200 C/C	5-2L-T8@200 C/C	7-2L-T8@200 C/C	-	-	-
B18	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	2-2L-T8@200 C/C	2-2L-T8@200 C/C	2-2L-T8@200 C/C	-	-	-
B19	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	6-2L-T8@200 C/C	4-2L-T8@200 C/C	6-2L-T8@200 C/C	-	-	-
B20	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	13-2L-T8@120 C/C	-	13-2L-T8@120 C/C	-	-	-
B21	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	10-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B22	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	2-2L-T8@200 C/C	2-2L-T8@200 C/C	2-2L-T8@200 C/C	-	-	-
B23	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	12-2L-T8@120 C/C	-	12-2L-T8@120 C/C	-	-	-
B24	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	4-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B25	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	32-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B26	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	12-2L-T8@120 C/C	-	12-2L-T8@120 C/C	-	-	-
B27	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	24-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B28	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	5-2L-T8@200 C/C	3-2L-T8@200 C/C	5-2L-T8@200 C/C	-	-	CANTILEVERED
B29	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	10-2L-T8@120 C/C	-	10-2L-T8@120 C/C	-	-	-
B30	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	10-2L-T8@120 C/C	-	11-2L-T8@110 C/C	-	-	-
B31	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	1-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B32	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	5-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B33	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	10-2L-T8@120 C/C	-	10-2L-T8@120 C/C	-	-	-
B34	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 + 2-T16	11-2L-T8@110 C/C	-	11-2L-T8@110 C/C	-	-	-
B35	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	6-2L-T12@120 C/C	-	6-2L-T12@120 C/C	-	-	-
B36	250	600	3-T16	3-T16	3-T16	3-T16 + 2-T16	3-T16	3-T16	11-2L-T8@120 C/C	2-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B37	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16 + 3-T16	8-2L-T12@110 C/C	-	7-2L-T12@120 C/C	-	-	-
B38	250	600	3-T16	3-T16 + 3-T16	3-T16	3-T16 + 3-T16	3-T16 + 2-T16	3-T16 + 2-T16	9-2L-T12@100 C/C	-	9-2L-T12@110 C/C	-	-	-
B39	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	3-2L-T8@200 C/C	1-2L-T8@200 C/C	3-2L-T8@200 C/C	-	-	-
B40	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	3-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B41	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	1-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B42	250	600	3-T16	3-T16	3-T16	2-T25	2-T25	2-T25 + 2-T16	5-2L-T8@200 C/C	3-2L-T8@200 C/C	5-2L-T8@200 C/C	-	-	-
B43	250	600	3-T16 + 2-T16	3-T16 + 3-T16	3-T16 + 2-T16	2-T25 + 2-T16	2-T25 + 2-T16	2-T25 + 2-T16	13-2L-T10@100 C/C	2-2L-T10@130 C/C	13-2L-T10@100 C/C	-	-	-
B44	250	600	3-T16 + 2-T16	3-T16	3-T16 + 2-T16	2-T25 + 2-T16	2-T25	2-T25	11-2L-T8@120 C/C	4-2L-T8@200 C/C	12-2L-T8@110 C/C	-	-	-
B45	250	600	3-T16	3-T16	3-T16	2-T25	2-T25	2-T25	11-2L-T8@120 C/C	15-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-
B46	250	600	3-T16	3-T16	3-T16	3-T16	3-T16	3-T16	11-2L-T8@120 C/C	9-2L-T8@200 C/C	11-2L-T8@120 C/C	-	-	-

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ARCHITECTURAL CONSULTANTS:

muralage
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

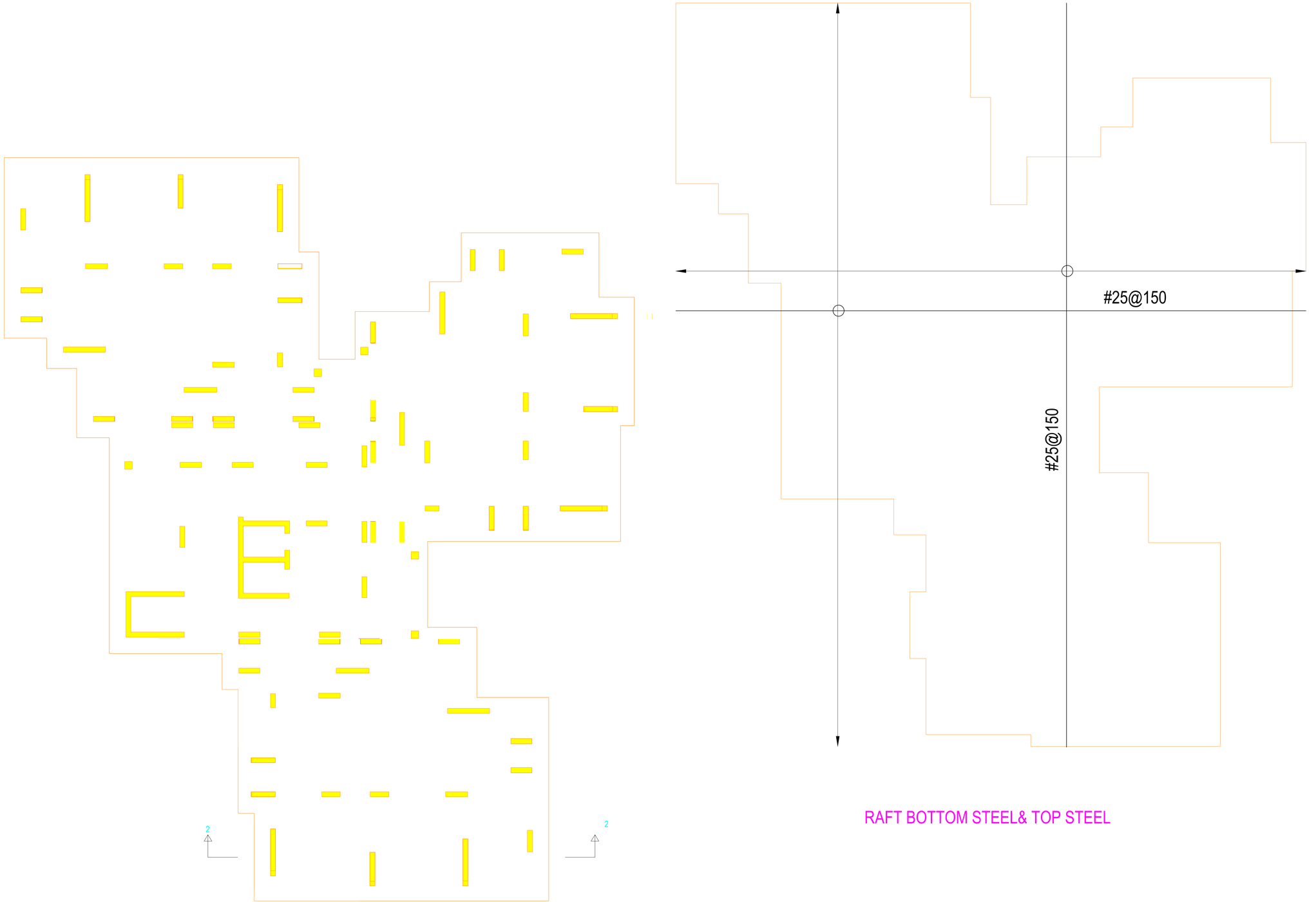
DRG. TITLE:

TYPE - VI RESIDENTIAL FLAT

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\10
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

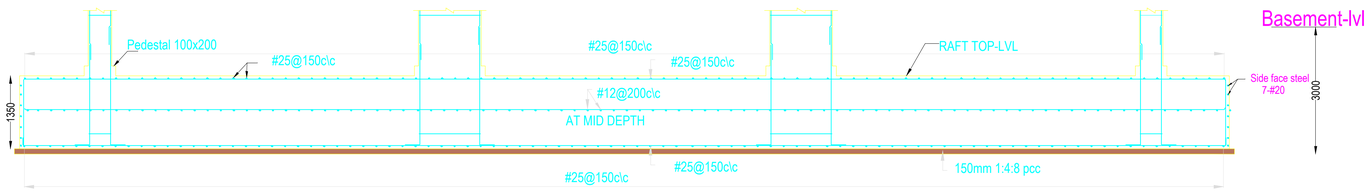
DRG. TYPE:
TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY



RAFT BOTTOM STEEL& TOP STEEL

FOUNDATION PLAN



SECTION 2-2

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m u r a l a g e
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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

FOUNDATION PLAN

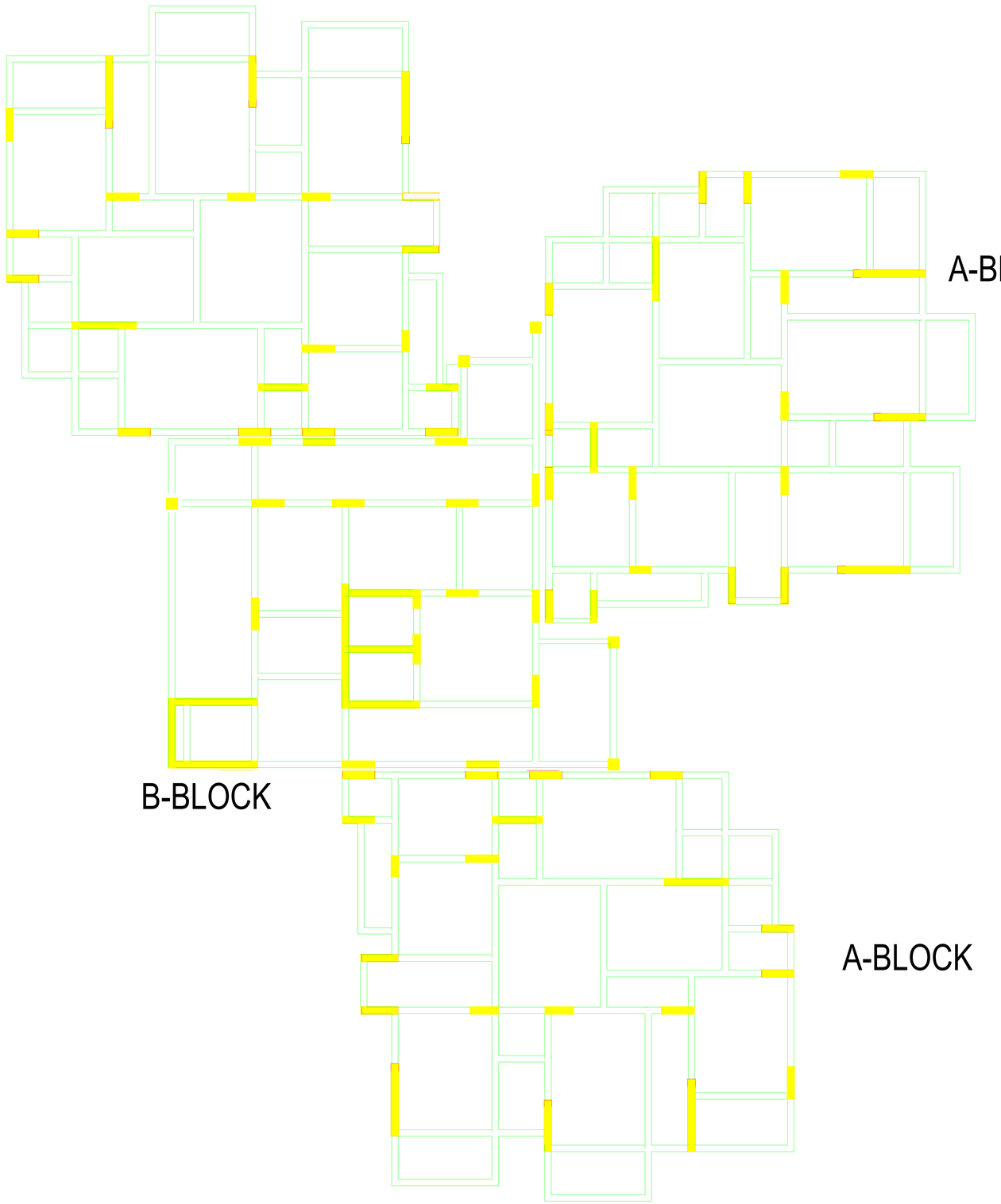
TYPE - VI RESIDENTIAL FLAT

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\11
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY



RCC GRID PLAN AT TYPICAL FLOOR-LVL
TYPE - VI RESIDENTIAL FLAT

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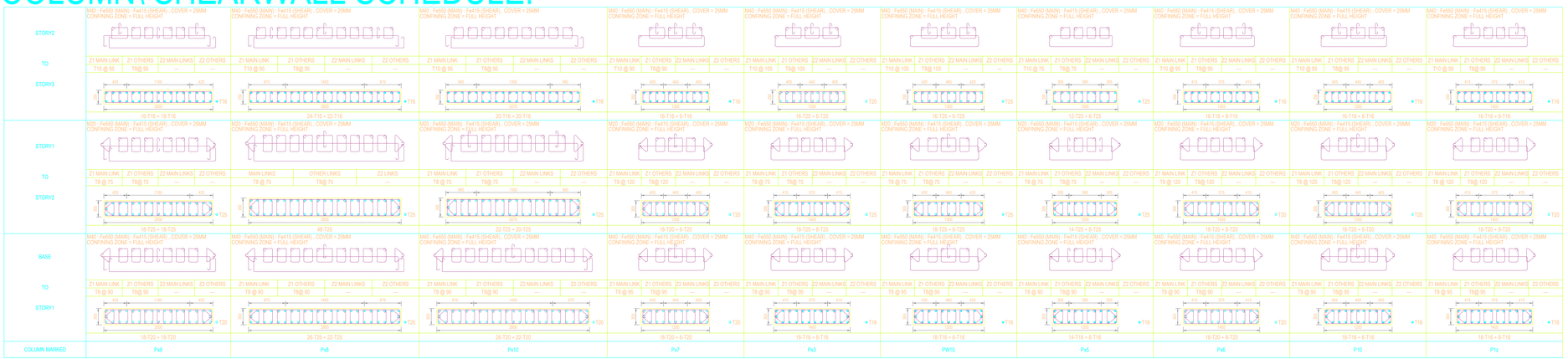
DEALT BY:	DATE:	SCALE:	SHEET NO.
nidhi	17-3-26	1:100	STRT\12
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

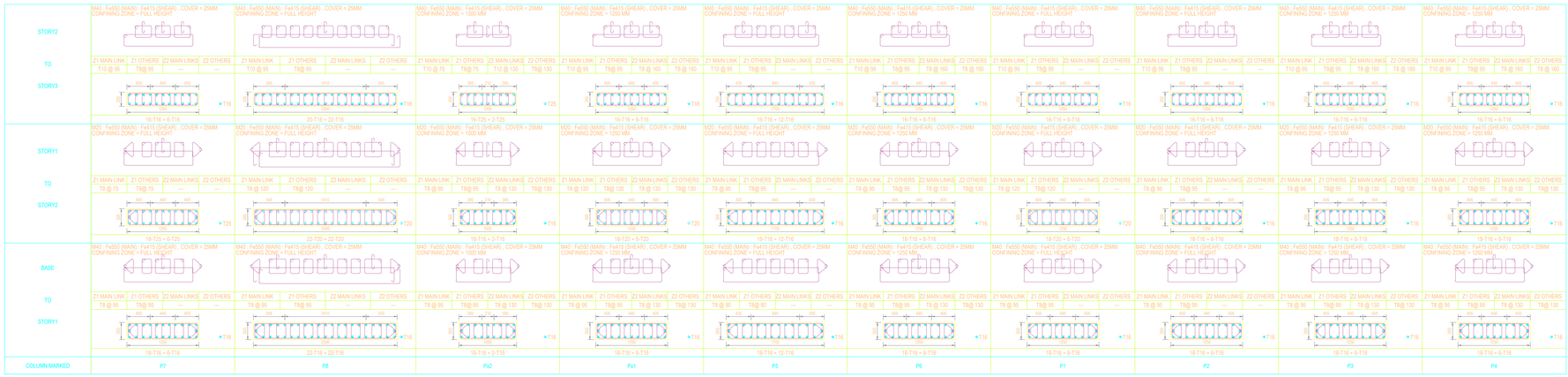
DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY

COLUMN\ SHEARWALL SCHEDULE:





COLUMN AND WALL SCHEDULE
(SCALE 1:25)
NOTES:
1. Z1 = SPECIAL CONFINING ZONE As PER IS 456 : 2000 + IS 13920 : 2016, Z2 = REMAINING ZONES As PER IS 456 : 2000 + IS 13920 : 2016

2. (M) – STEEL GRADE For MAIN REINFORCEMENT.
3. (S) – STEEL GRADE FOR SHEAR REINFORCEMENT/LINKS

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT:

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

DRG. TITLE:

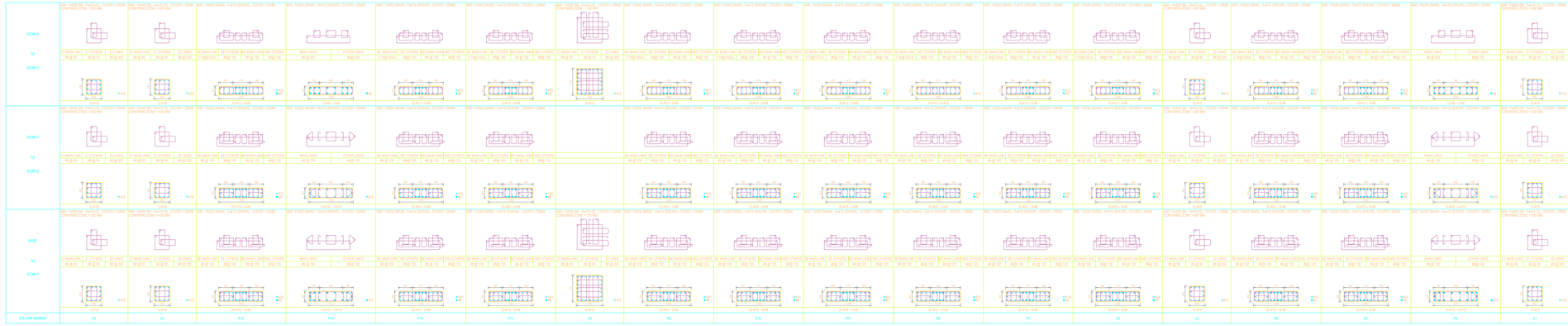
COLUMN\ SHEARWALL SCHEDULE:
TYPE - VI RESIDENTIAL FLAT

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\13
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

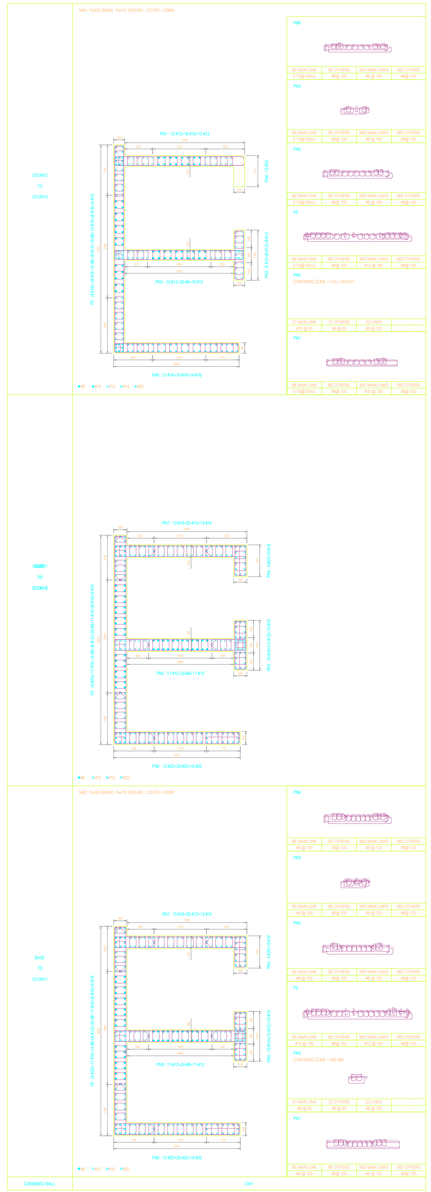
DRG. TYPE:
TENDER DRAWINGS - STRUCTURE

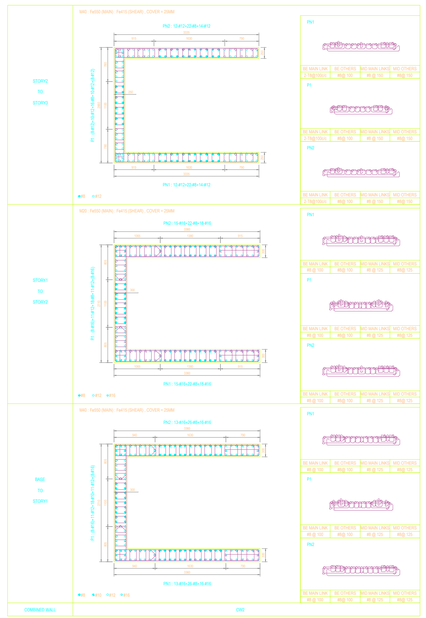
TENDER PURPOSE ONLY

COLUMN\ SHEARWALL SCHEDULE:



COLUMN AND WALL SCHEDULE
(SCALE 1:25)
NOTES:
1. BE = BOUNDARY ELEMENT AS PER IS 456 : 2000 + IS 13920 : 2016. PROVIDE CONFINING REINFORCEMENT ACROSS ENTIRE HEIGHT OF WALL IN THE BOUNDARY ELEMENT
2. ZY = SPECIAL CONFINING ZONE AS PER IS 456 : 2000 +IS 13920 : 2016, ZY = REMAINING ZONES AS PER IS 456 : 2000 + IS 13920 : 2016
3. (M) – STEEL GRADE FOR MAIN REINFORCEMENT
4. (S) – STEEL GRADE FOR SHEAR REINFORCEMENT/LINKS





COMBINED WALL SCHEDULE
(SCALE 1:25)
NOTES:
1. ZY = SPECIAL CONFINING ZONE AS PER IS 456 : 2000 + IS 13920 : 2016, ZY = REMAINING ZONES AS PER IS 456 : 2000 + IS 13920 : 2016
2. (-) or DENOTES BARS WITHIN INTERSECTION

PROJECT:

NOTES:-

[GENERAL]

[1] ALL DIMENSIONS ARE IN M.M. UNLESS OTHERWISE MENTIONED.
[2] ONLY FIGURED DIMENSIONS ARE TO BE FOLLOWED NEITHER THE BARS SHALL BE COUNTED NOR THE DIMENSIONS SCALED FROM THE DRG.
[3] ANY DISCREPANCY IN THE DRGS. SHALL BE BROUGHT TO THE NOTICE OF ARCHITECT / CONSULTANT. AND CLARIFICATION OBTAINED IN WRITING PRIOR TO EXECUTION OF WORK.
[4] HIGH YIELD STRENGTH DEFORMED BARS OF YIELD STRESS 550 N/MM2 WHICH SHALL CONFORM TO 1786-2008 SHALL BE USED AS REINFORCEMENT
[5] CLEAR COVER OF OUTER LAYER REINF. SHALL BE AS FOLLOWS.
(a) FOUNDATION = 50 M.M. (b) COLUMN = 40 M.M. (c) BEAM = 25 M.M.
(d) SLAB = 20 M.M. (e) WAIST SLAB = 20 M.M. (f) WALL 25MM
[6] LAP / DEVELOPMENT LENGTH 'Ld ' FOR DIFFERENT DIA. OF BARS FOR M - 40 SHALL BE AS 50*DIA OF BAR.
[7] CONC. MIX FOR R.C.C. WORK SHALL BE OF GRADE M - 40 CONFIRMING TO I.S. 456 - 2000.
[8] NECESSARY FIXTURE FOR ELECTRICAL, PLUMBING, ETC. SHALL BE PROVIDED IN SLAB, BEAMS BEFORE EXECUTION AS PER RELEVANT DRGS.

LOAD BEARING WALL

[1] ALL THE WALL LOAD BEARING AS PER SPANNING OF SLAB AS SHOWN IN DRG
[2] MUST BE ONE BRICK WALL THICKNES 1:6 CEMENT SAND MORTOR EXCEPT HATCHED WALL 1:3 CEMENT SAND MORTOR AS PER P.W.D SPECIFICATION. 1\2 BRICK WALL OR PARTION WALL MUST BE 1:3 CEMENT SAND MORTOR.
[3] DOTTED LINE WITH NAME STARTING WITH PRIFIX "B" IS R.C.C BEAM.
[4] BED BLOCK OF CONCRETE M-20 GRADE MUST BE PROVIDED BELOW BEAM.
[5] AT JOINT ,CORNER& AT JAMB OF OPENING IN WALL SINGLE BAR #12 PROVIDED AS VERTICAL STEEL.

[FOUNDATION]

[1] THE LAYOUT OF BUILDING SHALL BE GIVEN FROM THE LATEST ARCH. DRG.
[2] THE DESIGN DATA FOR FOUNDATION HAS BEEN TAKEN FROM SOIL TEST REPORT PROVIDED BY THE DEPT./ CLIENT NET SBC =21.15 TIM2 AT DEPTH 9.0M BELOW GROUND-LVL FOR ISOLATED SQUARE FOOTING FOR FRAME TYPE STRUCTURE.
[3] THE DEPTH OF FOUNDATION SHALL BE 9000MM BELOW GENERAL GROUND-LVL

[BEAMS]

[1] FOR LOCATION OF BEAMS REFER GRID PLAN.
[2] WHERE TWO LAYERS OF REINF. BARS ARE TO BE PROVIDED, SPACER BAR ARE TO BE PROVIDED AT SPACING OF 1000 MM. MAX. AND THE DIA OF THE SPACER BAR SHALL BE HIGHER OF DIA OF LONGITUDINAL BARS OR 25 MM.
[3] MAX. 3 NOS. OF BARS SHALL BE PROVIDED IN A LAYER OF 230 WIDE BEAM.

[SLABS]

[1] CRANKING & CURTAILMENT OF BOTTOM REINF. SHALL BE DONE AS PER TYP DETAIL OF SLAB.
[2] THE CROSS REINF. / TEMP. REINF. BELOW TOP REINF.i.e. #8@300 c/c IS TO BE PROV. JUST BELOW THE MAIN TOP STEEL WHICH HAS NOT BEEN SHOWN IN THE DRG.

S.No.	R.No.	Date	Description	By

REVISION

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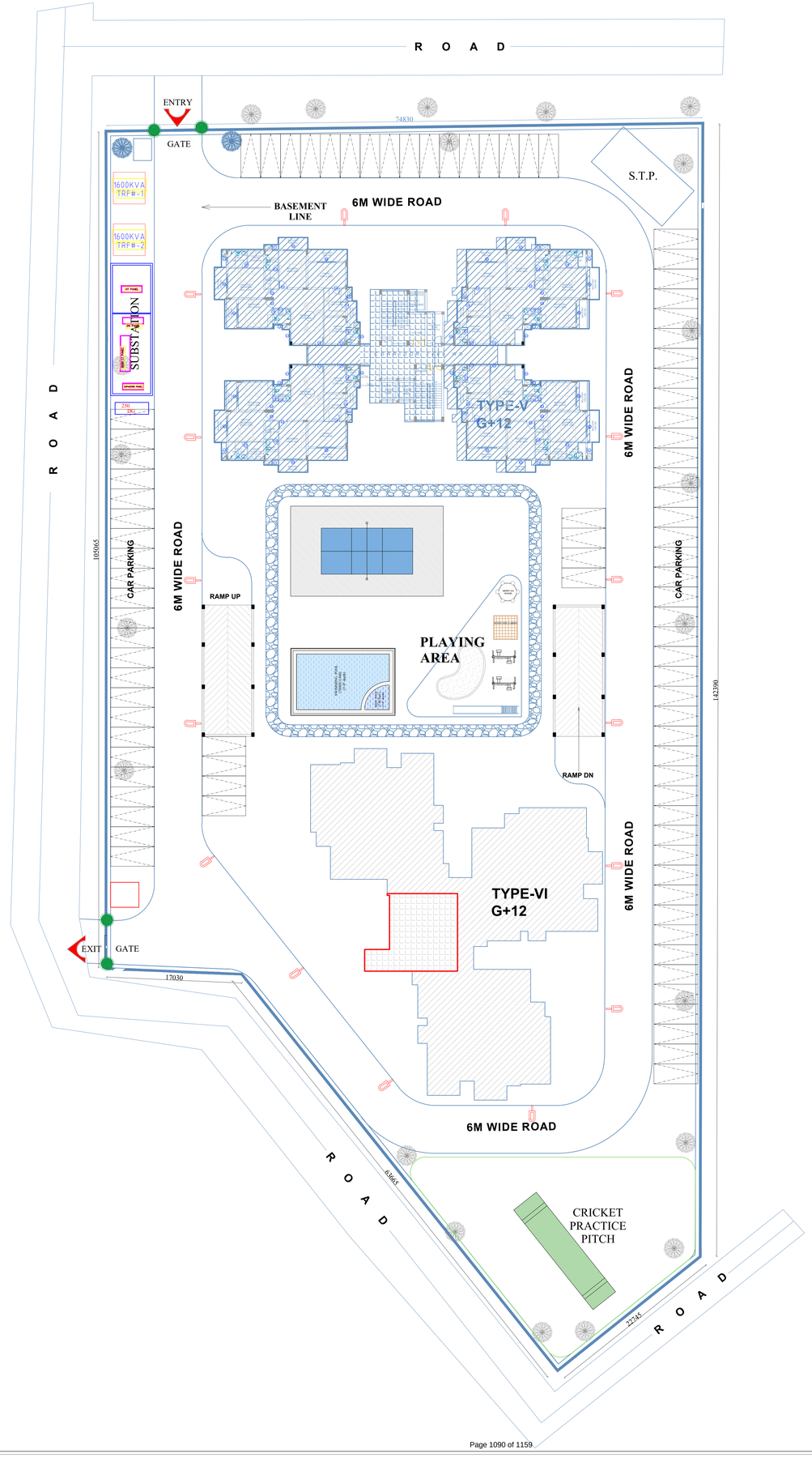
COLUMN\ SHEARWALL SCHEDULE: TYPE - VI RESIDENTIAL FLAT

DEALT BY: nidhi	DATE: 17-3-26	SCALE: 1:100	SHEET NO. STRT\14
CHECKED BY: S.SINHA	DRG. NO.	REVISION NO. 01	

DRG. TYPE:

TENDER DRAWINGS - STRUCTURE

TENDER PURPOSE ONLY



LEGEND

SL. NO.	DESCRIPTION	SYMBOL
1.	9 MTR. GI OCTAGONAL POLE	
2.	LED GATE LIGHT	

DWARKA SECTOR-19,DELHI
DWG AREA=0.9680 Hact.=2.3920 Acr

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15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

DRAWING TITLE :
SITE PLAN

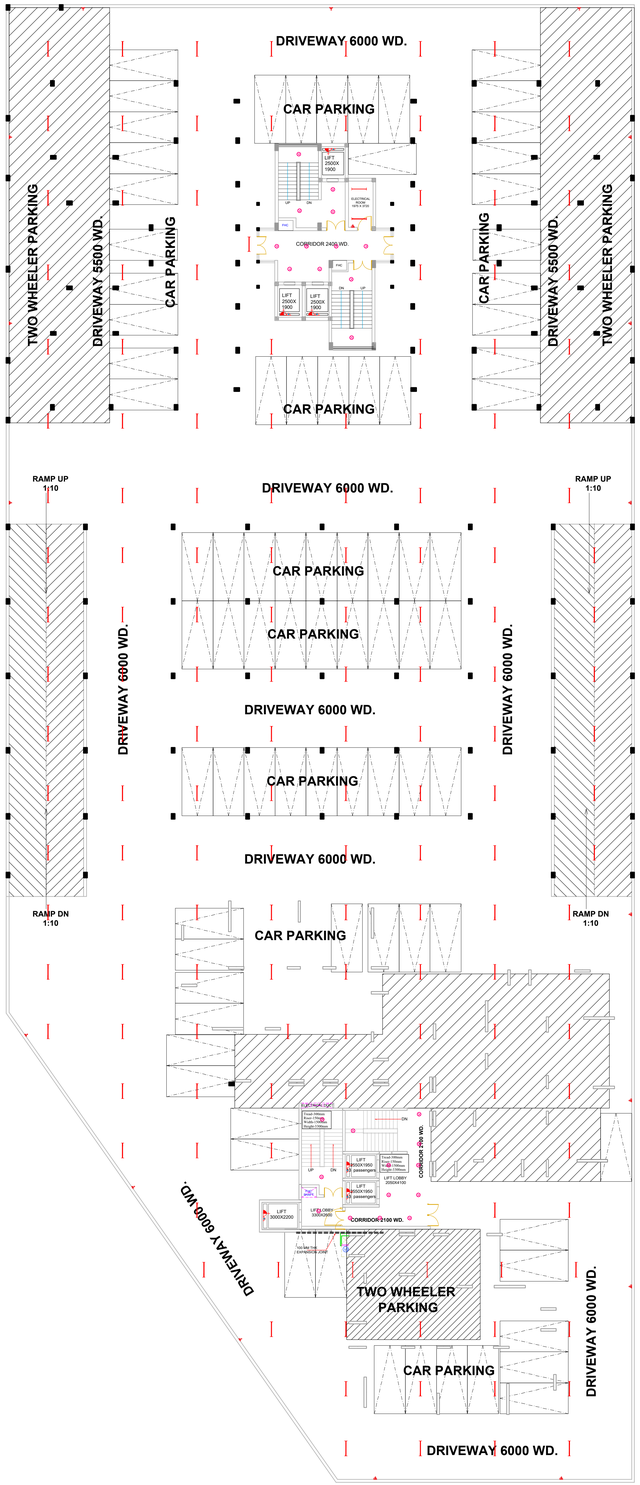
DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

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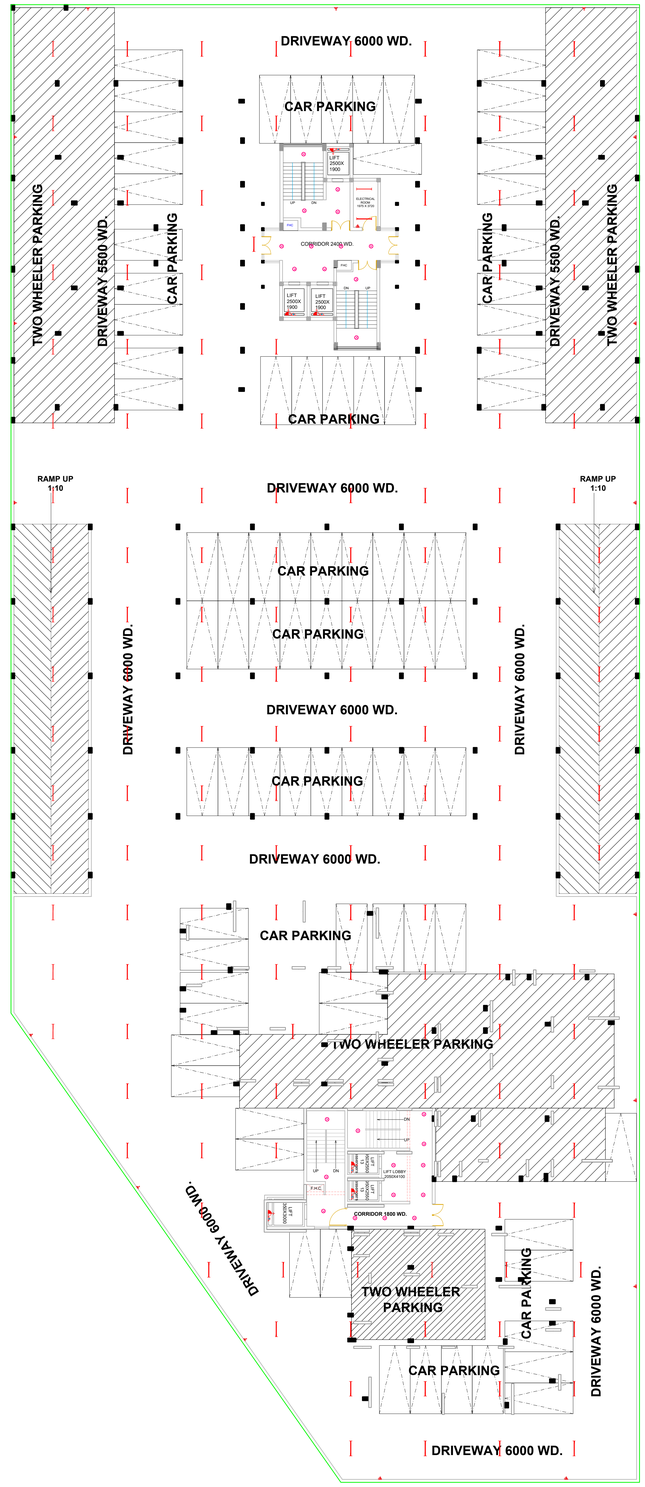
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CHECKED BY		
APPROVED BY		

TENDER PURPOSE ONLY



BASEMENT PLAN -01



BASEMENT PLAN -02

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN(WALL MOUNTED)
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT
	20-22 WATT LED BATTEN(CEILING MOUNTED)
	BRACKET LIGHT

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CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
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Job No:

BUILDING NAME :
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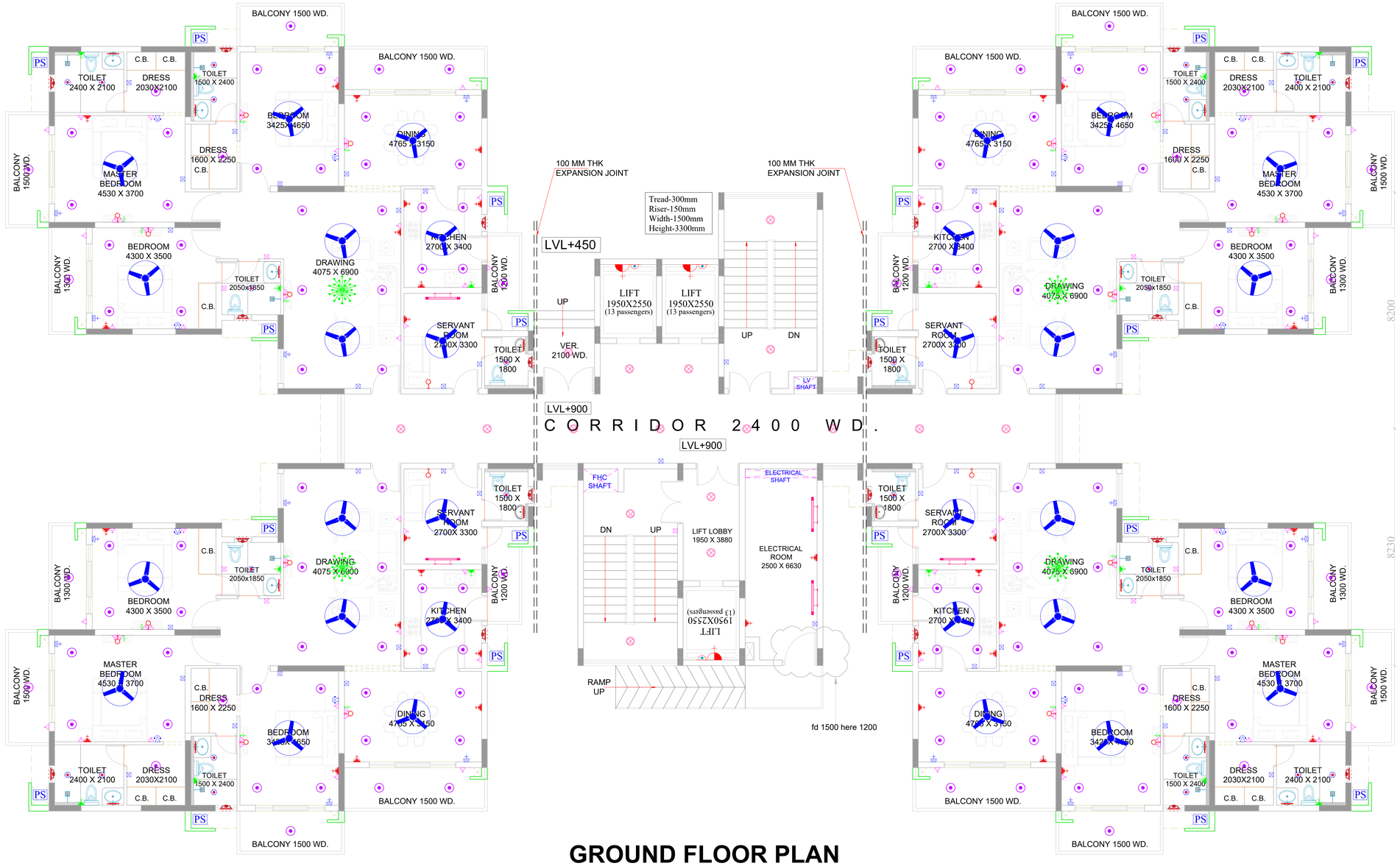
DRAWING TITLE :
BASEMENT PLAN

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE: | SHEET SIZE: A1 | DATE: 16-03-26 | REV. NO: R0

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GROUND FLOOR PLAN

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
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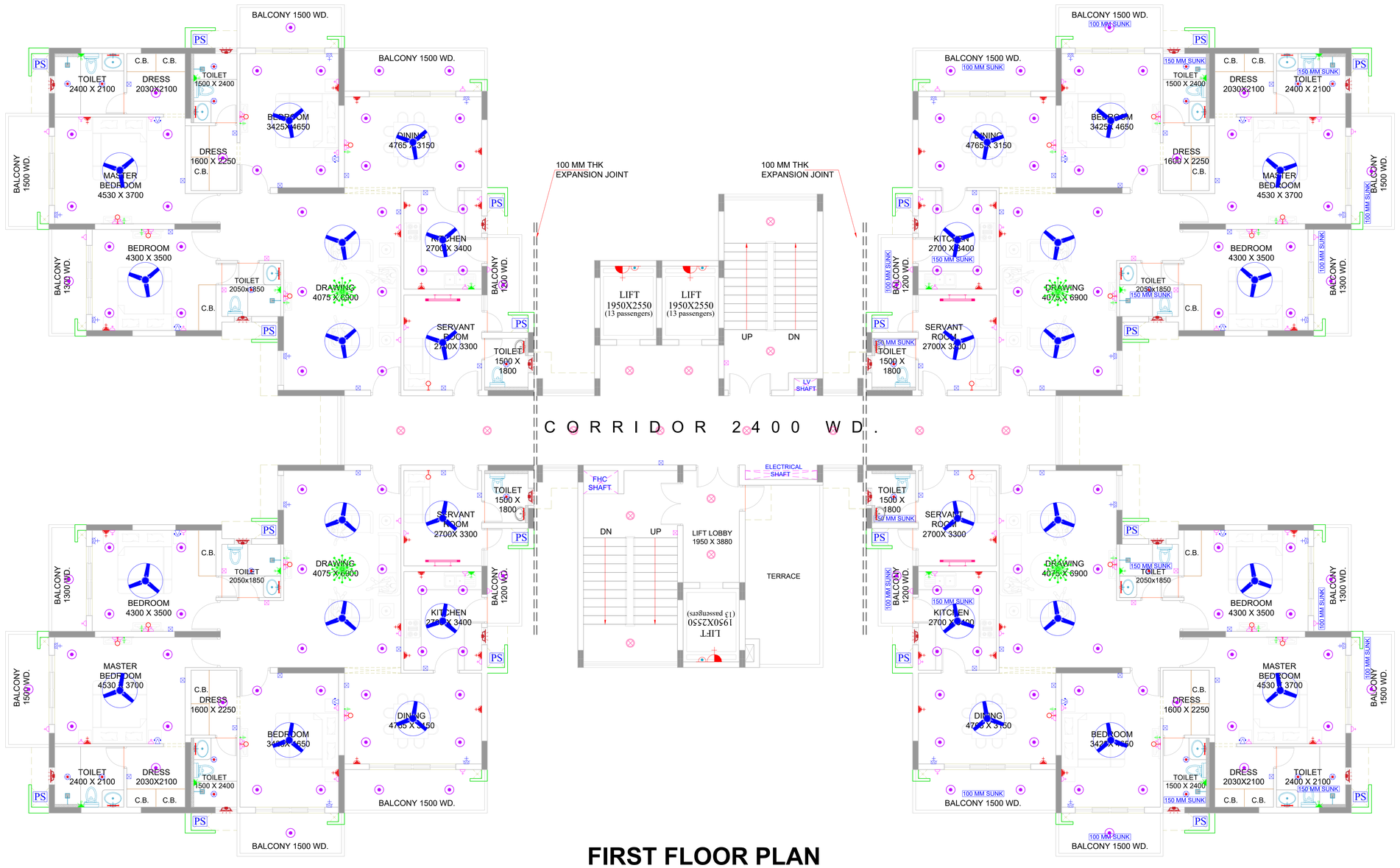
DRAWING TITLE :
GROUND FLOOR PLAN ELECTRICAL

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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FIRST FLOOR PLAN

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
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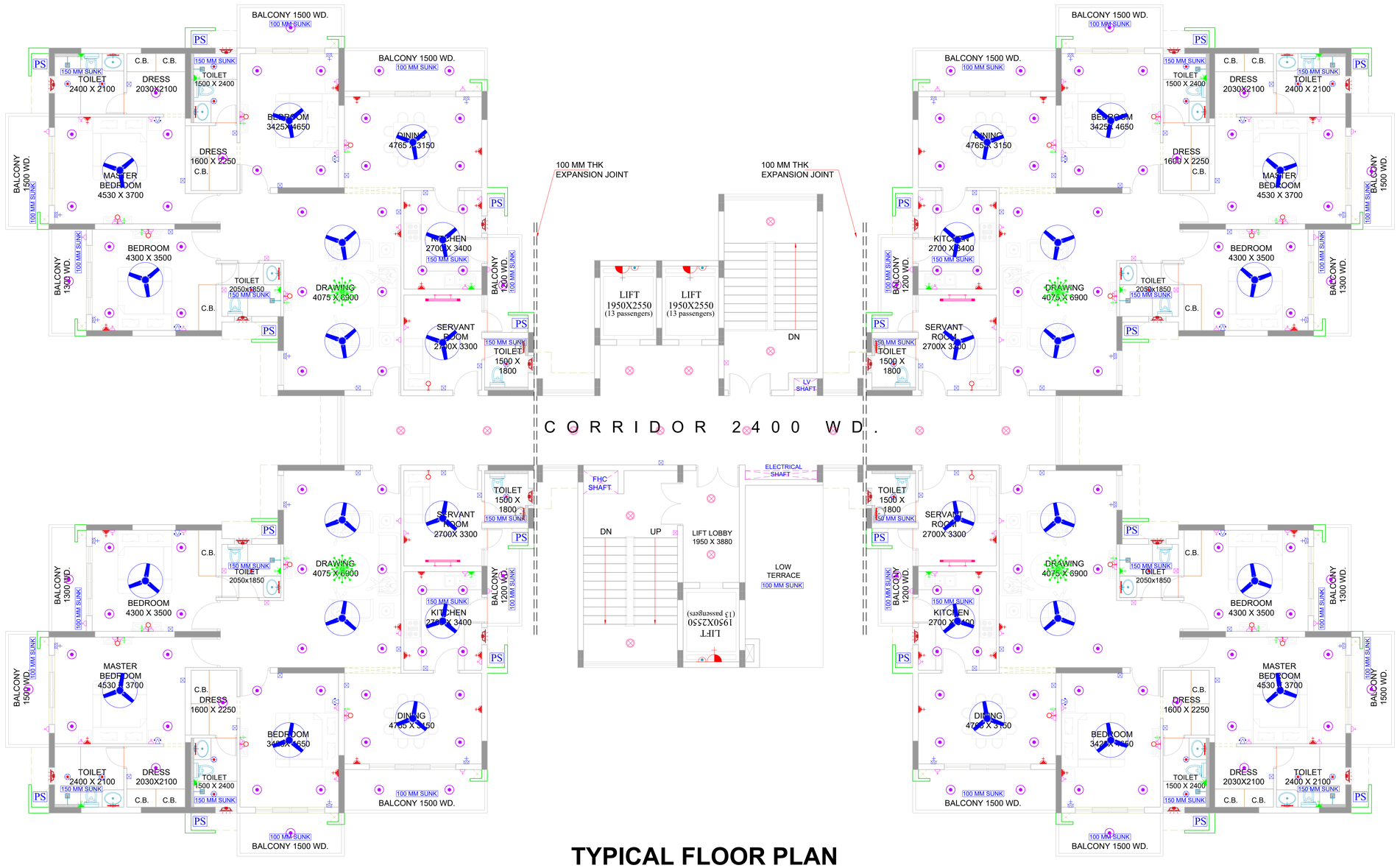
DRAWING TITLE :
FIRST FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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CHECKED BY		
APPROVED BY		



TYPICAL FLOOR PLAN
2ND TO 12TH

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
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	25A AC POWER POINT
	TV POINT
T	TELEPHONE POINT

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13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

PROJECT MANAGEMENT CONSULTANT

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(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

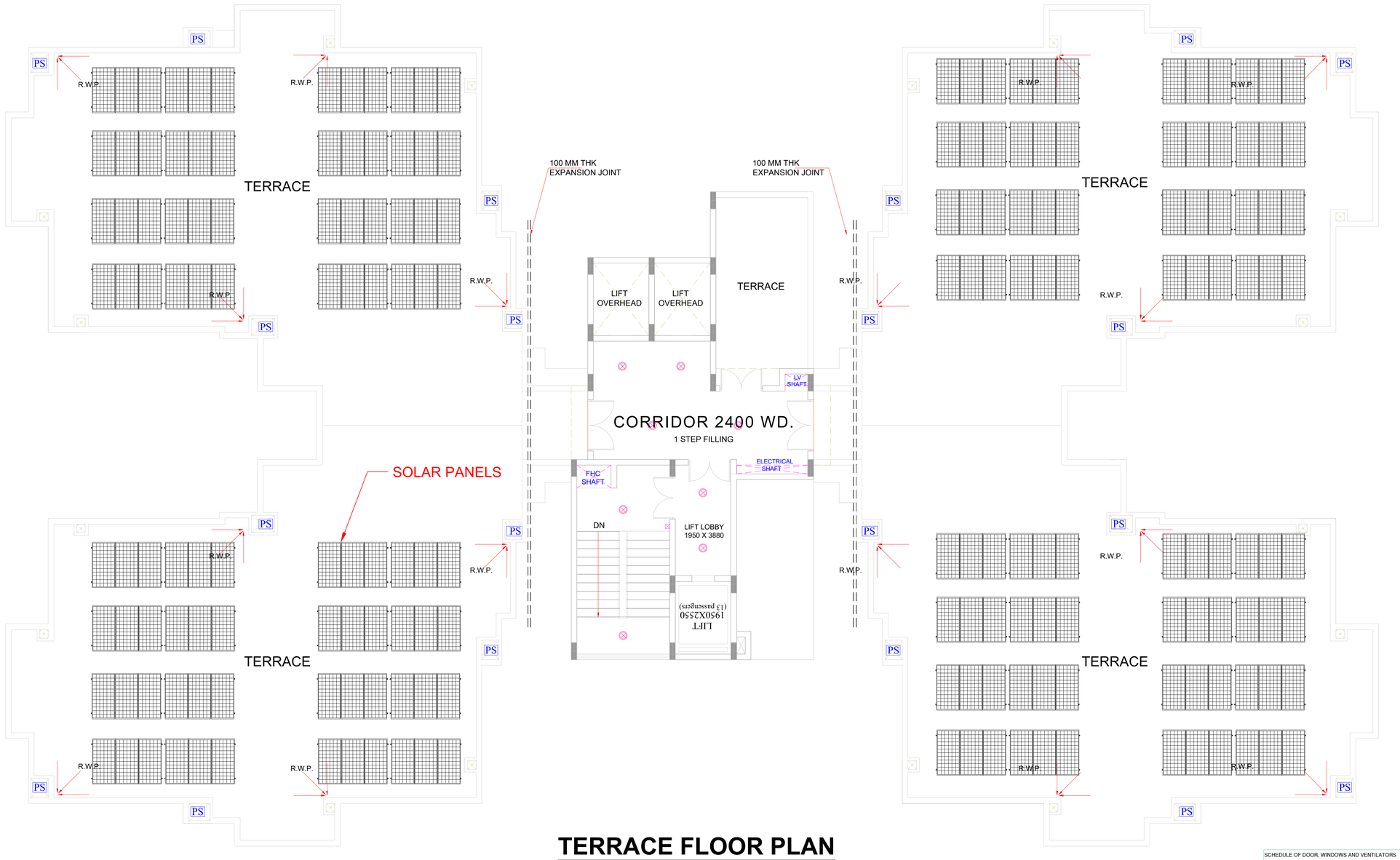
DRAWING TITLE :
TYPICAL FLOOR PLAN (2ND TO 12TH FLOOR)

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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TERRACE FLOOR PLAN

SCHEDULE OF DOOR, WINDOWS AND VENTILATORS						
S.NO.	TYPE	WIDTH	HEIGHT	SILL	LINTEL	NOs.
DOORS :						
1	FD	1500	2550	00	2550	03

TENDER PURPOSE ONLY

LEGEND	
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT

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CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
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Job No:

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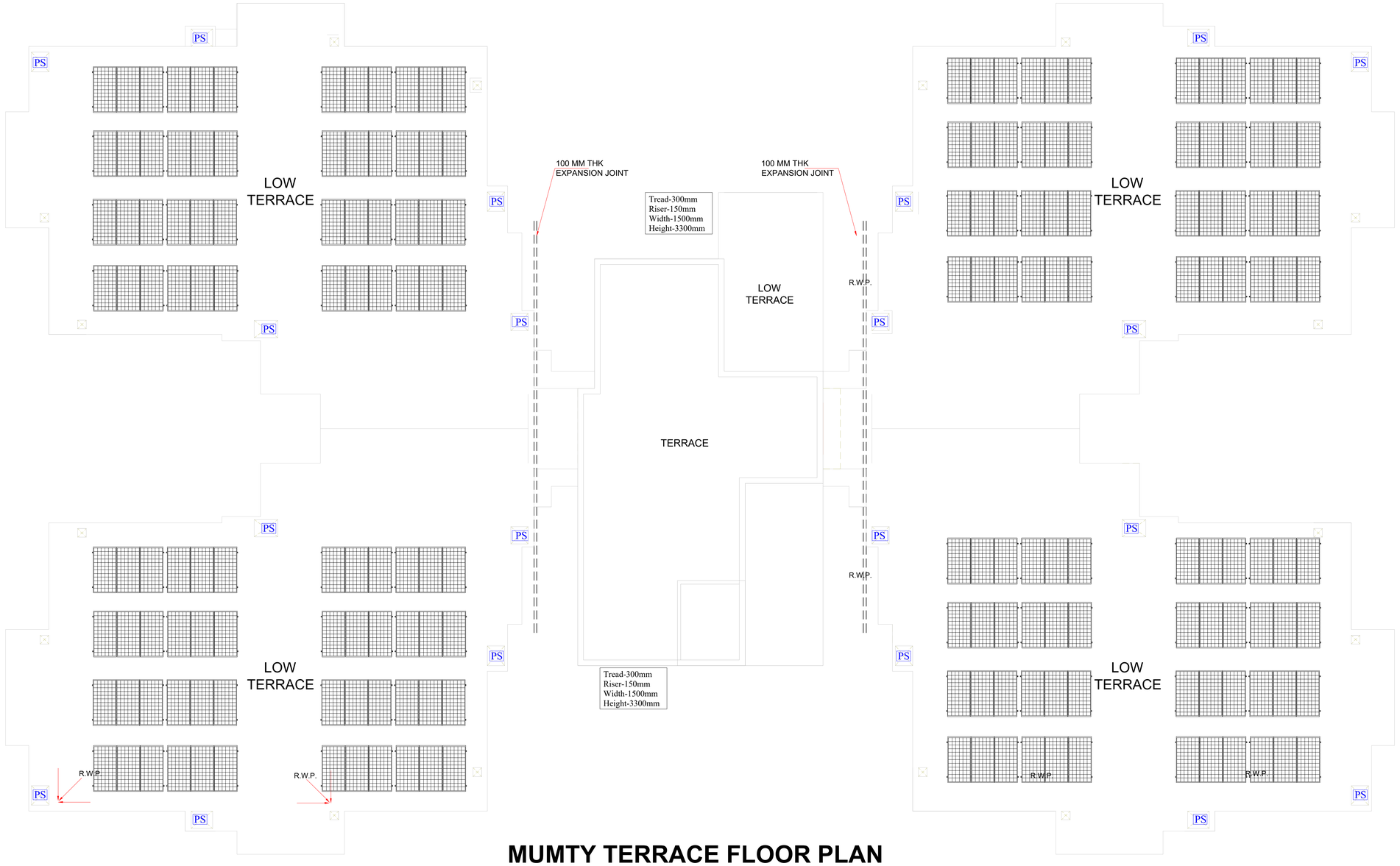
DRAWING TITLE :
TERRACE FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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MUMTY TERRACE FLOOR PLAN

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT

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CIVIL & STRUCTURAL			FPS		
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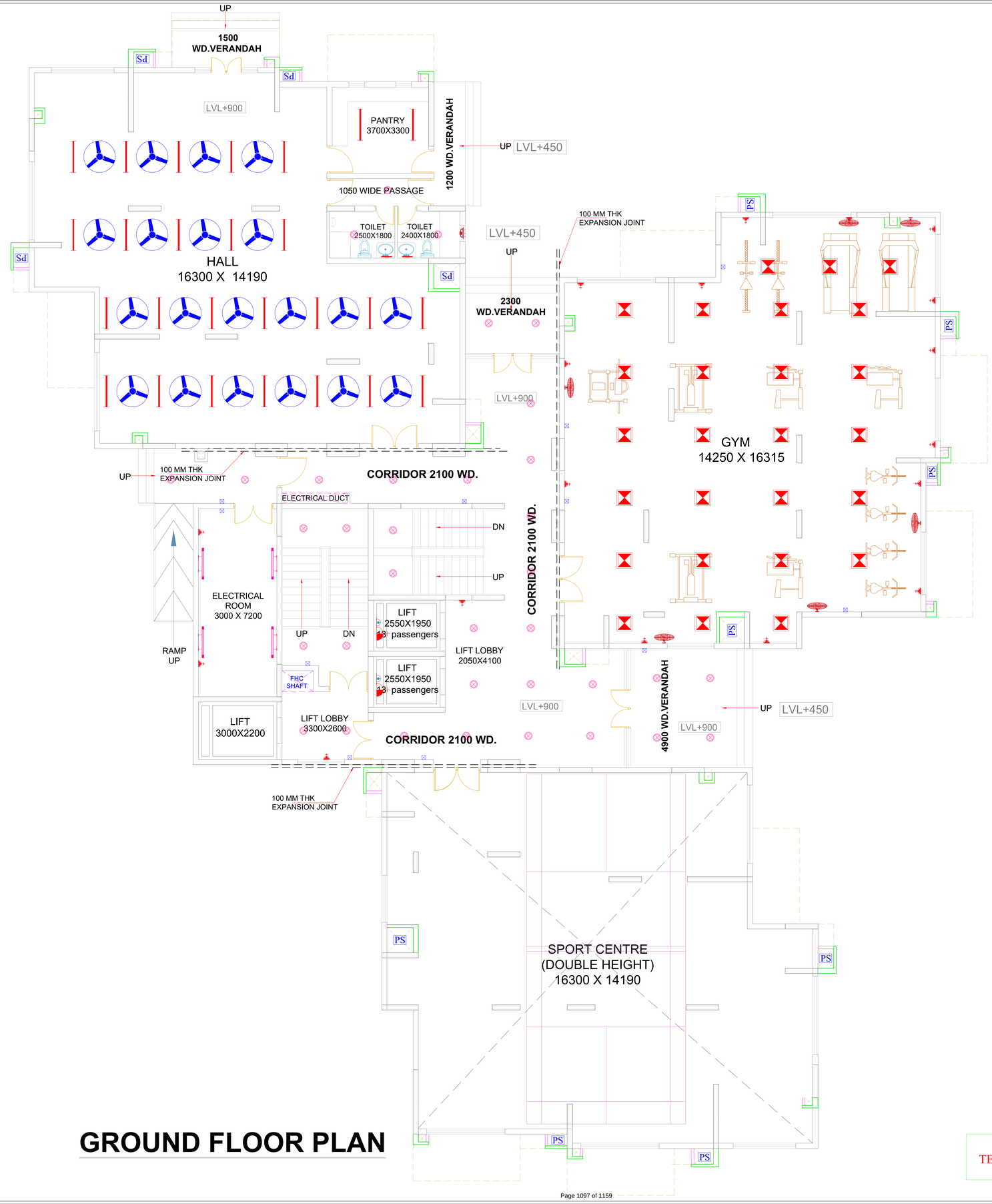
DRAWING TITLE :
TERRACE FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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GROUND FLOOR PLAN

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN(WALL MOUNTED)
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT
	20-22 WATT LED BATTEN(CEILING MOUNTED)
	BRACKET LIGHT

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
GROUND FLOOR PLAN

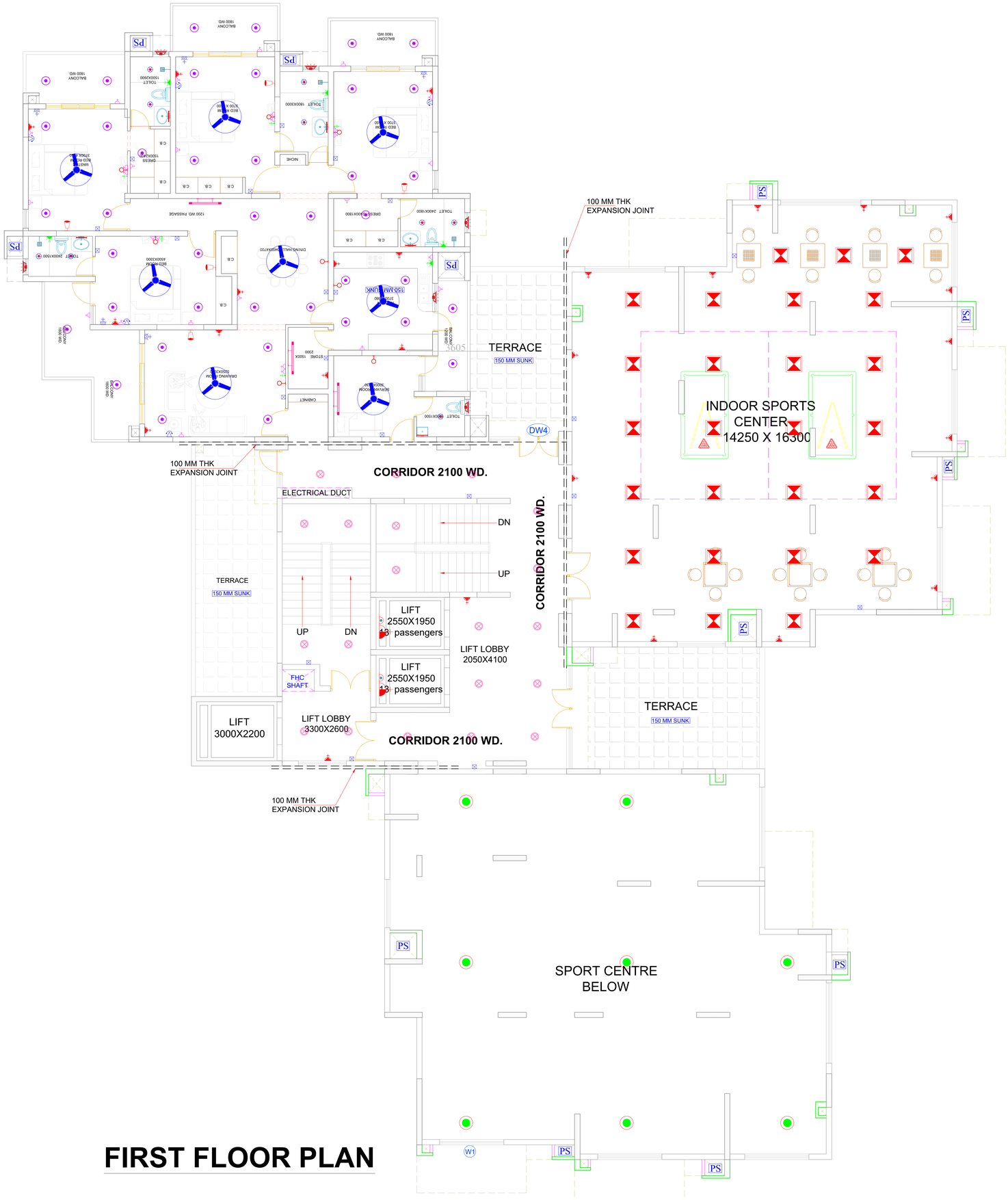
DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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TENDER PURPOSE ONLY



FIRST FLOOR PLAN

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN(WALL MOUNTED)
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT
	20-22 WATT LED BATTEN(CEILING MOUNTED)
	BRACKET LIGHT

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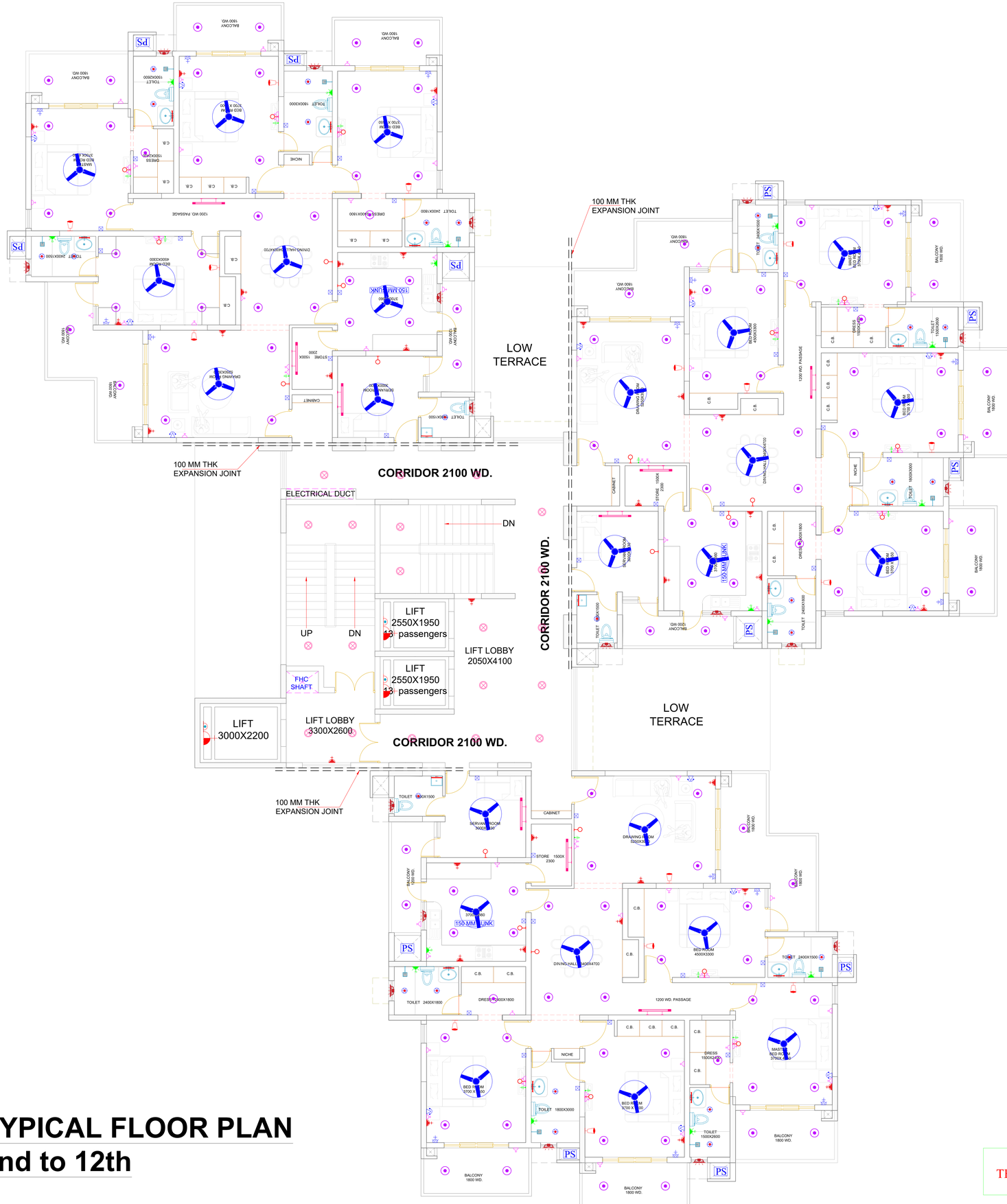
DRAWING TITLE :
FIRST FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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TYPICAL FLOOR PLAN
2nd to 12th

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN(WALL MOUNTED)
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT
	20-22 WATT LED BATTEN(CEILING MOUNTED)
	BRACKET LIGHT

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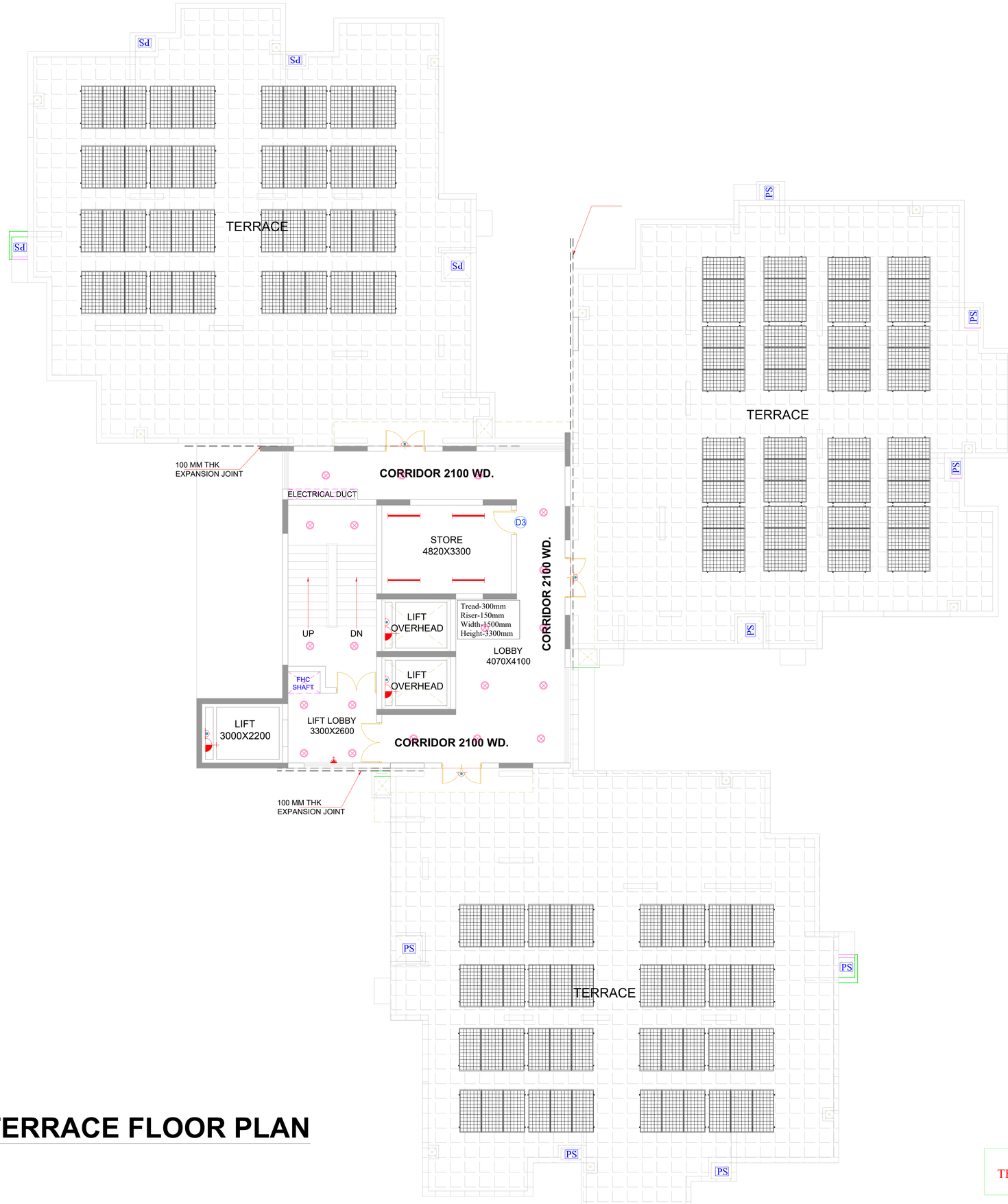
DRAWING TITLE :
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DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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TERRACE FLOOR PLAN

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	20-22 WATT LED BATTEN(WALL MOUNTED)
	15-18 WATT DOWNLIGHTER
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G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT
	20-22 WATT LED BATTEN(CEILING MOUNTED)
	BRACKET LIGHT

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13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT :

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
TERRACE FLOOR PLAN

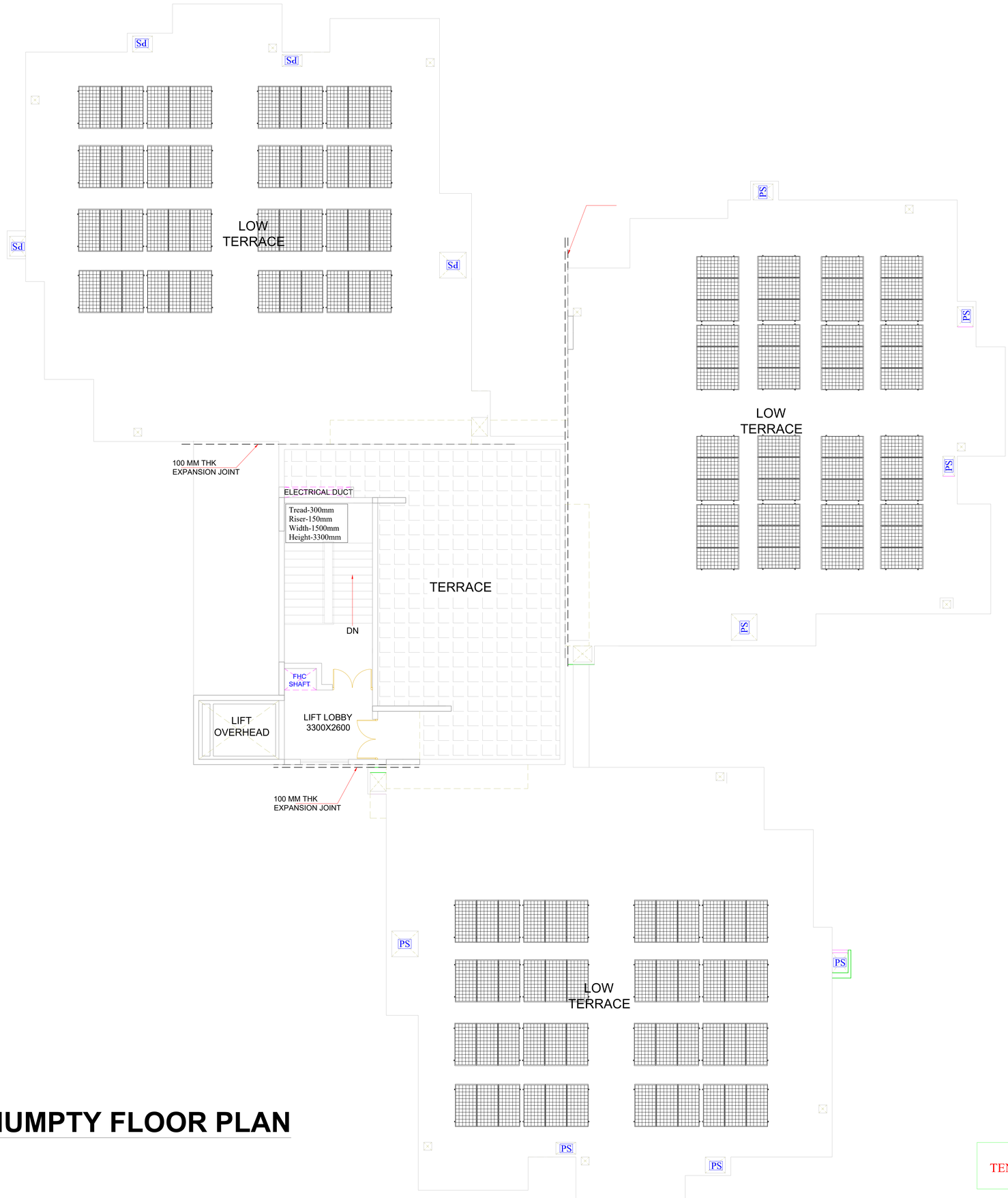
DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		

TENDER PURPOSE ONLY



MUMPTY FLOOR PLAN

TENDER PURPOSE ONLY

	LEGEND
	36 WATT (2 X 2) LED PANEL LIGHT
	20-22 WATT LED BATTEN(WALL MOUNTED)
	15-18 WATT DOWNLIGHTER
	12-15 WATT DOWNLIGHTER
	6-8 WATT DOWNLIGHTER
	80 WATT HIGHBAY LIGHT
	1200 MM CEILING FAN
	EXHAUST FAN
	CHANDELIER
	10 WATT LED MIRROR LIGHT
	SWITCH BOARD
	10 WATT BULKHEAD
	DISTRIBUTION BOARD
	EXHAUST FAN
	LED BULB
G	GEYSER POINT
	6A POWER POINT
	16A POWER POINT
	6/16A POWER POINT
	25A AC POWER POINT
	TV POINT
	TELEPHONE POINT
	20-22 WATT LED BATTEN(CEILING MOUNTED)
	BRACKET LIGHT

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CIVIL & STRUCTURAL			FPS		
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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

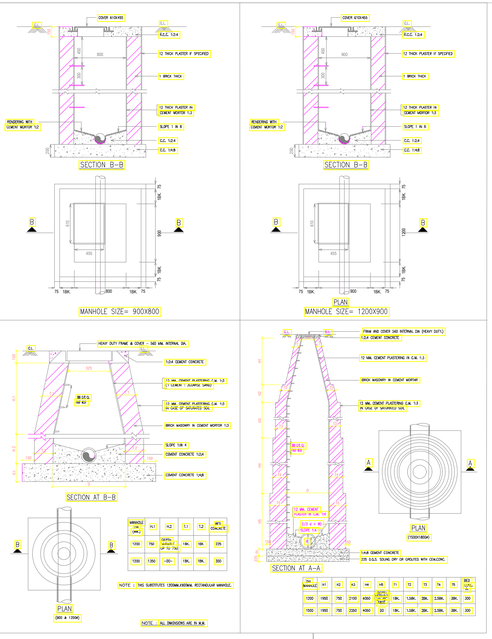
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MUMTY LEVEL FLOOR PLAN

DRAWING TYPE :
TENDER DRAWINGS - ELECTRICAL

SCALE:	SHEET SIZE: A1	DATE: 16-03-26	REV. NO: R0

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LEGEND:- DRAIN CHANNEL

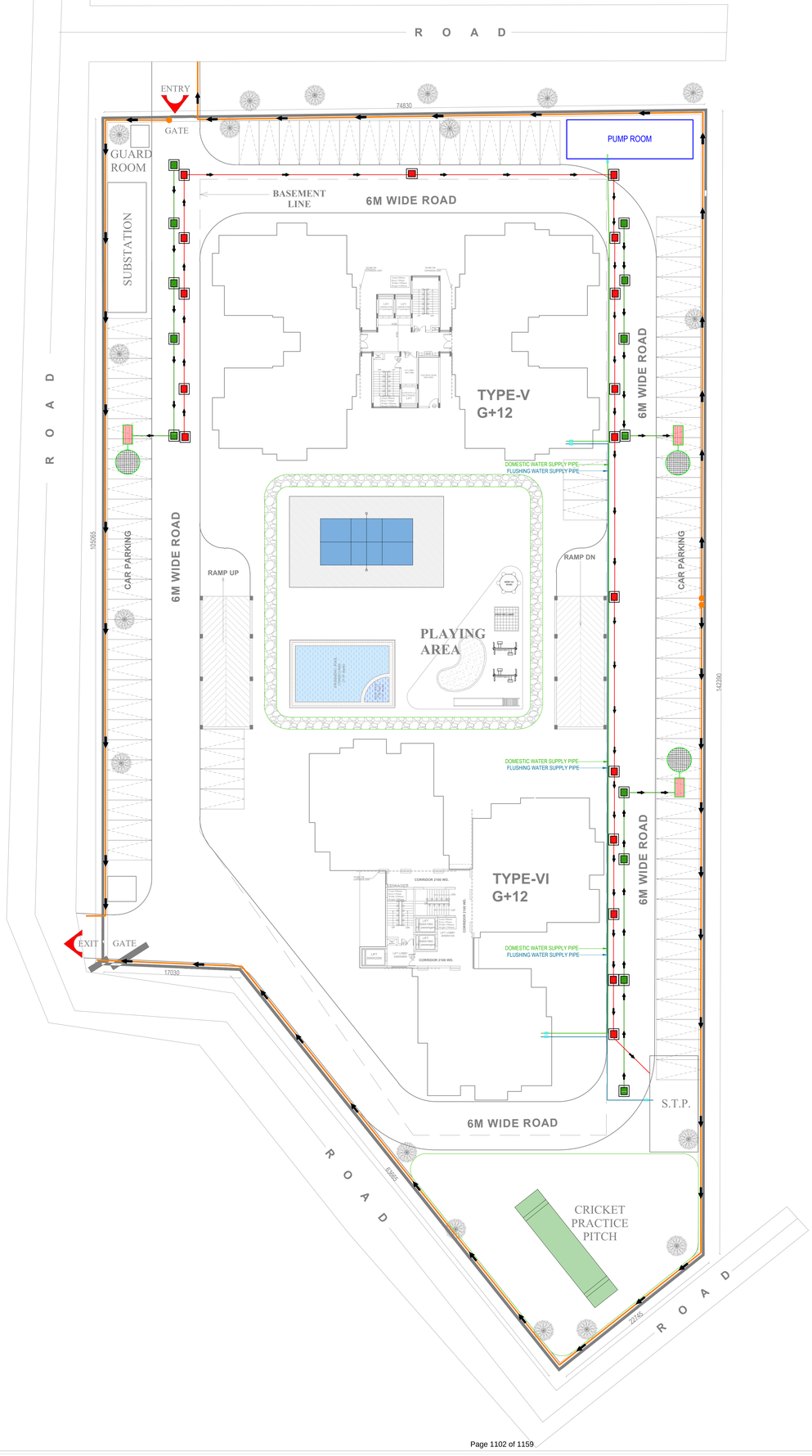
SYMBOL	DESCRIPTION
	300 mm Wide Drain Channel

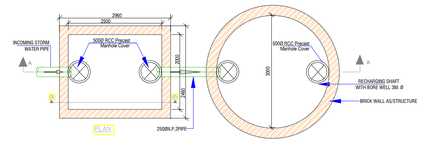
MANHOLE DETAILS
1. For various depths the recommended thickness of wall may be as follows
Depth of the chamber thickness of wall a) Up to 2.25 m : 200 mm (one brick length) b) From 2.25 m up to : 300 mm (one and 3.0 m half brick length) c) From 3.00 m up to : 400 mm (two brick 5.0 m length) d) From 5.00 m up to : 500 mm (two and 9.0 m half brick length) e) Fe) Above 9.00 m : 600 mm (three brick length)
2. Manholes may be rectangular, arch or circular type. The minimum internal size of manholes, chambers (between faces of masonry) shall be as follows:
a) Rectangular manholes: (i) For depths less than 1.0 mtr depth - 900 mm × 800 mm (ii) For depths from 1.0 m and up to 1.65 m 1200 mm × 900 mm
b) Circular manholes: (i) For depths above 1.65 m and up to 2.30 m - 1200 mm diameter (ii) For depths above 2.30 m and up to 9.00 m - 1500 mm diameter

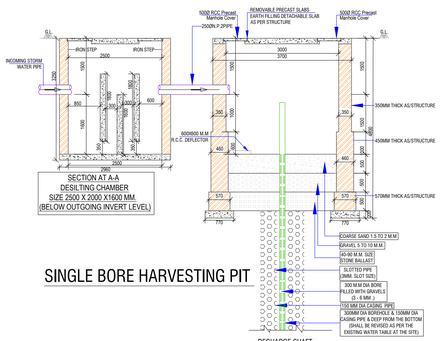
Notes :- SEWER LINE	
1	ALL DIMENSIONS ARE IN METER UNLESS NOTED OTHERWISE.
2.	FOR PIPES SIZE, SLOPES, LEVELS ETC. REFER DRAWINGS.
3.	ANY DISCREPANCY IN THE DRAWING SHALL BE BROUGHT TO THE NOTICE OF THE ARCHITECT/S./ CONSULTANTS.
4.	ALL PIPES SHALL BE NP2 PIPE PIPES
5.	SEWER LINE LAYOUT IS INDICATIVE SEWER SHALL BE LAID ALIGNED AS PER ACTUAL ROAD SECTION AND LEVEL.
6.	THIS DRAWING SHOULD BE READ IN CONJUNCTION AND OTHER RELEVENT ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES DRAWINGS.
9.	PIPE SHALL BE LAID OF FOLLOWING SLOPES:- (i) 150 Ø NP2 PIPE- 1 IN 125 (ii) 250 Ø NP2 PIPE- 1 IN 250 (iii) 300 Ø NP2 PIPE- 1 IN 300 (iv) 350 Ø NP2 PIPE- 1 IN 375 (v) 450 Ø NP2 PIPE- 1 IN 500

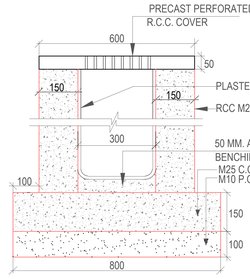
Notes :- ETP LINE	
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NOTES:- WATER SUPPLY	
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4.	PIPES LAYOUT IS INDICATIVE PIPES SHALL BE LAID AND ALIGNED AS PER ACTUAL ROAD SECTION AND LEVEL.
5.	WATER SUPPLY MAINS SHALL BE LAID DEEP ENOUGH SO THAT A MINIMUM 750 MM. COVER IS AVAILABLE WHEN LAID UNDER FOOTPATH OR SOFT AREA AND 900 MM. WHEN LAID UNDER ROAD.
6.	THIS DRAWING SHOULD BE READ IN CONJUNCTION AND OTHER RELEVENT ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES DRAWINGS.
7.	ALL WATER SUPPLY PIPES
8.	25ø IRRIGATION TAPING POINT

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

DRAWING TITLE :
ALL COORDINATE DWG

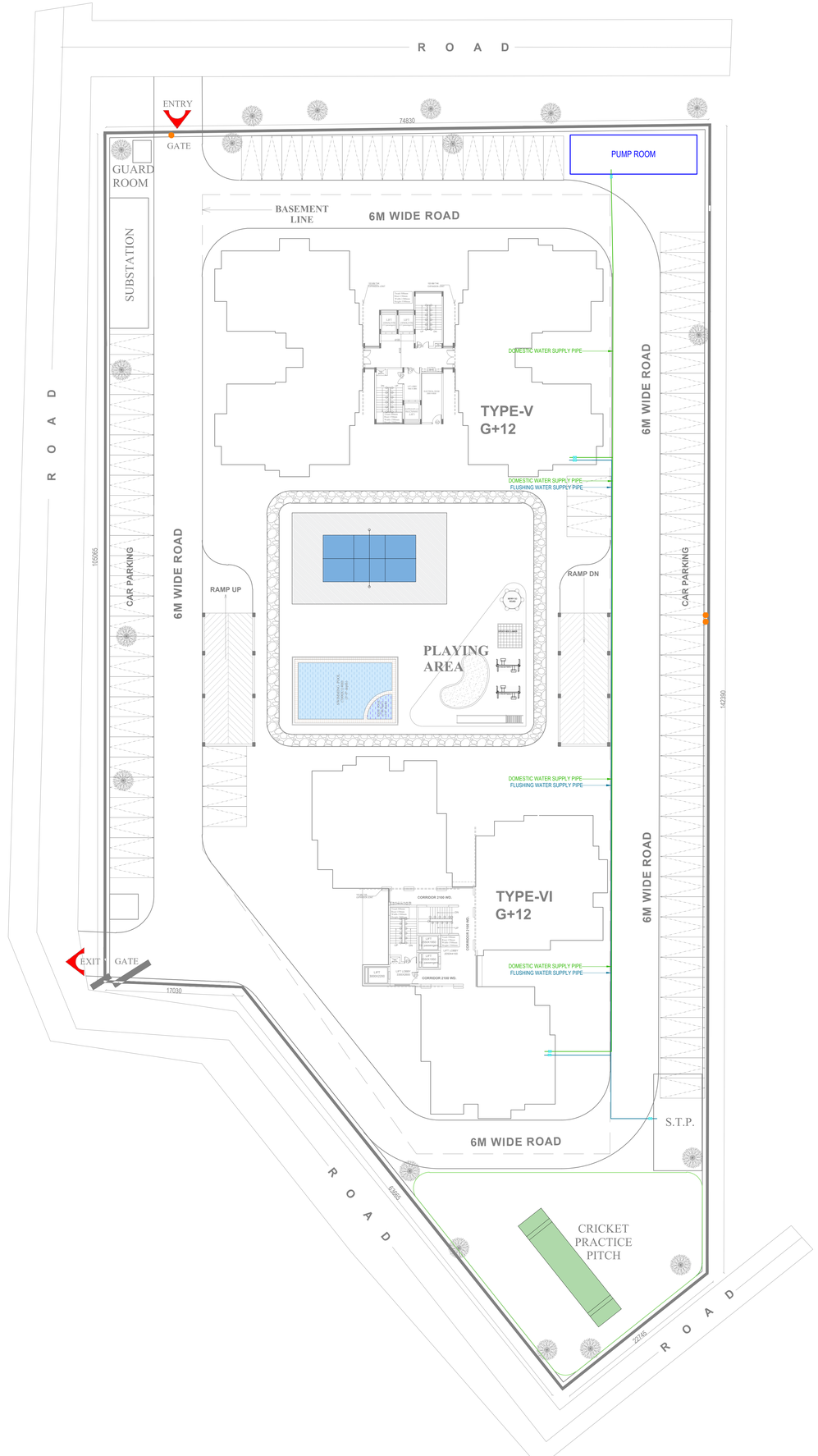
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE: SHEET SIZE: A1 DATE: 09-02-26 REV. NO: R0

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TENDER PURPOSE ONLY



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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

DRAWING TITLE :
EXTERNAL WATER SUPPLY

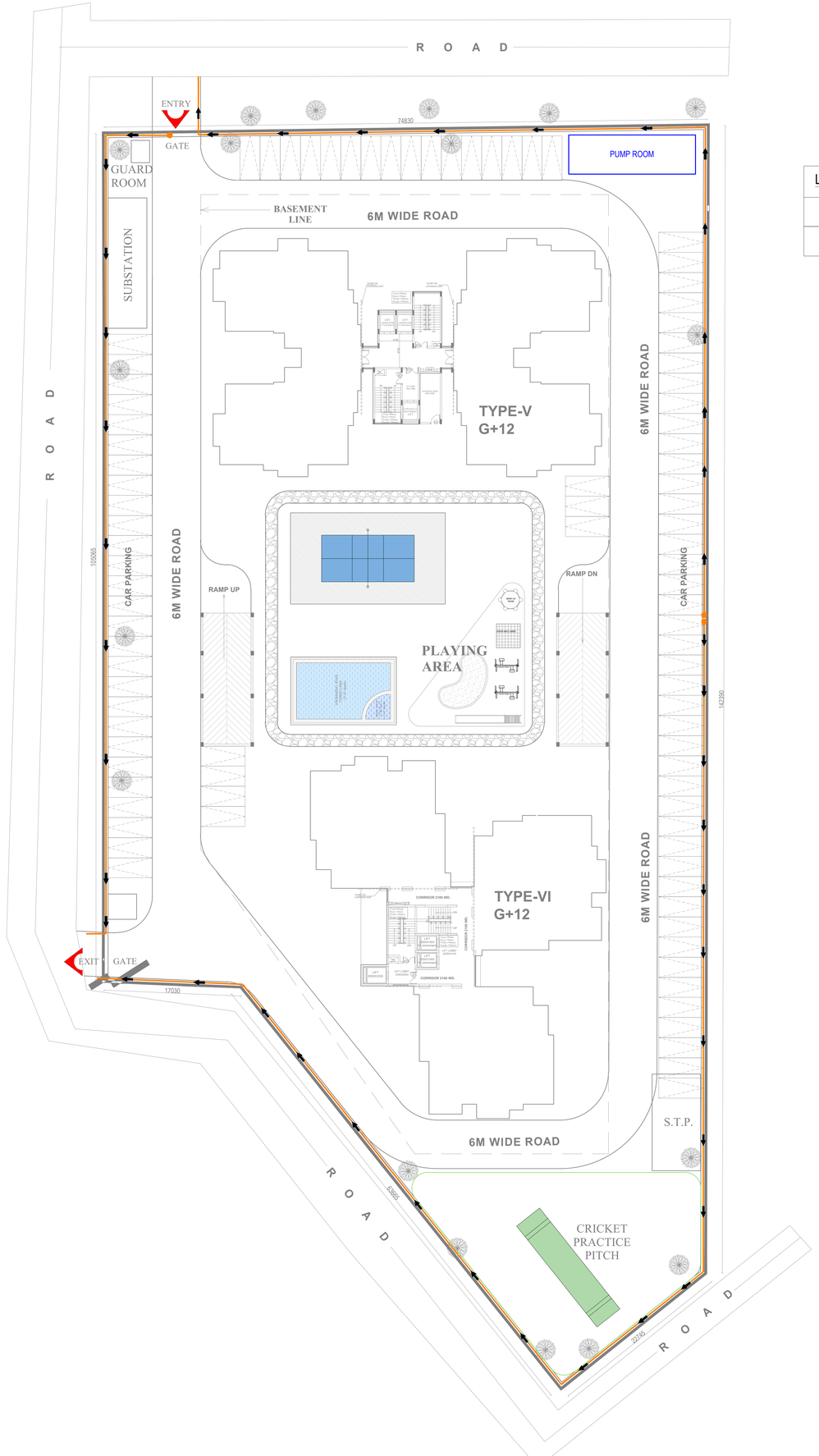
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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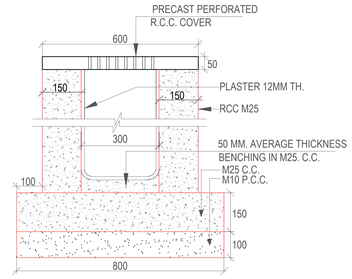
	SIGN	DATE
DESIGNED / DRAWN BY		
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APPROVED BY		

TENDER PURPOSE ONLY



LEGEND:- DRAIN CHANNEL

SYMBOL	DESCRIPTION
	300 mm Wide Drain Channel



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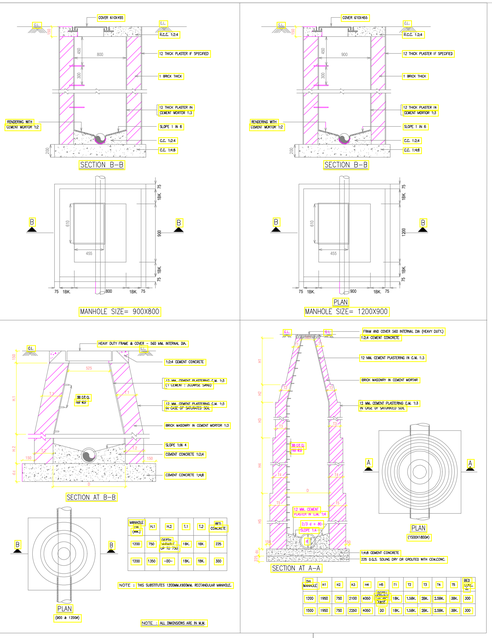
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

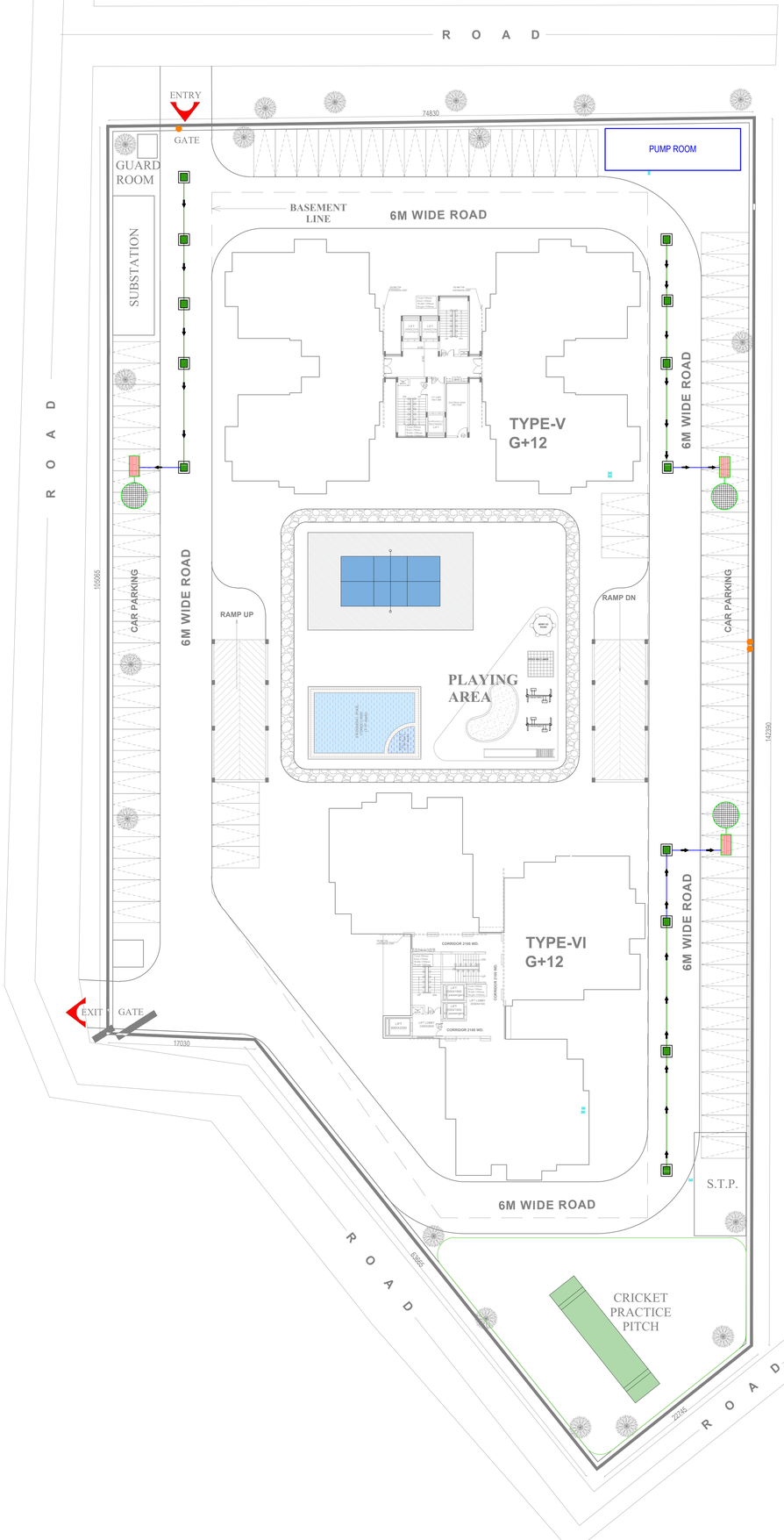
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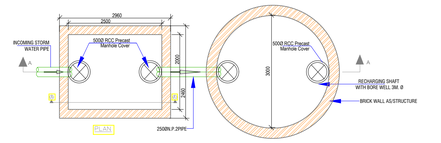
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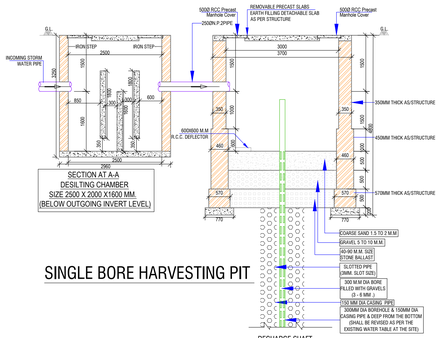
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TENDER PURPOSE ONLY









SINGLE BORE HARVESTING PIT

RECHARGE SHAFT
RAIN WATER HARVESTING DETAILS

LEGEND:- DRAIN CHANNEL

SYMBOL	DESCRIPTION
	300 mm Wide Drain Channel

MANHOLE DETAILS

1. For various depths the recommended thickness of wall may be as follows

Depth of the chamber thickness of wall
a) Up to 2.25 m : 200 mm (one brick length)
b) From 2.25 m up to : 300 mm (one and 3.0 m half brick length)
c) From 3.00 m up to : 400 mm (two brick 5.0 m length)
d) From 5.00 m up to : 500 mm (two and 9.0 m half brick length)
e) Fe) Above 9.00 m : 600 mm (three brick length)

2. Manholes may be rectangular, arch or circular type. The minimum internal size of manholes, chambers (between faces of masonry) shall be as follows:

a) Rectangular manholes:
(i) For depths less than 1.0 mtr depth - 900 mm × 800 mm
(ii) For depths from 1.0 m and up to 1.65 m 1200 mm × 900 mm

b) Circular manholes:
(i) For depths above 1.65 m and up to 2.30 m - 1200 mm diameter
(ii) For depths above 2.30 m and up to 9.00 m - 1500 mm diameter

Notes :- SEWER LINE

1	ALL DIMENSIONS ARE IN METER UNLESS NOTED OTHERWISE.
2.	FOR PIPES SIZE, SLOPES, LEVELS ETC. REFER DRAWINGS.
3.	ANY DISCREPANCY IN THE DRAWING SHALL BE BROUGHT TO THE NOTICE OF THE ARCHITECT/S./ CONSULTANTS.
4.	ALL PIPES SHALL BE NP2 PIPE PIPES
5.	SEWER LINE LAYOUT IS INDICATIVE SEWER SHALL BE LAID ALIGNED AS PER ACTUAL ROAD SECTION AND LEVEL.
6.	THIS DRAWING SHOULD BE READ IN CONJUNCTION AND OTHER RELEVENT ARCHITECTURAL, STRUCTURAL AND OTHER SERVICES DRAWINGS.
9.	PIPE SHALL BE LAID OF FOLLOWING SLOPES:- (i) 150 Ø NP2 PIPE- 1 IN 125 (ii) 250 Ø NP2 PIPE- 1 IN 250 (iii) 300 Ø NP2 PIPE- 1 IN 300 (iv) 350 Ø NP2 PIPE- 1 IN 375 (v) 450 Ø NP2 PIPE- 1 IN 500

MANHOLE DETAILS

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(ii) For depths above 2.30 m and up to 9.00 m - 1500 mm diameter

SYMBOL	DESCRIPTION
	150Ø NP2 PIPE
	250Ø NP2 PIPE
	SEWERAGE MAN HOLE
	HARVESTING PIT

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14.FURNITURE LAYOUT IS TENTATIVE.
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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
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REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT

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(A Govt. of India Undertaking-Ministry of Jal Shakti)

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m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

DRAWING TITLE :
EXTERNAL RAINWATER HARVESTING PIT

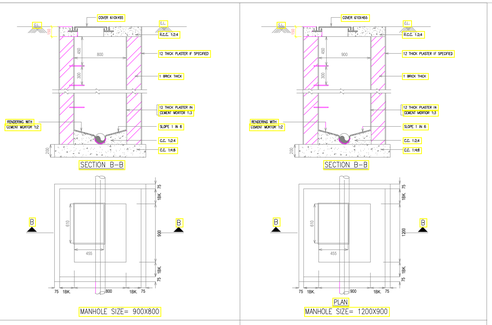
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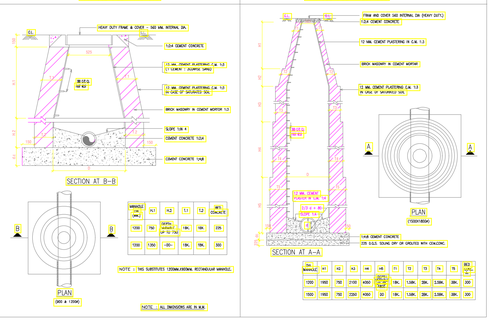
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TENDER PURPOSE ONLY



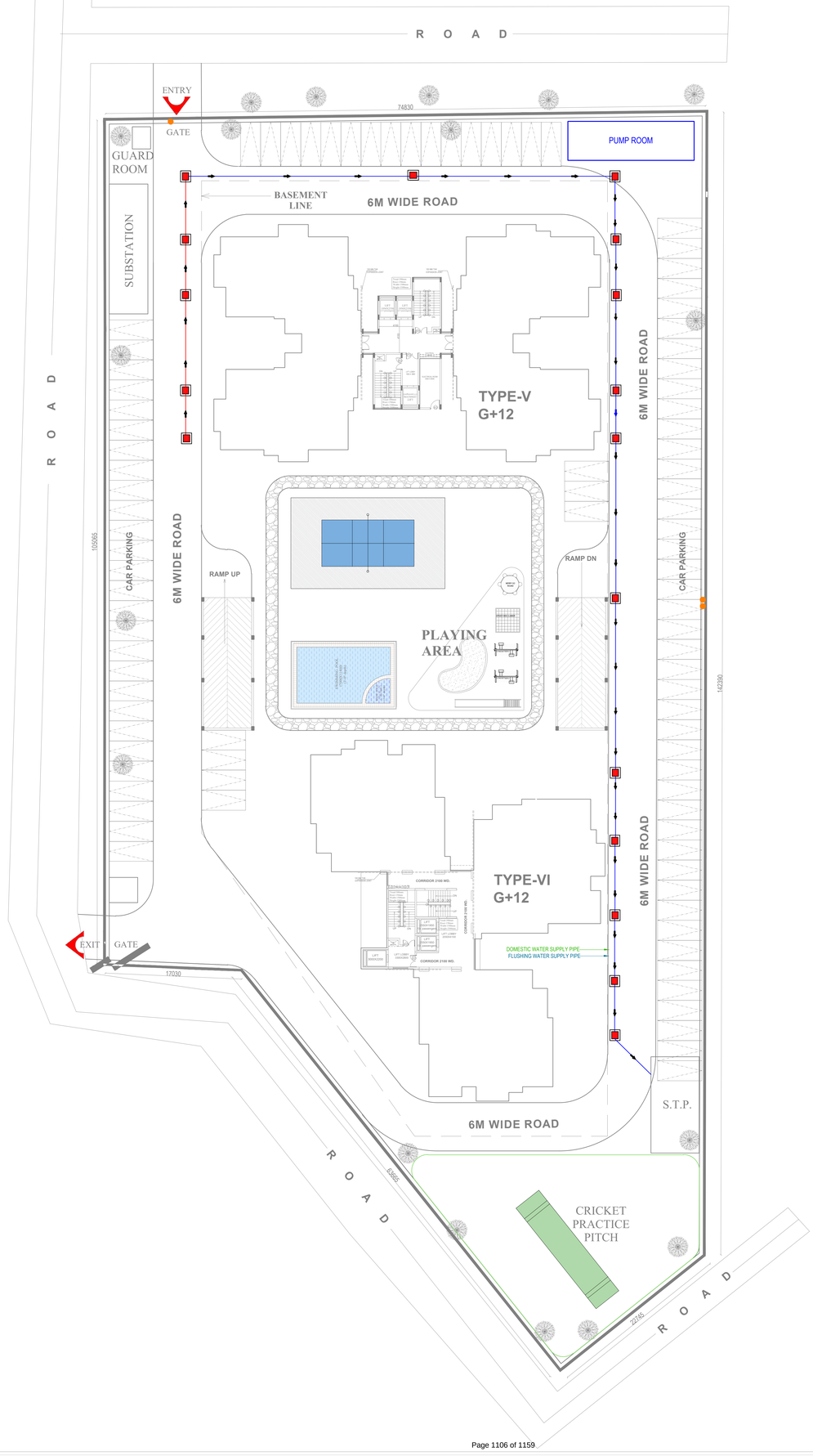


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LEGEND:- SEWERAGE	
SYMBOL	DESCRIPTION
	150Ø NP2 PIPE
	250Ø NP2 PIPE
	SEWERAGE MANHOLE



TENDER PURPOSE ONLY

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
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ARCHITECTURE			HVAC		
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ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

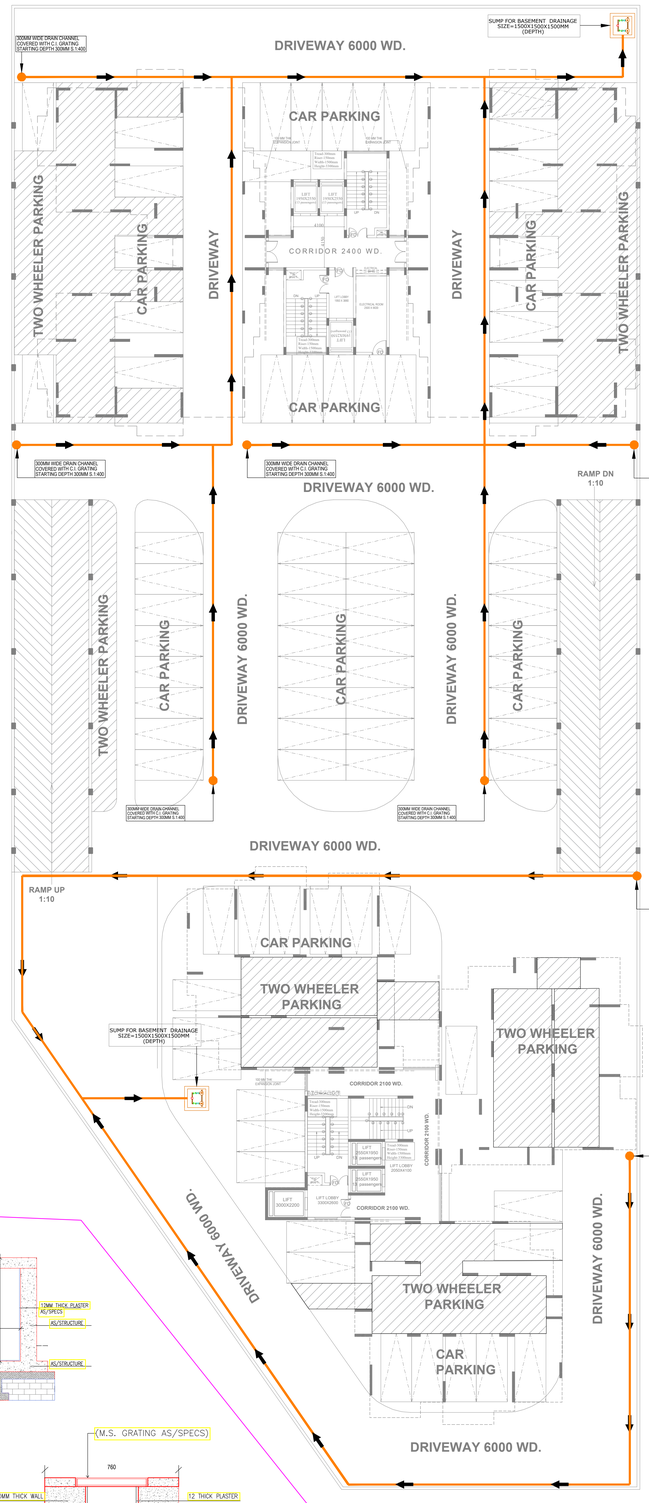
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DRAWING TYPE :
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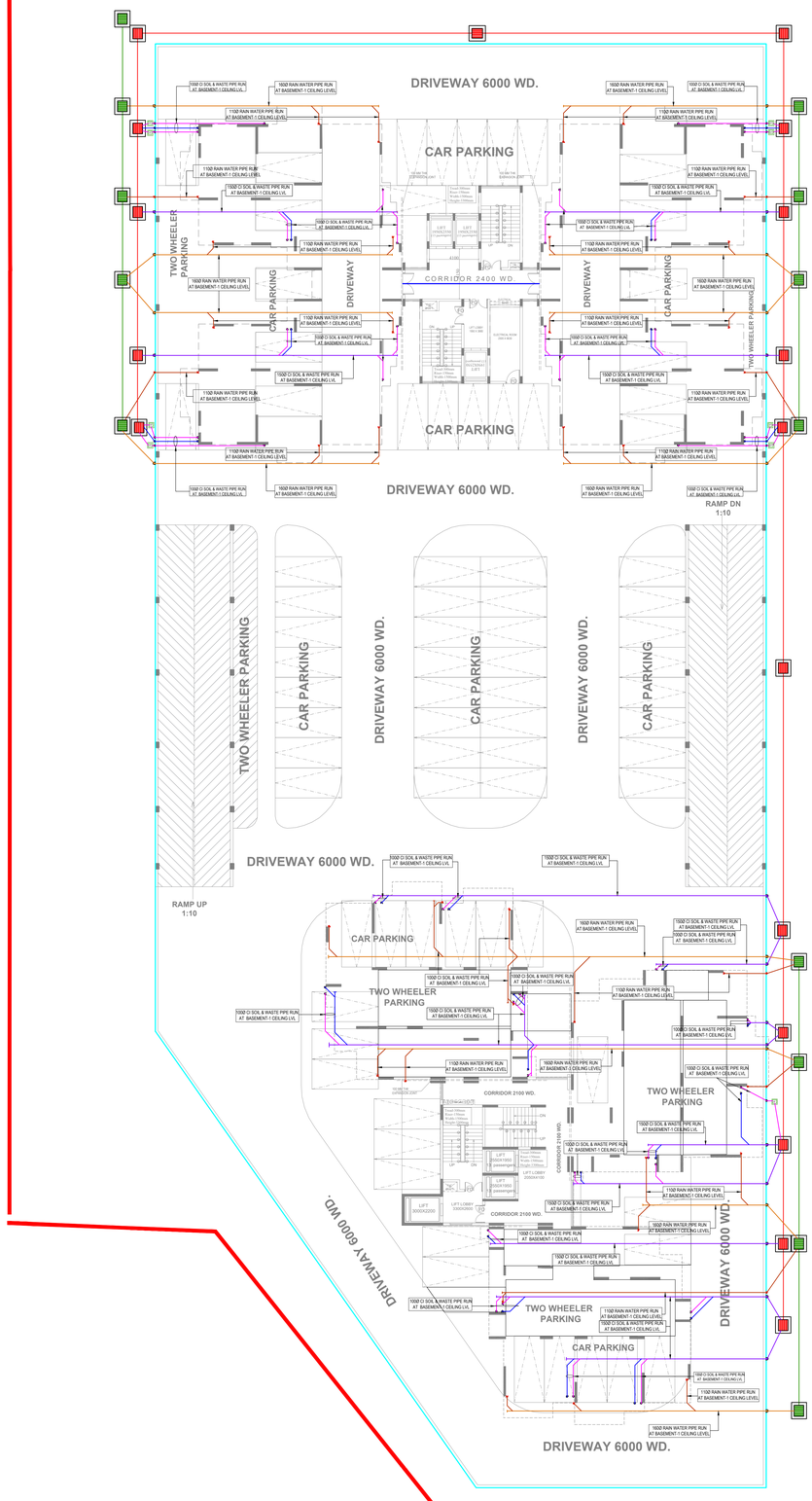
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BASEMENT PLAN -02



BASEMENT PLAN -01

LEGEND:- DRAIN CHANNEL

SYMBOL	DESCRIPTION
	300 mm Wide Drain Channel

TENDER PURPOSE ONLY

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CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
BASEMENT

DRAWING TITLE :
BASEMENT PLUMBING PLAN

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

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GROUND FLOOR PLAN

LEGEND:-	
SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
F	VERTICAL FLUSHING WATER SUPPLY PIPE
R	110Ø uPVC. RAIN WATER PIPE
S	100Ø CI. SOIL VENT PIPE
W	100Ø CI. WASTE VENT PIPE
	110Ø uPVC. RAIN WATER PIPE
	100Ø CI.SOIL PIPE
	75Ø CI. WASTE PIPE
	32Ø uPVC. WASTE PIPE
	CPVC COLD WATER PIPE
	CPVC HOT WATER PIPE
	CPVC HOT WATER RETURN
	CPVC FLUSHING WATER PIPE
FT	FLOOR TRAP
UT	URINAL TRAP
BT	BOTTLE TRAP
	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

TENDER PURPOSE ONLY

EXTERNAL PIPE & MANHOLE

Note :- External manhole to manhole pipe size & manhole invert level , connection level will be provided on external sewerage, & rain water harvesting drawings.
Please refer external drawing for the same

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

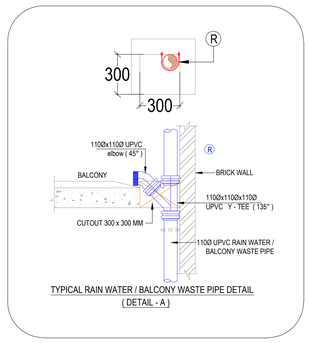
DRAWING TITLE :
GROUND FLOOR PLUMBING PLAN

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

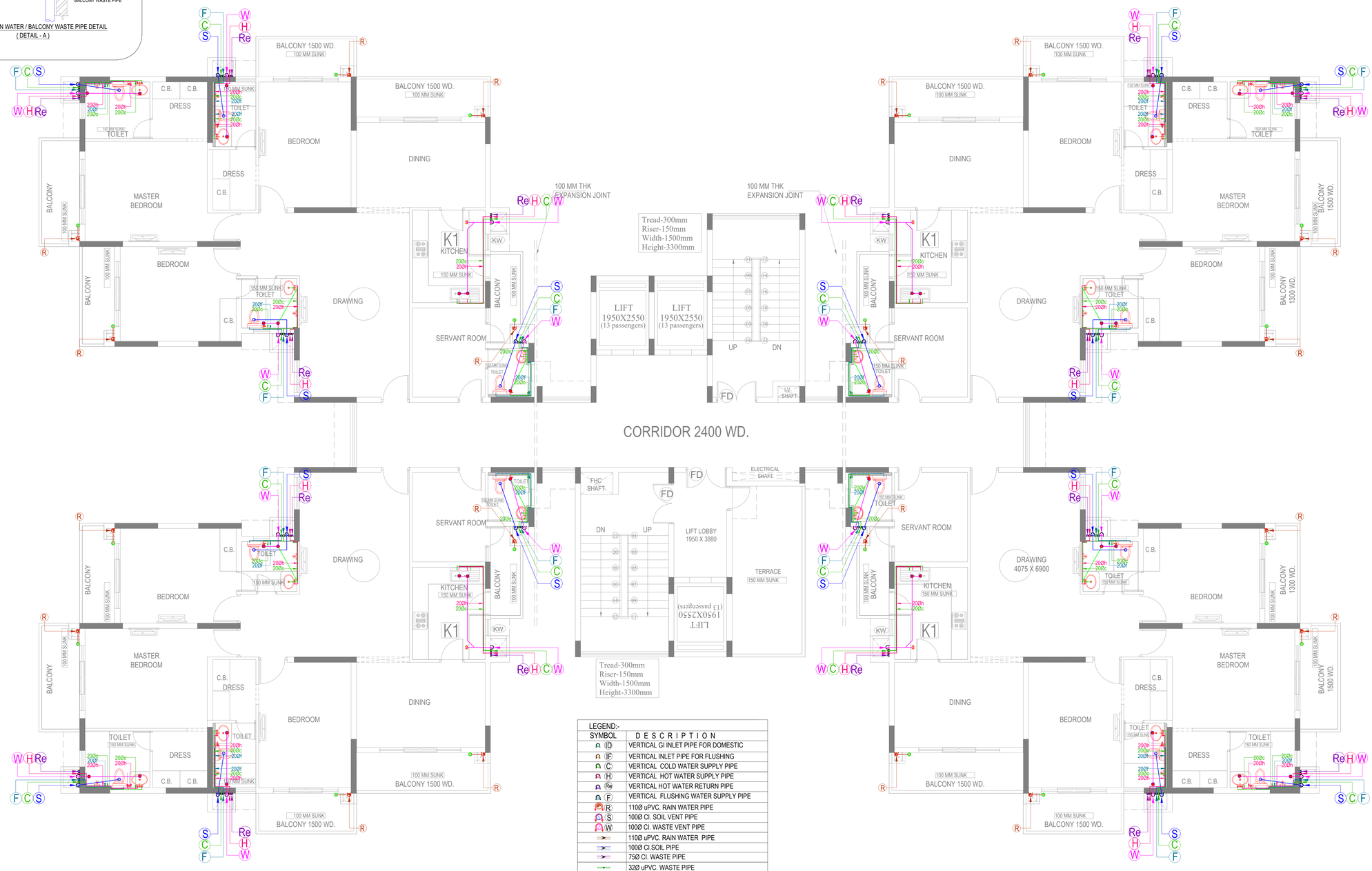
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CHECKED BY		
APPROVED BY		



TYPICAL RAIN WATER / BALCONY WASTE PIPE DETAIL
(DETAIL - A)



LEGEND:-	
SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
F	VERTICAL FLUSHING WATER SUPPLY PIPE
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	CPVC COLD WATER PIPE
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UT	URINAL TRAP
BT	BOTTLE TRAP
	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
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	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

FIRST FLOOR PLAN

TENDER PURPOSE ONLY

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11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of DELHI

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

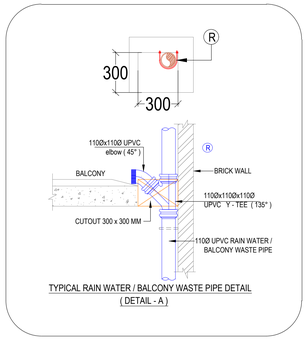
BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
FIRST FLOOR PLUMBING PLAN

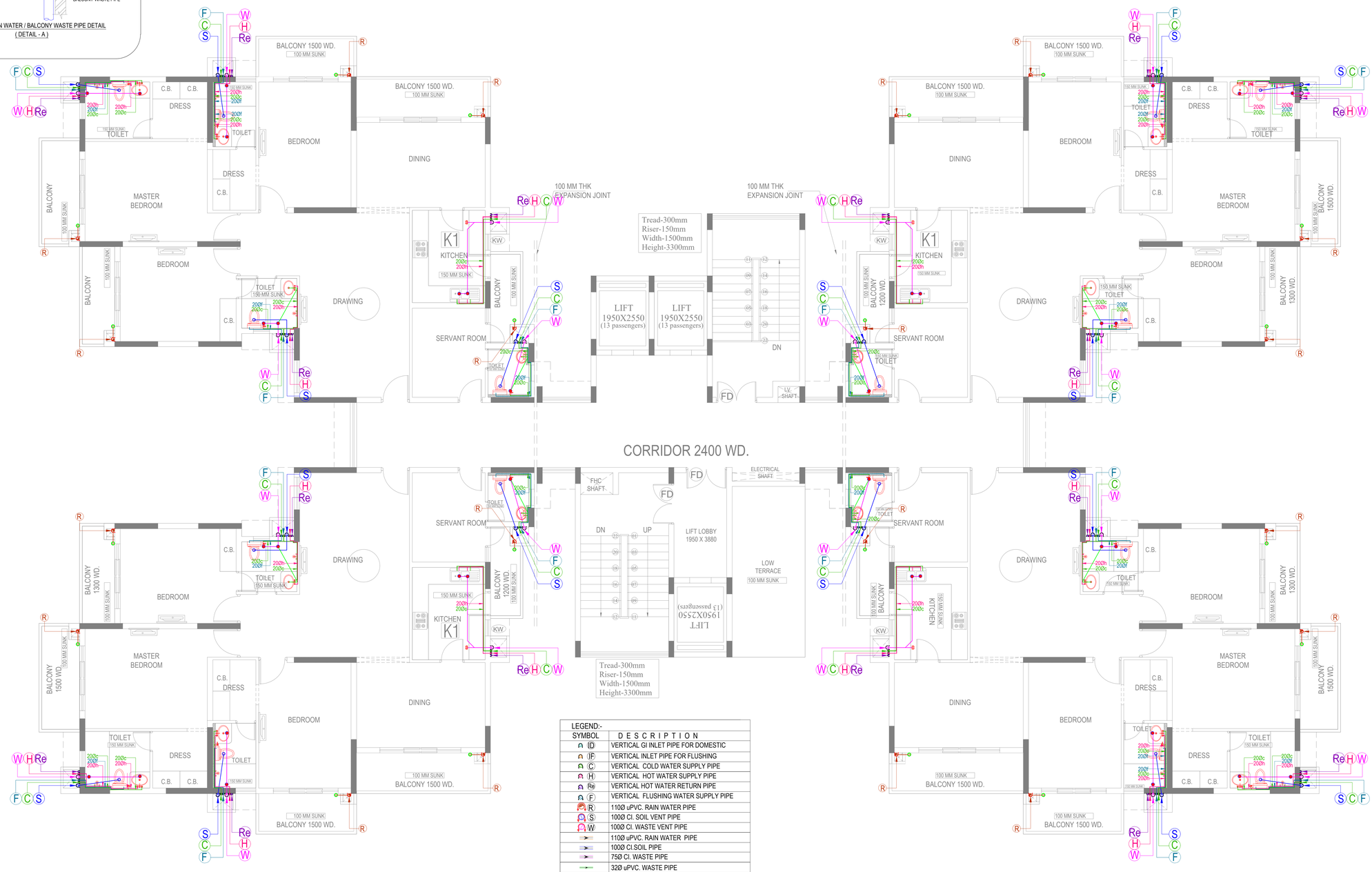
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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APPROVED BY				



TYPICAL RAIN WATER / BALCONY WASTE PIPE DETAIL
(DETAIL - A)



LEGEND:-	
SYMBOL	D E S C R I P T I O N
(D)	VERTICAL GI INLET PIPE FOR DOMESTIC
(IF)	VERTICAL INLET PIPE FOR FLUSHING
(C)	VERTICAL COLD WATER SUPPLY PIPE
(H)	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
(F)	VERTICAL FLUSHING WATER SUPPLY PIPE
R	110Ø uPVC. RAIN WATER PIPE
S	100Ø CI. SOIL VENT PIPE
W	100Ø CI. WASTE VENT PIPE
	110Ø uPVC. RAIN WATER PIPE
	100Ø CI.SOIL PIPE
	75Ø CI. WASTE PIPE
	32Ø uPVC. WASTE PIPE
	CPVC COLD WATER PIPE
	CPVC HOT WATER PIPE
	CPVC HOT WATER RETURN
	CPVC FLUSHING WATER PIPE
FT	FLOOR TRAP
UT	URINAL TRAP
BT	BOTTLE TRAP
	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

TYPICAL FLOOR PLAN
2ND TO 12TH

TENDER PURPOSE ONLY

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R0						

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CIVIL & STRUCTURAL			FPS		
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Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

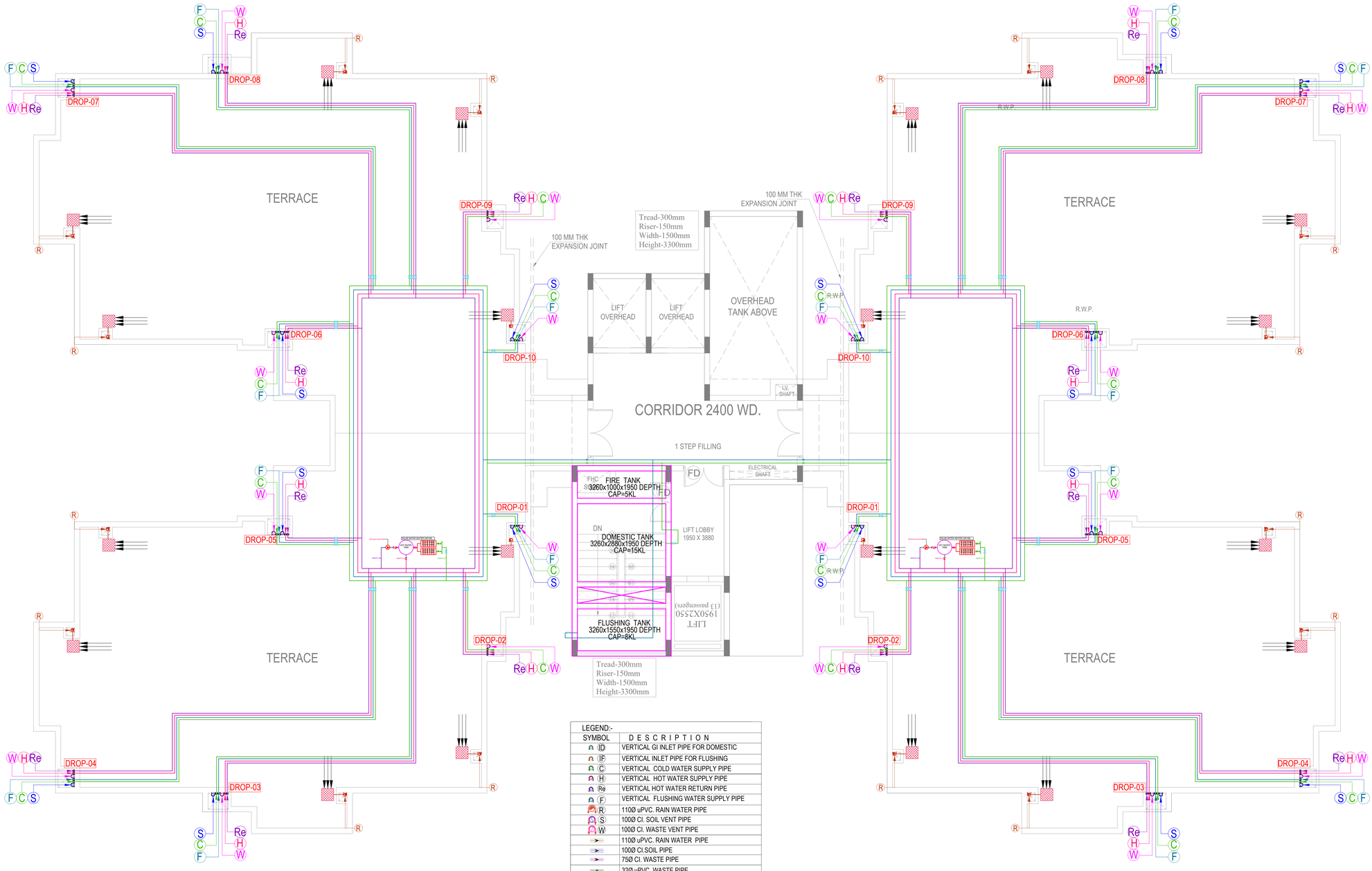
DRAWING TITLE :
TYPICAL FLOOR PLUMBINGPLAN (2ND TO 12TH FLOOR)

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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APPROVED BY		



LEGEND:-

SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
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W	100Ø CI. WASTE VENT PIPE
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	32Ø uPVC. WASTE PIPE
	CPVC COLD WATER PIPE
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UT	URINAL TRAP
BT	BOTTLE TRAP
GT	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

TERRACE FLOOR PLAN

TENDER PURPOSE ONLY

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R0						

REVISIONS

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ARCHITECTURE			HVAC		
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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
TERRACE FLOOR PLUMBING PLAN

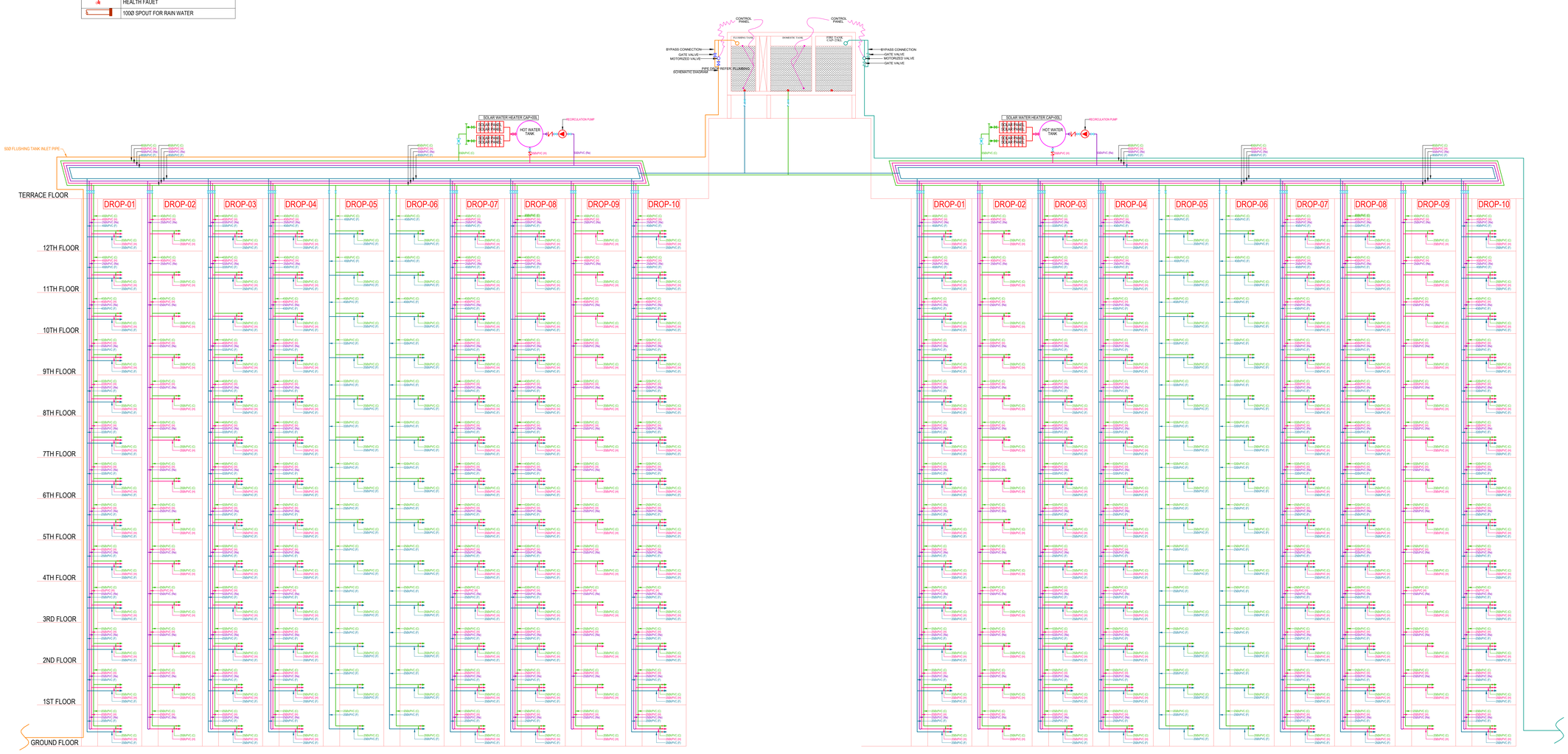
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE: | SHEET SIZE: A1 | DATE: 09-02-26 | REV. NO: R0

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LEGEND:-	
SYMBOL	D E S C R I P T I O N
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(C)	VERTICAL COLD WATER SUPPLY PIPE
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(Re)	VERTICAL HOT WATER RETURN PIPE
(F)	VERTICAL FLUSHING WATER SUPPLY PIPE
(R)	110Ø uPVC. RAIN WATER PIPE
(S)	100Ø CI. SOIL VENT PIPE
(W)	100Ø CI. WASTE VENT PIPE
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	NP2 PIPE FOR SEWERAGE LINE
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	HEALTH FAUET
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ARCHITECTURE			HVAC		
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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
SLD PLUMBING PLAN

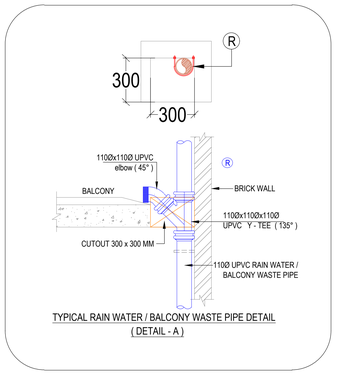
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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TENDER PURPOSE ONLY



TYPICAL RAIN WATER / BALCONY WASTE PIPE DETAIL
(DETAIL - A)

LEGEND:-	
SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
F	VERTICAL FLUSHING WATER SUPPLY PIPE
R	110Ø uPVC. RAIN WATER PIPE
S	100Ø CI. SOIL VENT PIPE
W	100Ø CI. WASTE VENT PIPE
	110Ø uPVC. RAIN WATER PIPE
	100Ø CI.SOIL PIPE
	75Ø CI. WASTE PIPE
	32Ø uPVC. WASTE PIPE
	CPVC COLD WATER PIPE
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	CPVC HOT WATER RETURN
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UT	URINAL TRAP
BT	BOTTLE TRAP
GT	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

EXTERNAL PIPE & MANHOLE

Note :- External manhole to manhole pipe size & manhole invert level , connection level will be provided on external sewerage, & rain water harvesting drawings.
Please refer external drawing for the same



GROUND FLOOR PLAN

TENDER PURPOSE ONLY

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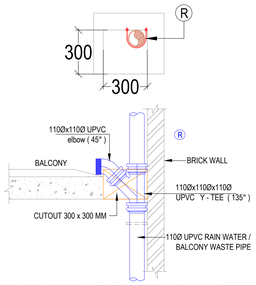
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GROUND FLOOR PLUMBING PLAN

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE: | SHEET SIZE: A1 | DATE: 09-02-26 | REV. NO: R0

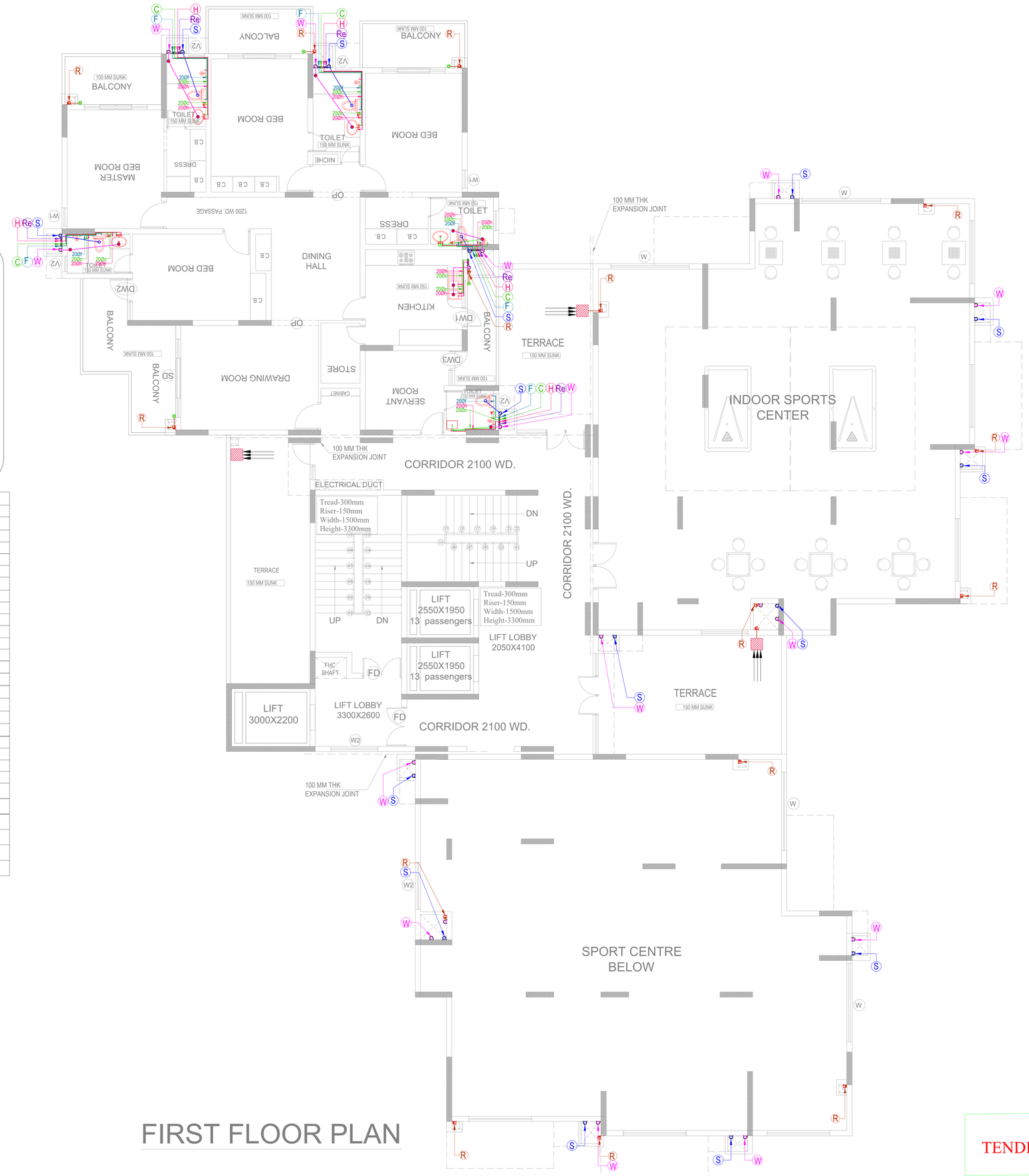
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CHECKED BY		
APPROVED BY		



TYPICAL RAIN WATER / BALCONY WASTE PIPE DETAIL
(DETAIL - A)

LEGEND:-	
SYMBOL	D E S C R I P T I O N
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(F)	VERTICAL INLET PIPE FOR FLUSHING
(C)	VERTICAL COLD WATER SUPPLY PIPE
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Re	VERTICAL HOT WATER RETURN PIPE
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M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER



FIRST FLOOR PLAN

TENDER PURPOSE ONLY

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6.DRAWING NOT TO BE SCALED, WRITTEN DIMENSIONS TO BE FOLLOWED.
7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
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11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

PROJECT MANAGEMENT CONSULTANT

WAPCOS

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architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

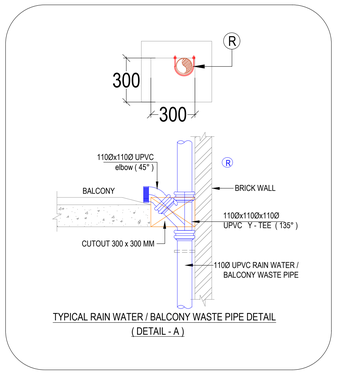
DRAWING TITLE :
FIRST FLOOR PLUMBING PLAN

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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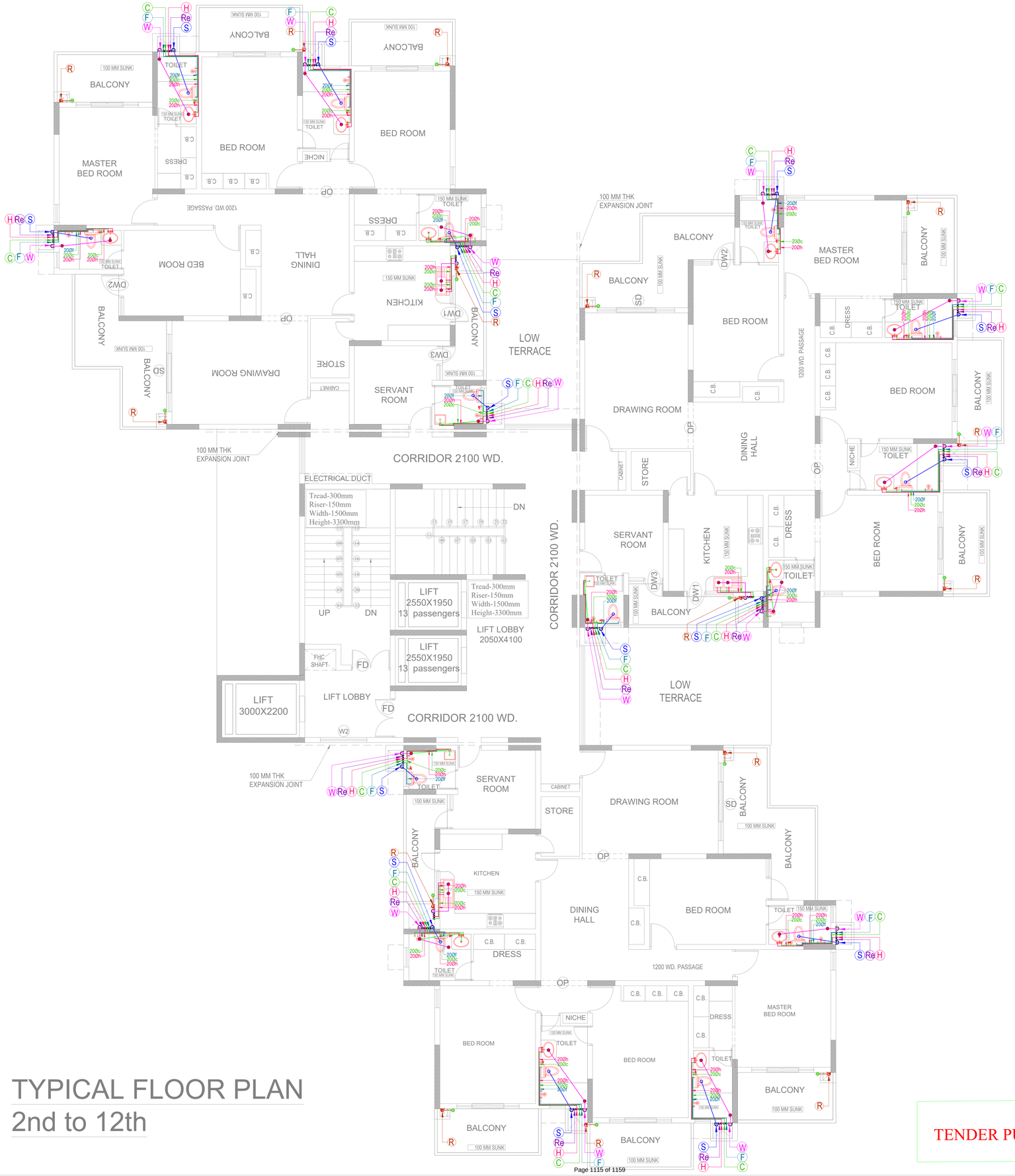
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DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



TYPICAL RAIN WATER / BALCONY WASTE PIPE DETAIL
(DETAIL - A)

LEGEND:-

SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
F	VERTICAL FLUSHING WATER SUPPLY PIPE
R	110Ø uPVC. RAIN WATER PIPE
S	100Ø CI. SOIL VENT PIPE
W	100Ø CI. WASTE VENT PIPE
	110Ø uPVC. RAIN WATER PIPE
	100Ø CI.SOIL PIPE
	75Ø CI. WASTE PIPE
	32Ø uPVC. WASTE PIPE
	CPVC COLD WATER PIPE
	CPVC HOT WATER PIPE
	CPVC HOT WATER RETURN
	CPVC FLUSHING WATER PIPE
FT	FLOOR TRAP
UT	URINAL TRAP
BT	BOTTLE TRAP
GT	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER



TYPICAL FLOOR PLAN
2nd to 12th

TENDER PURPOSE ONLY

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CIVIL & STRUCTURAL			FPS		
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ELV SYSTEM			PHE		

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Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

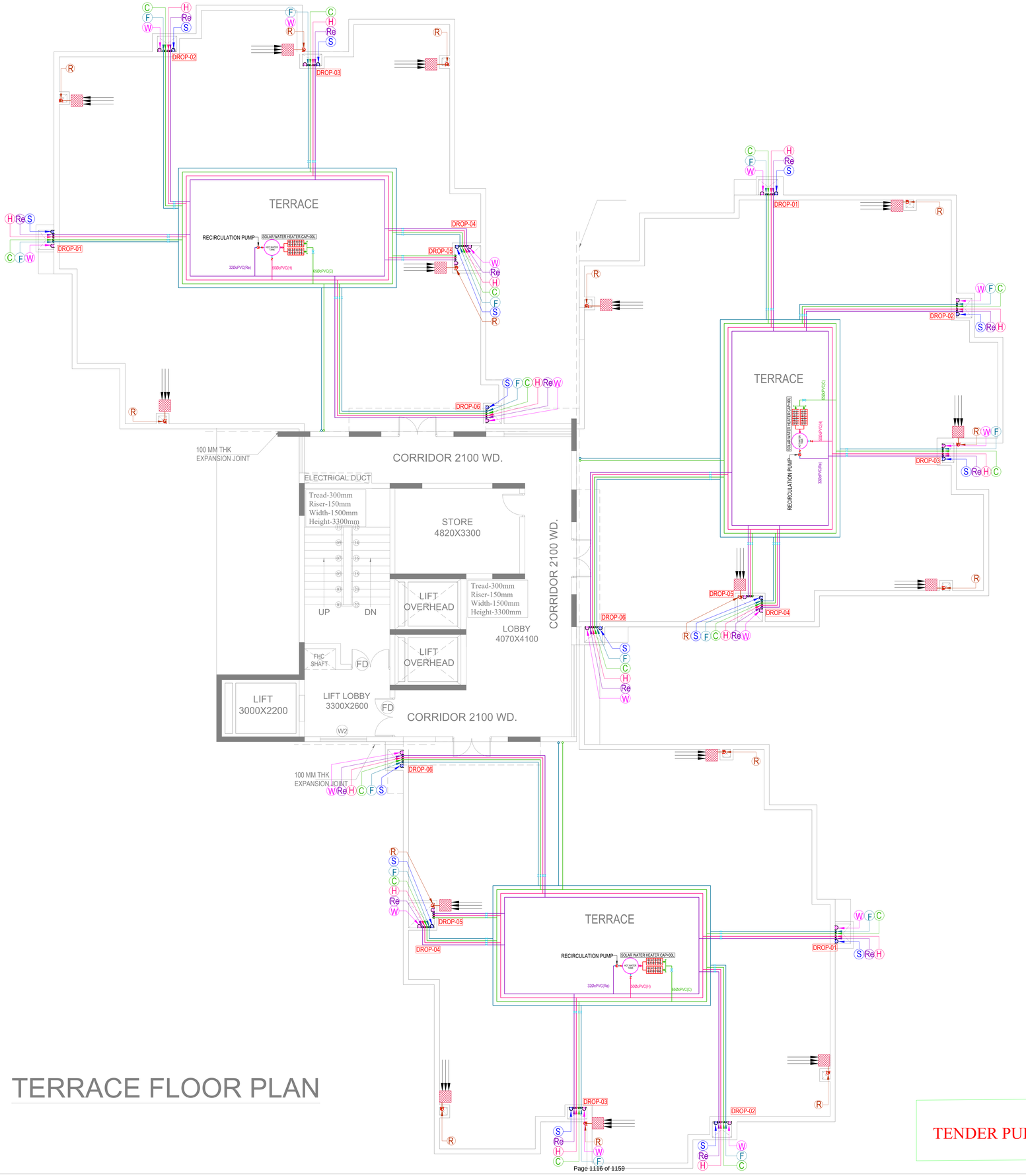
DRAWING TITLE :
TYPICAL FLOOR PLUMBING PLAN (2ND TO 12TH FLOOR)

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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CHECKED BY		
APPROVED BY		



TERRACE FLOOR PLAN

LEGEND:-

SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
Re	VERTICAL HOT WATER RETURN PIPE
F	VERTICAL FLUSHING WATER SUPPLY PIPE
R	110Ø uPVC. RAIN WATER PIPE
S	100Ø CI. SOIL VENT PIPE
W	100Ø CI. WASTE VENT PIPE
	110Ø uPVC. RAIN WATER PIPE
	100Ø CI.SOIL PIPE
	75Ø CI. WASTE PIPE
	32Ø uPVC. WASTE PIPE
	CPVC COLD WATER PIPE
	CPVC HOT WATER PIPE
	CPVC HOT WATER RETURN
	CPVC FLUSHING WATER PIPE
FT	FLOOR TRAP
UT	URINAL TRAP
BT	BOTTLE TRAP
GT	300X300 GULLY TRAP
	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

TENDER PURPOSE ONLY

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REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

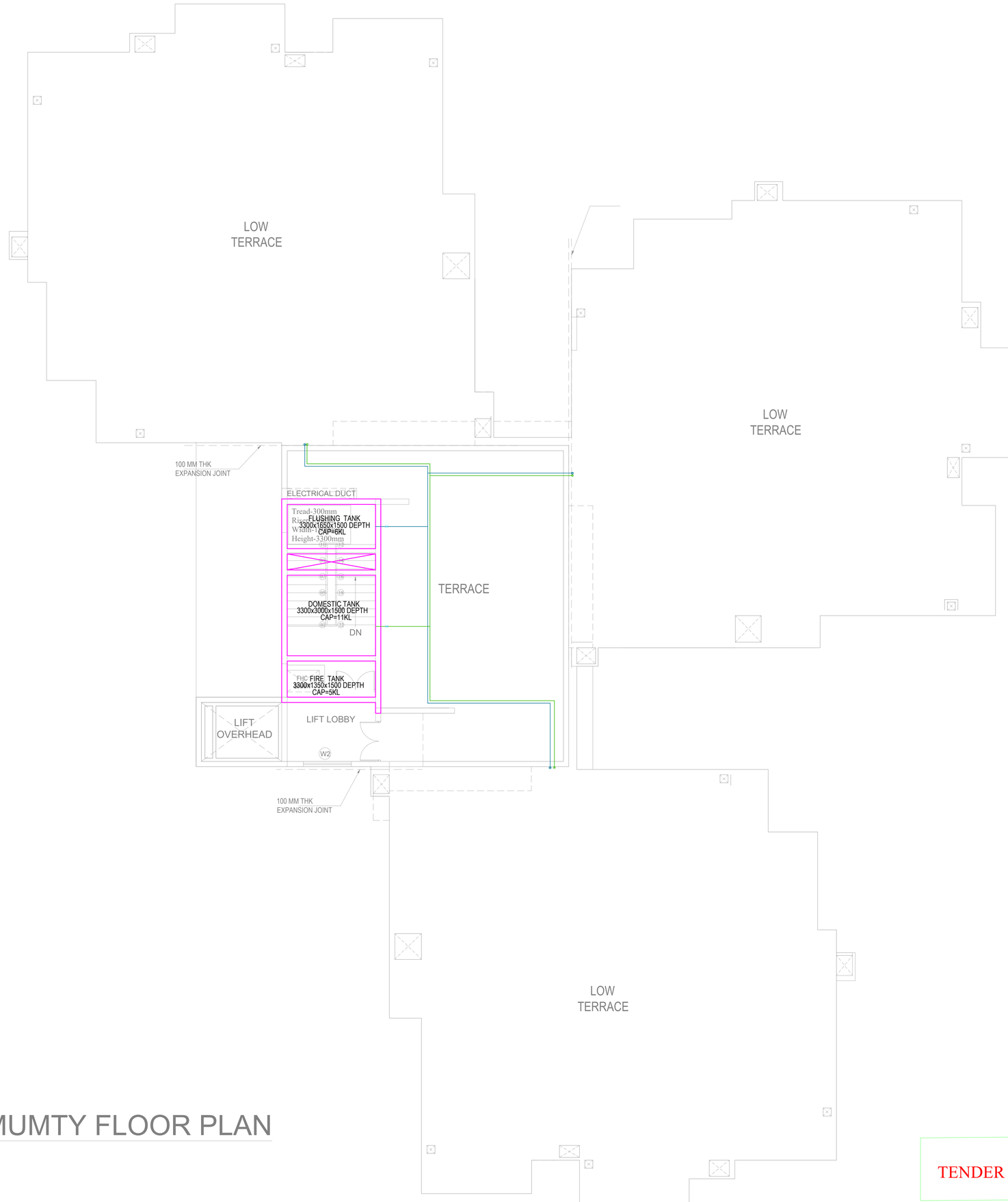
DRAWING TITLE :
TERRACE FLOOR PLUMBING PLAN

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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LEGEND:-	
SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
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R	110Ø uPVC. RAIN WATER PIPE
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	450X450 KHURRA
M.H.	900X800 RAIN WATER MAN HOLE
M.H.	900X800 SEWERAGE MAN HOLE
	NP2 PIPE FOR SEWERAGE LINE
	NP2 PIPE FOR RAIN WATER LINE
	HEALTH FAUET
	100Ø SPOUT FOR RAIN WATER

MUMTY FLOOR PLAN

TENDER PURPOSE ONLY

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R0						

REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
MUMTY LEVEL FLOOR PLUMBING PLAN

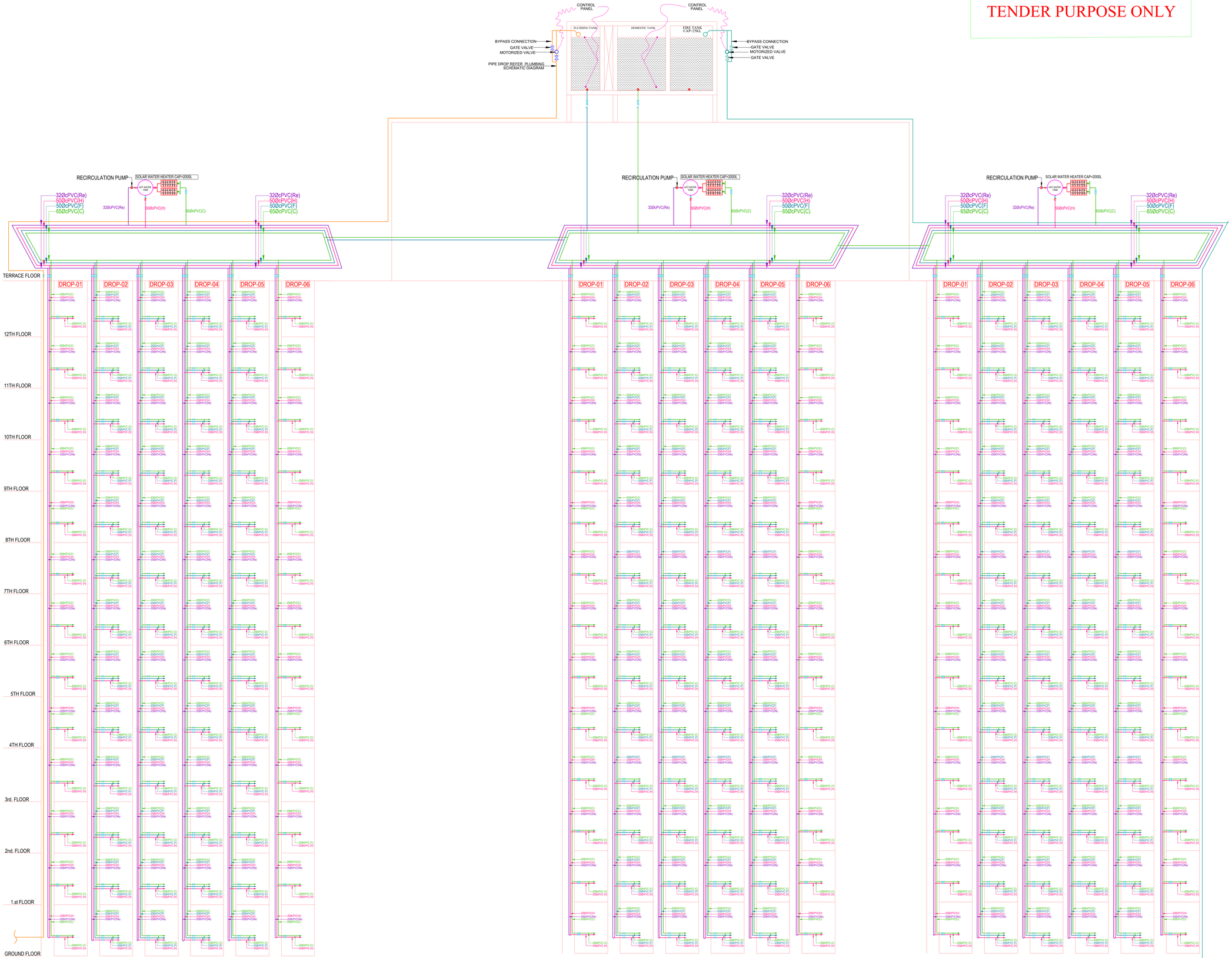
DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

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TENDER PURPOSE ONLY



LEGEND:-	
SYMBOL	D E S C R I P T I O N
ID	VERTICAL GI INLET PIPE FOR DOMESTIC
IF	VERTICAL INLET PIPE FOR FLUSHING
C	VERTICAL COLD WATER SUPPLY PIPE
H	VERTICAL HOT WATER SUPPLY PIPE
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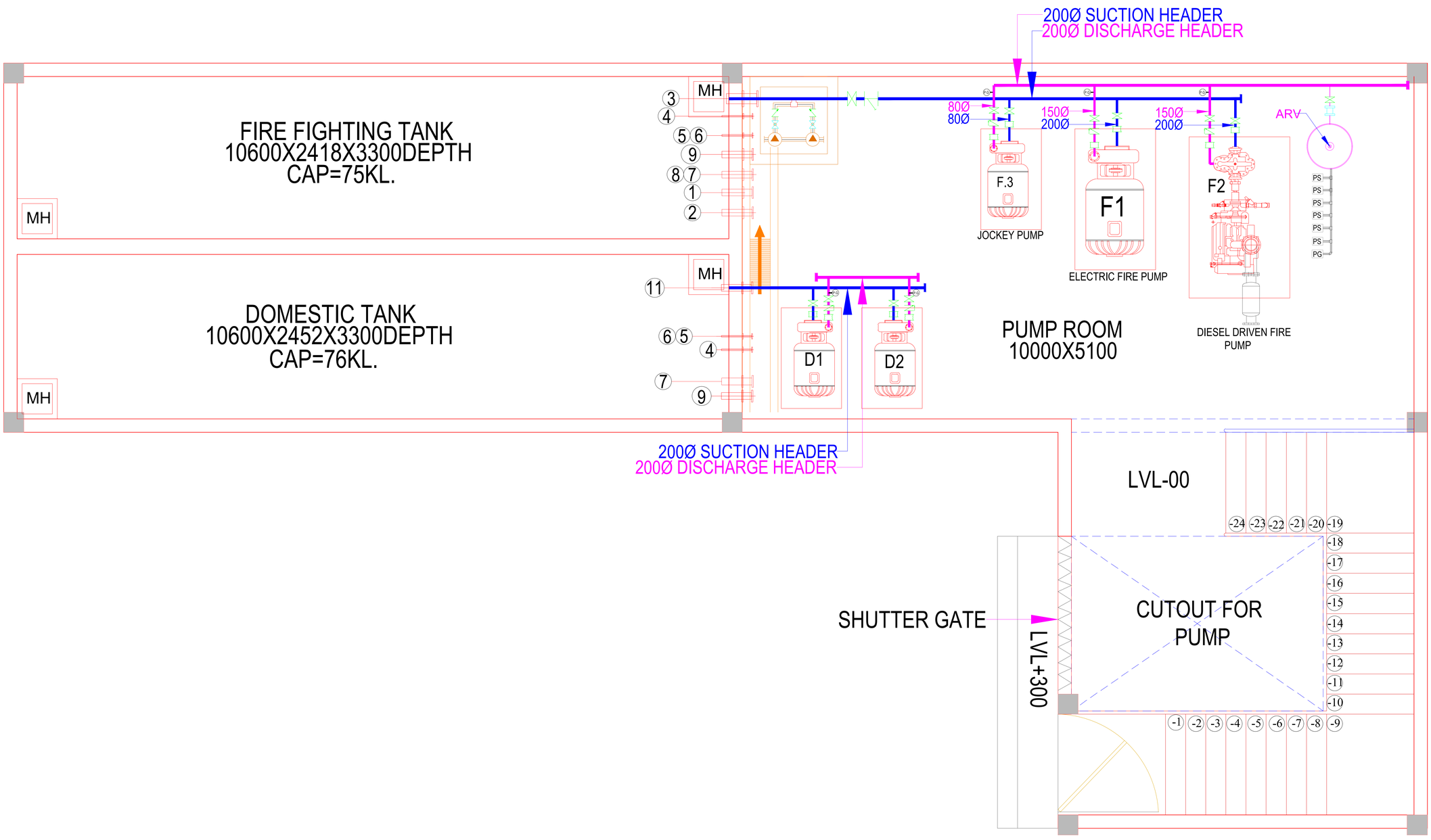
DRAWING TITLE :
SLD PLUMBING PLAN

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

SCALE: | SHEET SIZE: A1 | DATE: 09-02-26 | REV. NO: R0

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PUMP ROOM U.G.T.TANK

DRAWING TITLE :
PUMP ROOM U.G.T.TANK

DRAWING TYPE :
TENDER DRAWINGS - PLUMBING

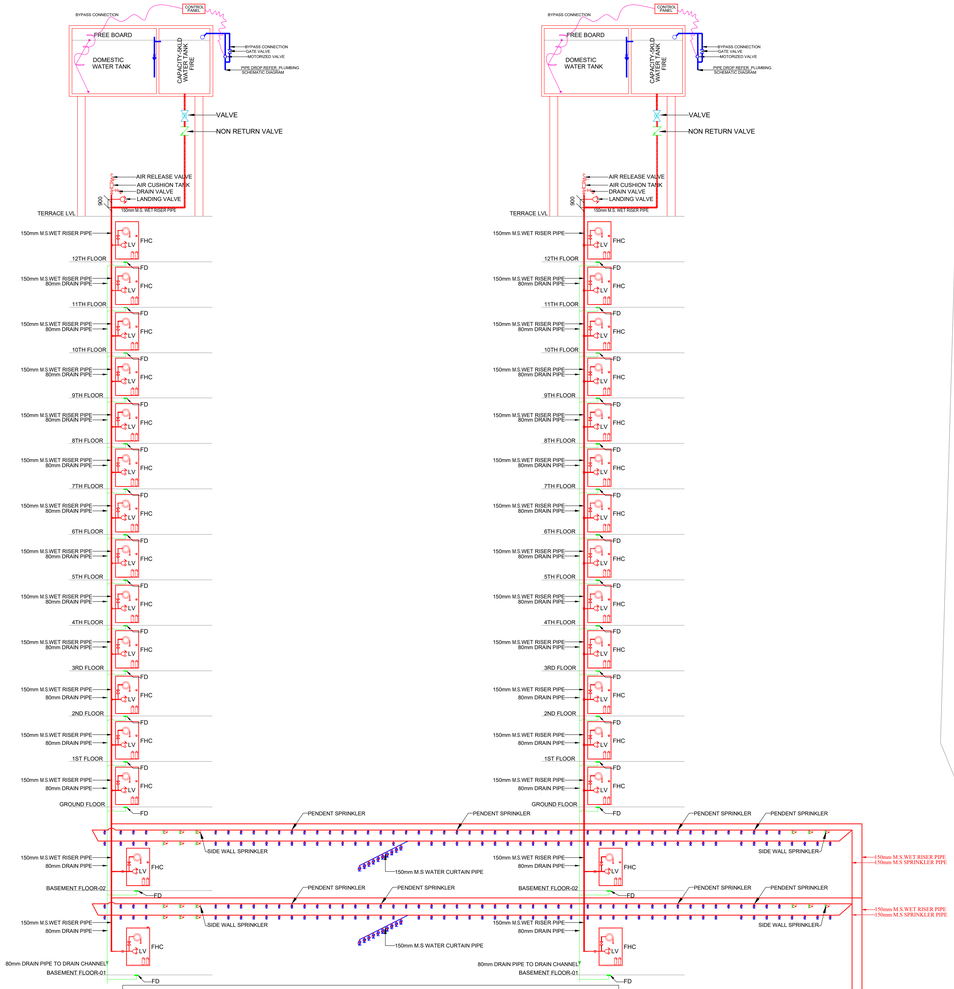
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RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

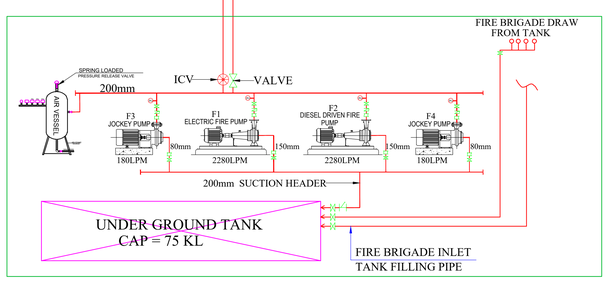
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DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		

LEGEND:- FIRE FIGHTING

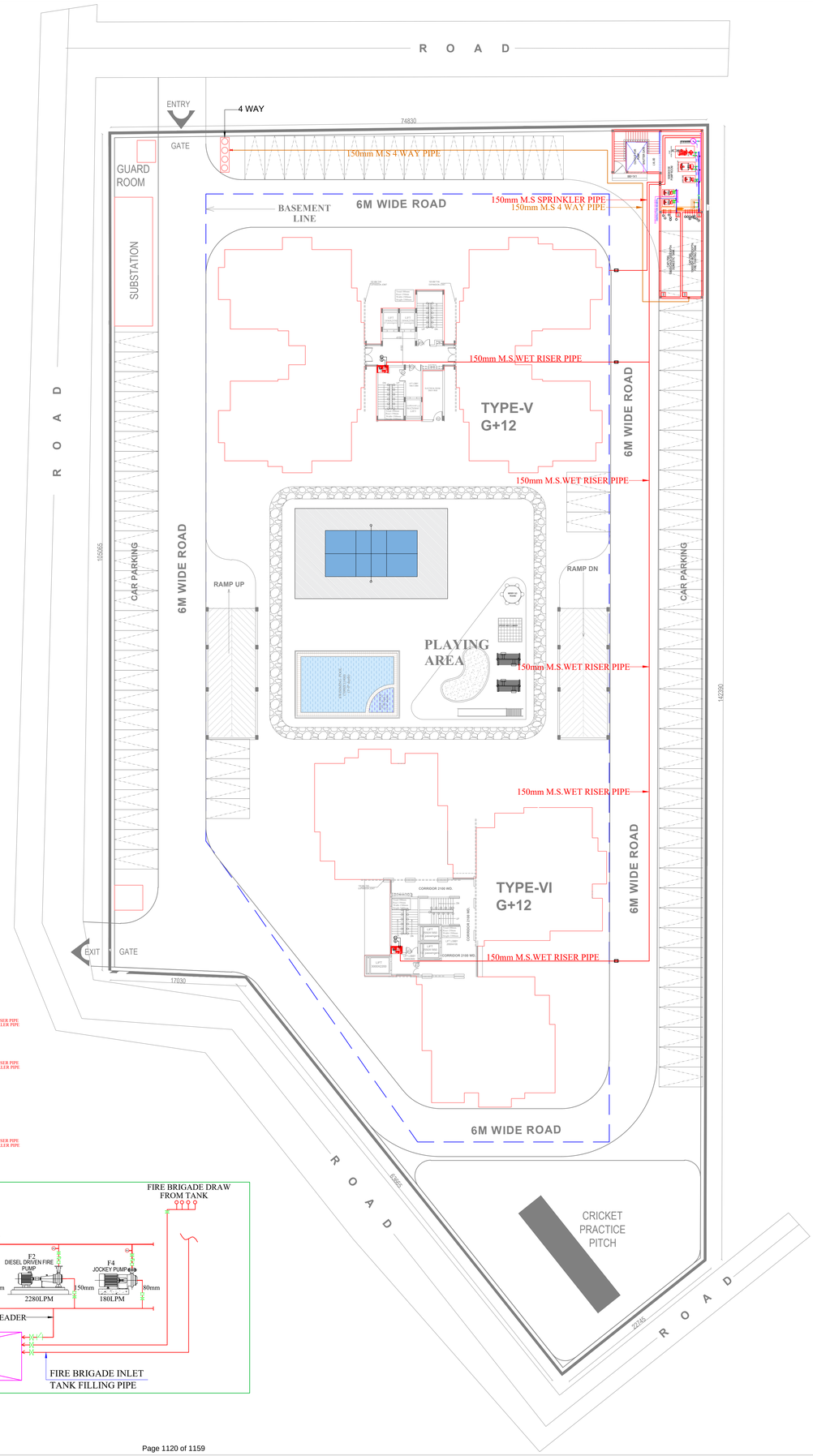
SYMBOL	DESCRIPTION
	150Ø SPRINKLER RISER PIPE
	150Ø WET RISER PIPE
	150Ø WATER CURTAIN PIPE
	150mm M.S 4 WAY PIPE
	4 WAY
	SLUICE VALVES
	VALVE CHAMBER (SIZE OF CHAMBER WILL BE AS PER SITE)



Fire Schematic Drawing



TENDER PURPOSE ONLY



LEGEND

SL. NO.	DESCRIPTION	SYMBOL
1.	ROAD	
2.	NORTH DIRECTION	
3.	BOUNDARY	
4.	TREE	
5.	PLAIN AREA	
6.	DIGGING AREA	
7.	GRID	

DWARKA SECTOR-19,DELHI
DWG AREA=0.9680 Hact.=2.3920 Acr

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12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
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CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
SITE PLAN

DRAWING TITLE :
SITE PLAN
EXTERNAL FIRE FIGHTING PLAN

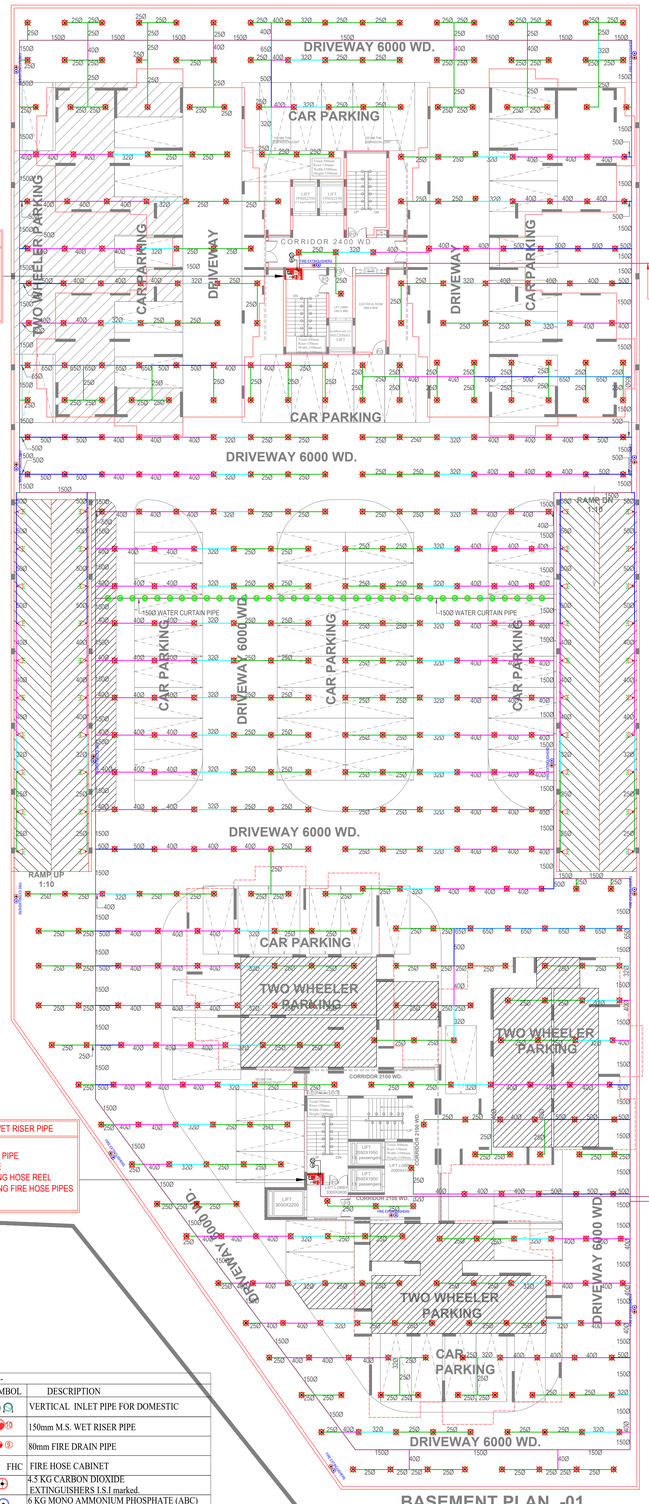
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TENDER DRAWINGS - FIRE FIGHTING

SCALE:	SHEET SIZE: A1	DATE: 09-02-26	REV. NO: R0

RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
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APPROVED BY		

NOTE- (1) -ELECTRICAL AND MACHINE ROOM 4.5 kg Co2
TYPE FIRE EXTINGUISHERS PROVIDED

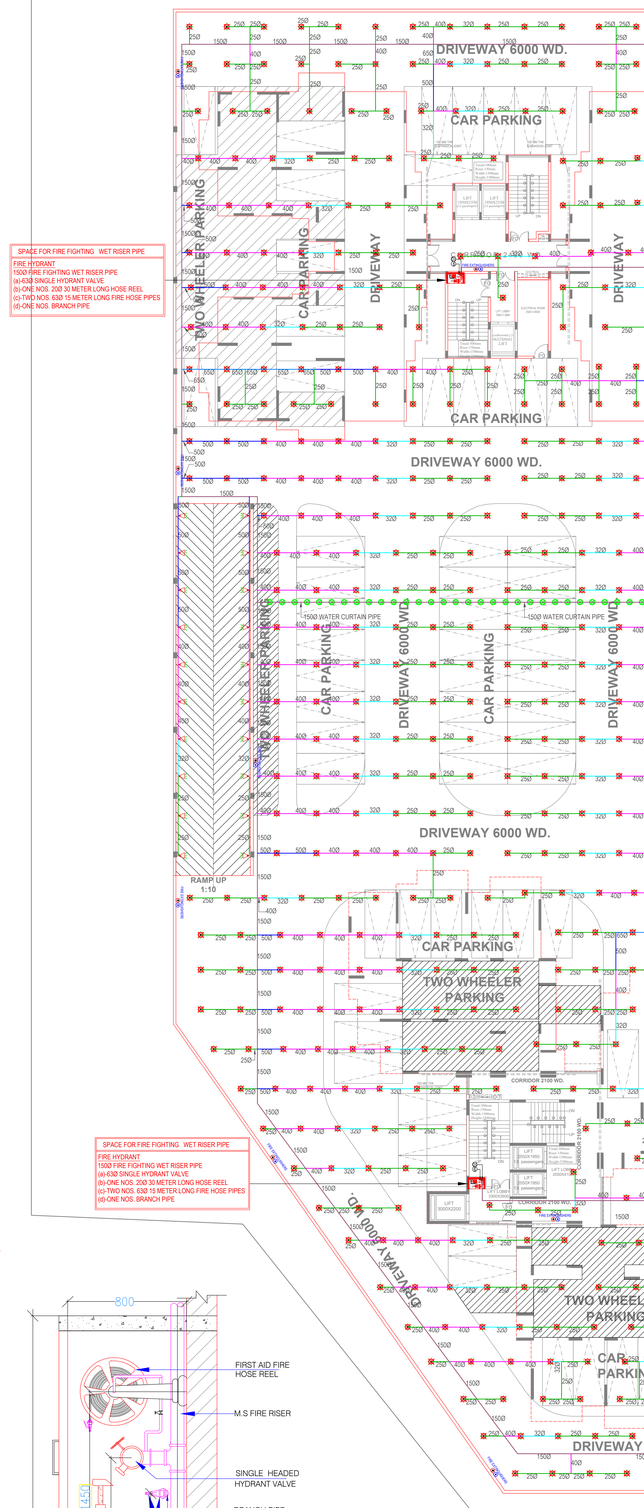


SPACE FOR FIRE FIGHTING WET RISER PIPE

FIRE HYDRANT
150Ø FIRE FIGHTING WET RISER PIPE
(a)-63Ø SINGLE HYDRANT VALVE
(b)-ONE NOS. 20Ø 30 METER LONG HOSE REEL
(c)-TWO NOS. 63Ø 15 METER LONG FIRE HOSE PIPES
(d)-ONE NOS. BRANCH PIPE

150mm M.S.WET RISER PIPE
150mm M.S SPRINKLER PIPE

BASEMENT PLAN -01

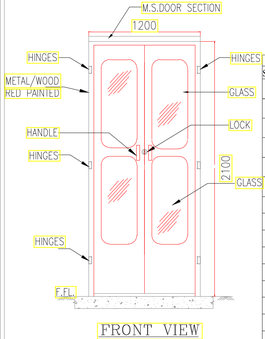


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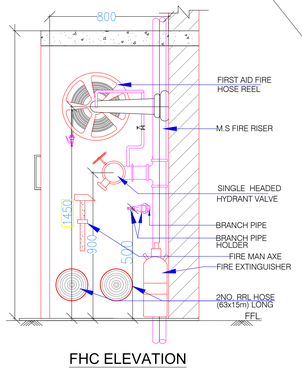
150mm M.S.WET RISER PIPE
150mm M.S SPRINKLER PIPE

BASEMENT PLAN -02

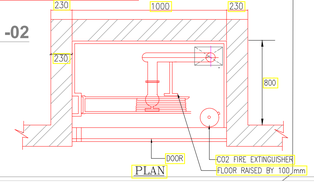


LEGEND:-

S.NO.	SYMBOL	DESCRIPTION
1		VERTICAL INLET PIPE FOR DOMESTIC
2		150mm M.S. WET RISER PIPE
3		80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS
7		WATER CURTAIN PIPE
8		PENDENT SPRINKLER (68 DEGREE)
9		SIDE WALL SPRINKLER
10		25Ø FIRE PIPE MS ('C' CLASS)
11		32Ø FIRE PIPE MS ('C' CLASS)
12		40Ø FIRE PIPE MS ('C' CLASS)
13		50Ø FIRE PIPE MS ('C' CLASS)
14		65Ø FIRE PIPE MS ('C' CLASS)
15		150Ø FIRE PIPE MS ('C' CLASS)



FHC ELEVATION



PLAN

TENDER PURPOSE ONLY

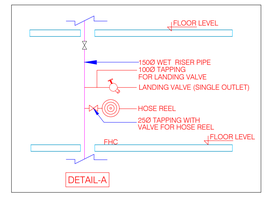


TABLE OF SPRINKLER PIPE DIA SIZING

NO. OF SPRINKLER	PIPE DIA IN MM
1 - 2	25 DIA
3	32 DIA
4 - 6	40 DIA
7 - 10	50 DIA
11 - 28	65 DIA
29 - 45	80 DIA
46 - 75	100 DIA
75 TO ABOVE	150 DIA

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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muralage
architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
BASEMENT

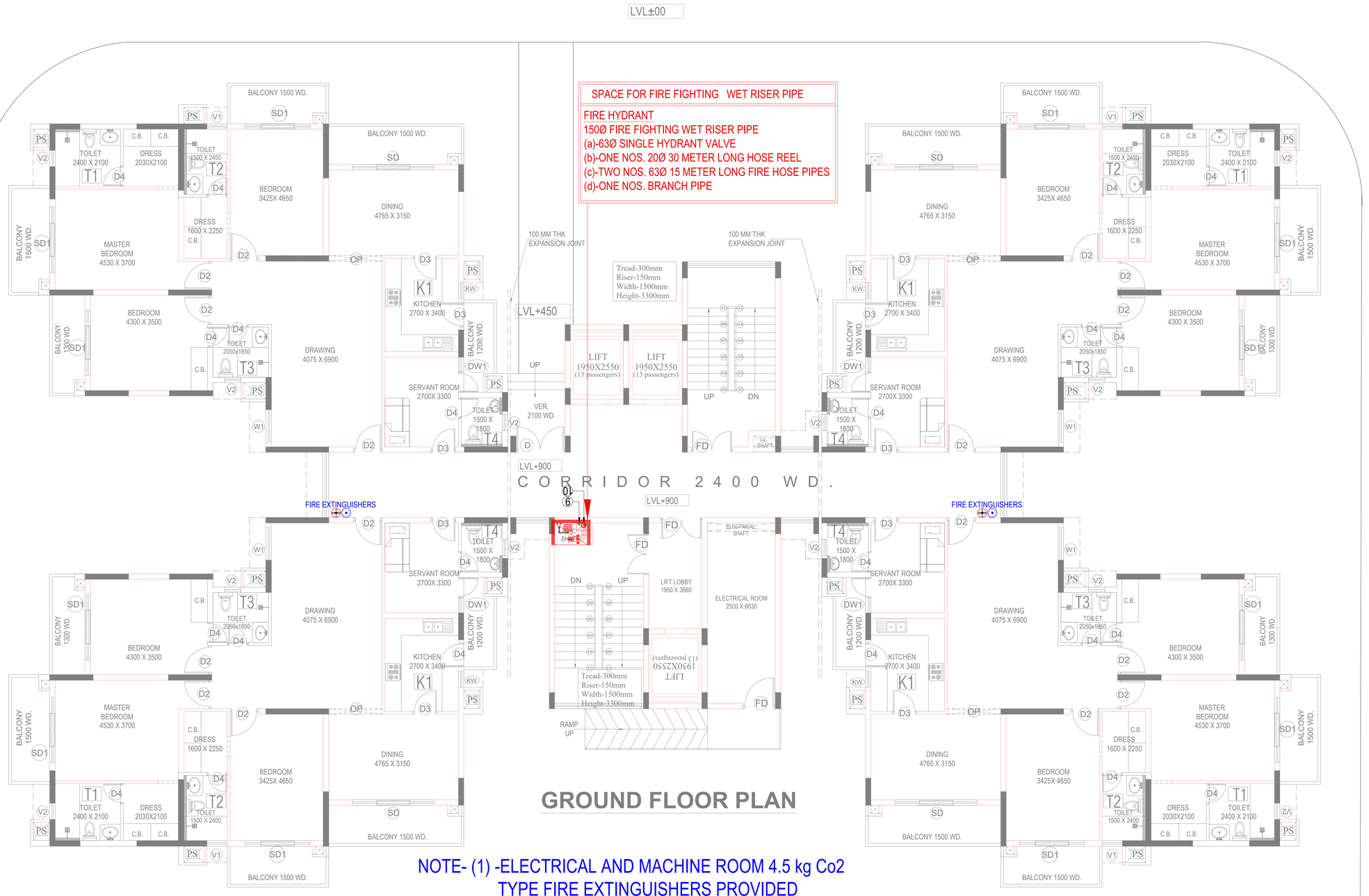
DRAWING TITLE :
BASEMENT FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

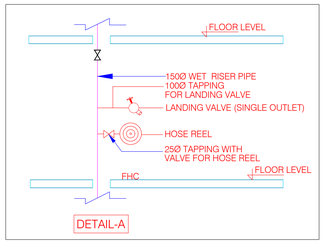
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RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

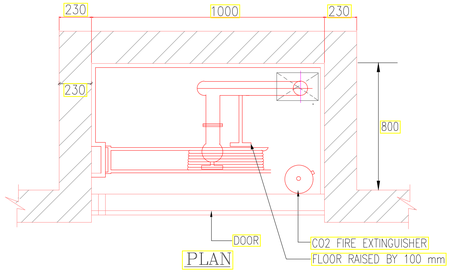
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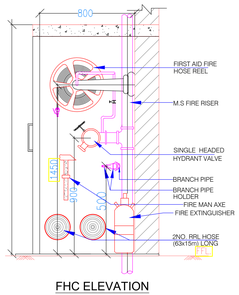


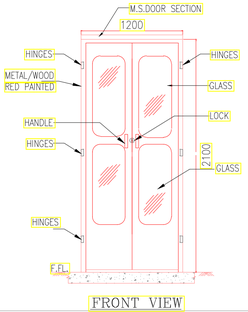
NOTE- (1) -ELECTRICAL AND MACHINE ROOM 4.5 kg Co2 TYPE FIRE EXTINGUISHERS PROVIDED



LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
1		VERTICAL INLET PIPE FOR FIRE FIGHTING
2		150mm M.S. WET RISER PIPE
3		80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS







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CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

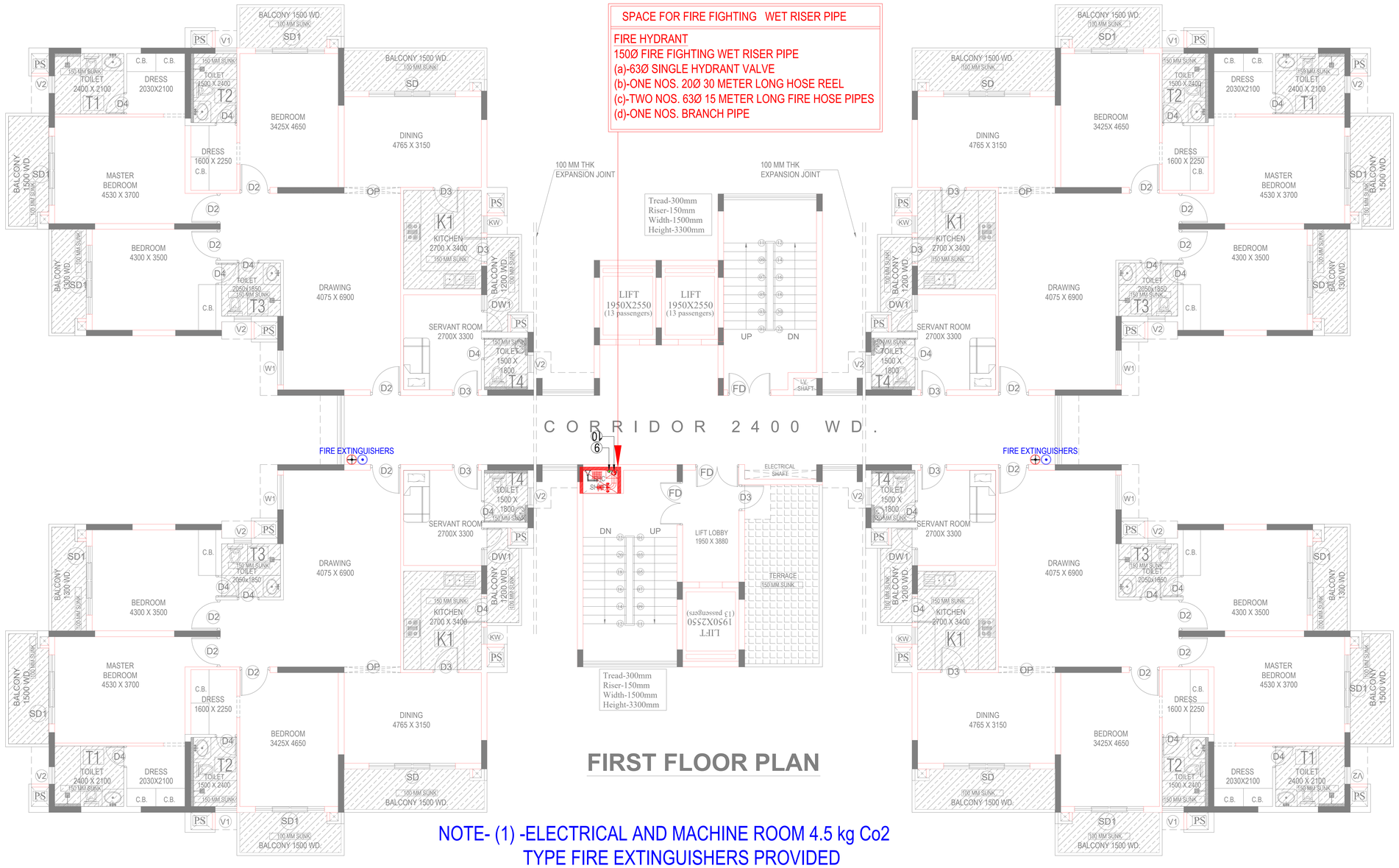
DRAWING TITLE :
GROUND FLOOR PLAN
FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

SCALE: SHEET SIZE: A1 DATE: 05-03-26 REV. NO: R0

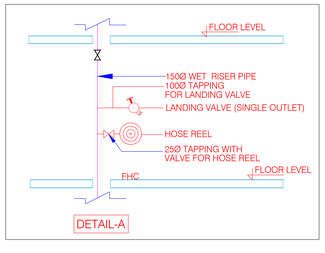
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DESIGNED / DRAWN BY		
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APPROVED BY		

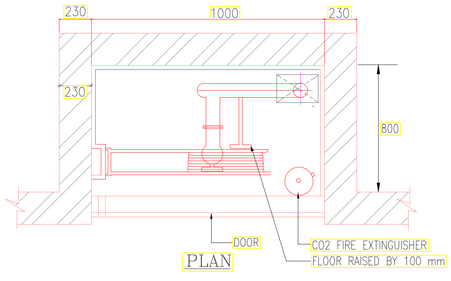


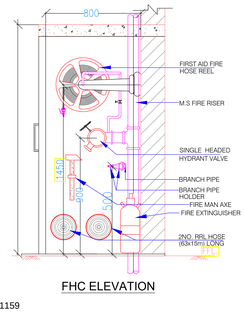
FIRST FLOOR PLAN

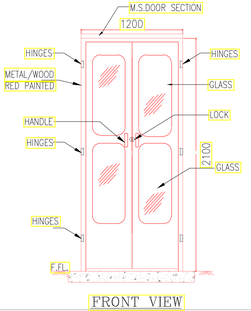
NOTE- (1) -ELECTRICAL AND MACHINE ROOM 4.5 kg Co2 TYPE FIRE EXTINGUISHERS PROVIDED



LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
1		VERTICAL INLET PIPE FOR FIRE FIGHTING
2	10	150mm M.S. WET RISER PIPE
3	9	80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
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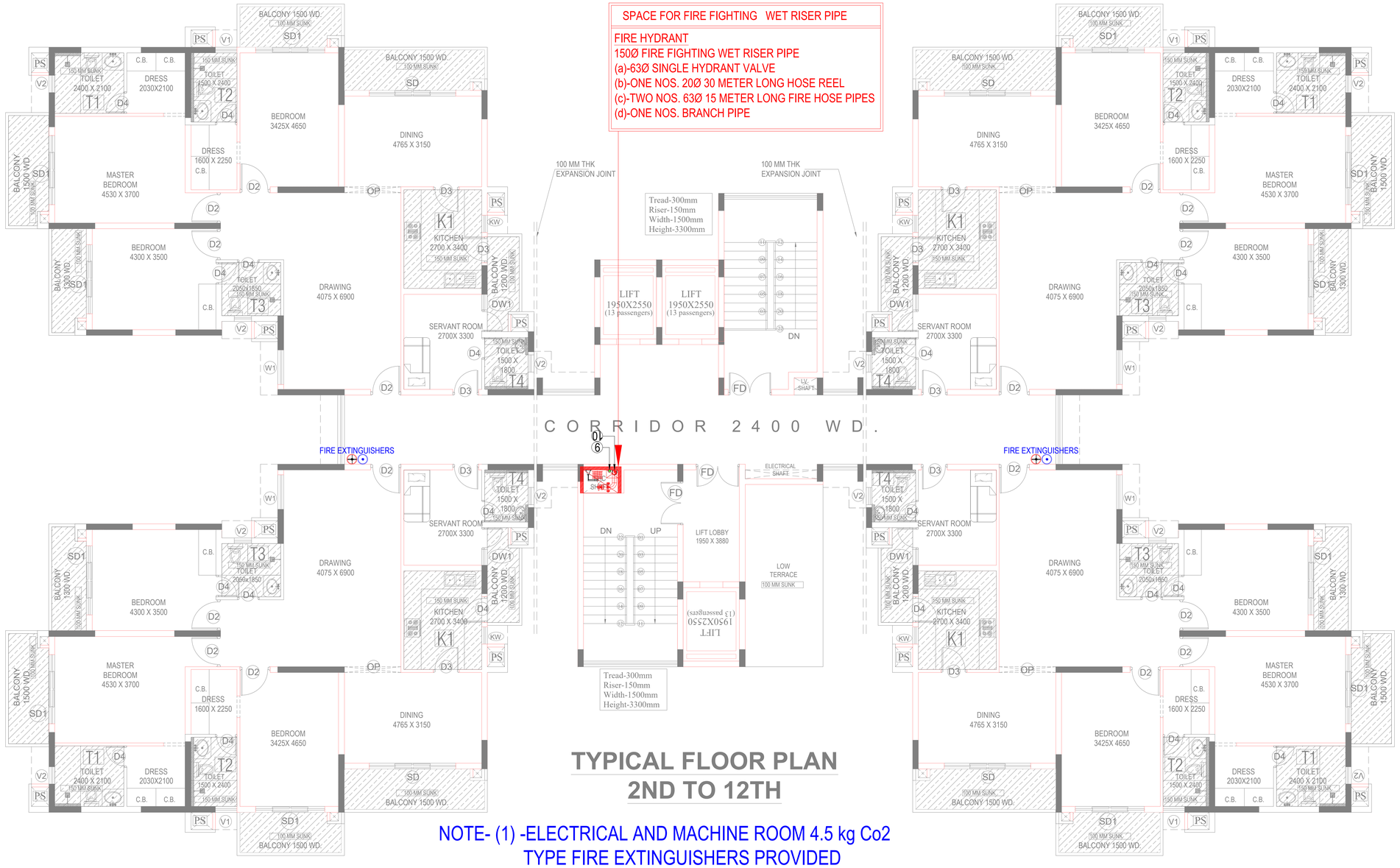
DRAWING TITLE :
FIRST FLOOR PLAN
FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

SCALE: | SHEET SIZE: A1 | DATE: 05-03-26 | REV. NO: R0

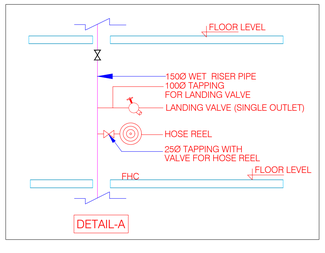
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DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		

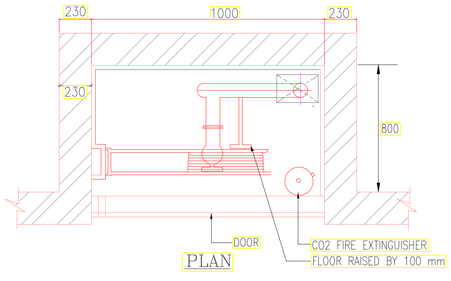


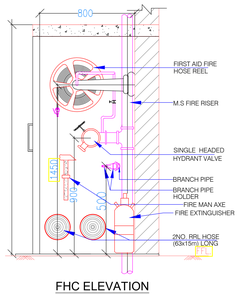
TYPICAL FLOOR PLAN 2ND TO 12TH

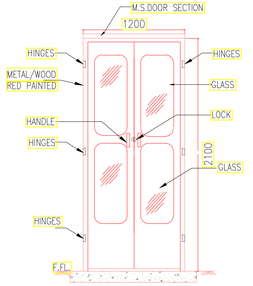
NOTE- (1) -ELECTRICAL AND MACHINE ROOM 4.5 kg Co2 TYPE FIRE EXTINGUISHERS PROVIDED



LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
1		VERTICAL INLET PIPE FOR FIRE FIGHTING
2	10	150mm M.S. WET RISER PIPE
3	9	80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS







TENDER PURPOSE ONLY

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12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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architecture , master planning , interior design conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

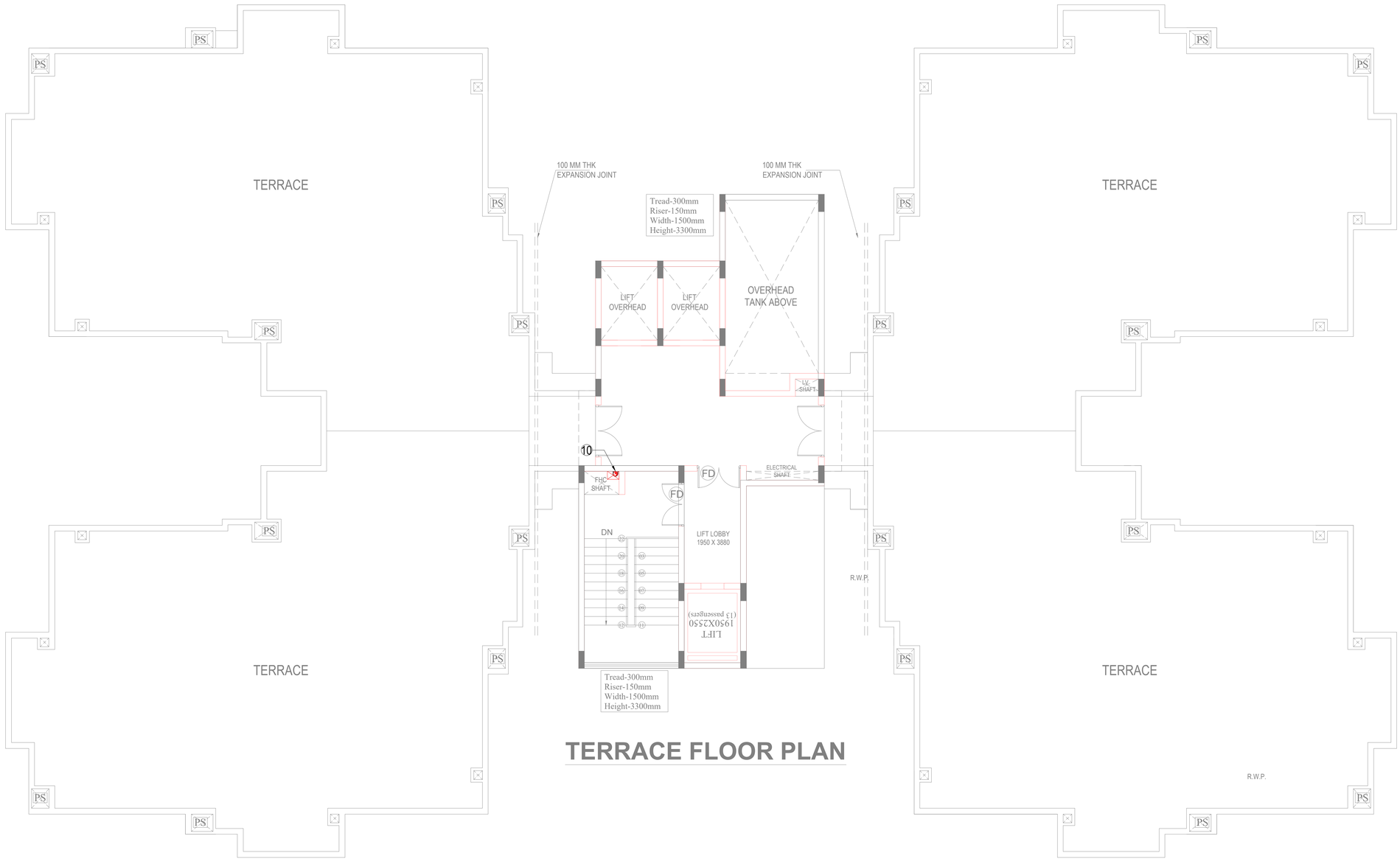
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TYPICAL FLOOR PLAN (2ND TO 12TH FLOOR) FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

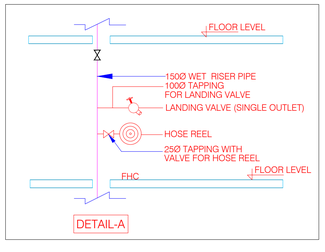
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RELEASED FOR ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

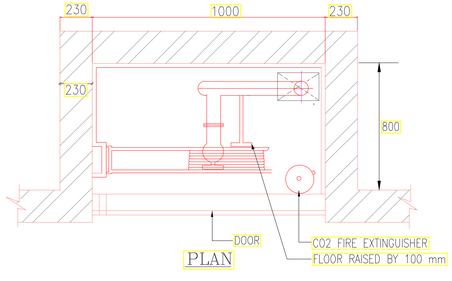
	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
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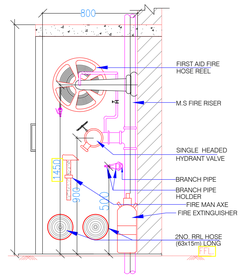
TERRACE FLOOR PLAN



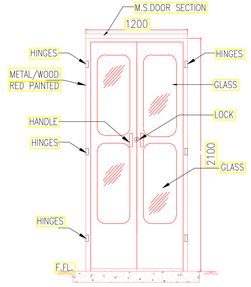
LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
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3	80	80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS



PLAN



FHC ELEVATION



FRONT VIEW

TENDER PURPOSE ONLY

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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
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CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

DRAWING TITLE :
TERRACE FLOOR PLAN
FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

SCALE:	SHEET SIZE: A1	DATE: 05-03-26	REV. NO: R0

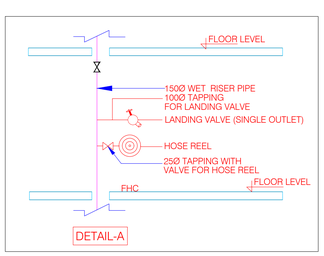
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	SIGN	DATE
DESIGNED / DRAWN BY		
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APPROVED BY		

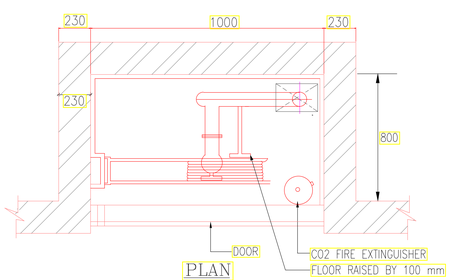


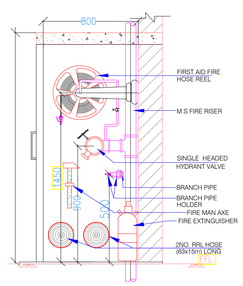
MUMTY TERRACE FLOOR PLAN

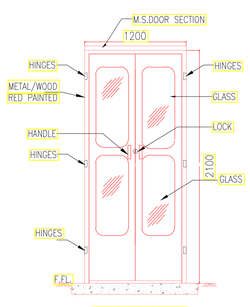
MUMTY FLOOR PLAN



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R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
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ELV SYSTEM			PHE		

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PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

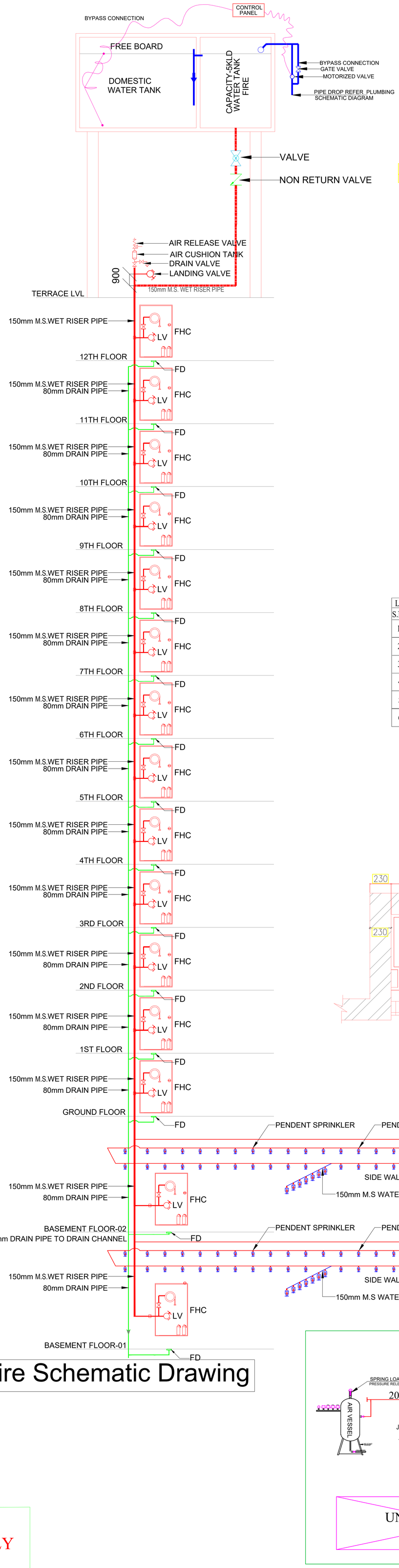
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MUMTY FLOOR PLAN
FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

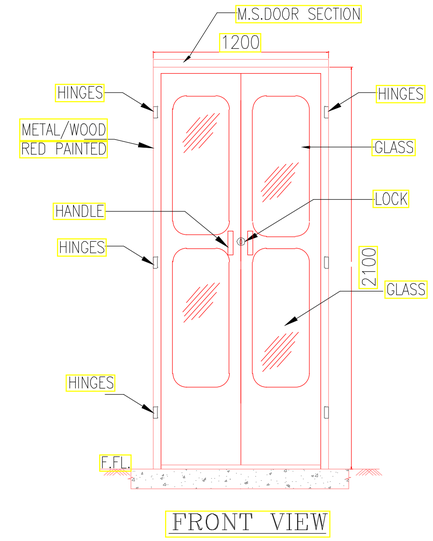
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RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

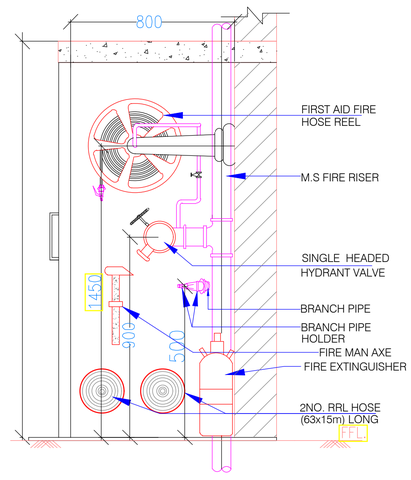
	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



Fire Schematic Drawing

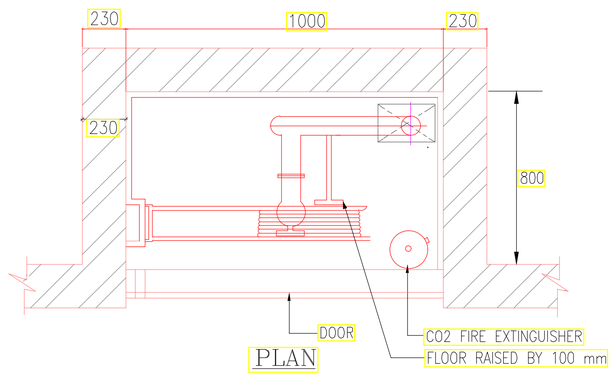


FRONT VIEW

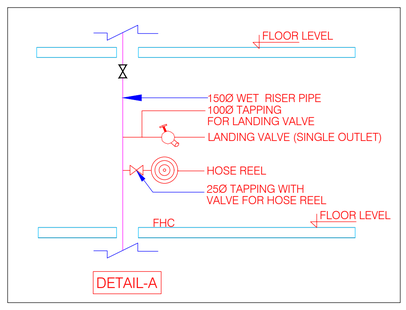


FHC ELEVATION

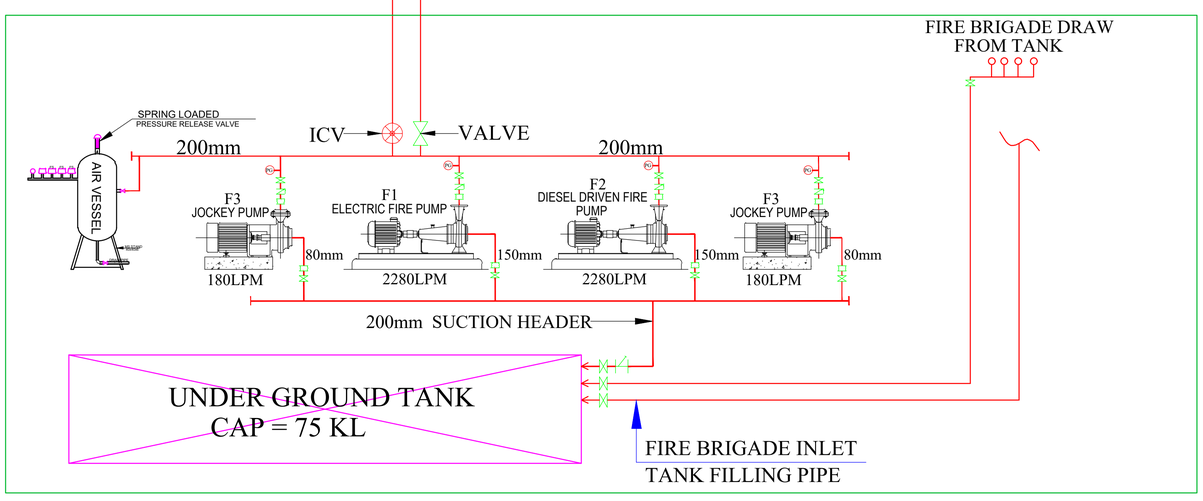
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PLAN



DETAIL-A



TENDER PURPOSE ONLY

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CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
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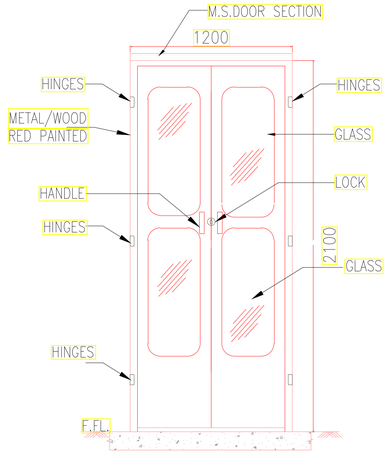
Job No:

BUILDING NAME :
TYPE - V RESIDENTIAL FLAT

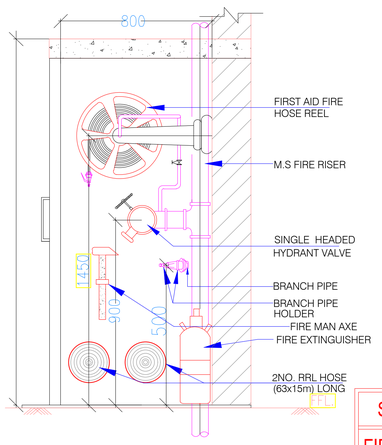
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FIRE FIGHTING SLD PLAN

DRAWING TYPE :
TENDER DRAWINGS - FIRE FIGHTING

SCALE:	SHEET SIZE: A1		DATE: 05-03-26	REV. NO: R0
RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION
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DESIGNED / DRAWN BY				
CHECKED BY				
APPROVED BY				



FRONT VIEW

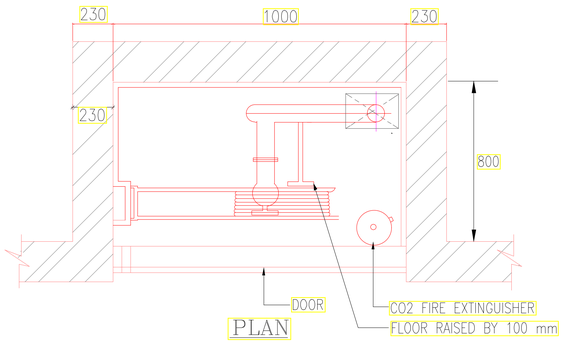


FHC ELEVATION

SPACE FOR FIRE FIGHTING WET RISER PIPE

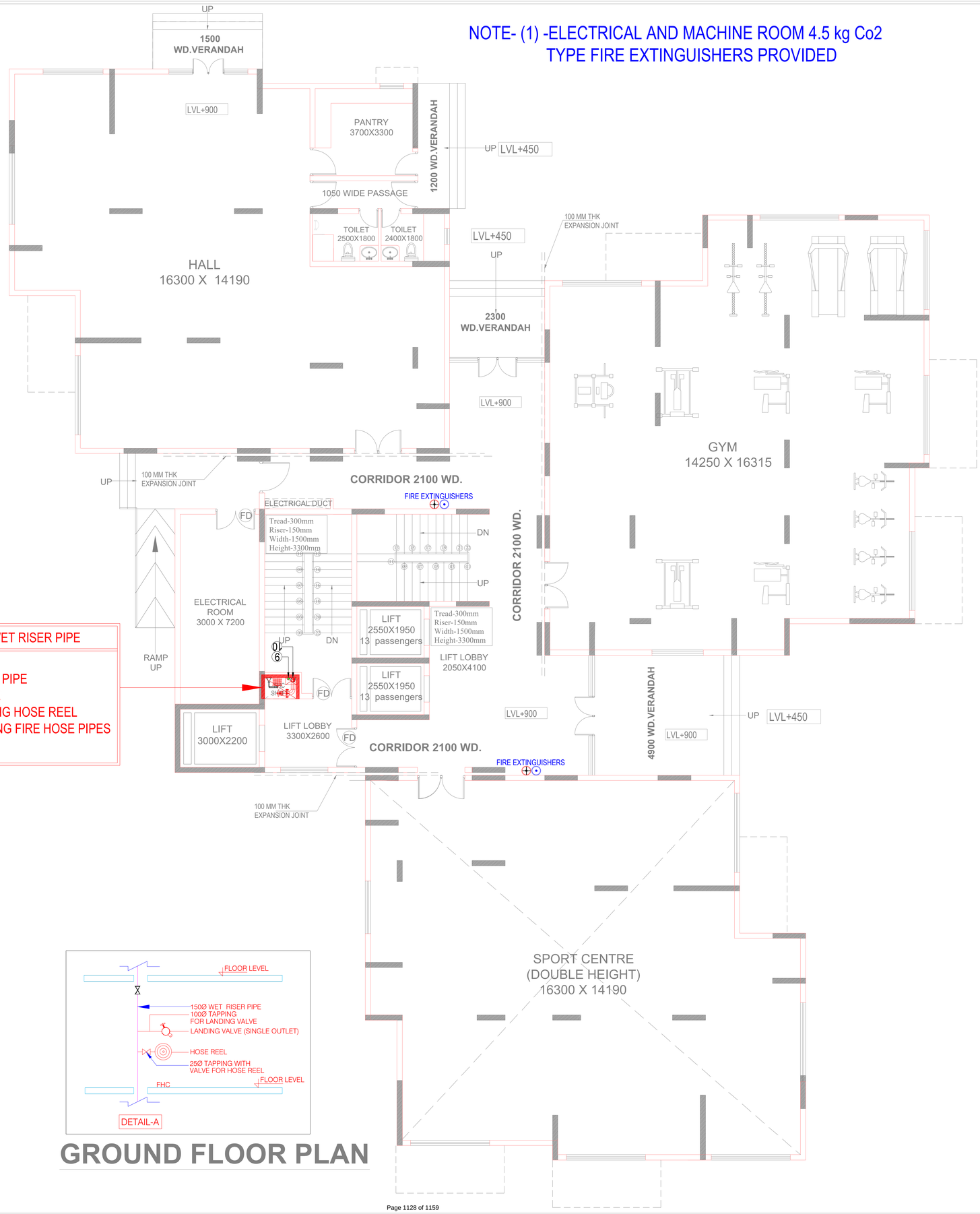
FIRE HYDRANT
150Ø FIRE FIGHTING WET RISER PIPE
(a)-63Ø SINGLE HYDRANT VALVE
(b)-ONE NOS. 20Ø 30 METER LONG HOSE REEL
(c)-TWO NOS. 63Ø 15 METER LONG FIRE HOSE PIPES
(d)-ONE NOS. BRANCH PIPE

LEGEND:-		
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PLAN

GROUND FLOOR PLAN



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6.DRAWING NOT TO BE SCALED, WRITTEN DIMENSIONS TO BE FOLLOWED.
7.THIS DRAWING HAS TO BE READ IN CONJUNCTION WITH RESPECTIVE CONSULTANTS DRAWINGS.
8.SPOT DETAILS GIVEN TO LARGER SCALE SHALL SUPERCEDE GENERAL DRAWINGS AT SMALLER SCALES.
9.UNLESS NOTED OTHERWISE (U.N.O), ALL EXTERNAL WALLS SHALL BE 200 MM THICK & INTERNAL WALLS 150 MM THICK WALLS.
10.UNLESS MENTIONED OTHERWISE, NIB OF WALLS AT COLUMN FACE TO BE AT 100 MM & IF NIB IS LESS THAN 100 MM AT COLUMN FACE TO BE ZERO FOR DOOR FRAME INSTALLATION.
11.UNLESS NOTED OTHERWISE (U.N.O), NIB OF WALLS TO BE AT 100 MM FOR DOOR FRAME INSTALLATION.
12.REFER SEPARATE DRAWINGS FOR TOILET & WET AREA DETAIL.
13.ALL GLASS DOORS AS PER VENDOR DETAILS & SPECIFICATIONS.
14.FURNITURE LAYOUT IS TENTATIVE.
15.UNLESS NOTED OTHERWISE (U.N.O), ALL COUNTER SLAB WIDTH SHALL BE 600 MM .

REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

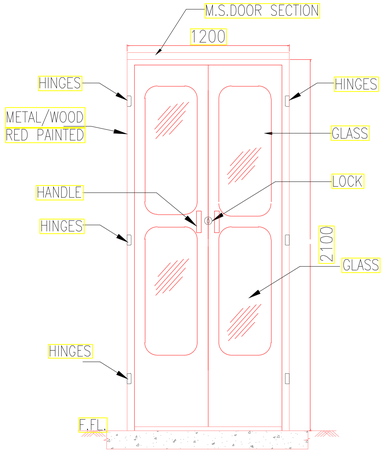
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FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS

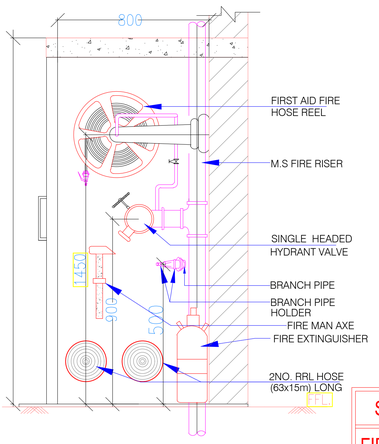
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RELEASED FOR	☐ PRELIMINARY	☐ INFORMATION	☑ APPROVAL	☐ CONSTRUCTION

	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



FRONT VIEW

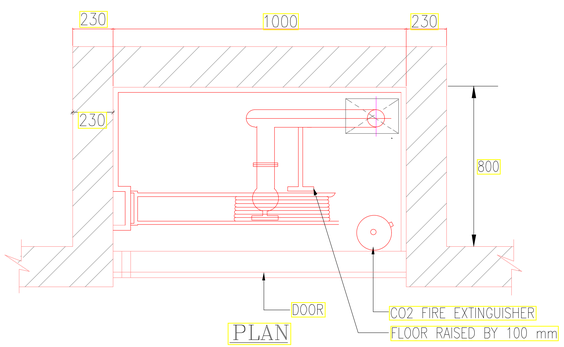


FHC ELEVATION

SPACE FOR FIRE FIGHTING WET RISER PIPE

FIRE HYDRANT
150Ø FIRE FIGHTING WET RISER PIPE
(a)-63Ø SINGLE HYDRANT VALVE
(b)-ONE NOS. 20Ø 30 METER LONG HOSE REEL
(c)-TWO NOS. 63Ø 15 METER LONG FIRE HOSE PIPES
(d)-ONE NOS. BRANCH PIPE

LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
1	ID	VERTICAL INLET PIPE FOR FIRE FIGHTING
2	10	150mm M.S. WET RISER PIPE
3	9	80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS

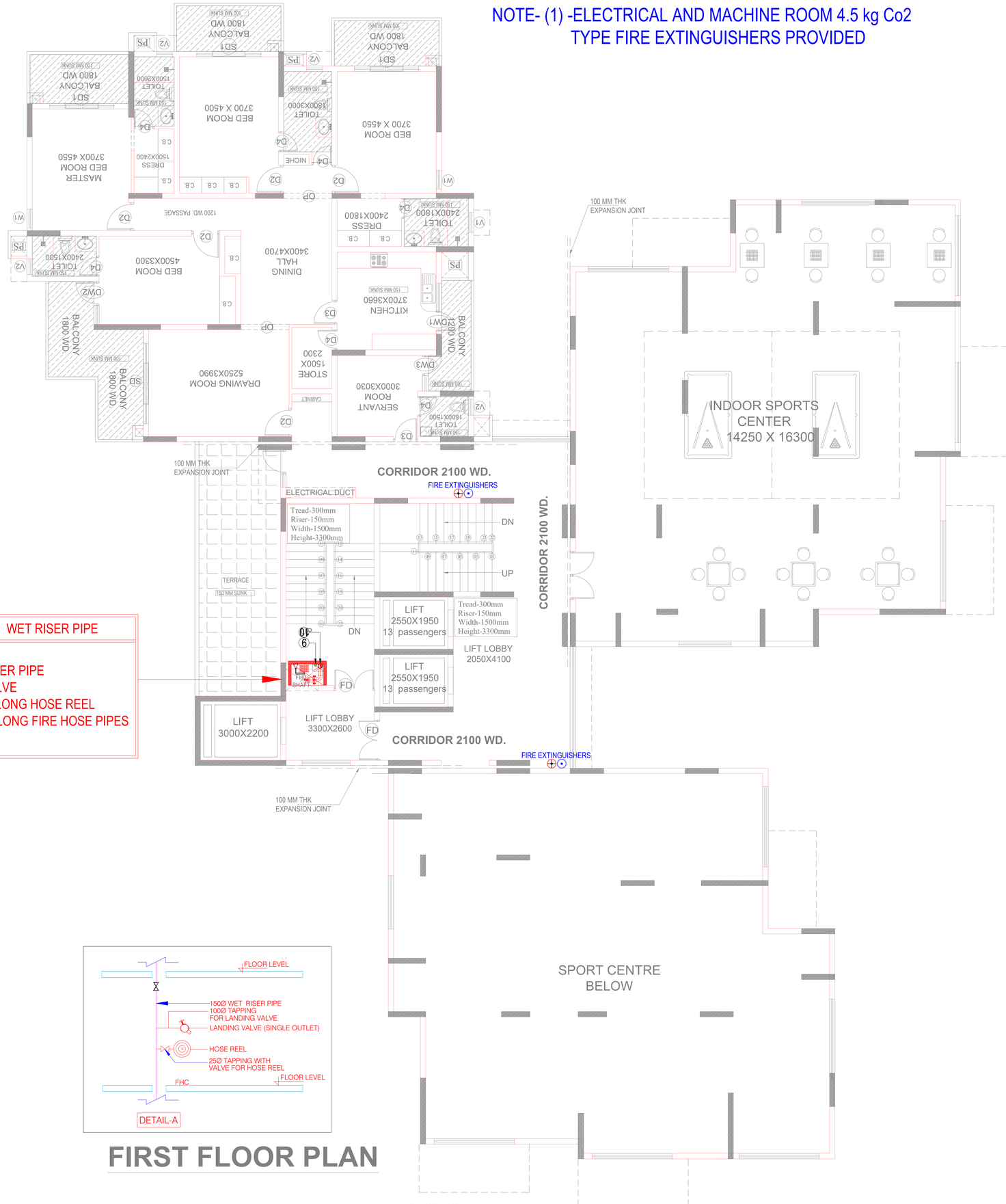


PLAN

DETAIL-A

FIRST FLOOR PLAN

NOTE- (1) -ELECTRICAL AND MACHINE ROOM 4.5 kg Co2 TYPE FIRE EXTINGUISHERS PROVIDED



TENDER PURPOSE ONLY

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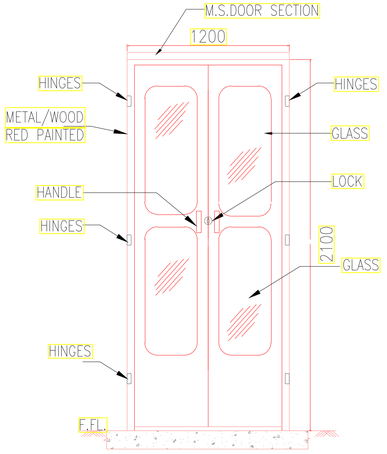
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FIRST FLOOR PLAN
FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS

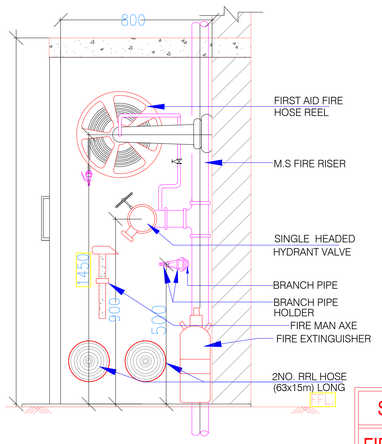
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CHECKED BY		
APPROVED BY		



FRONT VIEW

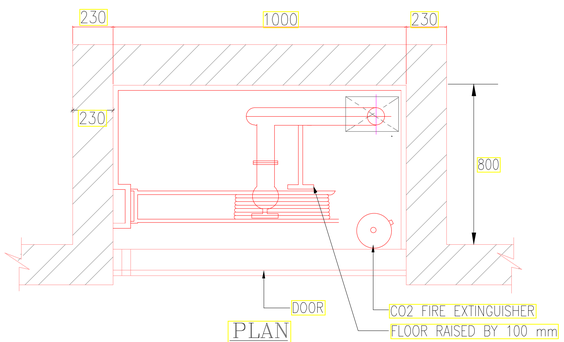


FHC ELEVATION

SPACE FOR FIRE FIGHTING WET RISER PIPE

FIRE HYDRANT
150Ø FIRE FIGHTING WET RISER PIPE
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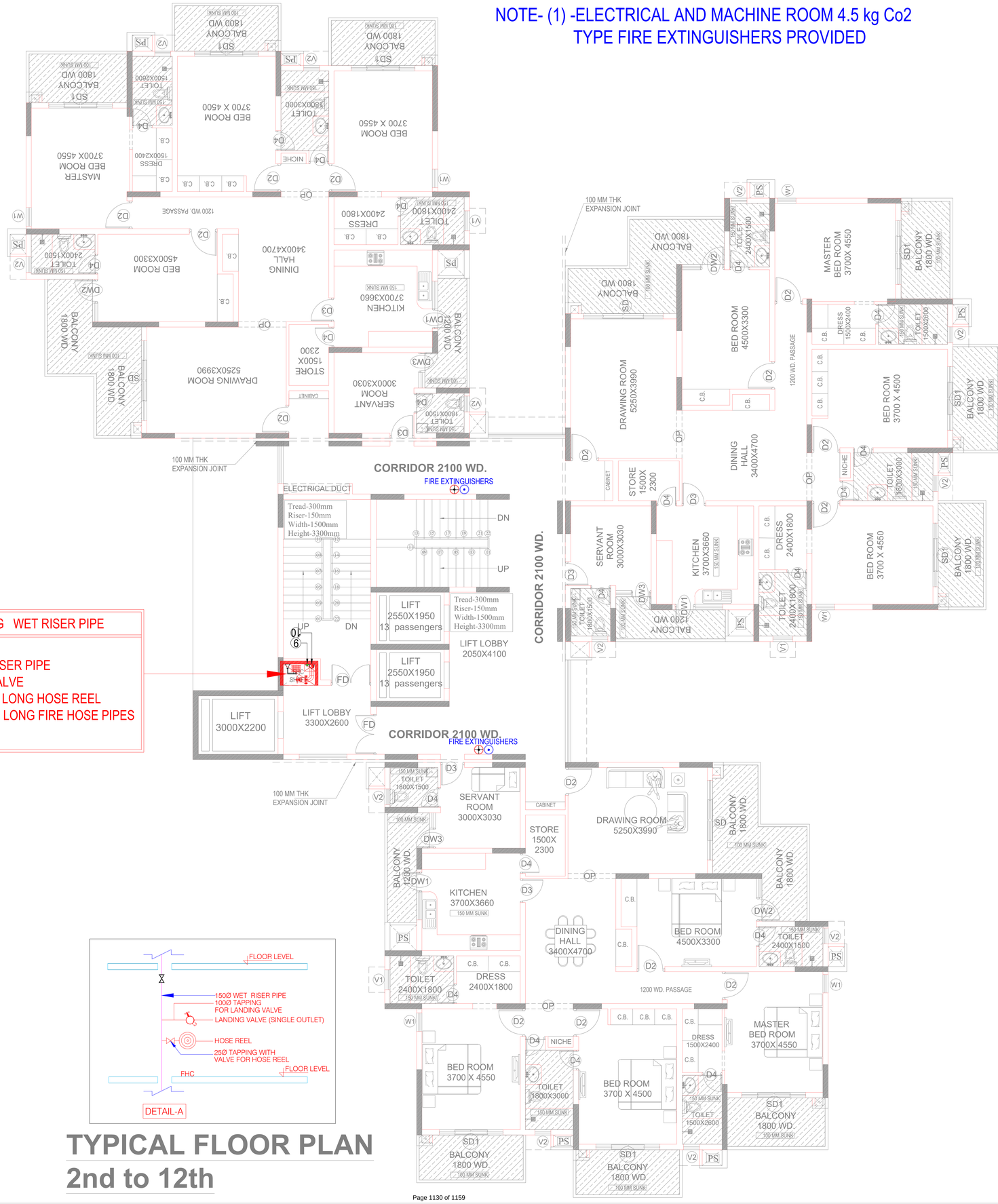


PLAN

DETAIL-A

TYPICAL FLOOR PLAN
2nd to 12th

NOTE- (1) -ELECTRICAL AND MACHINE ROOM 4.5 kg Co2 TYPE FIRE EXTINGUISHERS PROVIDED



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REVISIONS

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ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
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ELV SYSTEM			PHE		

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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME : TYPE - VI RESIDENTIAL FLAT

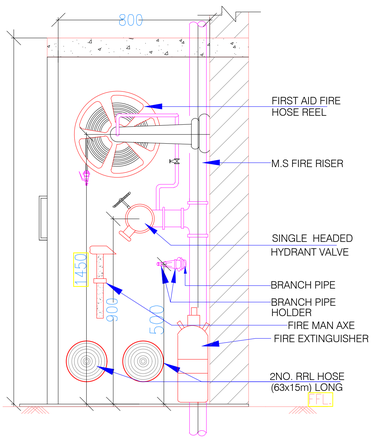
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DRAWING TYPE : **TENDER DRAWINGS**

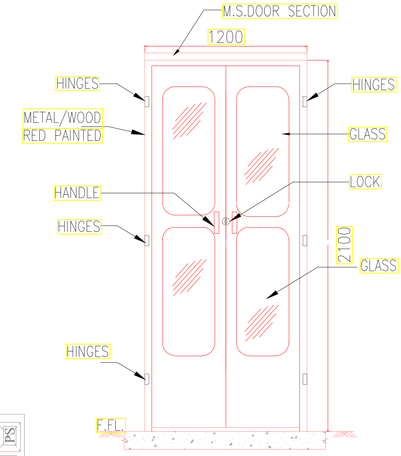
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RELEASED FOR: ☐ PRELIMINARY ☐ INFORMATION ☑ APPROVAL ☐ CONSTRUCTION

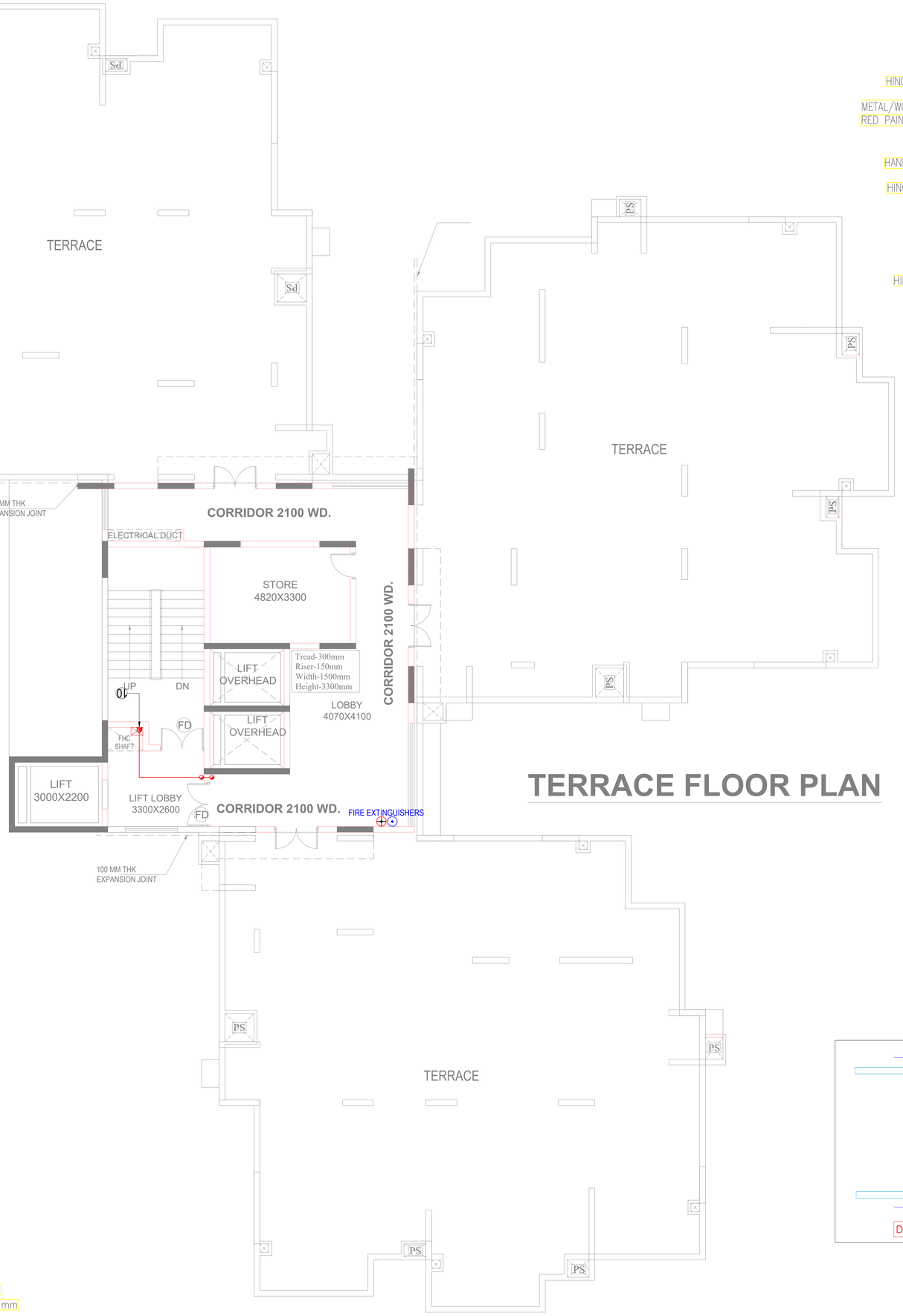
	SIGN	DATE
DESIGNED / DRAWN BY		
CHECKED BY		
APPROVED BY		



FHC ELEVATION

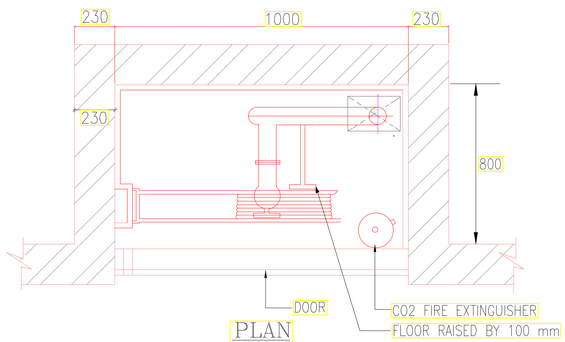


FRONT VIEW

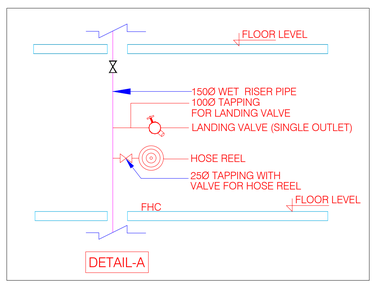


TERRACE FLOOR PLAN

LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
1	ID	VERTICAL INLET PIPE FOR FIRE FIGHTING
2	10	150mm M.S. WET RISER PIPE
3	9	80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS



PLAN



DETAIL-A

TENDER PURPOSE ONLY

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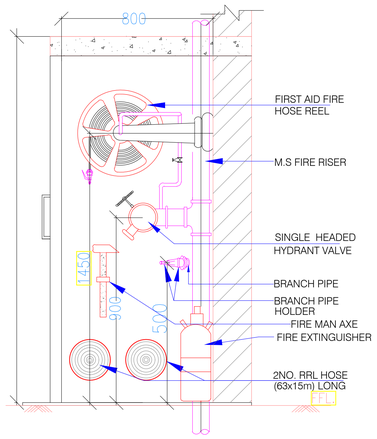
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FIRE FIGHTING PLAN

DRAWING TYPE :
TENDER DRAWINGS

SCALE:	SHEET SIZE: A1	DATE: 05-03-26	REV. NO: R0

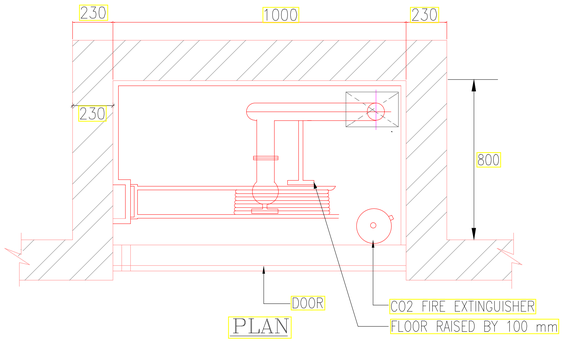
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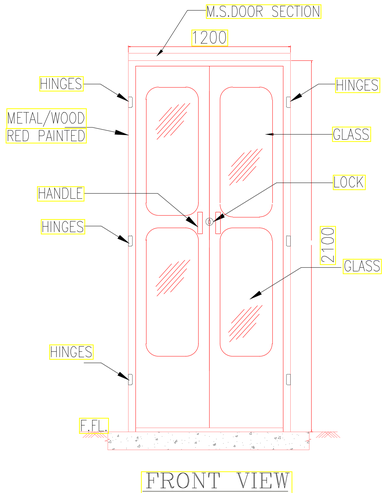


FHC ELEVATION

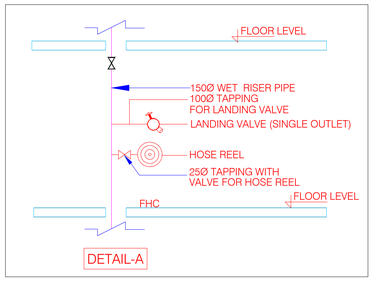
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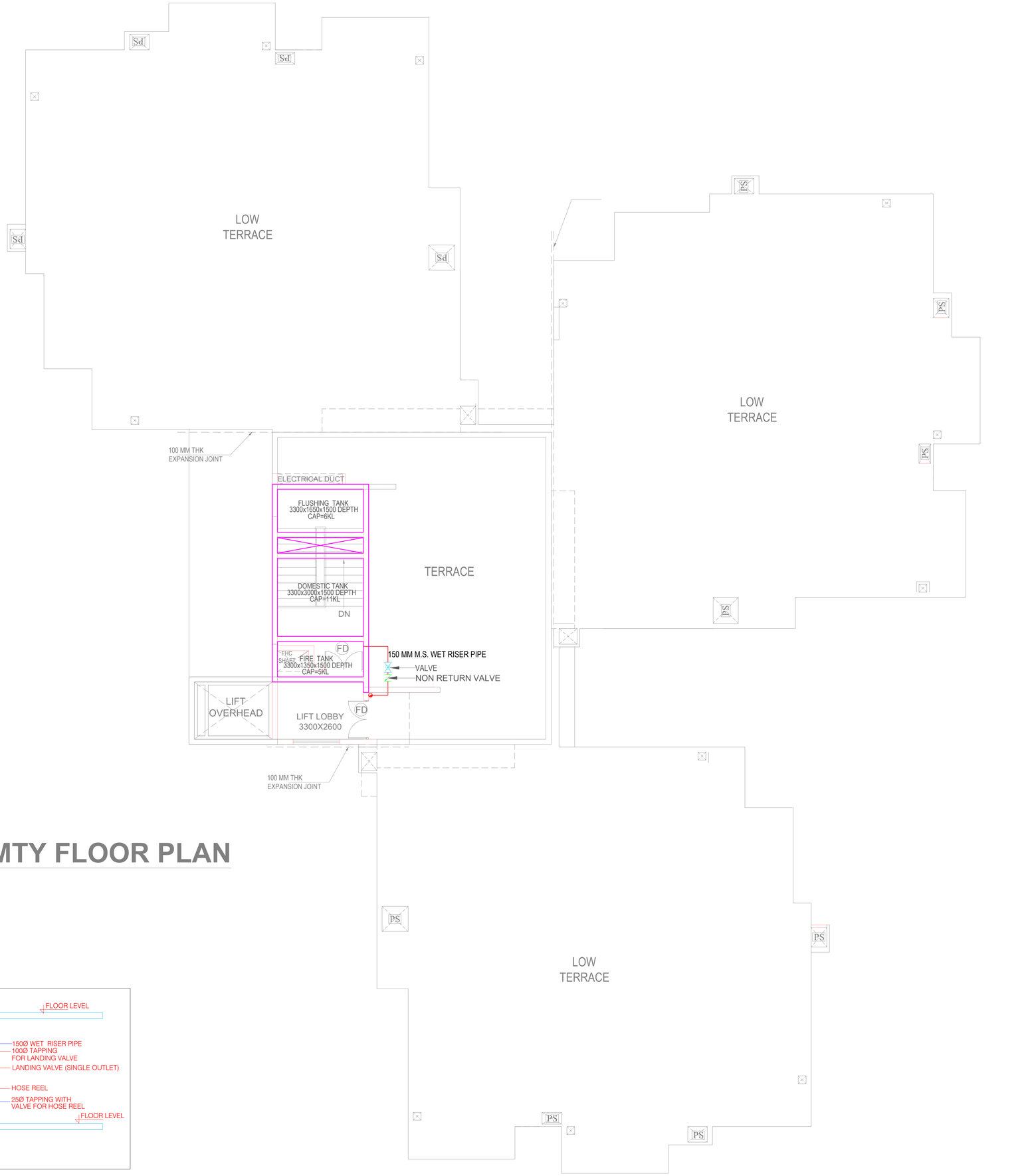
PLAN



FRONT VIEW



DETAIL-A



MUMTY FLOOR PLAN

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BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

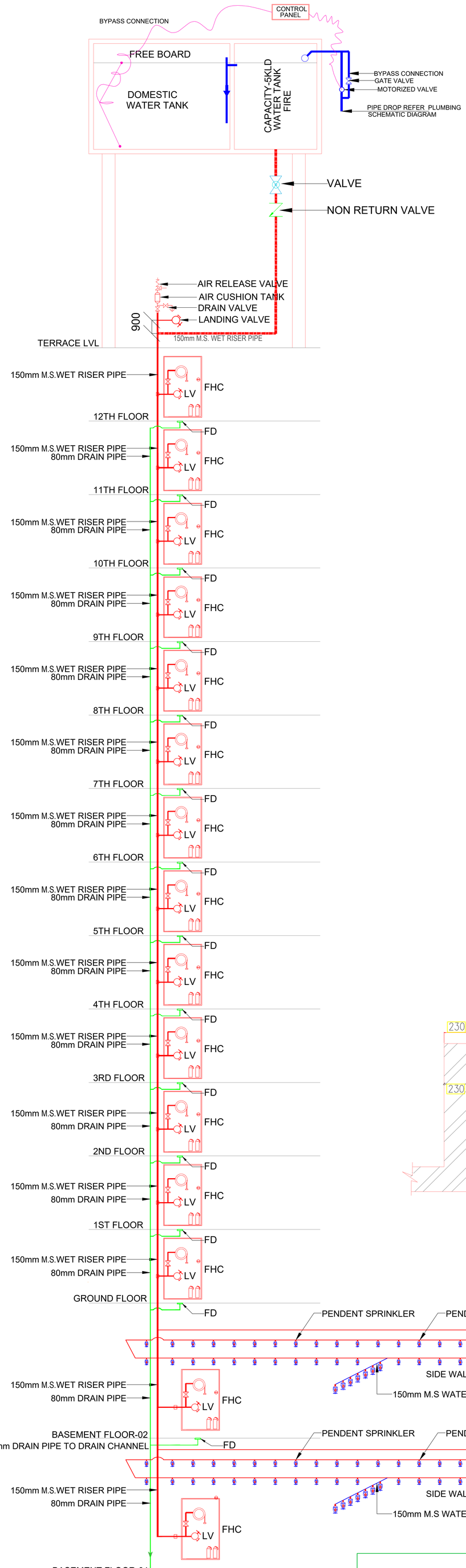
DRAWING TITLE :
MUMTY FLOOR PLAN
FIRE FIGHTING PLAN

TENDER DRAWINGS

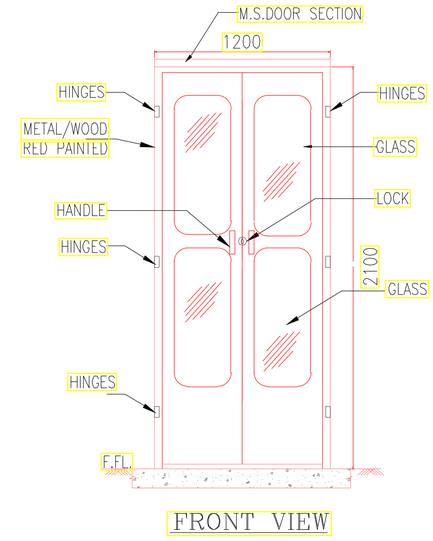
SCALE:	SHEET SIZE: A1	DATE: 05-03-26	REV. NO: R0

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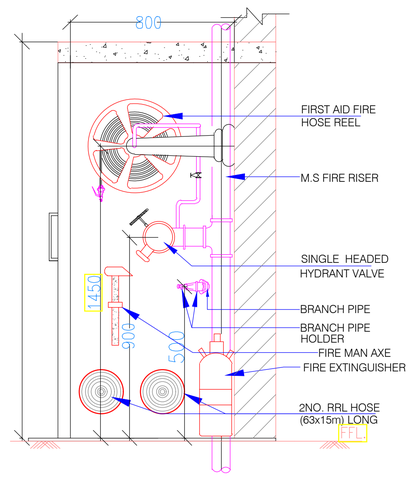


Fire Schematic Drawing

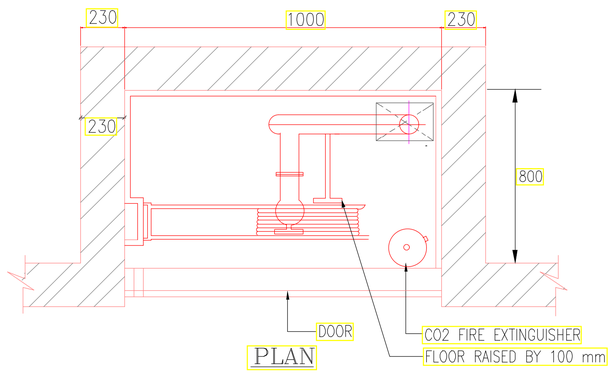


FRONT VIEW

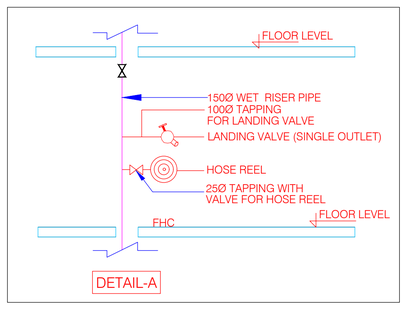
LEGEND:-		
S.NO.	SYMBOL	DESCRIPTION
1	ID	VERTICAL INLET PIPE FOR FIRE FIGHTING
2	10	150mm M.S. WET RISER PIPE
3	9	80mm FIRE DRAIN PIPE
4	FHC	FIRE HOSE CABINET
5		4.5 KG CARBON DIOXIDE EXTINGUISHERS I.S.I marked.
6		6 KG MONO AMMONIUM PHOSPHATE (ABC) TYPE CARTRIDGE OPERATED EXTINGUISHERS



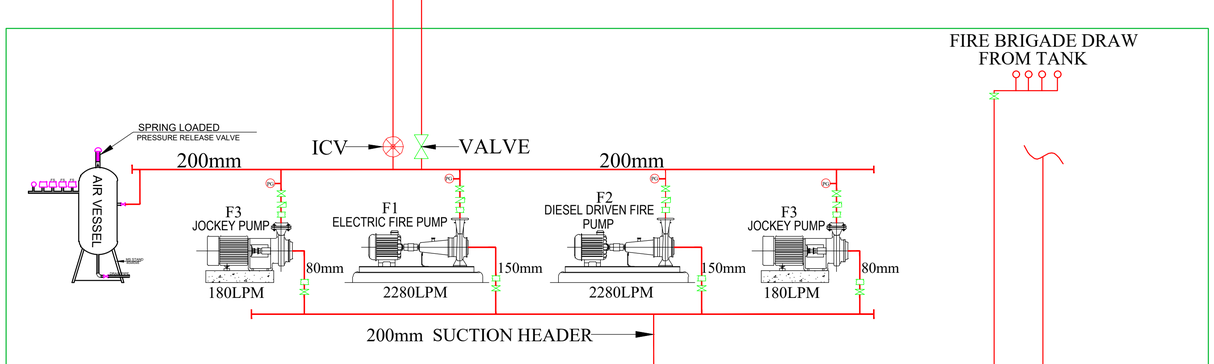
FHC ELEVATION



PLAN



DETAIL-A



TENDER PURPOSE ONLY

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14.FURNITURE LAYOUT IS TENTATIVE.
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REV.NO.	DATE	DESCRIPTION	DESIGNED	DRAWN	CHECKED	APPROVED
R0						

REVISIONS

CHECKED BY	SIGN	DATE	CHECKED BY	SIGN	DATE
ARCHITECTURE			HVAC		
CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

CLIENT

Department of Law, Justice and Legislative Affairs, Government of National Capital Territory (NCT) of Delhi

सत्यमेव जयते

PROJECT MANAGEMENT CONSULTANT

WAPCOS LIMITED
(A Govt. of India Undertaking-Ministry of Jal Shakti)

ARCHITECTURAL CONSULTANTS:

m u r a l a g e
architecture , master planning , interior design
conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
TYPE - VI RESIDENTIAL FLAT

DRAWING TITLE :
FIRE FIGHTING SLD PLAN

DRAWING TYPE :
TENDER DRAWINGS

SCALE:	SHEET SIZE: A1	DATE: 05-03-26	REV. NO: R0

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CIVIL & STRUCTURAL			FPS		
ELECTRICAL			PIPING		
ELV SYSTEM			PHE		

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conservation , landscaping , project management
A-3/269 , vibhav khand , gomti nagar , lucknow
phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
BUILDINGS AND SITE CONTEXT

DRAWING TITLE :
3d VIEWS 1

DRAWING TYPE :
TENDER DRAWINGS - ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 29-05-26	REV. NO: R0

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APPROVED BY		













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phone no.. : 2980139, 2320715

PROJECT:

Construction of Judicial Officers Flats at Sector-19, Dwarka, DELHI

Job No:

BUILDING NAME :
BUILDINGS AND SITE CONTEXT

DRAWING TITLE :
3d VIEWS 2

DRAWING TYPE :
TENDER DRAWINGS - ARCHITECTURE

SCALE:	SHEET SIZE: A1	DATE: 29-05-26	REV. NO: R0

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WAPCOS LIMITED

A Government of India Undertaking - Ministry of Jal Shakti
76-C, Institutional Area, Sector-18, Gurugram, Haryana - 122015
Tel: +91-124-2399830 | Website: www.wapcos.co.in

Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works

At Sector-19 Dwarka, Delhi

Document Reference:	WAP/C&C/DelhiLaw/2026/01
Issue Date:	July 30th, 2026
Issued by:	Centre for Commercial & Construction, WAPCOS Limited

Volume - IV

FINANCIAL BID & SCHEDULE OF PAYMENTS

Part A

Financial Bid

Financial QUOTE

Name of Work: Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works at Sector-19 Dwarka, Delhi.

NIT No. WAP/C&C/DelhiLaw/2026/01 Dated 30.07.2026

To be Submitted online on e-tendering portal

Validate Print Help

Percentage BoQ

Tender Inviting Authority: WAPCOS Limited

Name of Work: Engineering, Procurement and Construction (EPC) of Judicial Officers Residential Flats and External Infrastructure Development Works at Sector-19 Dwarka, Delhi

Contract No: WAP/C&C/DelhiLaw/2026 Dated

Name of the Bidder/ Bidding Firm / Company :						

PRICE SCHEDULE

(This BOQ template must not be modified/replaced by the bidder and the same should be uploaded after filling the relevent columns, else the bidder is liable to be rejected for this tender. Bidders are allowed to enter the Bidder Name and Values only)

The Price Schedule in excel format should be uploaded of Volume-IV of Tender Document

NUMBER #	TEXT #	NUMBER #	TEXT #	NUMBER	NUMBER #	TEXT #
Sl. No.	Item Description	Quantity	Units	Estimated Rate in Rs. P	TOTAL AMOUNT Exclusive of GST in Rs. P	TOTAL AMOUNT (Exclusive of GST/Taxes) In Words
1	2	3	4	5	6	7
1	Total estimated cost as per Bill of Quantities attached in Volume-IV (in Rs.)	1.000	Nos	1365143477.00	1365143477.00	INR One Hundred Thirty Six Crore Fifty One Lakh Forty Three Thousand Four Hundred & Seventy Seven Only
Total in Figures					1365143477.00	INR One Hundred Thirty Six Crore Fifty One Lakh Forty Three Thousand Four Hundred & Seventy Seven Only
Quoted Rate in Figures			Select		0.00	INR Zero Only
Quoted Rate in Words	INR Zero Only					

Notes:-

1. The Performa for filling the Total Amount is given in BoQ Sheet. Bidder shall fill the quote in percentage above or below or at par with respect to the estimated cost of the project. The percentage shall be quoted only up to two decimal place in BoQ sheet and shall upload the valid file under the Financial Bid on e-tendering Portal.

2. Prices quoted by the Bidder shall include all Materials, Tools & Plant, labour, supervision, profit; other levies together with all general risks, liabilities and obligations set out or implied in the contract, applicable Labour Cess, cost of insurance to this contract, all applicable tax liabilities like Income Tax & Surcharges, etc. Any other taxes /cess as per Government directives shall be deducted from each bill paid to the Contractor, from time to time. Prices quoted by the Bidder shall exclusive of GST. The GST shall be paid extra, as per actual.

3. The Contractor shall issue Tax Invoices to the Employer showing (i) Basic amount (ii) GST amount separately in each bill. It is mandatory to bidders to deposit GST within time limit framed by Govt. of India, if applicable. The Goods and Services Tax (GST), shall be reimbursed to the Agency only after uploading of bills by Contractor on GST Portal “to avail Input benefit of GST”.

4. The company shall be performing all its duties of deduction TDS and other deduction on payment made to the contractor as per applicable legislation in force on the date of submission of bid or to be newly / amended introduced during the execution of the Contract.

Part B

Schedule of Payments

SCHEDULE OF STAGE PAYMENT/STATEMENT FOR WORKS

1) The Contractor shall base its claim for interim payment for the work executed till the end of the month for which the payment is claimed supported with all the particulars and documents in accordance with of any the agreement. The basis of the payment on “Pro rata basis’ shall be worked out on the percentage of the work done of the total scope of work under their activity/item for the respective cost center.

2) The proportion assigned to an item will apply only to the Awarded Contract Price. It shall not apply to any addition or reduction to the contract price arising from the issue of any change of Scope of Order. A Change of Scope of Order shall specify the stages of interim payments for the works covered in such order.

3) Within 21 (Twenty-One) Days of the receipt of the Stage Payment Statement, the Engineer in Charge shall determine the amount due and payable to the contractor, after adjusting the payments already released to the contractor against the said statement. In case where there is a difference of opinion as to the value of any stage the final decision of Engineer in Charge will prevail. Payment by the Employer shall not be deemed to indicate the Employers acceptance, approval, consent or satisfaction of the work done.

4) All such interim payments shall be regarded as payment by way of advances against final payment only and shall not preclude the requiring of bad, unsound and imperfect or unskilled work to be rejected, removed, taken away and reconstructed or re-erected. Any certificate by the Engineer in Charge to the work done or material delivered forming part of such payment, may be modified or corrected by any subsequent such certificates or by the final payment certificate and shall not by itself be conclusive evidence that any work or material to which it relates is/are in accordance with the contract and specifications. Any such interim payment, or any part thereof shall not in any respect conclude, determine or effect in any way powers of the Engineer in Charge under the contract or any of such payments be treated as Final settlement and adjustment of accounts or in any way vary or effect the contract.

5) Mainly Payment will be made after completion of particular “STAGE OF CONSTRUCTION” as per the detail in the Scope of Work in compliance of all the conditions mentioned in the Tender Document. If any stage of construction is completed partially, then payment will be made on pro- rata basis, if agreed by Engineer - in - charge. The pro-rata percentage will be analyzed by the Engineer- in-charge and no dispute in this regard will be entertained

6) Percentage mentioned in column in the table are to facilitate the payment to contractor after completion of particular stage of construction. Percentage mentioned against particular Stage of Construction may not be actual cost of that particular stage of construction. The final 100% payment, depicts the total cost of work as per the scope of work and in compliance with all conditions mentioned in tender document.

7) The main scope of work and specifications for each component shall be governed as detailed in Volume I, II & III of the tender document and final payment shall be made accordingly, to the Contractor.

8) The nomenclature/Description of Major Cost Centre in Schedule of Payment is in brief/indicative for reference of particular heads/trades of work, whereas, the scope of work to be executed under the respective Cost Centre has been defined substantially in the documents forming part of this tender, Scope of Work, Design Basis Report (DBR), Technical Specifications and drawings etc.

9) It will be deemed that contractor has understood the entire scope of work as reflecting/evident/incidental thereto from the individual and/or join treading of one or more documents out of Special Conditions of Contract, Scope of Work, DBR, Technical Specifications and drawings and the Schedule of Payment in its entirety. Accordingly, the contractor's quoted amount are deemed to have taken into account the complete work in order to make the buildings & complex fit for its intended purpose i.e. handing over for end use, to the entire satisfaction of PMC/Department of Law, GNCTD.

10) Any work/item prescribed/reflected in Special Conditions of Contract (SCC), scope of work, DBR, Technical Specification, drawings etc. irrespective of conflict and difference of opinion shall be deemed to be included in the major cost center and contractor is bound to carry out all items/work without any extra cost. The decision of the Engineer-in-charge shall be final and binding to the contractor in this regard.

PREAMBLE

All running/intermediate & final payments shall be made to the agency in accordance with the following schedule:

1. Unless explicitly stated otherwise in the Tender Documents, the payment shall be as per provisions of tender and payment shall be as per actual measurements on submission of RA/Final bills by the agency.

2. Method of measurement of Plinth Area (As per CPWD PAR 2025)

   The total Plinth area shall be the sum total of built-up covered areas measured at each floor level of the buildings for the categories mentioned under 2.1 below and excludes the areas given in 2.2.

2.1 For the purpose of plinth area, following shall be included:

a) Area of the wall at the floor level excluding plinth offsets, if any; when the building consists of columns projecting beyond cladding, the plinth area shall be taken up to the external face of cladding (in case of corrugated sheet cladding outer edge of corrugation shall be considered)
   Note: In case, a common wall is owned jointly by two owners, only half the area of such walls shall be included in the plinth area of one owner.
b) Shafts for sanitary, water supply installations, garbage chute, telecommunication, electrical, fire-fighting, air-conditioning and lifts.
c) Stair case: Main stair case, open spiral/service stair case/fire escape stair case etc.
   (i) 100 percent of the plan area of main/service/fire escape stair (enclosed in defined stair hall and mumty at top)
   (ii) 50 percent of the plan areas of service/fire escape/open stairs (without any enclosure around and mumty at top).
   Note: Any type of steps, ladder/cat-ladder, spiral/flat, with or without side guard rails created for the purpose of approaching inaccessible terrace or from terrace to top of bulk water storage tanks or otherwise for maintenance purposes shall not account for plinth area.
d) In case of open verandah with parapets:
   (i) 100 percent areas for the portion protected by the projections above and
   (ii) 50 percent area for the portion unprotected from above.
e) In case of balcony projections with railing/parapets:
   (i) 100 percent area of the balcony covered by projection above
   (ii) 50 percent area of the uncovered balcony
f) In case of alcove made by cantilevering a slab beyond external wall:
   (i) 25 percent of the area for the alcove of height up to 1 m.
   (ii) 50 percent of the area for the alcove of height more than 1 m and up to 2 m.
   (iii) 100 percent of the area for the alcove of height more than 2 m.
g) Area of mumty and machine rooms (Refer sketch-4)
h) Mezzanine floors shall be measured as different floor levels with deduction for lesser floor heights than the standard heights.

2.2 The following shall not be included in the plinth area

a) Area of loft
b) Area of architectural band, cornice, etc.
c) Area of vertical sun breaker or box louver projecting out and other architectural features, for example slab projection for flower pot, etc.
d) Terrace
e) Open platform or ground
f) Towers, turrets, domes projecting above terrace level.

3. In case there is any change in scope as defined in the contract, the contractor shall carry out the changes as per direction of Engineer in Charge and nothing extra shall be payable to the contractor on account of same if the additional cost of such work is up to 0.25% (zero decimal two five percent) of the accepted tendered amount and worked out as per sub-clause 12.3. Variations/deviations up to 0.25% (zero decimal two five percent) of the accepted tendered amount shall be deducted from overall variations/ deviations for making payment.

4. Nothing extra shall be paid for services of various consultants such as detailed survey, Soil investigation, architectural, structural, MEP Services, BIM modelling, Green building, services, proof checking, various statutory approvals etc. and related expenses for consultancy services. The agency shall quote the rates taking this aspect also into consideration.

5. Nothing extra shall be paid for testing of various materials, cost of materials used for testing, handling & transportation and related expenditure. The agency shall quote the rates taking this aspect also into consideration.

6. All duties, GST, fees, octroi and other levies & taxes shall be payable by the Contractor and nothing extra shall be paid. The agency shall quote the rates taking this aspect also into consideration.

7. For intermediate payments on “pro-rata basis” amount shall be worked out on the basis of fraction of work done out of total scope of work under each activity / Item. The assessment made by Engineer-In-Charge or successor thereof shall be final in this regard.

8. The rates to be quoted by contractor is inclusive of all the services, consultancy work etc., mentioned in NIT/tender document required to achieve the complete functionality of the all-proposed buildings. However, the final payment will be based on actual plinth area executed and measured at site after completion of work and final payment will be based on rates quoted in Schedule of Financial Bid.

9. The deviations, modifications or variations are governed as per Clause 12 of GCC.

10. The Table 1 Breakup of the Total Accepted Contract Cost Mentioned below shall be applicable for assigning Accepted Contract cost to each Building/ work. The Employer may choose to issue the Letter of acceptance/ commencement of work in parts as per the availability of funds and site.

11. Any work/item prescribed/reflected in Additional/ Special Conditions of Contract, scope of work, DBR, Finishing Schedule, Technical Specification, drawings etc. irrespective of conflict and difference of opinion shall be deemed to be included in the cost centre and contractor is bound to carry out all items/work without any extra cost, unless specified. The decision of the Engineer-in- charge shall be final and binding to the contractor in this regard.

12. It will be deemed that contractor has understood the entire scope of work as reflecting/ evident/ incidental thereto from the individual and/or conjoint reading of one or more documents out of Additional/ Special Conditions of Contract, Scope of Work, DBR, Finishing Schedule, Technical Specifications, tender drawings etc., forming part of tender document and schedules of Payment in its entirety. Accordingly, the contractor’s quoted amount are deemed to have taken into account the complete work in order to make the Buildings & Complex fit for its intended purpose i.e. handing over for end use, to the entire satisfaction of Department of Law, GNCTD.

13. Payment shall be made as per the schedule of payment as per Tables and Annexures Mentioned in this Volume.

Table1: Breakup of the Cost of Individual Buildings/ Services of Total Cost (Major Cost Centers)

Sr. No.	*DESCRIPTION OF MAJOR COST CENTRES*	*Plinth Area (sqm.)*	*Weightage in % of total Contract Value*	*Major Cost Centre*
I	Planning, Designing, Preparation of Detailed drawings, statutory approvals, submission & obtaining approval from Engineer in Charge etc. for entire scope of work	*Job*	*1.00%*	*'A'*
II	***Building Works***			
1	Engineering, Procurement and Construction of **Common Basements (2 level basement in tower and non-tower areas)** including Foundation Works, Retaining Wall/ Diaphragm Walls/ Contiguous Piling, all Civil works in Sub-Structure and Super-Structure, Water Proofing, MEP (Mechanical Ventilation, Electrical, Plumbing, etc.), Fire Fighting, Fire Alarm & Public Address System, Lifts, EPABX, LAN & Data Networking system, Access Control System, IBMS within battery limit, fixed Fit out locker rooms, service rooms, toilets, public utilities, parking signs, markings, signage, boom barriers etc., including any other component necessary for completion, occupation and handing over the building etc. to the owner/client, complete as per Scope of Work, Technical Specifications Design Basis Reports, Drawings, Finishing as per Schedule and terms and conditions of Tender Document.	*11200*	*27.25%*	*"B"*
2	Engineering, Procurement and Construction of **Type V Residence Building of G+12 Floors** including all Civil works, Water Proofing, MEP (Mechanical, Electrical, Plumbing, etc.), Fire Fighting, Fire Alarm & Public Address System, Lifts, fixed Fit-out wooden furniture in Wardrobes in Rooms, Kitchen, Dress, Shoe-rack, Cupboards etc. & EPABX, LAN & Data Networking system, Access Control System, IBMS within battery limit, markings, signage and allied works etc., including any other component necessary for completion, occupation and handing over the building etc. to the owner/client, complete as per Scope of Work, Technical Specifications Design Basis Reports, Drawings, Finishing as per Schedule and terms and conditions of Tender Document.	*11850*	*28.75%*	*"C"*
3	Engineering, Procurement and Construction of **Type VI Residence Building of G+12 Floors** including all Civil works, Water Proofing, MEP (Mechanical, Electrical, Plumbing, etc.), Fire Fighting, Fire Alarm & Public Address System, Lifts, fixed Fit-out wooden furniture in Wardrobes in Rooms, Kitchen, Dress, Shoe-rack, Cupboards etc. & EPABX, LAN & Data Networking system, Access Control System, IBMS within battery limit, markings, signage and allied works etc., including any other component necessary for completion, occupation and handing over the building etc. to the owner/client, complete as per Scope of Work, Technical Specifications Design Basis Reports, Drawings, Finishing as per Schedule and terms and conditions of Tender Document.	*11150*	*28.15%*	*"D"*
	Sub-Total – A		***84.15%***	
III	***External Development Works***			
4	Engineering, Procurement and Construction of **Site Development & External Infrastructure and other ancillary work including Plot Levelling, Cutting & Filling, Road works, Footpaths/ Pathways, Parking Areas, Gate & Guard Room Complex, Swimming Pool with other ancillary works, Sports Facilities, Tot lot area with equipment, Boundary Wall, Benches/ Sitting Arrangements, Services Tranches, Horticulture, Retaining walls, Landscaping around the buildings, Markings, Signage, Boom Barriers etc.** including any other component necessary for completion, occupation and handing over the services etc. to the owner/client, complete as per Scope of Work, Technical	*Job*	*2.80%*	"E"

Sr. No.	*DESCRIPTION OF MAJOR COST CENTRES*	*Plinth Area (sqm.)*	*Weightage in % of total Contract Value*	*Major Cost Centre*
	Specifications Design Basis Reports, Drawings, Finishing as per Schedule and terms and conditions of Tender Document.			
5	Engineering, Procurement and Construction of **ESS Building** including Civil, Mechanical, Electrical, Plumbing etc. including any other component necessary for completion, occupation and handing over the building etc. to the owner/client, complete as per Scope of Work, Technical Specifications Design Basis Reports, Drawings, Finishing as per Schedule and terms and conditions of Tender Document.	*200*	*1.15%*	"F"
6	Engineering, Procurement and Construction of **2 Nos. of Under Ground Tanks (UGT)** (Fire + Raw + Domestic + Irrigation + Flushing Water Tanks), with minimum total capacity 151 KL with pump rooms with pumping system including Civil, Electrical, Plumbing pumps, Firefighting Pumps, Hydrants, Pipelines etc. including any other component necessary for completion, occupation and handing over the services etc. to the owner/client, complete as per Scope of Work, Technical Specifications Design Basis Reports, Drawings, Finishing as per Schedule and terms and conditions of Tender Document.	*Job*	*0.47%*	"G"
7	Engineering, Procurement, Construction, Testing and Commissioning of **External Electrification works** comprising **11/0.433 KV Electrical Substation,** including supply, installation of **HT and LT panels** with all allied **substation equipment** along with **2 Nos. 1600 KVA, oil cooled 11/0.433 KV transformers** with OLTC with RTCC Panel, 11 kV HT VCB cubical panel and 11 KV RMU/HT Metering panel, Comprising of required I/C & O/G, , RMUs/VCBs, LT panels With BUSBAR connections, providing Main LT panel with required switchgears for incomers from transformers and DG set with outgoings as required for buildings, services & utilities, HT/LT cabling & termination, earthing, lightning protection, all internal electrical work of substation building with required accessories, associated civil works, and all allied works, along with, liasioning with service provider and PWD etc. including any other component necessary for completion, occupation and handing over the components, services etc. to the owner/client, complete as per Scope of Work, Technical Specifications Design Basis Reports, Drawings, OEMstandards, statutory requirements, and terms & conditions of Tender Document.	*Job*	*1.25%*	"H"
8	Engineering, Procurement, and Construction of minimum capacity of **70 KLD Sewage Treatment Plant (STP)** complete in accordance with the scope of work, DBRs, drawings, technical specifications, and terms and conditions of the Tender Document.	*Job*	*0.35%*	"I"
9	Engineering, Procurement, Construction, Testing and Commissioning of following with all required accessories, complete in accordance with the scope of work, DBR, drawings, specifications, and terms and conditions of the Tender Document. 1) **External Water Supply Infrastructure**, including Pump Room, Transmission mains, and distribution networks 2) **Development of Bore Well System,** including Pumps and all associated civil, Mechanical, Electrical & allied works, complete in all aspect. 3) **External Sewerage works** including manholes, trenches, sewerage network lines, and all associated civil & allied works and connection to required system, complete in all aspect. 4) **Storm Water Drainage Works** including Drain Channel, Box drains, catch pits, manholes, culverts, Infiltration trench or Swale and all associated civil, structural, and allied works and connection	*Job*	*1.05%*	"J"

Sr. No.	*DESCRIPTION OF MAJOR COST CENTRES*	*Plinth Area (sqm.)*	*Weightage in % of total Contract Value*	*Major Cost Centre*
	to Municipal lines 5) **Rain Water Tanks** including rain Water Harvesting & Recharge Pits including all Service lines, and all associated civil & allied works and connection to required system, complete in all aspect. 6) **External Fire Fighting Infrastructure**, including supply and installation of all the required equipment/items, Fire Hydrants, Fire Pumps, Control Panels, distribution networks, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.			
10	Engineering, Procurement, Construction, Testing and Commissioning of following with all required accessories, complete in accordance with the scope of work, DBR, drawings, specifications, OEM standards, statutory requirements, and terms & conditions of Tender Document. 1) **Earthing Works** including supply and installation of required items, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. 2) **Electrical, Low Voltage, Extra Low Voltage Works** including supply and installation of L.T. & H.T. Cables & other required items, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. 3) **DG Set Works** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. 4) **External Street Lighting System** including supply and installation of poles, foundations, Solar Hybrid LED Lighting plus LED street light fittings, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. 5) **Roof top Solar On-grid System** including supply and installation of all the required equipment/items, foundations, Solar Panels, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. **6) Electrical Vehicle Charger Work** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. **7) Intelligent Fire Alarm System** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect. **8) Fire Suppression System** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	*Job*	*4.60%*	"K"
11	Engineering, Procurement, Construction, Testing and Commissioning of **LAN & Data, UPS, IP CCTV System, Telephone Active Passive, WIFI Networking & IPEBAX System, ICT and Building Management System (BMS)**, including structured cabling With AIM solutions, switches, routers, servers, racks, network security systems, UPS & power distribution, passive and active components, Data Center (DC & DR With control command center) building automation system (fire alarm integration, access control, CCTV interface, energy management), Hardware, software, licenses, civil/electrical works, and all accessories necessary for complete functionality, executed as per approved drawings,	*Job*	*3.00%*	"L"

Sr. No.	*DESCRIPTION OF MAJOR COST CENTRES*	*Plinth Area (sqm.)*	*Weightage in % of total Contract Value*	*Major Cost Centre*
	technical specifications, OEM standards, statutory requirements and tender conditions, including handing over in fully operational condition.			
12	Engineering, Procurement, Installation and Commissioning of **Information Signages including all External and Internal Signages,** like Main Gate, Entry/ Exit, Campus Directional Totem, Traffic regulatory Signage, Fire Evacuation Photo luminescent, Area Identification, Basement Ceiling Hung, Entry Area Identification Signs For Ramp, Basement Signages etc. along with all fittings and accessories, associated civil, mechanical, electrical works, and all allied works, including any other component necessary for completion and handing over the Components etc. to the owner/client, all in accordance with the scope of work, drawings, specifications, and terms and conditions of the Tender Document, complete in all respects.	*Job*	*0.18%*	"M"
	Sub-Total B		**14.85%**	
	Grand Total (A+B)		**100%**	

Note:

1) Any Work/ Building under the Major Cost Centre may be added or deleted under the scope, within the Deviation limit as per clause no. 12.3 of GCC. No Claim on reduction of Overheads and Profit shall be entertained due to deletion of any building/ works or scope of work.

2) The Total Amount quoted for the project shall be applied to each cost centre in the percentages mentioned against each work.

MAJOR COST CENTRE "A" SCHEDULE OF PAYEMENT FOR PLANNING AND DESIGNING WORKS

Sl. No.	Mile Stone	Schedule of Payment
i	*On approval of inception report & Site Survey, Geotechnical investigations and preparation of preliminary drawings / services etc.*	*10%*
ii	*On approval of Design Basis report of structure and on obtaining approval of Structural Drawings from Engineer in Charge after duly vetted structural drawings from IIT Delhi or any other IIT.*	*20%*
iii	*On Submission of Design Basis report and duly proof checked all MEP Service drawings, external development & landscaping works etc. and on obtaining approval from Engineer in charge.*	*15%*
iv	*On finalization of proposal for DG sets, STP, WTP & sub-station and other electrical services and fixtures etc.*	*15%*
v	*On Submission of all local bodies and statutory clearances after obtaining from respective statutory bodies/government departments.*	*40%*
	TOTAL	**100.00%**

MAJOR COST CENTRE "B" SCHEDULE OF PAYEMENT FOR COMMON BASEMENT (2 LEVEL BASEMENT IN TOWER AND NON-TOWER AREAS) - COMPLETE FOUNDATION WORK, RCC RETAINING WALLS, ALL CIVIL & MEP ETC.

Sl. No.	Mile Stone		Schedule of Payment
1	Completion of Excavation, Foundation, RCC Retaining Walls & Plinth including Grade beams & slab.		**40.00%**
	1.1	*On Completion of Excavation including back filling and disposal of surplus earth etc.*	5.00%
	1.2	*On Completion of PCC, Anti-Termite Treatment and Water Proofing Work etc.*	5.00%
	1.3	*On Completion of Construction of RCC Retaining Wall including Water Proofing Work etc.*	15.00%
	1.4	*On Completion of Foundation Works etc.*	10.00%
	1.5	*On Completion of Columns, Plinth Beams and walls up to plinth level and Grade slab at start of basement floor level etc.*	5.00%
2	Completion of RCC Framed Structure of Basement Floors		**30.00%**
	2.1	*On casting of columns above Plinth beam Level and up to beams soffit of Second Level Basement Floor etc.*	5.00%
	2.2	*On casting of Second Level Basement Floor slab with beams and allied works*	10.00%
	2.3	*On casting of columns above Second Level Basement Floor and up to beams soffit of First Level Basement Floor etc.*	5.00%

Sl. No.	Mile Stone		Schedule of Payment
	2.4	*On casting of First Level Basement Floor slab with beams and allied works*	10.00%
3	On Completion of brick work including fixing of door and window frames, Internal & External Plastering, drainage sumps etc.		**5.00%**
4	On Completion of all the services including plumbing, electrical and firefighting works etc.		**8.00%**
5	On Completion of all finishing works including Flooring, VDF flooring, painting i/c putty & Primer, Fixing of Door shutters, windows & Ventilators including hardware and fittings etc.		**7.00%**
6	All miscellaneous works such as railing work, steel work, Signages works, Plinth protection, ramps, etc.		**5.00%**
7	On Completion of all balance works, testing and commissioning of services lines, cleaning of site and Taking away of Tools and plants, machinery and construction equipment etc.		**1.00%**
8	Upon receiving Completion certificate or Occupation certificate from local body or NOC from statutory authorities to occupy the buildings		**2.00%**
9	**Submission of Handing over of asset along with:** • Building wise inventory • As built drawings including all services both Civil and E & M. • As built BIM Model • All original warranty card/bond from OEMs for all the equipment along with copy of bill • Obtaining at least GRIHA 4 Star Certification • Successful Handing over to Department of Law, GNCTD, Delhi.		**2.00%**
	TOTAL		**100.00%**

MAJOR COST CENTRE "C" SCHEDULE OF PAYEMENT FOR *TYPE V RESIDENTIAL QUARTERS BUILDING OF G+12 FLOORS*

Sl. No.	Mile Stone		Schedule of Payments
1	**Completion of RCC Framed Structure**		**35.00%**
	1.1	*On Completion up to Floor Ground level*	*2.50%*
	1.2	*On Completion up to Floor One level*	*2.50%*
	1.3	*On Completion up to Floor Two level*	*2.50%*
	1.4	*On Completion up to Floor Three level*	*2.50%*
	1.5	*On Completion up to Floor Four level*	*2.50%*
	1.6	*On Completion up to Floor Five level*	*2.50%*
	1.7	*On Completion up to Floor Six level*	*2.50%*
	1.8	*On Completion up to Floor Seven level*	*2.50%*
	1.9	*On Completion up to Floor Eight level*	*2.50%*
	1.10	*On Completion up to Floor Nine level*	*2.50%*
	1.11	*On Completion up to Floor Ten level*	*2.50%*
	1.12	*On Completion up to Floor Eleven level*	*2.50%*
	1.13	*On Completion up to Terrace level*	*2.50%*
	1.14	*On completion of Terrace Tank, Mumty, Lift Machine room, parapet & water proofing of terrace etc. as per the scope of work.*	*2.50%*
2	**Completion of brick work, finishing works i.e. Plastering, flooring, fixing of doors & windows, interior & exterior painting etc.**		**41.00%**
	2.1	*Completion of brick work including fixing of door and window frames*	*5.00%*
	2.2	*Completion of Internal & External Plastering, Water proofing works i/c Façade works if any*	*5.00%*
	2.3	*All type of Wall Panelling, Cladding, Kitchen Slab etc.*	*6.00%*
	2.4	*All types of Flooring, skirting, dado and window sills, jambs etc.*	*8.00%*
	2.5	*Fixing of Door shutters, windows & Ventilators including hardware and fittings*	*5.00%*
	2.6	*Internal painting i/c putty & primer and finishing in all respects*	*2.50%*
	2.7	*External painting i/c putty & Primer, and Finishing in all respects*	*2.50%*
	2.8	*Supply and Fitting of woodwork like modular kitchen, wardrobe, cupboards, shoe rack i.e. Fixed fit-out Furniture's etc.*	*4.00%*
	2.9	*All miscellaneous works such as False Ceilings, railing work, steel work, glass work, Signages works, Jali work/ louvers, Plinth protection, ramps, approaches, Overhead Tanks etc.,*	*3.00%*
3	**On completion of all sanitary & water supply fixtures & Plumbing work etc.**		**7.50%**
	3.1	*Overall laying of pipe network for internal Plumbing i/c water supply & sewerage, firefighting, rain water in position inside the building & connection with OHTs and UGTs including Fittings and Fixtures and its testing, as per the Scope of work.*	*5.00%*
	3.2	*Internal Sanitary installation works, Gully chambers and connection up to first Manhole etc. including Fittings and Fixtures for complete plumbing works etc. and its testing, as per the Scope of work.*	*2.50%*
4	**Installation of Systems in Various E & M Services**		***12.50%***
	4.1	*Internal Electrification Works such as conduits & cable trays, wires & cables, Power points, light points, fan points, modular switches & sockets, Bus Ducts*	*4.00%*

Sl. No.	Mile Stone		Schedule of Payments
		& rising mains, MCB DBs & LT panels, meters & floor panels, earthing, aviation light & lighting protection, Power wiring/cabling, Led light fixtures, Fans, Provision for Gysers & RO, AC (Copper pipeing & Drain piping for split AC) etc. and other related works.	
	4.2	*Fire detection and fire- fighting system and Wet risers and sprinkler system, automatic FIRE ALARM SYSTEM AUTOMATIC & PA System, Fire Suppression, Fire Extinguishers, Pressurised MECHANICAL VENTILATION SYSTEM and other related works i/c all Piping Works, Fire Fighting Pumps upto External UGT Fire Tank.*	*3.00%*
	4.3	*Passenger/ Service lifts etc. complete and other related works*	*3.00%*
	4.4	*On completion of testing and integrated commissioning of all services and equipment's.*	*2.50%*
5	Completion of all balance works, testing and commissioning of services lines, cleaning of site and Taking away of Tools and plants, machinery and construction equipment		**2.00%**
6	Upon receiving Completion certificate or Occupation certificate from local body or NOC from statutory authorities to occupy the buildings		**1.00%**
7	Submission of Handing over of asset along with: • Building wise inventory • As built drawings including all services both Civil and E & M. • As built BIM Model • All original warranty card/bond from OEMs for all the equipment along with copy of bill • Obtaining at least GRIHA 4 Star Certification • Successful Handing over to Department of Law, GNCTD, Delhi		**1.00%**
	TOTAL		**100.00**

MAJOR COST CENTRE "D" SCHEDULE OF PAYEMENT FOR *TYPE VI RESIDENTIAL QUARTERS BUILDING OF G+12 FLOORS*

Sl. No.	Mile Stone		Schedule of Payments
1	**Completion of RCC Framed Structure**		**35.00%**
	1.1	*On Completion up to Floor Ground level*	*2.50%*
	1.2	*On Completion up to Floor One level*	*2.50%*
	1.3	*On Completion up to Floor Two level*	*2.50%*
	1.4	*On Completion up to Floor Three level*	*2.50%*
	1.5	*On Completion up to Floor Four level*	*2.50%*
	1.6	*On Completion up to Floor Five level*	*2.50%*
	1.7	*On Completion up to Floor Six level*	*2.50%*
	1.8	*On Completion up to Floor Seven level*	*2.50%*
	1.9	*On Completion up to Floor Eight level*	*2.50%*
	1.10	*On Completion up to Floor Nine level*	*2.50%*
	1.11	*On Completion up to Floor Ten level*	*2.50%*
	1.12	*On Completion up to Floor Eleven level*	*2.50%*
	1.13	*On Completion up to Terrace level*	*2.50%*
	1.14	*On completion of Terrace Tank, Mumty, Lift Machine room, parapet & water proofing of terrace etc. as per the scope of work.*	*2.50%*
2	**Completion of brick work, finishing works i.e. Plastering, flooring, fixing of doors & windows, interior & exterior painting etc.**		**41.00%**
	2.1	*Completion of brick work including fixing of door and window frames*	*5.00%*
	2.2	*Completion of Internal & External Plastering, Water proofing works i/c Façade works if any*	*5.00%*
	2.3	*All type of Wall Panelling, Cladding, Kitchen Slab etc.*	*6.00%*
	2.4	*All types of Flooring, skirting, dado and window sills, jambs etc.*	*8.00%*
	2.5	*Fixing of Door shutters, windows & Ventilators including hardware and fittings*	*5.00%*
	2.6	*Internal painting i/c putty & primer and finishing in all respects*	*2.50%*
	2.7	*External painting i/c putty & Primer, and Finishing in all respects*	*2.50%*
	2.8	*Supply and Fitting of woodwork like modular kitchen, wardrobe, cupboards, shoe rack i.e. Fixed fit-out Furniture's etc.*	*4.00%*
	2.9	*All miscellaneous works such as False Ceilings, railing work, steel work, glass work, Signages works, Jali work/ louvers, Plinth protection, ramps, approaches, Overhead Tanks etc.,*	*3.00%*
3	**On completion of all sanitary & water supply fixtures & Plumbing work etc.**		**7.50%**
	3.1	*Overall laying of pipe network for internal Plumbing i/c water supply & sewerage, firefighting, rain water in position inside the building & connection with OHTs and UGTs including Fittings and Fixtures and its testing, as per the Scope of work.*	*5.00%*
	3.2	*Internal Sanitary installation works, Gully chambers and connection up to first Manhole etc. including Fittings and Fixtures for complete plumbing works etc. and its testing, as per the Scope of work.*	*2.50%*
4	**Installation of Systems in Various E & M Services**		***12.50%***
	4.1	*Internal Electrification Works such as conduits & cable trays, wires & cables, Power points, light points, fan points, modular switches & sockets, Bus Ducts*	*4.00%*

Sl. No.	Mile Stone		Schedule of Payments
		& rising mains, MCB DBs & LT panels, meters & floor panels, earthing, aviation light & lighting protection, Power wiring/cabling, Led light fixtures, Fans, Provision for Gysers & RO, AC (Copper pipeing & Drain piping for split AC) etc. and other related works.	
	4.2	*Fire detection and fire- fighting system and Wet risers and sprinkler system, automatic FIRE ALARM SYSTEM AUTOMATIC & PA System, Fire Suppression, Fire Extinguishers, Pressurised MECHANICAL VENTILATION SYSTEM and other related works i/c all Piping Works, Fire Fighting Pumps upto External UGT Fire Tank.*	*3.00%*
	4.3	*Passenger/ Service lifts etc. complete and other related works*	*3.00%*
	4.4	*On completion of testing and integrated commissioning of all services and equipment's.*	*2.50%*
5	Completion of all balance works, testing and commissioning of services lines, cleaning of site and Taking away of Tools and plants, machinery and construction equipment		**2.00%**
6	Upon receiving Completion certificate or Occupation certificate from local body or NOC from statutory authorities to occupy the buildings		**1.00%**
7	Submission of Handing over of asset along with: • Building wise inventory • As built drawings including all services both Civil and E & M. • As built BIM Model • All original warranty card/bond from OEMs for all the equipment along with copy of bill • Obtaining at least GRIHA 4 Star Certification • Successful Handing over to Department of Law, GNCTD, Delhi		**1.00%**
	TOTAL		**100.00**

MAJOR COST CENTRE "E" SCHEDULE OF PAYEMENT FOR SITE DEVELOPMENT & EXTERNAL INFRASTRUCTURE WORKS - SITE LEVELING, ROAD, FOOTPATH, PAVED PARKING, GATE & GUARD ROOM ETC.

S. No.	Milestones	Schedule of Payment
1	Site Levelling i/c cutting & filling, Services Tranches, retaining wall and associated works, complete	6.00%
2	Construction of Roads with Kerb Stone etc. including associated work, complete in all aspects	16.00%
3	Construction of Paved Surface Parking Areas along the Roads, Footpath, Pathways including associated work, complete in all aspects	12.00%
4	Construction of Gate & Guard Room Complex with all ancillary work, complete in all aspects	18.00%
5	Construction of Boundary Wall along the campus with all ancillary work, complete in all aspects	16.00%
6	Construction of Swimming Pool with other ancillary works, complete in all aspects	10.00%
7	Construction/ Development of Sports Facilities, Tot lot area including supply and installation of required equipment with all ancillary work, complete in all aspects	8.00%
8	Development of Horticulture Areas, Landscaping around the buildings, Plantation of Trees etc. with associated work, complete in all aspects	5.00%
9	Construction/ Development of Sitting Arrangements, Benches all across the campus, Boom Barriers, Markings, Signage etc. including associated work, complete in all aspects	6.00%
10	Upon receiving Completion certificate or Occupation certificate from local body or NOC from statutory authorities to occupy the buildings	1.00%
11	Submission of Handing over of asset along with: • Building wise inventory • As built drawings including all services both Civil and E & M. • As built BIM Model • All original warranty card/bond from OEMs for all the equipment along with copy of bill • Obtaining at least GRIHA 4 Star Certification • Successful Handing over to Department of Law, GNCTD, Delhi	2.00%
	TOTAL	**100.00%**

MAJOR COST CENTRE "K" SCHEDULE OF PAYEMENT FOR Earthing, Electrical LV Works, DG Set, External Street Lighting, Solar Roof Top System, Electric Vehicle Charger, Fire Alarm and Fire Suppression System etc.

S. No.	Milestones	Schedule of Payment
1	Submission of Design, Calculations, Shop drawing & Technical Data Sheets and obtaining approval from Engineer-in-Charge	**2.00%**
2	**Earthing Works** including supply and installation of required items, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**0.60%**
a	On Supply of Equipment & other Materials etc.	0.30%
b	On Completion of Installation	0.20%
c	On Testing & Commissioning	0.10%
3	**Electrical, Low Voltage, Extra Low Voltage Works** including supply and installation of L.T. & H.T. Cables & other required items, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**5.00%**
a	On Supply of Equipment & other Materials etc.	2.50%
b	On Completion of Installation	1.50%
c	On Testing & Commissioning	1.00%
4	**DG Set Works** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**2.40%**
a	On Supply of Equipment & other Materials etc.	1.50%
b	On Completion of Installation	0.50%
c	On Testing & Commissioning	0.40%
5	**External Street Lighting System** including supply and installation of poles, foundations, Solar Hybrid LED Lighting plus LED street light fittings, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**49.00%**
a	On Supply of Equipment & other Materials etc.	25.00%
b	On Completion of Installation	19.00%
c	On Testing & Commissioning	5.00%
6	**Roof top Solar On-grid System** including supply and installation of all the required equipment/items, foundations, Solar Panels, control panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**7.00%**
a	On Supply of Equipment & other Materials etc.	3.50%
b	On Completion of Installation	2.00%
c	On Testing & Commissioning	1.50%
7	**Electrical Vehicle Charger Work** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**22.00%**

a	On Supply of Equipment & other Materials etc.	12.00%
b	On Completion of Installation	6.00%
c	On Testing & Commissioning	4.00%
8	**Intelligent Fire Alarm System** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**7.00%**
a	On Supply of Equipment & other Materials etc.	3.50%
b	On Completion of Installation	2.00%
c	On Testing & Commissioning	1.50%
9	**Fire Suppression System** including supply and installation of all the required equipment/items, panels, cabling, earthing, junction boxes, brackets, hardware and all associated civil/electrical works, complete in all aspect.	**3.00%**
a	On Supply of Equipment & other Materials etc.	1.50%
b	On Completion of Installation	1.00%
c	On Testing & Commissioning	0.50%
10	On Successful Handing/ Taking over to Department of Law, GNCTD, Delhi	**2.00%**
	Total	**100.00%**

MAJOR COST CENTRE "L" SCHEDULE OF PAYEMENT FOR LAN & Data, WIFI Networking & IPEBAX System, UPS, IP CCTV System, Telephone Active Passive etc.

S. No.	Milestones	Schedule of Payment
1	Submission of Design basis report, Node/Matrix calculation, Wifi Heatmapping, Shop Drawing, Technical Data Sheets and BIM Model and approval from Engineer-In Charge	5.00%
2	On Supply of Equipment's & other Materials etc.	50.00%
3	On Completion of Installation of Equipment's, Cabling etc.	30.00%
4	On Testing & Commissioning	10.00%
5	On Successful Handing/ Taking over to Department of Law, GNCTD, Delhi	5.00%
	Total	**100.00%**