INDIAN INSTITUTE OF MANAGEMENT MUMBAI
Vihar Lake Road, Powai, Mumbai-400087

TENDER DOCUMENT

FOR

Construction of G+1 Executive Dining Hall Near MDP Hostel Building, Interior Renovation & Furnishing Works for Kitchen in Pragati Vihar Building and Furniture work including Interior Alterations Within MDP Hostel Building and setting up of Industrial Kitchen in Pragati Vihar and Swami Vivekanada Hall

NIT No.: WAP/INFS-1/IIMM/R&M/2025/03
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Volume-II
Tender Specifications

Invited By:
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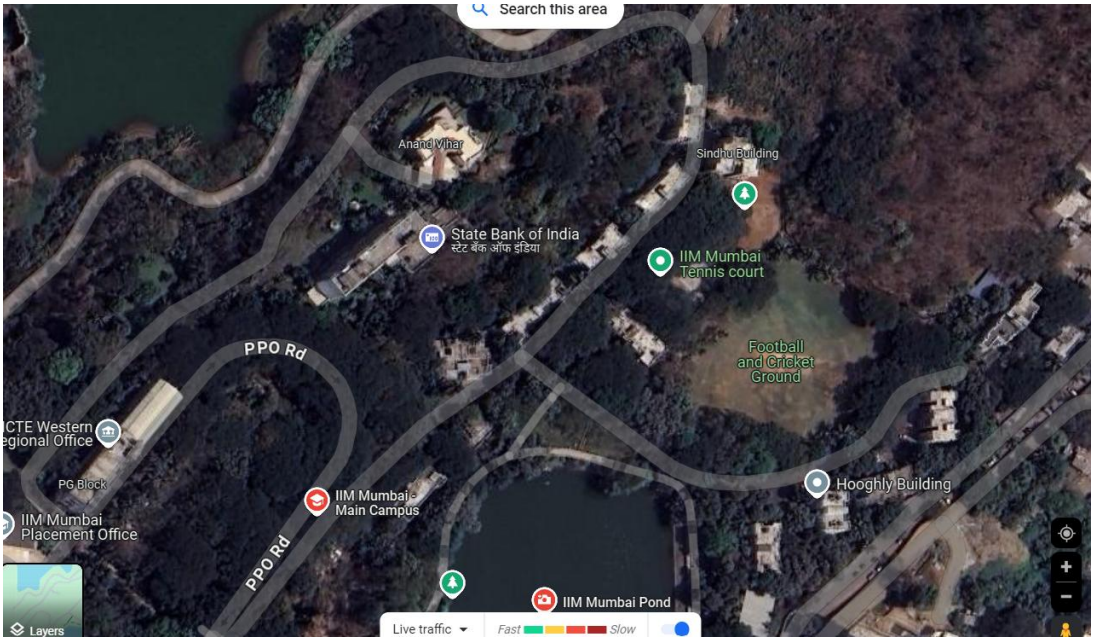
SECTION-VIII
SCOPE OF WORK

1.0 Site:

The site is located within the Indian Institute of Management Mumbai Near and at Pragati Vihar Building located at vihar lake road, Powai, Mumbai.



The work majorly comprises of following heads.

1. Part-A Civil, Electrical and MEP works for Construction of G+1 Executive Dining Hall in the backyard of Pragati Vihar Building in IIM Mumbai.
2. Part B Civil, Electrical and MEP works for Interior Refurbishment / Renovation of new Kitchen area after demolition of old construction at Ground & First Floor, Pragati Vihar Building in IIM Mumbai
3. Part C: Proposed Furniture Works Including Interior Furnishing Works Multi-Purpose Hall & Ground & First Floor, Pragati Vihar Building.
4. Part D Supply, Installation, Testing and Commissioning of Kitchen Equipment, Ventilation System in MDP Hostel Building.
5. Part E: Supply, Installation, Testing and Commissioning of Kitchen Equipment, Ventilation System, LPG Gas Bank Pipe line, Waste Management System and other ancillary works in Swami Vivekananda Hall at IIM Mumbai.

The details items are places under Bill of Quantities along with Item description and Technical specifications in the tender for execution of works as per direction of PMC/ Architects/ Engineer-

In-Charge

2.0 Construction Schedule

S. No.	Name of work	Total Duration	M-1 Feb-25	M-2 Mar-25	M-3 Apr-25	M-4 May-25	M-5 Jun-25	M-6 Jul-25	M-7 Aug-25	M-8 Sep-25
1	**Part-A** Construction of G+1 Executive Dining Hall in the backyard of Pragati Vihar Building in IIM Mumbai,	8 Months								
2	**Part B** Proposed Interior Repair & Renovation at Ground & First Floor, Pragati Vihar Building in IIM Mumbai	8 Months								
3	**Part C** Proposed Furniture Works Including Interior Furnishing Works Multi-Purpose Hall & Ground & First Floor, Pragati Vihar Building.	2.5 Months								
	1st Floor									
	2nd Floor									
	3rd Floor									
	4th Floor									
	5th Floor									
4	**Part D** Supply, Installation, Testing and Commissioning of Kitchen Equipment, Ventilation System in MDP Hostel Building.	3 Months								
5	**Part E:** Supply, Installation, Testing and Commissioning of Kitchen Equipment, Ventilation System, LPG Gas Bank Pipe line, Waste Management System and other ancillary works in Swami Vivekananda Hall at IIM Mumbai	3 Months								

Note: **The institute operations are running during the construction. Hence it is desired that the work of Industrial Kitchen IN Vivekananda Hall Boys Hostel and Pragati Vihar , and Furniture works of MDP Hostels shall be planned for execution and completion during April & May 25 (i.e. during summer vacation) with least interference.**

Section- IX
Technical Specification

1.0 GENERAL SCOPE OF WORK

IIM-Mumbai desires to construct a G+1 storey structure to be used as a Dining centre including renovation works to be carried out within the Hostel building within IIM Mumbai campus at Powai with the briefscope as below:

A) Civil and other allied works for the Proposed G+1 storeyed structure

The broad scope of work shall include Civil Works, Plumbing & Sanitary works, Water supply, Internal and External Electrical works, Services works, Interior / Furniture & Exterior finishing works etc.

B) Civil, Interiors, Furniture and other allied works for MDP Hostel (Pragati Vihar building) inside Hostel building extended portion including Repair of Kitchen and SITC of Industrial kitchen equipment's works for Approx. 400 Student Capacity.

C) Civil, Industrial kitchen works and other allied works for 1200 Student Capacity in Vivekananda Hall building inside Hostel building extended portion.

The broad scope of work shall include Civil Works, Plumbing & Sanitary works, Water supply, Internal and External Electrical works, Services works, Interior / Furniture & Exterior finishing works etc.

The work to be performed under this specification shall include providing all labour, supervision, materials, storages, inventories, all enabling works like scaffolding, watch and ward for the works, power, fuel, construction equipment, water, tools and plants, supplies, transportation, all taxes and duties, all labour welfare and safety measures, complete and all other incidental items not shown or specified, but reasonably implied or necessaryfor successful completion of the work including Contractor's supervision andin strict accordance with the drawings and specifications, inspection and testing standards and field quality control and testing as given in the tender documents and the complete execution of the works. The scope shall also include preparation of fabrication drawings and bar bending schedules, based on the drawings released for construction and getting the same approved by the Engineer-in-Charge.

The contractor shall have sole responsibility of co-ordination for constructionactivities, though he may employ separate sub- contractors Electrification including LT installation, Lifts and fire-fighting, HVAC etc. All co-ordination and interfacing with all the sub- contractors shall be done by the contractor.

2.0 COMPLETION PERIOD:

Completion period for combined package shall be 8 months from the date ofLOA.

3.0 SPECIFICATION FOR WORK, QUALITY AND WORKMANSHIP

Work shall be carried out as per C.P.W.D. specifications and for items not covered in the C.P.W.D. specifications the details shall be as outlined in thistechnical specification or relevant IS codes (latest).

The specifications are intended for the general descriptions of the work, quality and workmanship. The specifications are not, however, intended to cover the minute details and the work shall be executed according to the best Central Public Works Department practices or to the recommendations of relevant Indian Standard/International Codes like ASTM/DIN or according tothe instructions of the Engineer-in-Charge.

All the materials of the project shall be sourced from the List of Approved Makes as provided herein. For items whichare not available in the "List of Approved Makes", the decision of Engineer-in-charge shall be final. The procurement of various materials shall be either from the manufacturer or their main authorized dealers to ensure thatno duplicate/spurious makes are used in the works. The Contractors are required to submit manufacturer's test certificates for the lots supplied at site with due endorsements by the actual dealers/vendors/sellers.

Notwithstanding all the above, the contractor shall be held responsible for theexecution of works and use of proper materials as per the tender specifications. Any material shall be approved by the Engineer-in-charge before put to use.

Wherever reference to CPWD/Indian Standard Codes and Practices is made,it shall be to the latest edition/revision of the same, issued up to 7 days priorto the date of opening of this tender.

The tenderer must obtain clarifications, if any, regarding the specifications and all other tender documents before submission of the tender in writing with the Employer in respect of interpretation of any portions of these documents.

4.0 TESTS OF MATERIALS/WORKMANSHIP

All mandatory tests shall be carried out as required in the CPWD specifications and IS codes. Test mentioned in individual items/specificationsshall also be carried. All tests required for all materials shall be at the Contractor's cost. In case of items not covered in the CPWD specifications and IS code contractor shall arrange testing as per practice of the industry without any additional cost. Manufacture's test certificate of the relevant batch of material procured shall also be submitted for all measure items.

5.0 LAYOUT AND LEVELS

The layout and levels of all buildings, structures etc. shall be made by the Contractor at his own cost from the general grid of the plot and bench marksas approved by the Engineer-in-Charge. The Contractor shall also assist in the form of instruments, materials and men to Engineer-in-Charge for checking the detailed layout and correctness of the layout and levels, at his own cost. But the Contractor shall be solely responsible for correctness of layout and levels. The levels and heights mentioned in the tender drawingsare only tentative. The works shall be carried out as per Construction drawings issued after the award of the works.

6.0 CONSTRUCTION METHOD

The tenderer shall submit construction schedule, names of specializedagencies/products, list of construction equipment to be deployed and write-upto indicate in a broad outline how he intends to execute the work with the best co-ordination among various sub-packages (or sub-heads). These shallform part of this Tender.

7.0 DRAWINGS:

Drawings enclosed with this Tender Document shall form a part of this specification and supplement the requirement specified herein. The tender drawings are preliminary and meant for tender purpose only. These drawings provide a general idea about the work to be performed under the scope of this Contract and are by no means final drawings showing the full range of work under the scope. Work shall be executed strictly according to 'Released for Construction' (or 'Good for Construction') drawings with additions, alterations and modifications made from time to time as required by the Employers.

The Contractor is required to furnish a schedule indicating their requirementsof 'Release for Construction' drawings compatible with the approved detailedconstruction program within 10 days of award of the work for scrutiny and approval and subsequent finalization of the Employers. 'Good for Construction' drawings shall be issued to the contractor progressively duringthe execution of the contract as per actual progress achieved and requirements at site. Based on the 'Released for Construction' drawings, contractor will prepare reinforcement placement drawings including the Bar Bending Schedule, Steel Fabrication Drawings, all other shop drawings etc.
Any technical clarifications required regarding the drawings/specifications during the progress of works shall be obtained from the Engineer-in-Chargeallowing a minimum of four working days for processing. Such "Requests forInformation" (RFI) shall be in approved format which can be obtained from Engineer-in-Charge.

The actual terminal point of scope of works under this contract shall be as shown in 'Good for Construction' drawings.

8.0 APPROVED VENDORS AND MAKES:

The Vendors / Makes are available in "List of Approved Makes"For items which are not available in the same, the decision of Engineer-in-charge shall be final.

However, to facilitate procurement, the list of makes, shall be treated as indicative list, which is not comprehensive in nature.

9.0 APPROVED SUB-CONTRACTORS:

If the tenderer wishes to appoint any sub-contractor for scope of Electrification, HT & LT installation, HVAC, Safety, fire-fighting etc. approval of Engineer-in-charge shall be obtainedbased on their technical experience and qualifications as approved by the Engineer in charge.

If at any time during the construction, the works are suspended by any approved vendor/sub-vendors, due to any reason whatsoever, the works shall be completed within the contract period by any other vendor subject tothe Employer's approval, at no additional costs, whatsoever.

10.0 PRE DISPATCH INSPECTION:

Necessary dispatch clearance for all bought out items shall be accorded by executing site. Inspection of the items, based on the criticality, shall also be carried out by executing site.
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.
The type test report for transformer, diesel engine and alternator as per relevant standards shall be submitted for purchaser's approval.

11.0 MAINTENANCE CREW DURING DEFECT LIABILITY PERIOD:

The tenderer shall submit along with the offer, the details of crew (number, level and detailed skills) to take adequate care of routine maintenance and also the minimum inventory of spares for the Employer's approval.

12.0 MISCELLANEOUS

(a) The contractor shall be responsible for watch and ward of all the works, equipments and various materials till complete handing over the works and allnecessary arrangements to co-ordinate with watch and ward of other contractors working simultaneously and also of the Employers shall be made to the complete satisfaction of the Engineer-in-Charge.

(b) The list of deliverables which are to be submitted to the Employer shall be discussed and finalized by the Employer at the time of award. The Contractor shall necessarily submit all the drawings/documents/other deliverables unless anything is waived. The contractor shall submit 4 (four) sets of drawings/design documents/test reports as may be required for the approval of the Employer.

(c) The contractor shall co-operate with the representatives of the Employer fordue verifications of various compliances of various statutory regulations andtax compliances as and when required. All the documents of record shall bemade available to the Employers and copies, wherever required, shall be submitted.

(d) Employer 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.

(e) The Contractor shall make arrangements for regulation of traffic by engaging security staff. They shall also make necessary arrangements to prevent unauthorized entry in the premises

(f) Contractor shall comply with all regulations of local authorities without anyfinancial implication to IIM-Mumbai.

13.0 COMPLETION CERTIFICATE

On completion of the work the Contractor shall obtain completion certificate from local bodies or statutory body viz. MCGM, CFO, MCGM Ward Office, MMRDA, MHADA, NOC's issuing departments of MCGM etc for and on behalf of the Owners / Consultants for the construction as contemplated in this contract. However the Owner & Consultant may also help contractor to the extent of writing letters toLocal bodies for expediting approval, if required. Further if any fee is requiredto be paid to the local/statutory bodies, the same shall be reimbursed to contractor by the owner against documentary evidence.

PREAMBLE TO SPECIFICATIONS

1.1 GENERAL

All Works shall be measured net as completed or as fixed in place with no allowance (unless specified for) for cuttings, wastage, joints, risks etc. No allowance shall be made for large or small quantities, narrow widths, easy access or difficult positions or other exceptional circumstances. Any work executed over and above the dimensions given in drawings or sketches provided by the Engineer in charge or written instructions by the Engineer in charge shall be ignored, and no payment shall be made for such extra work. In other words, payment shall be made for authorized Permanent Works only. Unless otherwise specified measurements shall be taken as per the provisions of I.S. code 1200.

1.2 TOLERANCE:

Tolerance only for the purpose of calculating quantities shall be as under. Linear dimensions shall be measured correct to the 0.01 m. Area shall be worked out correct to the 0.01 Sq.m. volume (Cubic contents) shall be worked out correct to the 0.01 cubic meter and weight shall be worked out correct to 0.001 Tone or 1 Kg. as applicable, and thickness to 1.0 mm unless otherwise specified.

1.3 TRANSPORT:

The shortest practicable route as approved by Engineer in charge shall measure distance.

1.4 FULL PROVISIONS:

The rates/percentage inserted by Contractor/tendered against various items / amount of work detailed in various parts of schedule shall be deemed to include every allowance necessary, without extra measurement or charge for meeting the requirement of various components/parts of the contract documents viz. Particular Specifications. Standard Specifications of Goa P.W.D. item wise specifications, Additional Special Conditions and Mandatory Instructions, Preambles and Notes to Schedule Items, description of Schedule items, which shall all be read together, and any or all of the following unless specifically provided for to the contrary.

a. Compliance with all the conditions of contract including General Conditions of Contract., Schedule of Quantities, Particular Specifications, drawings including notes thereon, Specifications in Standard Specifications and other Specification in this Contract of Goa P.W.D., Relevant Indian Standard Specifications, and other Specification in this Contract. All India Standard Schedule of Rates 1986 "Standard Specifications" of Govt. of India as and where applicable.

b. All labour, materials, tools and plant, equipment and transport (which may be) required in preparation for and in the full and entire execution and completion of the Works, including waste in materials, carriage and cartage, carrying in, all leads and lifts. Hoisting, seating, fitting and fixing in position.

c. Local Conditions: Nature of Works, local facilities for supply of labour and materials, accessibilities to site, and all other matters affecting the execution and completion of the Works.

d. Duties etc. : Payment of any Octroi, Terminal Tax, Turnover Tax, Toll Tax, Contract Sales Tax, Ground Rent, Environmental Cess or any other duties and levies on materials obtained for the Works and any duties in respect of patent rights including Works contract sales tax etc.

e. Supervision: Competent supervision of the Works.

f. Labour: Reasonable terms and conditions of employment liabilities to pay compensation, pay wages in accordance with payment of wages Act wages as per statutory enactments, temporary accommodation, sanitation etc. compliance with Contract Labour Act.

g. Water and Power: Provision of all water and power required including temporary plumbing and electrical connections.

h. Temporary workshops, stores, office, labour camps foundation for crane etc.: Provision of such structures as required for efficient execution of the work, removing and cleaning up site on completion of work.

i. Precautions against risk: Precautions to prevent loss or damage from all or any risks, insurance of sheds or any temporary accommodation provided by Client, watching and lighting and provisions pertaining to these in General Conditions of Contract.

j. Notices, Fees etc.: Compliance with statutory provisions of regulations and/or byelaws of any local authority and/or any public service company or authority affected by the Works.

k. Setting out the Works including all apparatus required.

l. Site Drainage: Removal at no extra cost of all water that may accumulate due to springs, sub-soil water, rains, flood/tides and any other causes on the site during the progress of the Works or in trenches and excavations.

m. Execution of work in a workman like manner including providing facilities for inspection etc.

n. Rectification of bad work: Rectification or removal and reconstruction of any work which (as decided by the engineer) has been executed with unsound or imperfect material or unskilled or unsatisfactory workmanship or a quality inferior to that contracted for, whether during construction or prior to the expiry of the maintenance period.

o. Responsibility for damages and loss of all construction materials etc. at the site until handed over to Client.

p. Removal of Rubbish: Removal of rubbish and debris and cleaning of any dirt before handing it to Client.

q. Cleaning site and Works: Removal by the contractor, off the site any temporary structure any tools, plant and materials and sweeping, washing, cleaning joinery, removal of splashes of paint and lime wash and leaving the whole structure neat and tidy.

r. Completion: Completion of the Works to the satisfaction of the Engineer on or before the stipulated date of completion.

s. Difficult Positions: Accessibility or otherwise to site, easy or difficult positions in work. Co-ordination with CLIENT/ PWD/Any other statutory body for obtaining permission for diversion of traffic or any other facilities during execution of this project.

t. Errors: Rectification of all errors to the satisfaction of the Engineer (e.g. when excavation is carried out deeper than ordered or required level shall be made up with concrete as specified for the foundation at no extra cost.

u. Maker's instructions: Compliance with maker's instructions in the case of proprietary articles.

v. Curved work etc.: Work of any quantity, size or shape, whether level, inclined, curved, battered etc.

w. Waste: All wastes, laps, seams, joints (rough or fair cutting) cutting, straight / raking, circular and making good.

x. Artificial Lights: To include for all lighting, kerosene or electric power as the case may be, when need arises for use of lighting out Works.

y. Tests: Carrying out all tests at field laboratory and or any other laboratory approved by Engineer as per relevant Indian Standards in required frequencies.

GENERAL SPECIFICATIONS

1.0 These specifications shall be read in conjunction with the Particular Specifications for various items of work. The Contractor shall carefully acquaint himself with the general specifications, coordinate the same with any other specifications forming a part of the Contract Document and determine his contractual obligations for the execution of various items of work in accordance with good engineering practices.

2.0 REFERENCE TO THE STANDARD CODES OF PRACTICE:

2.1 All standards, tentative specifications, specifications, code of practice referred to shall be the latest editions including all applicable official amendments and revisions. The contractor shall make available at site all relevant Indian Standard Codes of Practice as applicable.

2.2 In case of discrepancy between standards, codes of practice, tentative specifications, specifications referred to, these specification, shall govern.

3.0 CONTRACTOR TO PROVIDE:

The Contractor shall provide and maintain at site throughout the period of Works the following at his own cost and without extra charge, the cost being held to be included in the Contract Rates.

3.1 All labour, materials, plant, equipment and temporary Works required to complete and maintain the Works to the satisfaction of the Engineer.

3.2 Lighting for night work, and also whenever and wherever required by the Engineer.

3.3 Temporary fences, guards, lights and protective work necessary for protection of workmen, supervisors, engineers or any other persons permitted access to the site.

3.4 All equipment, instruments and labour required by the Engineer for measurement of the Works.

3.5 The contractor shall provide all necessary equipments to test the approved materials which are to be incorporated into the works. All the pegs for setting out the works and fixing the levels required for the execution thereof shall be as desired by Engineer-in-charge, be built in masonry at such places and in such a manner as the Engineer-in-charge may direct. The contractor shall carefully protect and preserve all bench marks and other marks used in setting out the works.

3.6 SWING TYPE WEIGH BATCHESS:

Contractor shall also provide platform swing type weigh batches of approved make (as per I.S. 2722 portable swing type).

3.7 Any layout of equipment not specifically mentioned above which can reasonably be held necessary for the completion and maintenance of the Works to the satisfaction of the Engineer.

4.0 DIMENSIONS:

4.1 Written dimensions on drawings shall supersede measurement by scale and drawings to a large scale shall take precedence over those to a smaller scale. Special dimensions or directions in the specifications shall supersede all others. All dimensions shall be checked on site prior to execution.

4.2 The dimensions where stated do not allow for waste, laps, joints, etc. but the Contractor shall provide at his own cost sufficient labour and materials to cover such waste, laps, joints, etc. and the rate quoted is inclusive of such provision and no separate payment will be made for the same.

4.3 The levels, measurements and other information concerning the existing site as shown on the drawings are believed to be correct, but the Contractor should verify them for himself and also examine the nature of the ground as no claim or allowance whatsoever will be entertained on account of any errors or omissions in the levels or the description of the ground levels or strata turning out different from what was expected or shown on the drawings.

5.0 SETTING OUT OF WORKS:

The Contractor shall set out the Works indicated in the Conditions of Contract.

The Contractor shall provide suitable stones with flat tops and build the same in concrete for temporary bench marks. All the pegs for setting out of the Works and fixing the levels required for the execution thereof shall, if desired by the Engineer, be built in masonry at such places and in such a manner as the Engineer may direct. The Contractor shall carefully protect and preserve all bench marks and other marks used in setting out the Works.

6.0 MATERIALS:

6.1 QUALITY:

All materials used in the Works shall be of the best quality of their respective kinds as specified herein, obtained from sources and suppliers approved by the Engineer and shall comply strictly with the tests prescribed hereafter, or where tests are not laid own in the specifications, with the requirements of the latest issues of the relevant Indian Standards.

6.2 SAMPLING AND TESTING:

All materials used in the Works shall be subjected to inspection and tests in addition to test certificates. Samples of all materials proposed to be employed in permanent Works shall be submitted to the Engineer for approval before they are brought to the site.

Samples provided to the Engineer for their retention are to be labeled in boxes suitable for storage. Materials or workmanship not corresponding in character and quality with approved samples will be rejected by the Engineer.

Samples required for approval and testing must be supplied sufficiently in advance to allow for testing and approval, due allowance being made for the fact that if the first samples are rejected further samples may be required. Delay to the Works arising from the late submission of samples will not be acceptable as a reason for delay in completion of the Works.

Materials shall be tested before leaving the manufacturer's premises, quarry or source, wherever possible. Materials shall also be tested on the site and they may be rejected if not found suitable or in accordance with the specifications, notwithstanding the results of the tests at the manufacturer's Works or elsewhere or test certificates or any approval given earlier.

The contractor will bear all expenses for sampling and testing, whether at the manufacturer's premises at source, at site or at any testing laboratory or institution as directed by the Engineer. No extra payment shall be made on this account.

6.3 DISPATCH OF MATERIALS:

Materials shall not be dispatched from the manufacturer's Works to the site without written authority from the Engineer.

6.4 TEST CERTIFICATES:

All manufacturer's certificates of test, proof sheets, etc. showing that the materials have been tested in accordance with the requirement of this specifications and of the appropriate Indian Standard are to be supplied free of charge on request to the Engineer.

6.5 REJECTION:

Any materials that have not been found to conform to the specifications will be rejected forthwith and shall be removed from the site by the Contractor at his own cost.

6.6 The Engineer shall have power to cause the Contractors to purchase and use such materials from any particular source, as may in his opinion be necessary for the proper execution of the work.

7.0 STORING OF MATERIALS AT SITE:

All materials used in the Works shall be stored on racks, supports, in bins, under cover etc. as appropriate to prevent deterioration or damage from any cause whatsoever to the entire satisfaction of the Engineer. The storage of materials shall be in accordance with IS 4082 "Recommendation on stacking and storage of construction materials on site" and as per IS 7969 "Safety code for handling and storage of building materials".
The materials shall be stored in a proper manner at places at site approved by the Engineer. Should the place where material is stored by the Contractor be required by the Employer for any other purpose, the Contractor shall forthwith remove the material from that place at his own cost and clear the place for the use of the Employer.

8.0 WATER:

8.1 Water for Construction:

Clean fresh water only shall be used for the Works. The water shall be free from any deleterious matter in solution or in suspension. The quality of water shall conform to IS 465.

8.2 Storage:
The Contractor shall make his own arrangements for storing water, if necessary, in drums or tanks or cisterns, to the approval of the Engineer. Care shall be exercised to see that water is not contaminated in any way.

9.0 WORKMANSHIP:

9.1 All Works shall be true to level, plumb and square and the corners, edges and corners in all cases shall be unbroken and neat.

9.2 Any work not to the satisfaction of the Engineer or his representative will be rejected and the same shall be rectified, or removed and replaced with work of the required workmanship at no extra cost.

10.0 LOADING TESTS:

10.1 The Engineer shall during the progress of the Works or during the period of maintenance, instruct the Contractor that a loading test or any other non-destructive test such as ultrasonic test or smith Hammer Test be made on the Works or any part thereof if, in his opinion such a test or tests be deemed necessary for one or more of the reasons herein below specified.

10.1.1 The site made concrete test cubes failing to attain the specified strength.

10.1.2 The shuttering for concrete Works being prematurely removed.

10.1.3 Overloading during construction of the Works or part thereof;

10.1.4 Concrete improperly cured;

10.1.5 If any portion of the work is carried out without prior approval in writing of the Engineer or his representative to proceed with such work;

10.1.6 If concrete is honeycombed or damaged or in the opinion of the Engineer particularly weak in important or critical areas of the structure where weakened concrete will affect the ability of the structure to carry design loads;

10.1.7 Any other circumstances attributed to alleged negligence on the part of the Contractor which, in the opinion of the Engineer, results in the Works or any part thereof being of less than the expected strength;

10.1.8 Any reason other than the foregoing.

10.2 The tests shall be made at the Contractor's own cost whether the results of such tests be satisfactory or otherwise.

10.3 All the loading tests and other tests like N. D. Test will be carried out strictly in accordance with the instructions of the Engineer. Load testing will generally follow the procedure set out in Indian Standard Codes of Practice, but the Engineer is not bound to follow the Indian Standard Codes of Practice and in his absolute discretion may issue instructions differing from the procedure set out in the Indian Standard Codes of Practice.

10.4 If in the opinion of the Engineer the result of the loading tests and other tests like N.D. Tests is not satisfactory, the Engineer shall instruct that such parts of the Works as he specifies shall be taken down or cut out and reconstructed to comply with the specifications, or other remedial measures shall be taken to make Works secure to the satisfaction of the Engineer. The Contractor shall take down, or cut out and reconstruct the defective work or shall take the remedial measures instructed at his own cost.

PARTICULAR SPECIFICATIONS

EARTHWORK & METAL PACKING

A.1 Excavation for all Works and of materials required for filling shall be to the exact width, length and depth shown on the drawings or as directed in writing by the Engineer. If excavation is carried out to greater width, length, depth than required, the Contractor shall make good, at his own cost, the extra depth by sound masonry or concrete filling, and extra length or width filled in by well consolidated earth or if the Engineer thinks it necessary for the stability of the work, by masonry or concrete as he may direct.

A.2 Excavated material required for filling shall be stacked or dumped where indicated by the Engineer. Excavated material not required for filling and any surplus material shall be removed and spread on the site where and as directed by the Engineer or carted away from the site as directed by the Engineer. Dumping of this surplus material shall be in an orderly manner and according to the levels/grades as indicated by the Engineer. The maximum radius for dumping of this surplus material on site from excavations will be as noted in the bill of quantities. The cost of such removal and spreading shall be borne by the Contractor and held to be included in the Contract Rates.

A.3 The Contractor shall, at the Contract Rates make provision for all shoring, pumping, dredging, bailing out or draining water whether subsoil or rain or other water and the excavation shall be kept free of water while the masonry work or concrete work is in progress and until the Engineer considers the work well set (Refer IS: 3764 Safety for Excavation Work). The sides of trenches shall be kept vertical and the bottom horizontal and shall be run level throughout or properly stepped as directed by the Engineer.

The Contractor shall effect and maintain during progress of Works temporary fences around dangerous excavations.

A.4 Excavation in ordinary soil means excavation in marine clay saturated or unsaturated with water or ordinary hard soil including stiff heavy clay, hard shale, or compact soil or any material which can be removed by the ordinary application of spades, picks and pick axes. This shall also include removal of isolated boulders each having a volume not more than 0.05 corms.

A.5 Excavation in soft rock includes limestone, sandstone, laterite, etc. Or other rock which can be quarried or split with crowbars or wedges. This shall also include excavation of tarred pavements, masonry work and rock boulders each having a volume of not less than 0.05 cu.m and not more than 0.25 cu.m.

A.6 Excavation in hard rock includes any rock found in ledges or masses in its original form or sheet rock or cement concrete, excavation of which in the opinion of the Engineer requires the use of compressed air equipment, sledge hammer and blasting.

A.7 In case of any difficulty concerning the interpretation of Clauses A.4, A.5 and A.6 above, the Engineer shall decide whether the excavation in a particular material is in ordinary soil, soft rock or hard rock and his decision in this matter shall be final and binding on the Contractor and without appeal.

A.8 The foundation trenches shall be inspected and passed by the Engineer before such approval concrete or masonry work is commenced and the Contractor shall hold an order in writing to this effect, otherwise the Contractor shall be liable to have this work removed for inspection.

A.9 The earth / murum for backfilling in foundation shall be got approved by the Engineer. In the foundation the backfilling shall be done in layers not more than 300 mm thick and shall be thoroughly watered and consolidated by approved method. The rate for backfilling in foundation is deemed to have been included in the excavation rate.

A.10 <u>Murum Filling</u>

A.10.1 The backfilling in plinth and other places which are required for leveling shall be done in layers not more than 300 mm thick. The filling shall be watered and thoroughly consolidated by vibratory roller of approved capacity in case of platforms and by mechanical compactors in case of all buildings. The process shall be repeated till the required level is achieved. After the backfilling is completed the surface shall be uniformly dressed and levelled. Murum of approved quality brought by the contractor from outside source having liquid limit not more than 40 and platicity index not more than 20 and minimum dry density not less than 1700 Kg. per m3 shall be used for filling and spread in layers not more than 300mm, to the required line and grade, watered and compacted with 8-10 tonnes power road roller so as to attain atleast 95% of modified proctor dry density.

A.11 Metal Packing: Unless otherwise specified, stone for metal packing shall consist of crushed or broken stone. It shall be hard, durable and free from disintegrated particles, excessive dust and other objectionable matter.

Grading of coarse aggregates shall conform to one of the gradings given in the following tables:

Grading No	**Size range in mm**	**Sieve desig-nation (IS.460) Passing**	**% by weight the sieve**	**Remark**
1.	90mm	100mm	100	Suitable
	to 40mm	80mm	65-85	for
	63mm	25-60	100mm	
	40mm	0-15	consolidated	
	20mm	0-5	thickness	

Grading No	**Size range in mm**	**Sieve desig-nation (IS.460) Passing**		**% by weight the sieve**	**Remark**
2.	63mm	80mm		100	Suitable
	to 40mm	63mm		90-100	for 75mm
		50mm	35-70		consolidated
		40mm	0-15		thickness 20mm 0-5
	3.	50mm	63mm		100 Suitable
		to 20mm	50mm		95-100 for 65mm
			40mm	35-70	
consolidated			20mm	**0-10**	
thickness		**10mm**	**0-5**		

Screening to fill the voids shall consist of the same material as coarse aggregates and shall conform to the grading given below:

Classification	**Size of nation**	**Sieve desig-passing**	**% by weight**
A.	12.5mm	12.5 mm	100
	10.0 mm	90-100	
	4.75 mm	10-30	
		150 micron	0-8
B.	10.0mm	10.0 mm	100
	4.75 mm	85-100	
	150 micron	10-30	

The metal packing shall be done in layers not more than 100 mm compacted thickness. For 150 mm compacted thickness, it shall be done in two layers each of 75 mm compacted thickness.

After laying, each layer shall be compacted thoroughly by mechanical Compactor in case of buildings & by vibrating roller in case of roads, as specified or by other equivalent method approved by the Engineer. Slight sprinkling of water shall be done at the time of rolling.

After rolling has been completed, screening shall be applied uniformly and gradually to fill the interstices and the surface shall be dry rolled. In no case shall screenings be dumped in a heap on the rolled surfaces. Rolling shall be accompanied with brooming.

After application of screening and rolling, the surface shall be copiously sprinkled with water and rolled. If necessary additional screening shall be applied to fill the voids if any. Rolling shall be continued until the coarse aggregates are well bonded. Care shall be taken that the base of sub-grade does not get damaged due to addition of excessive quantities of water during the construction.

A.13 Measurements:

a) Measurements of excavation shall be solid measurements of the material prior to its removal. Measurement shall be of exact length and width as indicated in the drawings and depth measured vertically, according to the drawings or Engineer's written instructions. Measurement shall be as per drawing and dimensions of bed concrete net without any allowance for increase in bulk. Extra excavation for working space and on account of slips or falls shall not be measured and that rate will include cost of inserting planking, strutting etc. and filling with selected soil after removal of planking.

Rates of excavation shall include the following provision,

a) Excavating either straight or curved or plain.

b) Bailing out by pumping or other measures all water which may accumulate in excavations or sites or in trenches or in pits from rains, springs, underground water, tidal water, broken water mains, drains, well or any other sources.

c) Setting out Works and all profiles, cross heads, boning rods, staves as well as all tools and plants.

d) All materials and labour required for fencing in protecting against risk of accident to open excavation etc. and for providing gangways with handrail across open trenches etc. where necessary, during the progress of Works.

e) Watching and lighting where necessary and as directed by the Engineer.

f) Forming "Tell Tales" or "Dead Men" in borrow pits and forming steps in deep excavation for facility of recording measurement.

g) Planking and strutting of adequate strength to be designed by Contractor and as directed by Engineer.

h) Excavation for insertion of planking and strutting and filling with soil after removal of planking and strutting.

i) Removal of slips or falls in excavation.

j) Carting away spoil or falls in excavation separating useful soil fit for reuse in filling.

k) Cleaning of irregular pockets and dewatering excavation.

l) Carting of all excavated stuff and disposing off within a lead of 0.5 Km. as directed by Engineer.

Measurements for excavation of soft rock and hard rock (Clauses A5 & A6) when section or trench measurement are absolutely not possible, stack measurement with 40 percent void deduction shall be given provided reasonable care has been taken to avoid deliberate hollows in the stack. The stacks of soft & hard rock's will be laid separately on an area as directed by Engineer-in-charge.

The measurement for murum filling shall be based on actual difference of levels before filling and after filling, leveling and compacting.

The rate for metal packing shall be based on final compacted thickness and shall include all labour, materials and the cost of rolling with road roller, or other equivalent method to obtain full compaction, application of screening, watering etc. complete. It shall be measured in cubic meters.

CONCRETE: PLAIN & REINFORCED

B.1 Cement

The Cement used shall be of the following grade with the prior approval of the Engineer shall be taken for any of the above brands. Proposed to be used in the work.

a.	Ordinary	
	Portland Cement (Gr 53)	IS: 12269 --- Only for RCC work
	(Only Birla Super, L&T,	
	Gujarat Ambuja, manikgarh or	
	any other approved brand	
	will be allowed to be used in	
	the work)	
b.	----- do ----	IS: 12239 ---For works other than
		RCC works.
c.	Sulphate Resisting Cement	IS: 12330/1988

Use: Cement shall be used in the order in which it is received. Cement in bags in storage for more than 3 months shall be retested before use.

Testing: Not withstanding test certificate given by manufacturer a sample shall be tested from every batch of cement delivered on site or once for every 1000 bags whichever is more frequent. Tests shall be carried out for fineness, initial and final setting time, and compressive strength (IS: 4031) and the results approved by the Engineer before use of the cement in permanent Works. Samples shall be taken immediately on receipt of cement at site. The methods and procedure of sampling shall be in accordance with IS: 3535. The Engineer may specify other forms of sampling and tests including chemical analysis, (IS:4032) if in his opinion the cement is of doubtful quality; the costs of such additional tests shall be borne by the Contractor.

B.2 Fine Aggregates (Sand)

1. It shall be river or pit sand conforming to IS: 383, obtained from sources approved by the Engineer. These sands, if found too coarse, shall be suitably blended with finer sand to obtain the desire grading. The provision of two types of sand and their stacking separately and their mixing in the specified proportions shall be at the Contractor's cost.

The sand shall not contain silt more than a total of 2% by weight or 7%by volume and shale, clay, silt and other structurally weak particles. A totaling to not more than 5% by weight. Chloride content in washed sand shall not be greater than 0.04% by weight and salty water in sad shall be thoroughly removed by washing sand in potable water

2. The grading of the sand shall conform to IS: 383.

The sand shall be screened on a 4.75 mm size screen to eliminate over-size particles.

The sand shall be washed in screw type mechanical washers in potable water to remove excess silt, clay and chlorides. The screening and washing of sand shall be completed at least one day before using it in concrete.

The washed sand shall be stored on a sloping concrete platform and in such a manner as to avoid contamination.

3. The aggregate shall be subjected to tests in accordance with IS 2386 as may be ordered by the Engineer. The cost of such tests shall be borne by the contractor.

B.3 Coarse Aggregates

1. Coarse aggregates for the Works shall be crushed stone conforming to IS: 383, obtained from sources as approved by the Engineer. Only Quarries having jaw crushers with choke feeding arrangement producing aggregates of nearly cubical shape shall be approved.

Aggregates shall be properly screened and if necessary washed clean before use.

2. Coarse aggregates containing flat or flaky pieces or mica shall be rejected.

3. Coarse aggregates shall be supplied in the following sizes

Nominal size	Maximum size	Minimum size
10mm	12mm	5mm
20mm	25mm	10mm
40mm	40mm	20mm
80mm	80mm	40mm

4. The grading of coarse aggregate shall be such that not more than 5% shall be larger than the maximum size and not more than 10% shall be smaller than the smallest size. Between these sizes the coarse aggregate shall be well graded.

5. The aggregates shall be subjected to tests in accordance with IS 2386 as may be ordered by the Engineer.

6. Aggregates shall be stored in such a way as to prevent segregation of sizes and avoid contamination with fines.

B.4 Mixers and Vibrators

1. For all concreting work the Contractor shall provide weigh batching plant of suitable capacity which shall be got approved before bringing it to the site. The plant used shall conform to IS: 2722.

2. The Contractor shall provide concrete mixers (IS: 1791 - Batch type concrete mixers, IS: 2439 - Roller Pan Mixer).

3. The Contractor shall provide at site Concrete Vibrators Immersion Type, IS: 2505 - Screed Board Concrete Vibrators, IS: 2506 supplied by recognized manufacturers.

The Contractor shall make available at site needle vibrators of sizes 25mm, 40mm, and 60mm for use in various appropriate locations of the structure.

B.5 Grade of Concrete

The concrete is designated as follows:

- Concrete M - 35/20
- The letter M refers to the mix

The number 35 represents the characteristic compressive strength of 15cm cubes at 28 days in MPa (Mega Pascals: 1MPa: 10 kg/cm2 approximately). M35 concrete thus has a characteristic strength of 350 kg/cm2.

The number /20 represents the maximum nominal size of aggregate in the mix, in this case 20mm.

B.6 Minimum Cement Content

For all structural concrete work the minimum cement content shall not be less than 360 kg/m3 of concrete from durability considerations.

B.7 Trial mixes: (for strength)

1. The Contractor is entirely responsible for the design of the concrete mixes. The design is however to be approved by the Engineer. At least 8 weeks before commencing any concreting in the Works, the Contractor shall make trial mixes using samples of coarse aggregates, sand, water super plasticizer and cement, typical of those to be used in the works, and which have been tested in an approved laboratory. A clean dry mixer shall be used and the first batch discarded.

2. The cement content for different grades of concrete and the required average strengths at 28 days for which the mixes shall be designed are specified below:

TABLE - 1

Grades of Concrete	Character-istic Strength (f'ck)	Target mean (f'cm) (Mpa)	Strength f'cm Mpa (Fcm)	Min Cement Content Kg/m3	*Water Cement Ratio (Max)	Maximum Slump at placing point (mm)	Cement Grade
M20/10	20	21	29	360	0.45	150	53
M20/20	20	21	29	360	0.45	50	53

M30/20	30	29	39	400	0.40	170	53
M35/20	35	36	44	450	0.40	100	53
M40/20	40	36	49	450	0.40	170	53

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* Note: 1. Proper workability will be achieved, without changing the water cement ratio by using adequate quantity of approved admixtures like super plasticizers at no extra cost to the Client.

2. The mixes are designed to yield mean strengths (f'cm) greater than the corresponding specified characteristic strengths (f'ck) as indicated in above Table. The difference between f'cm and f'ck is called the `Current Margin'. The value of the current margin has been set at 9 MPa for all grades of concrete. The concrete mixes shall be designed on the basis of required strength, desired workability, the maximum size of aggregate and also the various grades of cements as specified in IS : 10262-1982, Clause. Grade of cement shall be 53 as described in table 1 above. Accordingly the required cement content shall be ascertained. The Contractor has option to use either approved Super plasticizers or increased cement content to achieve the required strengths at his own cost and workability without affecting water cement ratio.

3. For each grade a total of 18 cubes shall be made. Of these 18 cubes made, not more than 6 may be made on any day and further, of the 6 cubes made in one day not more than 2 cubes may be made from any single batch. 9 of these cubes, each representing a different batch of concrete shall be tested at the age of 7 days and the remaining 9 cubes shall be tested at the age of 28 days. The making of the cubes, their curing, storing, transporting and testing shall be in accordance with Indian Standards IS: 516. The test shall be carried out in a laboratory approved by the Engineer.

4. If the average strength of the concrete cubes falls below the required target mean strength (f'cm) fresh preliminary mixes for that grade shall be made as before, until the trial mixes yield cubes of compressive strength at 28 days greater than the required average target mean strength (f'cm) at that age.

5. Whenever there is a significant change in the quality of any of the ingredients for concrete, the Engineer may at his discretion order the carrying out of fresh trial mixes. All costs for trial mixes and tests shall be to the Contractor's account and held to be included in the Contract Rates.

6. Before commencing the Works the Contractors shall submit to the Engineer for approval full details of all preliminary trial mixes and tests.

7. The Contractor shall carry out trial casting of a mock-up of at least one meter length of RCC member to establish the correctness of grading aggregates, suitability of formwork, of admixtures proposed, suitability of mould oil proposed to be used on formwork to prevent surface blemishes etc.,. All costs of such trial casting shall be included in the Contract Rates.

8. When the proportions of a concrete mix have been approved by the Engineer, the Contractor shall not vary the quality or source of the materials or the mix without the written approval of the Engineer.

B.8 Concrete Cube Tests:

The quality of hardened concrete will be verified by the following procedure:

1. The Engineer shall select random batches of concrete for examination without warning the Contractor and sampling will generally be done at the point of discharge from the mixer.

2. From the batches thus selected 6 concrete cubes shall be made in accordance with Indian Standards. However not more than 2 cubes may be made from any single batch. Of these 6 cubes thus made 3 cubes (each cube representing concrete of different batches) shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days.

3. All cubes shall be made, cured, stored, transported and tested in accordance with Indian Standards. The tests shall be carried out in a laboratory approved by the Engineer.

4. At least 6 cubes shall be made on each day's concreting until 60 cubes have been made for each grade of concrete. This is in the initial period.

5. After the initial period, subject to the acceptance of the Engineer, the frequency at which the cubes shall be made may be reduced as follows :

(1 set = 6 cubes, each pair of cubes representing concrete from a different batch.)

At least 1 set for each day's concreting consisting of:

a) 1 set for every 10 m3 or part thereof of concrete for critical structural elements like columns, arch etc. plus :

b) 1 set for every 40 m3 or part thereof for all other elements.

If concrete is batched at more than one point simultaneously the above frequency of making cubes shall be followed at each point of batching.

3 of the cubes of each set shall be tested at 7 days and the remaining 3 cubes shall be tested at 28 days from the day of casting the cubes.

B.9 Acceptability criteria

1. The strength requirement of any particular grade of concrete will be considered satisfactory if the 28 days' compressive strengths of individual sets (each set consists of 3 cubes) and of individual cubes satisfy the following requirements :

i. For the first five sets

a) The average strength determined from any group of 9, three consecutive test cubes exceeds the specified characteristic strength (f'ck) by not less than 0.8 times the current margin.

b) Only one individual cube test result in any set may fall below the specified characteristic strength (f'ck) provided that this value is not less than 95% of the specified characteristic strength (f'ck).

ii. Thereafter : Provided that the average strength of any fifteen consecutive cubes exceeds the specified characteristic cube strength by at least 0.9 times the current margin all the subsequent test results may be considered acceptable if :

a) The average strength as determined from any group of three consecutive test cubes exceeds the specified characteristic strength (f'ck) by not less than 0.6 times the current margin.

b) Only one individual cube test result in any set may fall below the specified characteristic strength provided that this value is not less than 90% of the specified characteristic strength.

2. Whenever a mix is redesigned due to a change in the quality of aggregates or cement or for any other reason, it shall be considered a new mix and initially subject to the acceptability criteria in B.9 above.

3. If the concrete produced at site does not satisfy the above strength requirements, the Engineer will reserve the right to require the Contractor to improve the methods of batching, the quality of the ingredients and redesign the mix with increased cement content if necessary. The Contractor shall not be entitled to claim any extra cost for the extra cement used for the modifications stipulated by the Engineer for fulfilling the strength requirements specified. The cost of carrying out concrete cube tests shall be covered in the rates for concrete items quoted by Contractor.

4. The above specification is based on an assumed standard deviation of 5.5 Mpa, and a probality of concrete strength falling below the desired minimum strength of lin 20. In case quality control is very good at site and the cube test results consistenly show a standard deviation better than the standard deviation assumed here the Engineer may at his discretion reduce the required target strength f'cm for any particular grade of concrete and in consequence the current margin.

B.10 It is the complete responsibility of the Contractor to design the concrete mixes by approved standard methods and to produce the required concrete conforming to the specifications and the strength requirements approved by the Engineer. It is expected that the Contractor will have competent staff to carry out this work.

B.11 Failure to meet specified Requirements:

1. If from the cube test results it appears that some portion of the Works has not attained the required strength, the Engineer may order that that portion of the structure be subjected to further testing of any kind whatsoever as desired by the Engineer, including, if so desired by him, full load testing of the suspected as well as adjacent portions of the structure as specified in the Conditions of Contract. Such testing shall be at the Contractor's cost. The Engineer may also reject the work and order its demolition and reconstruction at the Contractor's cost.

2. If the strength of concrete in any portion of the structure is lower than the required strength, but is considered nevertheless adequate by the Engineer so that demolition is not necessary, the Contractor shall be paid a lower rate for such lower strength concrete as determined by the Engineer.

B.12 As frequently as the Engineer may require, testing shall be carried out in the field for:

1) Moisture content and absorption and density of sand and aggregates
2) Silt content of sand
3) Grading of sand and aggregates
4) Slump test of concrete
5) Concrete cube test
6) Permeability test for concrete as per DN 1048 (Part-I). Allowable permeability on untreated concrete surface 25mm
7) Density and P H value of Plasticizer

The Contractor shall provide and maintain on site at all times, until the Works are completed, equipment and staff required for carrying out these tests. The Contractor shall grant the Engineer or his representative full access to his laboratory at all times and shall produce on demand complete records of all tests carried out on site.

Before concreting commences on any section of the Works the Contractor shall obtain approval of the Engineer or his representative as regards the formworks and reinforcement's conforming with the drawings. He shall also indicate to the Engineer in writing and obtain his approval for positions of construction joints.

B.13 Admixtures: Use of Melamine or Naphthalene based approved admixtures (Super plasticizer) is a must. They shall be such that the strength requirements are not affected by their use. The Admixtures will not be paid for separately. The admixtures shall also have the property of set retarding. Before approval of super plasticizer the contractor will submit test reports as specified in ASTMC-486 from an approved laboratory as approved by Engineer in charge. Subsequent batches will be tested for IR analysis, UV analysis and solid content or any other tests as directed by Engineer-in-charge.

B.14 Weigh Batching

All structural concrete shall be weigh batched. All concrete ingredients shall be batched by weight using a weigh batcher of an approved make (IS: 2722 Portable swing weigh batchers for concrete). Batching shall be to an accuracy of not less than 1/2 kg and the batcher shall be tested for accuracy of calibration before commencement of the Works and at least once a week thereafter or more frequently if so required by the Engineer.

Use of Ready Mix Concrete (RMC) is obtained and permitted at the discretion of the Engineer-in-charge and at no extra cost to the Client.

B.15 Water and Super plasticisers shall be batched by weight or by volume measures as approved by the Engineer. The method of batching shall be such as will ensure accuracy to 0.2 liters or better for water and 20 ml or better for plasticizers.

The Contractor shall provide the mixer operator with standard measures for dispensing water and plasticizers in accurate quantities as per design. Concrete mix containing water in excess of that specified shall be rejected and shall not be allowed for use in the Works.

B.16 Placing temperatures

During hot weather, concreting shall be in accordance with the procedures set out in IS: 7861, Parts I & II.

Fine and coarse aggregates for concreting shall be kept shaded and the concrete aggregates sprinkled with water for a sufficient time before concreting in order to ensure that the temperature of these ingredients is as low as possible prior to batching. The mixer and batching equipment shall be also shaded and if necessary painted white in order to keep their temperatures as low as possible. The placing temperature of concrete shall be as low as possible in hot weather and

care shall be taken to protect freshly placed concrete from overheating by sunlight in the first few hours of its laying. The time of day selected for concreting shall also be chosen so as to minimize placing temperatures. In case of concreting in exceptionally hot weather the Engineer may in his discretion specify the use of ice either flaked and used directly in the mix, or blocks used for chilling the mixing water. In either case, the Contractor shall be paid only the cost of such ice delivered on site and nothing extra for additional labour involved in weighing and mixing.

B.18 Transporting, placing, compacting and curing

1. Transporting, placing, compacting and curing of concrete shall be in accordance with IS: 456.

2. Transporting:

The mix after discharging from the mixers shall be transported by wheel barrows, buckets, pumps etc., without causing segregation and loss of cement slurry and without altering its desired properties, with regard to water cement ratio, slump, air content, cohesion and homogeneity. It should be ensured that the concrete is moved to its final destination before it attains initial set.

3. Placing :

The height of any single lift of concrete shall not exceed 1.5 m for walls or 2.0 m for columns.

The thickness of horizontal layers shall not exceed 300 mm. High velocity discharge of concrete causing segregation of mix shall be avoided. The concrete shall be placed in the forms gently and not dropped from a height exceeding 1.5m except in columns where the maximum allowed will be 2.0 m. Each layer of concrete shall be compacted fully before the succeeding layer is placed and separate batches shall follow each other so closely that the succeeding layer shall be placed and fully compacted before the layer immediately below has taken initial set. The layers should be sufficiently shallow, to permit knitting of two layers together by vibration.

The concreting of any portion or section of the work shall be carried out in one continuous operation and no interruption of concreting work will be allowed without approval of the Engineer.

4. Compaction

Internal (needle) and surface (screed board) vibrators of approved make shall be used for compaction of concrete.

a) Internal vibrators shall be used for compaction of concrete in foundations, columns, beams, buttresses arch section etc. For sections such as slabs, the concrete shall be compacted by surface type vibrators. Depending on the thickness of layer to be compacted, 25 mm, 40 mm, and 60 mm dia internal vibrators will be used. The concrete shall be compacted by use of appropriate diameter vibrator by holding the vibrator in position until:

i) Air bubbles cease to come to surface

ii) Resumption of steady frequency of vibrator after the initial short period of drop in the frequency, when the vibrator is first inserted.

iii) The tone of the vibrator becomes uniform.

iv) Flattened, glistening surface, with coarse aggregates particles blended into it appears on the surface.

After the compaction is completed, the vibrator should be withdrawn slowly from the concrete so that concrete can flow in to the space previously occupied by the vibrator. To avoid segregation during vibration the vibrator shall not be dragged through the concrete nor used to spread the concrete. The vibrator shall be made to penetrate, into the layer of fresh concrete below if any for a depth of about 150 mm. The vibrator shall be made to operate at a regular pattern of spacing. The effective radii of action will overlap approximately half a radius to ensure complete compaction.

5. To secure even and dense surfaces free from aggregate pockets, vibration shall be supplemented by tamping or rodding by hand in the corners of forms and along the form surfaces while the concrete is plastic.

6. A sufficient number of spare vibrator's specially needless, shall be kept readily accessible to the place of deposition of concrete to assure adequate vibration in case of breakdown of those in use.

25 mm diameter immersion vibrators shall be used in thin, 40 mm diameter immersion vibrators in fairly wide sections and 60 mm diameter vibrators in foundations and arch abutments. Screed vibrators shall be used for precast deck elements and in the in-situ deck slab concreting where the thickness of the slab is 50 mm.

7. Plain concrete in foundations shall be placed in direct contact with the bottom of the excavation, the concrete being deposited in such a manner as not to be mixed with the earth. Plain concrete also shall be vibrated to achieve full compaction, using needle or screed vibrators as necessary.

8. Concrete placed below the ground shall be protected from falling earth during and after placing. Concrete placed in ground containing deleterious substances shall be kept free from contact with such ground and with water draining therefrom during placing and for a period of seven days or as otherwise instructed thereafter. Approved means shall be taken to protect immature concrete from damage by debris, excessive loading, abrasion, vibrations, deleterious ground water, mixing with earth or other materials, and other influences that may impair the strength and durability of the concrete.

B.19 Construction Joints:

Engineer. Where vertical joints are required, these shall be shuttered and two coats of approved surface retarders shall be applied as directed by the Engineer on the surface of formwork in contact with concrete. The joint concrete shall not be allowed to take the natural slope of the concrete. Pouring sequence of concrete should be got approved from the Engineer. Retarders should be used to ensure that the previous layer of concrete does not get initial setting before the next layer is laid on it. Construction chemicals of approved polymer or epoxy compounds shall be used at no extra cost to client for maintaining bond between old & new concrete/at cold joints in concrete.

Before fresh concrete is placed against a vertical joint, the old concrete shall be chipped, cleaned and moistened. Where required, suitable expansion joints shall also be provided as directed by the Engineer.

No separate payment shall be allowed to the Contractor for forming joints or chipping and cleaning them and for using chemicals at the joints. When a horizontal construction joint is formed, provision shall be made for interlocking with the succeeding layer by the embedment of saturated wooden blocks or strips bevelled on four sides to facilitate their removal. Prior to the next pour the wooden pieces shall be loosened and removed in such a manner as to avoid injury to the concrete.

B.20 Curing of Concrete:

a) Curing shall be done as specified in I.S. 456
b) Concrete shall be cured with potable water for the specified period after the final setting of concrete.
c) In respect of concrete, where 53 grade cement is used, curing should be started within four hours of placement of concrete.
d) Use of sea water / creek water or brackish water for curing will not be allowed. Only potable water shall be used for curing.
e) Surfaces on which water cannot be retained shall be covered with jute or hessian cloth. The cloth shall be constantly kept wet / moist during the entire curing period.

B.21 Cracks:

1. If cracks develop in concrete construction, which in the opinion of the Engineer may be detrimental to the strength of the construction, the Contractor at his own expense shall test the slab or other construction as specified in Special Conditions. If under such test loads the cracks develop further, the Contractor shall dismantle the construction, carry away the debris, replace the construction and carry out all consequential work thereto.

2. If any cracks develop in the concrete construction, which in the opinion of the Engineer, are not detrimental to the stability of the construction, the Contractor at his own expense shall grout the cracks with polymer cement grout of approved quality and also at his own expense and risk shall make good to the satisfaction of the Engineer the surface finish of ceilings, etc. which in the opinion of the Engineer has suffered damage either in appearance or stability owing to such cracks. The Engineer's decision as to the extent of the liability of the Contractor in the above matter shall be final and binding.

B.22 Defective Concrete:

Should any concrete be found honeycombed or in any way defective, such concrete shall on the instruction of the Engineer be cut out by the Contractor till solid concrete is obtained and the portion is made good by using specially designed mix for such repair work. This shall be done at contractor's own expense.

B.23 Exposed Faces, Holes and Fixtures:

On no account shall concrete surfaces be patched or covered up or damaged concrete rectified or replaced until the Engineer or his representative has inspected the Works and issued written instructions for rectification. Failure to observe this procedure will render that portion of the Works liable to rejection; in which case it will be treated as rejection which has failed to meet specified strength requirements and dealt with according to Clause B.11.

Holes for foundation or other bolts or for any other purposes shall be moulded, and steel angles, holdfasts or other fixtures shall be embedded, according to the drawing or as instructed by the Engineer at no extra cost to the client.

B.24 Concrete surface:

The face of concrete for which formwork is not provided other than slabs shall be floated to a smooth finish. The floating shall be done so as not to bring an excess of mortar to the surface of the concrete. The top face of a slab intended to be surfaced with other material shall be left with a spaded finish.

B.25 Other applicable codes of practice for in-situ reinforced construction

All other requirements not covered by the above clauses shall be governed by relevant clauses of IS 456, IS 3370, IS 2571 and other relevant standards as may be applicable.

B.26 Precast Concrete

The provision in this section shall be considered supplementary to general provisions for reinforced concrete Works.

Handling & Storage

The precast units shall be stored as directed by the Engineer. The area intended for the storage of precast units should be surfaced in such a way that no unequal settlement can occur. To prevent deformation of slender units, they should be provided with supports at fairly close intervals and should also be safeguarded against tilting. Lifting and handling positions should conform to the Engineer's directions and drawings. In addition, location and orientation marks should be put on the members, as and where necessary. During erection the precast units should be protected against damage caused by local crushing and chafing effects of lifting and transport equipment. Corners and edges of precast units should be properly protected against any damage.

Temporary Supports and Connections:

Temporary supports provided during erection should take into account all construction loads likely to be encountered during the completion of joints between any combination of precast and in-situ concrete structural elements. The supports should be arranged in a manner that will permit the proper finishing and curing of any in-situ concreting and grouting associated with the precast member being supported when the gaps of joints have to be filled with concrete or mortar. The joints should first be cleaned and surface of the joints should be wetted. The mixing, placing and compacting of cement and mortar should be done with special care. Where mortar is specified of a dry consistency it should be in the proportion of 1 part of cement to 1 1/2 parts of sand and should be placed in stages and packed hard from both sides of the joint.

Tolerances

The following tolerances apply to finished precast products at the time of placement in the structure. The forms must be constructed to give a casting well within these limits:

1. Overall dimensions of members should not vary more than +/- 6mm per 3m length with a maximum variation of +/- 20mm.

2. Cross-sectional dimensions should not vary more than the following :

+/- 3mm for dimensions less than 150mm thick

+/- 4mm for dimensions over 150mm & less than 450mm

+/- 6mm for dimensions over 450mm to 1000mm

+/- 10mm for dimensions over 1000mm

3. Deviation from straight line in long sections should not be more than +/- 6mm upto 3m, +/- 10mm for 3m to 6m, +/- 12mm for 6m to 12m.
4. The above deviations are not applicable to PCC blocks which are dealt with separately.

B.27 Measurement

Concrete and reinforcement shall be paid separately unless otherwise specified.

The volume of concrete measured shall include that occupied by:

1. Reinforcement and other metal sections

2. Cast in components each less than 0.01 m3 in volume

3. Rebates fillets or internal splays each less than 0.005 m2 in cross sectional area.
4. Pockets and holes not exceeding 0.01 m3 in volume

5. For 1:3:6 PCC below foundations no payment shall be made for any shuttering used. The cost for this if any should be included in the rate for this item.

6. Rates for precast concrete is inclusive of cost of casting yard, moulding, and demoulding, concreting, handling, storing, curing transporting and erecting at site, including all clamping, bracing that may be required during erection including erection equipment and filling of joints in cement mortar etc. complete.

FORMWORK

C.1 Definition:

The term "Formwork" or "Shuttering" shall include all forms, moulds, sheeting, shuttering planks, alers, poles, posts, shores, struts and strutting, ties, uprights, walling, steel rods, bolts, wedges and all other temporary supports to the concrete during the process of setting.

C.2 Design:

The formwork shall be designed and constructed so that the concrete can be properly placed and thoroughly compacted to obtain the required shape, position and level subject to specified tolerances. It is the responsibility of the Contractor to obtain the results required by the Engineer, whether or not some of the work is sub-contracted. Approval of the proposed formwork by the Engineer will not diminish the Contractor's responsibility for the satisfactory performance of the formwork, nor for the safety and coordination of all operations.

To avoid delay and unnecessary rejection of the formwork the Contractor shall obtain the approval of the Engineer for the design of forms and the type of material used before fabricating the forms. (Ref. ACI 347 Formwork for Concrete or equivalent I.S. Code).

The Contractor shall prepare detailed formwork drawings indicating the sizes of all the members he proposes to use for formwork for raft, plinth beams, staircase, walls, columns top, slabs, floor beams, precast piles etc., and get approval from the Engineer before fabrication and erection.

The deflection of all members used in formwork shall not be more than 1/360 of span of the member or 3 mm, whichever is less.

The foundation of all shores shall be designed to suit the bearing capacity of soil to support the designed loads without settlement. If required the bearing capacity of soil shall be improved by providing compacted metal packing or lean concrete below the bearing plate and mudsills.

C.3 Materials:

1. All facing formwork to come in contact with concrete in different elements of the structure hall be of such material and size as specified on drawings or as instructed by the Engineer. Plywood whenever used for such concrete shall be changed after five reptitions or even earlier if instructed by Engineer.

2. Timber facing formwork to come in contact with concrete for "Exposed Concrete Surfaces" shall consist of lap jointed or tongue and grooved planks as directed by the Engineer and no joint shall permit leakage of mortar at all from cast-in-situ concrete.

3. All joints in shuttering and between shuttering and the surface of earlier concrete lift shall be sealed with 5 mm thick compressible material such as sponge or other approved materials so that no joint permits leakage of slurry.

4. The materials for other backing and supporting formwork and their sizes shall be selected by the Contractor and shall be subject to the approval of the Engineer.

C.4 Formwork for Exposed Concrete Surfaces:

The facing formwork, unless indicated otherwise on drawings, or specifically approved by the engineer in writing, shall generally be made with materials not less than the thickness mentioned below for different elements of the structure:

1. Plain and sloping slab soffits, and sides of beams, girders, joists ribs and sides of walls shall be made with:

a. Plywood plates not less than 12 mm thick (IS:4900 -Specification for Plywood for Concrete Shuttering Work) or 3mm thick with a 20 mm actual thickness timber plank backing, of specified sizes stiffened with a suitable timber frame-work.

The thickness of plywood for curved members shall be such that it can be bent to the required curvature, and shall be stiffened adequately to support the loads.

b. Steel plates not less than 3.15mm thick of specified sizes stiffened with a suitable structural frame work fabricated true to plane with a tolerance of $\pm$ 1 mm within the plate.

c. Timber planks of not less than 20 mm actual thickness (about 25 mm nominal thickness, but actual thickness shall prevail) and of specified surface finish, width and reasonable length.

2. Bottoms of beams, girders and ribs, and sides of columns shall bemade with :

a. Steel plates not less than 5mm thick of specified sizes stiffened with as suitable structural frame work, fabricated true to plans with a tolerance of(+/-)1mm within the plate

b. Timber planks of 35 mm actual thickness and of specified surface finish, width and reasonable length,

c. Plywood plates not less than 12 mm thick, of specified sizes stiffened with a suitable timber framework.

3. Grooves :

At all construction joints, proper grooves as per design shall be provided by fixing additional profiled timber strips to the formwork in such a way that the joint line is recessed and the cement mortar does not leak through the formwork during the concreting of the next pour.

C.5 Erection of Formwork:

The following shall apply to all formwork:

1. All shutter planks and plates shall be adequately backed to the satisfaction of the Engineer by a sufficient number and size of walers or framework to ensure rigidity during concreting. All shutters shall be adequately strutted, braced and propped to the satisfaction of the Engineer to prevent deflection under deadweight of concrete and superimposed live load of workmen, materials and plant, and to withstand vibration. No joints in props shall be allowed. Shuttering for sides of beams shall be properly supported by inclined rakers or horizontal structs.

C.6 Vertical props shall be made of adjustable steel such as Acrow and shall be supported on wedges or other measures shall be taken where the props can be gently lowered vertically during removal of the formwork. Props for an upper storey shall be placed directly over those in the storey immediately below, and the lowest props shall bear on a sufficiently strong area. Props shall have proper horizontal and vertical cross brackings to prevent any sway or bucking under load.

1. Care shall be taken that all formwork is set plumb and true to line and level or camber or batter where required and as specified by the Engineer.

2. Provision shall be made for adjustment of supporting struts where necessary. When reinforcement passes through the formwork care shall be taken to ensure close fitting joints against the steel bars so as to avoid loss of fines during the compaction of concrete. The props shall rest on firm base and shall not be found loose and wobbling.

3. If the formwork is held together by bolts or wires, these shall be so fixed that no such iron fixtures iron will be exposed on surfaces against which concrete is to be laid. In any case wires shall not be used with exposed concrete formwork. The Engineer may at his discretion allow the Contractor to use tie-bolts running through the concrete and the Contractor shall decide the location and size of such tie bolts in consultation with the Engineer. Holes left in the concrete by these tie-bolts shall be filled as specified by the Engineer at no extra cost.

4. In the shuttering for beams, columns, and walls provision shall be made for a port hole of convenient size so that all extraneous materials that may be collected could be removed just prior to concreting.

5. Formwork shall be so arranged as to permit removal of forms without jarring the concrete. Wedges, clamps and bolts shall be used wherever practicable instead of nails.

The formwork for beams and slabs shall be so erected that forms on the sides of the beams and the soffit of slabs can be removed without disturbing the beam bottoms or props under beams.

6. Surfaces of forms in contact with concrete shall be oiled with mould oil of approved quality. If required by the Engineer the Contractor shall execute different parts of the work with different mould oils to enable the Engineer to select the most suitable. The use of oil which results in blemishes on the surface of the concrete shall not be allowed. Oil shall be applied before reinforcement has been placed and care shall be taken that no oil comes in contact with the reinforcement while it is being placed in position. The formwork shall be kept thoroughly wet during concreting and the whole time that it is left in place.

7. Immediately before concreting is commenced, the formwork shall be carefully examined to ensure the following:

a. Removal of all dirt, shavings, sawdust and other refuse by brushing, washing, or by compressed air.

b. The tightness of joints between panels of facing forms and between these and any hardened core.

c. The correct location of tie bars, bracing and spacers, and especially connections of bracing.

d. That all wedges are secured and firm in position.

e. That provision is made for traffic on formwork not to bear directly on reinforcing steel.

f. Properly cured concrete cover blocks of the same mix as per parent concrete with binding wire embedded therein shall be used in sufficient number for maintaining specified concrete cover for reinforcement at the sides and bottoms of reinforced concrete members. These cover blocks should be adequately fastened to the reinforced steel by the binding

wire embedded in the cover blocks. Alternatively use of approved plastic cover blocks may be allowed at the discretion of the Engineer-in-charge. Use of stone or marble pieces as cover blocks shall not be permitted.

g. The Contractor shall obtain the Engineer's approval for dimensional accuracies of the work and for the general arrangement of propping and bracing. (IS: 3696 - Safety Code of Scaffolds and Ladders, IS: 4014 Steel Tubular Scaffolding I & II). It is imperative that for scaffolding heights of 3.6m and above timber posts or steel scaffolding be used with adequate bracings in horizontal and vertical planes. Bracings with bamboos will not be permitted. When timber posts are used the bracings shall consist of minimum 25mm thick wooden planks fixed to each post with at least two nails. The Contractor shall be entirely responsible for the adequacy of propping, and for keeping the wedges and other locking arrangements undisturbed through the decentering period.

(IS 8989 safety code for erection of concrete framed structures)

8. Formwork shall be continuously watched during the process of concreting. If during concreting any weakness develops and formwork shows any distress the work shall be stopped and remedial action taken.

C. 7 FORMWORK & FINISHING OF EXPOSED CONCRETE WORK

The surface finish for formed and unformed surfaces are classified and defined as below. Surface irregularities permitted for the various classes of finishes are termed either "abrupt" or "gradual". Fins or offsets caused by displaced or misplaced form sheathing, lining or form sections, by loose knots in form lumber or by otherwise defective form lumber are considered abrupt irregularities. All other cases are described as gradual irregularities. Gradual irregularities will be measured with a template consisting of a straight edge for plain surfaces or its equivalent for curved surface. The length of template for testing gradual irregularities on formed surfaces shall be 1.5 m in length, the permissible gradual irregularities being measured over this length of the template.

Special surface, finish and treatment falling outside of these classes but defined elsewhere by the Engineer/Architect shall also form part of these specifications.

C. 8 Camber:

Forms and false work shall be level or cambered as indicated in the drawings or as instructed by the Engineer.

C. 9 Tolerances:

In accordance with IS: 456.

C.10 Age of Concrete at Removal of Formwork

In accordance with IS: 456.

The Engineer may vary the periods specified in IS: 456 if he considers it necessary. Immediately after the forms are removed, they shall be thoroughly cleaned with a jet of water and a soft brush. Thorough cleaning Buffing of steel shuttering material after each use by mechanical buffing machine is a must.

C.11 Stripping of Formwork

Formwork shall be removed carefully without jarring the concrete, and curing of such exposed surface of concrete shall be commenced immediately. Concrete surfaces to be exposed shall, where required by the Engineer, be rubbed down with carborundum stone to obtain a smooth and even finish. Where the concrete requires plastering or other finish later the concrete surface shall be immediately hacked lightly all over as directed by the Engineer. No extra charge will be allowed to the Contractor for such work on concrete surfaces after removal of forms.

C.12 Reuse of Forms

The Contractor shall not be permitted reuse of timber facing formwork brought new on the Works more than 5 times for exposed concrete formwork. 5 uses shall be permitted only if forms are properly cared for, stored and repaired after each use. The Engineer may in his absolute discretion order rejection of any forms he considers unfit for use for a particular item, and order removal from the site of any forms he considers unfit for use in the Works. Used forms shall

not be brought on the site. Pitted, perforated, damaged, bent, warped or out of shape steel plates shall not be used as shuttering materials under any circumstances.

STRUCTURAL STEEL WORK

E.1 General:

1. Contractor to provide:

Unless otherwise stated, the Contractor shall provide all materials and equipment required to complete the Works in every respect, whether such materials are required as part of the permanent structures or temporary for fabrication or erection or maintenance including specifically structural steel plates, flats, bars, welding rods, rivets, bolts and nuts, paint, galvanizing welding sets in the shop and at site, all workshop facilities, derricks, cranes, pulley blocks, wire ropes, hemp or manila ropes, winches, erection cleats and temporary brackets or supports and all other materials required to deliver the Works complete in every respect.

All labour required for fabrication and erection for any cleaning, making good, rectifying, hauling, painting and for any other ancillary work required to complete fabrication and erection.

2. The Contractor shall observe all safety requirements for erection of structural steelwork as covered in IS 7205.

E.2 Drawings:

In respect of permanent steel structures included in the scope of contract.

1. The Engineer will supply to the Contractor profile drawings showing sizes of all structural members and typical connection details.
2. Should there be any discrepancy in the drawings, the Contractor is to refer the matter to the Engineer. The Contractor shall further provide a drawing showing the accurate setting out to line and level of all the anchor bolts intended for the work in a sufficient time for their inclusion in the work so as to maintain the building Program.
3. The Contractor is to prepare at his own expense all the necessary fabrication shop drawings and these shall be submitted to the Engineer in duplicate and be approved by him before fabrication is commenced. All such drawings shall show the dimensions of all parts, method of construction, welding and bolting. A further set of all approved fabrication drawings shall be supplied by the Contractor for use of the Engineer as required.
4. Approval by the Engineer of drawings or any other particulars submitted by the Contractor shall not relieve the Contractor of full responsibility for any discrepancies, errors or omissions therein. The Contractor shall at his own expenses supply such additional copies of his working drawings as are required for the use of the interested parties.

E.3 Materials

1. Structural Steel: All structural steel shall be of tested quality and shall conform to one of the following standards:

IS: 226 Structural steel (Standard Quality)
IS: 2062 Structural steel (Fusion welding quality)
IS: 961 High Tensile Structural Steel (Ordinary)

1. The Contractor shall supply to the Engineer copies of the manufacturer's certificate that the steel brought to the site for incorporation in the Works is of a quality fully complying with the specification. If required by the Engineer, the Contractor shall arrange for testing of the steel samples as per IS 1608 & IS 1599.
2. Welding Electrodes: Welding electrodes used for the Works shall conform to IS 814/latest and shall be supplied by a manufacturer approved by the Engineer and shall be of the grade approved by the Engineer. All Electrodes shall be kept dry. Any electrode which has part of its flux coating broken away or is damaged shall be rejected.
3. Bolts and Nuts: Bolts and nuts used for the Works shall unless otherwise specified be black bolts and nuts supplied by a manufacturer approved by the Engineer and shall conform to IS 1367.
4. For all other material required for the Works, the approval of the Engineer shall be obtained by the Contractor prior to the use of the material in the Works.

E.4 Workmanship & Fabrication:

1. For all the Works, workmanship shall be of first class quality, throughout, in conformity with I.S. 800-latest, and true to line, level and dimension as shown in the drawings or instructed by the Engineer.

2. All parts assembled for bolting shall be in close contact over the whole surface and all bearing stiffeners shall bear tightly at top and bottom. The component parts shall be so assembled that they are neither twisted nor otherwise damaged and specified cambers if any shall be provided. Drilling during assembling shall not distort the metal or enlarge holes. The butting surfaces at all joints shall be so cut and milled as to butt in close contact throughout the finished joint.
3. Hand flame cutting will not be permitted.
4. Punching of holes will not be permitted.
5. All welding for the Works shall be carried out by first class welders and shall be in accordance with I.S.S.816/, IS: 819, IS:1024, IS:1261, IS:1325 and IS:9595. The Engineer may at his discretion order periodic tests of the welder and/or of the welds produced by them. All such tests shall be carried out by the Contractor at his cost.
6. As much work as possible shall be welded in shops. The pieces shall be manipulated to ensure down hand welding for all shop joints as far as possible. All parts to be welded shall be arranged so as to fit properly on assembly. After assembly and before the general welding is to commence the parts are to be tack welded with small fillet or butt welds as the case may be. The tack welding must be strong enough to hold the parts together but small enough to be covered by the general welding. The welding procedure shall be so arranged that the distortion and shrinkage stresses are reduced to a minimum.
7. All joints required in the structure to facilitate transport or erection shall be as shown on the drawings or as specified by the Engineer. Should the Contractor need to provide joints in locations other than those specified by the Engineer he shall submit his proposals and obtain the prior sanction of the Engineer for such joints. The lengths of structural sections shall be the maximum normally available in the market. Jointing of shorter lengths in order to make up the lengths required shall not be permitted.
8. Each piece of steel work shall be marked distinctly before delivery, indicating the position and direction in which it is to be fixed. Three copies of a complete marking plan are to be supplied to the Engineer before erection commences.
9. In the case of welded fabrication any distortion remaining in the member after welding operations are completed shall be rectified by the Contractor at his own cost to the satisfaction of the Engineer. Adequate jigs and fixtures shall be used by contractor at his own cost, during fabrication to avoid any distortion/warping of the steel structure.
10. All members of trusses and lattice girders shall be straight throughout their length, unless shown otherwise on the drawings, and shall be accurately set to the lines shown on the drawings. Sheared edges of gussets or other members shall be straightened and dressed where necessary.
11. Templates and jigs and fixtures used throughout the work shall be all steel. In cases where actual materials have been used as templates for drilling similar pieces, the Engineer shall decide whether they are fit to be used as parts of the finished structure.

E.5 Testing of Welds

Butt welds - radiographic testing of 50% of welds shall be carried out. Fillet welds shall undergo Ultrasonic testing of 1 in 20 positions decreased to 1 in 50 if failures are less than 1 in 10.

E.6 Protection of Steel Works:

Hot Dipped Galvanizing:

1. Hot dipped galvanizing shall be carried out in accordance with IS-802 (Part II), IS: 5358 IS: 4759.
2. The steel work, prior to delivery, shall be cleaned for scale, rust, dirt, grease etc. by means of chipping, scraping, wire brushing using skilled operators and dipping in a caustic soda bath and then in a bath containing a dilute solution of hydrochloric acid.
3. The steel shall then be fluxed with ammonium chloride by immersion in a perplexing bath or by other approved means.
4. After perplexing, the steel shall be dipped into the pure (98.5%) molten Zinc held at a temperature between 440 degrees Centigrade to 470 degrees Centigrade. Proper arrangement shall be made to support the member. The size of the bath shall be such that it shall accommodate the individual member in its entirety.
5. The thickness of hot dipped galvanized coating shall be between 75-125 microns or the mass of zinc coating shall be between 610 to 765 g/m2.

6. Immediately after the steel has been removed from the bath, it shall be wiped and centrifuged to remove excess zinc and eliminate irregularities.
7. Proper vents of approved diameter shall be provided for all box members for proper venting of the enclosed space.
8. Care shall be taken to avoid the distortion of the steel member.

E.7 Erection & Site work

1. The Contractor shall be responsible for checking the alignment and level of foundation and correctness of foundation bolt centers, well in advance of starting erection work, and shall be responsible for any cones quences for non- compliance thereof. Discrepancies if any shall immediately be brought to the notice of the Engineer for his advice.
2. During erection the rough handling of fabricated materials such as bending, straining or pounding with sledges shall be avoided. Any damage to the structure during transportation or erection shall be immediately rectified by the Contractor at his own cost. The straightening of bent edges of plates, angles and other sections shall be done by methods which will not cause fracture.
3. The Contractor shall be responsible for the accurate positioning, leveling and plumbing of all steel work and placing of every part of the structure in accordance with the approved drawings and to the satisfaction of the Engineer. All Stanchion base, beam and girder bearings etc shall be securely supported on suitable steel packs. All reference and datum points shall be fixed near the Work Site for facilitating the erection work.
4. All equipment used by the Contractor shall be sufficient for the purpose and for the erection of the steelwork, in the time specified in the contract. Any lifting or erecting machinery shall be to the approval of the Engineer and shall be removed from the site if he considers such appliances dangerous or unsuitable for their function. The approval of the Engineer shall not relieve the Contractor of the responsibilities for the loads to which the erection equipment is called upon the carry. Adequate arrangements shall be made to resist wind loads and lateral forces arising at the time of erection.
5. The Contractor is entirely responsible for the stability of the structure during erection and shall arrange that sufficient temporary bolts, braces or guy ropes are used to ensure that work will remain rigid until final bolting, riveting or welding is completed. The Contractor shall supply and fix, without extra charge, any temporary bracing which may be necessary.
6. All steelwork shall be erected in the exact position as shown on the drawings. All vertical members shall be truly vertical throughout and all horizontal members truly horizontal, fabrication being such that all parts can be accurately assembled and erected. No permanent bolting, welding or grouting shall be done until proper alignment has been obtained.
7. At Stanchion splices and at other positions where concrete cover to the steel is liable to be restricted, bolts will be placed with their heads on the outside of the member.
8. All field assembly bolting and welding shall be executed in accordance with the requirements for shop fabrication excepting such as manifestly apply to shop conditions only. Where steel has been delivered painted the paint shall be removed before field welding for a distance of at least 50 mm on either side of the weld. The number of washers on permanent bolts shall not be more than two for the nut and one for the bolt head.

E.8 Rectification of damaged materials

Any error in shop work which prevents the proper assembly and lifting up of the parts by moderate use of drift pins or reaming or cutting shall be immediately reported to the Engineer and his approval of the method of rectification obtained in writing. Wrongly fabricated material whose erection in the field necessitates extra work shall be the responsibility of the Contractor. The entire costs of such operation including the replacement of defective members, if required, shall be borne by the Contractor.

E.9 Inspection

1. The Contractor shall inform the Engineer of the progress in fabrication as to when individual pieces are ready for inspection. All gauge templates necessary to satisfy the Engineer shall be supplied by the Contractor. The Engineer may at his discretion check the results obtained at the Contractor's Works by independent tests and should the material so tested be found unsatisfactory, the cost of such tests shall be borne by the Contractor.

E.10 Grouting of steel bases

1. Before grouting of stanchion bases, the Contractor shall take the following action:
a) Inform the Engineer.

b) Clean all holes, openings, recesses and the top of foundations of all dirt, mud, water, oil or other extraneous matter.

c) A frame shall be placed in position around the base plate with a provision for placing or injecting grout.

d) The Contractor shall provide screed bars or mild steel flats and fix them in mortar.

e) Holes shall be provided on the Stanchion bases for escape of air.

2. Grouting of steel beams, steel stanchions, bases and bearings and encasement of steelwork will be carried out by the Contractor after the steel work has been finally aligned and leveled and approval of Engineer obtained.

3. The bolt sleeves shall be grouted as a separate operation using neat cement grout of a creamy consistency, which shall be poured in so as to completely fill the holes. "Non- shrink" cements, and additives of approved make shall be used for all grouting operations.

4. The space between the top of the foundations and the underside of the base plate shall be completely filled with a mix 1:2 cement sand mortar and finished flush with edge of the base plate, mixed as thickly as possible consistent with fluidity and poured under a suitable head and tamped until the space has been properly filled.

E.11 Holding down and Anchor bolts

1. The holding down and anchor bolts should conform to the requirements laid down in IS: 5624 or as directed by the Engineer.

2. Installation: Individual bolts in groups of holding down bolts shall be positioned accurately within a tolerance of plus or minus 6mm. The bolts shall be set vertically to a tolerance of not more than 1 in 250.

3. During the casting of concrete the Contractor shall ensure that space between the bolt and sleeve is kept clean after removal of shuttering. The Contractor shall provide and fix timber plugs to maintain this space in a clean condition. The projecting threads of bolts shall be protected by approved wrapping material.

4. Grouting of bolt tubes by non-strink grout shall be carried out after the steelwork or equipment have been aligned, plumbed and levelled.

E.12 Mode of measurement

1. The pricing must include of all rolling margins, extras for length and size, allowance for waste, complete fabrication, delivery and erection, and caulking the gap between base plate and foundation, and hot dipped galvanizing.

2. Any temporary strutting, tying or anchor bolts, black bolts, fasteners, welding required to withstand the stresses of erection or construction loads are to be included in the price.

3. The payment for the steelwork will be for the weight of the steel work actually erected, i.e. plates, rolled sections, shear connections, cleats, splice plates.

Dimensions of the steelwork will be taken on site or from the actual shop working drawings as preferred by the Engineer. In calculating the weights of gusset plates, payment will be made for the least enclosing parallelogram or triangle. For structural sections the weight will be calculated on lengths actually used with no deduction for splay cuts or mitred

ends. In case of imported sections, the weights chargeable shall be the weight according to the relative standards of the country of origin. Full weight of the bolts and nuts will be paid for as per Indian Standard Codes weights without any deduction for shanks, etc. No account shall be taken of the weight of weld in calculating the weight of steelwork. Erection packing plates bedded in mortar and wedges shall not be measured but shall be included in the rates. No deduction shall be made for openings less than 0.1 m2 in area measured in plane for bolt holes. The weight of sheet steel, plate, strips and rolled sections shall be taken from the relevant Indian Standards. The effect on weight due to galvanizing will not be considered i.e. weight of black structural steel (untreated) shall be considered for measurement.

4. Unless otherwise specified, foundation and anchor bolt assemblies shall be measured separately including nuts and washers.

5. For calculating the weight of black steel will be considered and no weightage will be given for the increase/ decrease in weight due to galvanizing.

6. The insert plate with holdfast will have to be welded to the reinforcement.

MASONRY - BRICK WORK

1.0 **Indian Standards to be followed are:**

All relevant Standards as specified elsewhere in this Volume are applicable.

Indian Standards to be followed are:

1.	IS 226	Specification for steel standard quality.
2.	IS 269	Specification for ordinary and low heat Portland cement.
3.	IS 405	Specification for lead, sheet and strips.
4.	IS 412	Specification for expanded metal steel sheets for general purpose.
	Part 1	Mild steel and medium tensile steel bars.
5.	IS 712	Specification for building lime.
6.	IS 1069	Code of Practice for laying damp proofing treatment using bitumen felt.
7.	IS 1077	Specification for common burnt clay building bricks.
8.	IS 1322	Specification for Bitumen felts for waterproofing and damp proofing.
9.	IS 1635	Code of Practice for field slaking of building lime and preparation of putty.
10.	IS 2116	Specification for sand for masonry mortar.
11.	IS 2212	Code of Practice for Brick work.
12.	IS 2250	Code of practice for preparation and use of masonry mortars.
13.	SP 27	Handbook of method of measurement for building works.

2.0 **MATERIALS**

2.1 Bricks

2.1.1. Bricks shall be sound, hard, well-burnt, uniform in size, shape and colour, homogeneous in texture, giving a metallic ringing sound, free from flaws, cracks, holes, lumps or grit and arises should be square, straight and sharply defined. They shall not break when struck against each other and dropped flat from a height of 1m to the ground. They shall conform to Table No. 1 (reproduced as table 2 of enclosed Annexture) of IS 1077 giving classes of common burnt clay bricks.

2.1.2. Bricks shall be as specified and detailed in the BOQ. It shall have to be approved prior to procurement. Bricks shall be obtained from an approved source and shall be of uniform colour, size, shape. Bricks shall have smooth rectangular faces with sharp straight rectangle edges. Maximum absorption shall not be more than 15% of its dry weight on immersion in water for 24 hours. Minimum crushing strength shall be 35 kg/sq.cm if not specified in the BOQ.

2.1.3. Bricks of approved quality and quantity shall have to be procured by the contractor at the desired time. No delay or extra cost due to non-availability shall be accepted. The contractor is obliged to carry out the work as specified. It shall be the responsibility of the contractor to procure sufficient quantities of bricks and stack them at site or elsewhere to avoid delays.

2.2 Mortars

2.2.1 Mortars for masonry shall be prepared in accordance with IS 2250 code of practice for preparation and use of masonry mortars.

2.2.2 Cement

Cement used shall be ordinary portland cement conforming to IS 269 or as approved by the Engineer-in-charge.

2.2.3 Lime

Lime used shall conform to IS 712 specification for Building Limes. Field slaking shall be done as per IS 1635 code of practice for field slaking of lime and preparation of putty.

2.2.4 Water

Water used for masonry shall be clean and free from injurious amounts of deleterious materials and shall conform to specification given in concrete and mortar section.

2.2.5 Fine aggregate (sand)

Sand shall conform to IS 2116 specification for masonry mortars.

2.3 Damp proof course

Deleted

2.4 Metal reinforcement

Metal reinforcement used in brick masonry shall conform to the following Indian Standards Specifications.

a.	IS 432	Specification for Mild steel and medium tensile steel bars.
b.	IS 1566	Specification for steel fabric or hard drawn steel wire.
c.	IS 412	Specification for Expanded metal steel for general purpose.
d.	IS 226	Specification for other suitable reinforcement such as galvanized hoop iron.

3.0 MORTAR

Mortar shall be as specified under the respective item in the BOQ. Its preparation and material shall comply with concrete and mortar section of this volume.

4.0 WORKMANSHIP

4.1 Bricks used for masonry in cement mortar or cement-lime or mortar shall be soaked by immersing in water (so as to prevent bubbling) at least one hour prior to start of actual laying.

4.2 Bricks shall be laid in English bond unless otherwise specified. Half or cut bricks shall be used only for the purpose of bond and at no other place. Cut bricks shall be allowed in work.

4.3 Work shall be true to horizontal lines and perfect plumb. Vertical joints shall be truly vertical and those in alternate courses shall be in the same vertical line. Joints of each course shall be within the limit of 6mm to 10mm depending upon the size of bricks. Total height of 9cm brick with the 5 courses and 5 mortar joints shall be 50cm. In no case shall joint thickness of horizontal and vertical be more than stated above. Joints should be filled to full depth and checked each time.

Prior to start of work it must be noted and checked that bricks on top are full-size bricks (flat or brick on edge). To achieve this, precautions should be taken from the start of the first layer. Thickness of joints shall so adjusted so as to have full bricks on top. Also it must be noted and checked that all horizontal joints on every floor are at the same level, so as to allow proper bonding at junctions.

Required datum levels must be established throughout the floor and only then should work start.

It is equally important to take into account levels of windowsills, lintels, etc. while finalizing courses and joint thickness. In normal practice architects do take care of these while finalizing levels, but it is difficult to expect the ideal situation at all places. In such situation, the decision of the EIC shall be taken and in providing brick on edge, concrete sills, etc.

In addition, for convenience and speed, gauge boards of exact width shall be fixed at the edges of masonry to correct line and plumb. These boards shall be marked with course levels to achieve exact height of each course and full bricks at the top.

4.4 One or half brick thick wall shall have minimum one face in true plumb.

4.5 It is imperative to raise the brick work uniformly over complete work joined together. If this is not possible, racked brick work shall be done at 45 degrees to the vertical. To thing shall not be accepted.
4.6 All iron fixtures, pipe outlets, hold-fasts for doors and windows shall be fixed when the brick work is in progress. It must be embedded in cement mortar or concrete as specified or as directed by the EIC. Required treatment to fixtures shall be carried out prior to embedding.
4.7 To achieve better results and proper working, the following tools should be available with masons working at site:
1. Spirit level.
2. Wooden/Aluminium straight edge: 3m long.
3. 3 meter steel tape
4. Right angle 1/2 meter long
5. Line and pin strings
6. Plumb
7. Storey rods

4.8 Joint thickness shall be provided as discussed above. Joints shall be filled to full depth before second course is laid. Frogs shall be upward at all times. Joints shall be raked back to a minimum 10 to 15 mm while the mortar is wet. Surface of brick work shall be cleaned with coil string, wire brushes, etc. to keep the surface free for the nee operation. All dropped and spoiled mortar, brickbats, etc. shall be cleared from the floor before work is closed for the day.

4.9 Protection and curing:
Wet work shall be protected from rains by suitable covering. Masonry in cement or cement-lime mortar shall be kept constantly moist on all the faces for a minimum period of ten days. The top of masonry shall be left flooded with water at close of the day.
In case of brick work in lime mortar, curing shall commence two days after laying of masonry and shall continue for the next seven days.

4.10 Scaffolding independent of brick work i.e. double scaffolding shall be provided. It should be tied to brick work or structure at suitable intervals in both directions. Two rows of plank shall be provided all around. Planks shall be at least 50mm thick and well-tied to scaffolding. Railing to the outside face shall be provided. While erecting scaffolding. The following points must be noted and closely followed:

1. Minimum number of holes in the horizontal direction. Holes shall be formed by omitting header brick.
2. No holes in pillars under 1 meter in width.
3. No holes near the skew backs of arches.
4. Scaffolding must be sound and strong and easy to maintain.
5. Holes left must be closed white finishing the plaster.

5.0 **TYPES OF BRICK WORK.**
5.1 Walls 230mm thick or more.
5.1.1 Walls of 230mm thickness or more shall be constructed with approved and selected bricks. Mortar shall be as specified in the BOQ.
Points discussed above shall be followed for workmanship.

Brick wall of 230mm thickness shall be constructed from one side and one face shall be true and plumb. Thicker walls shall be constructed with masons on both faces and both the faces shall be true and plumb.
5.1.2 Measurements shall be in cubic meters.
5.2 Half brick work - plain or reinforced.
5.2.1 115mm thick brick work shall be called as half brick work. It shall be built by laying bricks in stretcher bond. Mortar shall be as specified in the BOQ.
These walls may be used for forming cavities or partition wall inside building. Brick work shall reinforced with 6mm M.S. dia bars, 2 bars at every third layer. Other reinforcing materials such as GI metal lath GI hoop iron 25mm x 1.6mm shall be used at every third layer as detailed by the manufacture. Embedding of reinforcement shall be done very carefully. All precautions shall be taken so that edges are not exposed. Lapping of bars and lath shall be proper and staggered.

5.2.2 Measurement shall be in square meters. Reinforcement shall not be measured separately.
6.0 **RATE**
6.1 The rate shall include the cost of all the materials and labour as described in their respective items of work and for all the operations as detailed in the respective specifications for the varies items of work. Brick on edge courses, cut brick corners, splays, reveals, cavity walls, shall be included in BRICK WORK - for the purpose of payment.

6.2 The following operations shall be included in the rate for BRICK WORK:

a. Raking out joints for plastering or for pointing done as a separate process or for finishing joints flush as work proceeds.

b. Preparing tops and sides of existing walls and the like for raising :

c. Rough cutting and waste for forming gables, cores of arches, splays at leaves and the like and all rough cutting in the body of brick-work, unless otherwise stated;

d. Plumbing to angles and battered surfaces.

e. Forming reveals to jambs where fair cutting on exposed faces is not involved.

f. Leaving holes for pipes, etc.

g. Building-in holdfasts, air bricks, fixing bricks, etc.

h. Building-in ends of beams, joists, slabs, lintels, sills, trusses etc.

i. Forming opening and flues for which no deduction is made.

j. Bedding wall plates, lintels, sills, roof tiles, corrugated sheets, etc. in or on walls, if not covered in their respective trade.

k. Leaving chases of section not exceeding 50cm in girth.

MASONRY - CONCRETE BLOCK WORK

1.0 **The Indian Standards to be followed are:**

All relevant Standards as specified elsewhere in this Volume are applicable.

1.1 Indian Standards to be followed are:

1. IS 269 Specification for ordinary and low heat portland cement
2. IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
3. IS 455 Specification for portland slag cement
4. IS 456 Code of Practice for plain and reinforced concrete.
5. IS 2185 (Part I) Soild cement concrete blocks.
6. IS 2572 Code of practice for construction of hollow concrete block masonry.
7. IS 2645 Specification for integral waterproofing compound.
8. IS 9103 Specification for admixtures for concrete.

2.0 **MATERIAL**

2.1 Cement

Ordinary portland cement complying to IS 269 shall be used unless specified, otherwise cement used shall of grade 33.

2..2 Aggregates

Aggregates shall conform to IS 383 requirements and as obtained in the concrete and mortar section of this volume. Grading shall be as indicated in IS 383. Fineness modules of the combined aggregates shall be between 3.6 and 4.

2.3 Water

Water conforming to IS 456 and as approved by the EIC shall be used. Details as given in Concrete and Mortar section II of this volume shall be followed.

2.4 Admixtures

Additives or admixtures may be added to the cement or concrete mix conforming to the IS specifications. Admixtures shall be chloride free and melamine polymer based.

Other additives or admixtures not being governed by Indian Standards shall be tested and checked that the same are not detrimental to durability. However any addition shall only be after the approval of the EIC.

3.0 **MANUFACTURE**

3.1 Concrete blocks may be hollow (open or closed cavity) or solid and shall be referred to by its nominal dimension. The term nominal dimension includes the thickness of the mortar joint. Provision I.S. Code 2185 shall be followed for all specifications of soild concrete blocks including specifications for actual dimensions, tolerances, sizes, shapes, faces and webs, grades of blocks etc.

3.2 Concreting

Concrete mix used for blocks shall be predesigned to give a strength of 50 Kg/Cm2. Concrete shall be mixed in the mechanical mixer. Blocks shall be moulded, laid and compacted with automatic machines table vibrator. Care shall be taken to see that the mix mould is filled up. Blocks shall be protected until they are sufficiently hardened to permit handling without damage. The solid concrete blocks shall have a minimum strength of 50 Kg/per square centimeter.

3.3. Curing & Drying

Blocks shall be cured in the curing yard by keeping them continuously moist for at least 14 days. Steam-cured blocks shall be preferred. Cured blocks shall be allowed to dry for a period of 4 weeks before being used. The blocks shall be allowed to complete their initial shrinkage before they are laid in the wall.

3.4 Physical requirements

All blocks shall be sound and free of cracks or other defects. For exposed construction face or faces shall be free of chips, or other imperfections, and the overall dimensions of the blocks shall be in accordance to tolerance as specified. Minimum compressive strength shall be 50 kg/cm2, maximum permissible water absorption shall not exceed the limit specified in I.S. Code 2185 dimensional variations shall be specified in I.S.2185.

3.5 Test

Test detailed in Appendices A to F of IS 2185 shall be conducted on samples of units selected according to the sampling procedure given here under to ensure conformity with the physical requirements as specified.

3.5.1 Sampling

A sample of 20 blocks shall be taken from every consignment of 5000 blocks or part thereof of the same size and same batch of manufacture. From these samples, the blocks shall be taken at random for conducting the test.

The blocks shall be taken at regular intervals during the course of work, preferably while being loaded or unloaded. In case samples are to be taken from the stacks, blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks.

3.5.2 The blocks shall be kept under cover and protected from extreme conditions of temperature, relative humidity and wind until they are required for test. The test shall be taken as soon as the sample has been taken.

3.5.3 Number of Tests

All the 20 blocks shall be checked for dimensions and inspected for visual defects. Out of the 20 blocks, 3 blocks shall be subjected to the test for block density, 8 blocks to the test for compressive strength, 3 blocks to the test for water absorption and 3 blocks to the test for drying shrinkage and later to the test for moisture movement. The remaining 3 blocks shall be reserved for retest for drying shrinkage and moisture movement if a need arises.

3.6 Blocks shall be approved if requirements of conditions mentioned in 11.2 to 11.5 (as given below) of IS 2185 (Part I) are satisfied.

1. The number of blocks with dimensions outside the tolerance limit and/or with visual defects, among those inspected shall not be more than two.
2. For Block density and compressive strength, the mean value determined shall be greater than of equal to the minimum limit specified in Table 2 of IS 2185 (Part I) and reproduced as Table 27 of Annexure.
3. For drying shrinkage and moisture movement, all the test specimens shall satisfy the requirements of the test. If one of more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All blocks shall satisfy the requirements. Drying shrinkage shall not exceed 0.1 percent.

4. For water absorption, the mean value determined shall not be more than 10 percent by mass.

4.0 **WORKMANSHIP**

4.1 General points discussed in Section IVA of this volume shall be applicable here. In total dry climate top and sides may be slightly moistened to avoid absorption of water from mortar.

4.2 Joints shall not be bigger than 10mm and will be perfectly horizontal and vertical. Joints shall be raked 10mm deep while mortar is wet.

4.3 Cut blocks shall not be used. Special solid precast blocks at site shall be cast well in advance to be used as spacers and to adjust breaking of vertical joints.

4.3.1 Cracks in block masonry are due to shrinkage or expansion of blocks or due to load settlement, thermal expansion or changes in moisture content in the structural members enclosing the block walls. The following measures are recommended to prevent formation of cracks.

a. While curing, the block masonry should be lightly sprinkled with water and not made excessively wet.

b. Expansion joints shall be provided in walls exceeding 30m in length.

c. Reinforcement should be provided in the bed joints in block work, one course above and one course below windows and above doors in order to distribute the shrinkage/temperature stresses occurring at the corners of openings, more uniformly throughout the walls.

d. R.C.C. band (called Patli) 80 mm thick and width equal to block masonry and having 10 m dia. two bars with 6 mm dia links @ 200 mm c/c shall be provided at every 1 meter interval in the block masonry. The gap between the topmost layer of block and the soffit of the beam shall be packed by lightly hammering flat pieces of shahabad / kota tiles and then the gaps will be covered by weld mesh of before closing them by cement plaster. The weld mesh will be extended at least 150 mm on the R.C.C. beam and 150 mm on block masonry and nailed to them with strong nails.

4.4 **SCAFFOLDING**

Scaffolding, independent of masonry work i.e. double scaffolding, shall be provided. It should be tied to masonry work or structure at suitable intervals in both directions. Two rows of planks shall be provided all around. These shall be at least 50mm thick and well-tied to the scaffolding. Railing to outside faces shall be provided. While erecting scaffolding the following points must be noted and closely followed:

1. Minimum number of holes in horizontal direction. Holes shall be formed by omitting header.
2. No holes in pillars under 1 meter in width.
3. No holes near the skew backs of arches.
4. Scaffolding must be sound and strong and easy to maintain.

4.5 Raking back shall be carried out at an angle not steeper than 45 degrees in case all the block work is not raised together.

4.6 The block should be of full height and no cut pieces shall be allowed PCC leveling course shall be laid to fill up the gap.

5.0 **MEASUREMENT**

Hollow or solid cement concrete block work shall be measured in sq.meter for the specified width.

6.0 **RATES**

Rates for items shall include following:

a. Material and labour, for the completion of items as specified including any centering, shuttering, curing etc.
b. Raking out of joints.
c. Preparation of the tops and sides.
d. Forming and preparing expansion, contraction or construction joints as detailed above or specified in the BOQ or drawings.
e. Making holes, openings, etc. for outlets, embedding downtake pipes, etc. wherever necessary during construction and finishing exposed surfaces as per instruction of the EIC.
f. Curing and protection as specified.
g. Making holes, openings, outlets, etc. embedding pipes, ends of beams, joints, slabs, trusses, sills, etc. whatever required during construction and neatly finishing the exposed surfaces and opening as per instructions of the EIC.

SECTION - G
PLASTERING AND POINTING

1.0 **INDIAN STANDARDS**

All relevant standards as specified elsewhere in this Volume are applicable.

1.1 Indian Standards to be followed are:

1. IS 383 Specification for coarse and fine aggregates from natural sources for concrete.
2. IS 412 Specification for expanded metal steel sheets for general purposes.
3. IS 1542 Specifications for sand for plaster.
4. IS 1635 Code of practice for field slaking of building lime and preparation of putty.
5. IS 1661 Code of practice for field slaking of building lime and preparation of putty.
6. IS 2394 Code of practice for application of lime plaster finish.
7. IS 2402 Code of practice for external rendered finishes.
8. IS 2645 Specifications for integral cement waterproofing compound.

2.0 **MATERIALS**

2.1 Cement, lime, surkhi, water shall conform to the respective specifications of Section II: (concrete & Mortar) of this volume.

2.1.1 Coloured cement may be either ready-mixed material or may be obtained by mixing pigments and cement at site. The pigments to be mixed with cement shall conform to Appendix 'A' of IS 2114 code of practice for laying in-situ Terrazzo floor finish.

2.2. Sand required for plastering work shall conform to IS 1542 specification. For white or coloured rendering, only quartz or silica sand shall be used. For textured finishes produced by treatment of freshly applied final or finishing coat with a tool coarser, particles used shall be screened through 3.35mm IS sieve or 2.36 mm IS sieve. For torn texture a slightly larger portion of material coarser than 4.75 IS sieve shall be used.

2.3 Aggregate shall conform to IS 383.

2.4 Marble dust obtained from crushing of hard marble stone shall not contain more than 8% of dust determined by field test. Fineness modules shall be greater than 1.0

2.5 Integral waterproofing compound shall conform to I.S. 2645 (specification for integral waterproofing compound).

2.6 Neeru shall be obtained by mixing lime putty and sand in equal proportions and chopped jute @ 4 Kg/cum of mortar and ground to fine paste in the chemical grinder to give fine butter like paste.

3.0 **WORKMANSHIP**

3.1 Preparation of mortar mix.

3.1.1. The material used in preparation of plastering mixes shall be measured by volume using gauge-boxes or by weight.

3.1.2 When cement is measured by weight, 1440 Kg. of material shall be taken equivalent to one cubic meter.

3.1.3. Mix proportion of lime, unless otherwise stated, generally refers to the volume of lime putty.

3.2 Mixing

3.2.1 Mixing shall be done mechanically or manually if approved by the EIC. Machine mixing shall be preferable to hand mixing for cement mortar. Each mortar batch shall be used within half an hour. Hand mixing shall be carried out on a clean, watertight platform. The mixing operation shall be continued with addition of necessary quantity of water until a uniform appearance and consistency of mortar is obtained.

3.3 Cement-lime or cement-sand-mortar shall be prepared as follows:

A. Lime putty and sand shall be mixed first and kept from drying out. Cement shall be added as and where required and mixed with water if necessary to the minimum extent to give a working consistency for the plaster.

B. If fine sand is used, cement and sand shall be dry mixed first. Lime putty, thinned with water, shall be added to the mixer and mixed until a satisfactory mortar obtained.

C. Cement and sand shall be mixed dry in required proportion to obtain a uniform colour, and water shall then be added to get the required consistency for the plaster.

3.3.1 Surfaces to be plastered must be clean and free from dust, loose material, oil, grease, mortar droppings sticking of foreign matter, traces of algae, etc. It is very important to ensure that there should not be any chance of the plaster getting debonded due to presence of materials harmful for bonding.

3.3.2 Raking out of joints is expected to be carried out alongwith masonry but it should be checked thoroughly so as to receive good key.

3.3.3 Walls should be sufficiently damp prior to plastering. Water from plastering mortar must not be absorbed by masonry under any condition.

3.3.4 Any unavoidable projections in masonry and concrete surfaces shall be chiselled back. Care shall be taken that surrounding surfaces are not damaged and reinforcement is not exposed.

3.3.5 Thickness of one coat should not be more than 12mm and less than 8mm for single coat finished plaster.

3.3.6 In case of multicoat plaster, sufficient time shall be allowed for the undercoat to harden (cured, dried and shrunk properly) before subsequent coats are applied.
3.3.7 Undercoats shall be scratched or roughened before they are fully hardened to form a mechanical key.
3.3.8 The method of application is also important and hence it is recommended that the mix be thrown on the surface rather than stuck with trowel. This increases the adhesion.
3.3.9 Scaffolding should be rigid, allowing free and safe movement on the platform and it should be at sufficient distance or height from the working areas. Scaffolding with railing gives more confidence to workers and increases the quality of work.
3.3.10 Actual plastering shall be undertaken only on the approval of the EIC. Plaster work should follow the steps mentioned below:
a. Surface must be thoroughly cleaned.
b. Plaster area must be provided with level dabs or spots allowing working and checking with 2-3 metre straight edge. Depth of plaster must not be less than 8mm at any point.
c. Required concealing services must be completed and tested before starting plastering work
d. No further cutting of masonry must be required.

e. Repairs carried out to masonry or concealing work must be cured and dry.
f. Surface must be sufficiently damp.
g. Plaster dabs are checked for plumb and level by the EIC or his representative.

h. Joints concealing and repairing areas must be covered with chicken mesh as per EIC's instruction.

3.3.11 Corners, external or internal, shall be finished along with final coat and will be rounded if so instructed by the Architect.

3.3.12 Plaster shall be cured for 14 days by wet curing except in neeru finish plaster. During this period plaster shall be protected from exposure to extremes of temperature and weather.
3.3.13 Plaster shall be levelled and lined by aluminium hollow section, 2-3m long, (This will give even and levelled surface). There shall not be more than 2mm difference in level when checked with 3m straight edge. It is important that enough pressing and beating is done to achieve compact filling of joints and that the area is fully compacted.

3.3.14 Finishing of plaster may be carried out with wooden float (randhas) or trowelled smooth with sheet metal trowels as specified. Care shall be taken to avoid excessive trowelling and over working of the wooden float.

3.3.15 All corners, internal or external, shall be truly vertical or horizontal. These shall be finished with a proper template to achieve best workmanship for rounding and chamfering as specified or directed.

3.3.16 Plaster shall be cut to correct horizontal or vertical line at the end of the day or if work requires to be suspended for any reason.
3.3.17 It is advisable to limit the area of plaster to 15 sq.mt. To avoid cracks due to thermal movements of dissimilar material in contact, it is advisable to provide joints treated with groove or any other detail as suggested by the Architect. These joints if not specified shall be treated with 150mm wide reinforcing chicken mesh (approved by the EIC) fixed over joints by G.I. nails and the area plastered.

4.0 TYPE OF PLASTER (to be provided ready Mix)

4.1 12mm thick ordinary cement sand plaster.

Single coat cement-sand plaster with cement-sand mix in proportion of 1:4 shall be carried out over the entire area as detailed above. This shall be finished with wooden float to give the best smooth surface possible. This may be for internal or external areas. Thickness may be from 10 to 15 mm maximum or as specified in the item or drawing.

4.2 18 to 25mm ordinary cement sand plaster.

This is the same as for the 12mm thick single coat plaster except that this shall be carried out in two coats. Maximum thickness of the undercoat shall be 12mm and balance in the second finishing coat. All operations remain the same and are as detailed in point 3.0

4.3 Neeru finish plaster

12 to 18mm thick internal plaster shall be carried out as above in single or two coats respectively. 2 to 3 mm thick neeru shall be applied over the plaster when it has just hardened. It shall be finished smooth by a steel trowel and worked over to achieve smoother finish. Curing shall start only after 24 hours after neeru punning has been completed. This shall not be hosed down like other plaster but kept wet by a slight sprinkling of water for a period of 10 days.

4.4. Cement finished plaster.

This shall be carried out in the same manner as in 4.1 and 4.2 for specified thickness in single or double coat. Then it shall be finished uniformly over the entire area with a paste of neat cement when the plaster has just hardened and finished smooth with a steel trowel. It shall be worked over again to achieve a smooth levelled surface. Quantity of cement applied shall be about 1 Kg/sq.mt.

4.6 Sand face plaster

4.6.1 This shall generally be carried out on the outside face and exposed area of masonry work and concrete work. It shall be of minimum 20mm thickness and shall be in two coats. The coat shall be C.M. 1:4 (1 cement and 4 sand) mixed with waterproofing compound 2% by weight of cement applied as usual and surface shall be keyed.

4.6.2 The second coat shall be applied after 7 to 10 days and shall be of C.M. 1:4 (1 cement and 4 sand). Mortar shall be mixed with slightly coarse sand. Mix shall be worked over with a gauge or wooden float to achieve an uniform surface.

4.6.3 The surface shall be allowed to harden sufficiently for sponging operation. Sponging shall be done by dipping sponge in cement water and removing fine particles and exposing large sand particles. The movement of sponge shall be such that no patches develop nor is excessive material removed from the surface. There shall not be a difference of more than 7mm when checked with 2m long straight edge.

5.0 **POINTING**

5.1 Pointing shall be done as soon as possible to achieve a good bond in the raked joint. Surface preparation shall be the same as specified in clause 3 above. Mortar shall be prepared as detailed in section 2. Minimum depth of mortar in joint shall be 10mm. Mortar shall be set in or pressed into the raked joint with a pointing trowel. Care shall be taken not to spread the corner edges or surface of masonry. It shall be further finished with a pointing tool. Pointing shall be cured for 7 days by hosing water.

5.2 Types of pointing.

5.2.1 Flush Pointing

The mortar shall be pressed into the joints and shall be finished, flush and levelled. The edges shall be neatly trimmed with a trowel and straightened.

5.2.2. Cut or weather struck pointing

The mortar shall first be pressed into joints. The top or horizontal shall be pressed back 3mm with the pointing tool so that the joint is sloping from top to bottom. The vertical joint shall be ruled pointed. Vertical and horizontal joint lines shall be at true right angles.

6.0 **MEASUREMENT**

6.1 Plaster and pointing work shall be measured in square meter to the second place of decimal.

6.2 Thickness of plaster shall be the minimum depth of plaster as specified. But if extra thickness occurs due to bad quality of bricks, stones or blocks or due to bad workmanship, the repairs required to be carried out shall be at the cost of contractor.

6.3

a) Grooves, pattas in continuation of large areas or plaster areas shall be considered as part of the plaster and not measured separately.
b) Isolated areas and width below 300mm shall be specified and detailed separately in the BOQ and measured in running meter.
c) Ceiling plaster, including ribbed beam slab shall be measured in square meters.
d) Beams and columns in continuation of masonry shall be measured in square meter.

6.4 Jambs, sills, coves, cornices, etc. shall be a part of plaster and no separate payment shall be made towards these items.

6.5 Deduction

a) Deduction for an opening in plaster shall not be for area less than 0.5 sqm. Same shall be applicable for pointing.
b) In case the opening area is 0.5 sq.m to 3.0 sq.m only 50% area shall be deducted from each face. Same shall be applicable for pointing.
c) In case the width of door or window frames are equal to masonry, full area of opening shall be deducted.

6.6. Plaster to ceiling and walls shall be measured separately if specified in the BOQ.

7.0 **RATE**

7.1 Description of item in the BOQ, unless otherwise stated, includes, wherever necessary, conveyance and delivery, handling, unloading, storing, fabrication, hoisting, all labour for finishing to required shape and size, setting, fitting and fixing in position, straight cutting and waste, return of packing and other incidental charges.
7.2 Levels and heights shall be as indicated in BOQ.
7.3 Preparation of surface shall be as approved by the EIC.
7.4 Trimming off the projections on masonry shall be included in the price.
7.5 Scaffolding and working platform shall be included in the price.
7.6 Materials as detailed and as required to complete item as specified shall be included in the price.
7.7 Curing of plaster or pointing shall be included in the price.
7.8 Cleaning of adjacent areas, windows, doors, frames etc. including masonry surfaces in exposed masonry work, shall be included in the price.
7.9 Forming grooves, for joints, between beams/columns and masonry etc. shall be included in the price. Any special treatment if detailed shall be measured separately and billed in BOQ.
7.10 Providing & fixing chicken mesh at junction of R.C.C. brick work, edges, corners, chiselled and repaired brick to plaster over concealed conduit etc. shall be as directed by the EIC it shall be considered as part of item and no separate charges will be payable.

8.0 REPAIRS TO PLASTER
8.1 The work includes cutting the patch and preparing the wall surface. Patches of 2.50 square metres and less in area shall be measured under item of „Repairs to Plaster" under this sub-head. Plastering in patches over 2.5 square metres in area shall be paid for at the rate as applicable to new work under sub head Finishing.
8.2 Scaffolding
Scaffolding as required for the proper execution of the work shall be erected. If work can be done safely with the ladder or jhoola these will be permitted in place of scaffolding.
8.3 Cutting
The mortar of the patch, where the existing plaster has cracked, crumbled or sounds hollow when gently tapped on the surface, shall be removed. The patch shall be cut out to a square or rectangular shape at position marked on the wall as directed by the Engineer-in-Charge or his authorized representative. The edges shall be slightly under cut to provide a neat joint.
8.4 Preparation of Surface
The masonry joints which become exposed after removal of old plaster shall be raked out to a minimum depth of 10 mm in the case of brick work and 20 mm in the case of stone work. The raking shall be carried out uniformly with a raking tool and not with a basuli, and loose mortar dusted off. The surface shall then be thoroughly washed with water, and kept wet till plastering is commenced. In case of concrete surfaces, the same shall be thoroughly scrubbed with wire brushes after the plaster had been cut out . 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.
8.5 Application of Plaster
Mortar of specified mix with the specified sand shall be used. The method of application shall be as described for single coat plaster work of the specified mix and under SP-CS-PL-05. The surface shall be finished even and flush and matching with the old surrounding plaster. All roundings necessary at junctions of walls, ceilings etc. shall be carried out in a tidy manner as specified in sub-head SP-CS-PL-05.

All dismantled mortar & rubbish etc. shall be disposed off within 24 hours from its dismantling promptly as directed by the Engineer-in-Charge.

8.6 Protective Measure

Doors, windows, floors, articles of furniture etc. and such other parts of the building shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed by the contractor at his own cost and the surface cleaned. Damages, if any, to furniture or fittings and fixtures shall be recoverable from the contractor.

8.7 Curing

Curing shall be done as per plaster work with special reference to the particular type of plaster mix as described under sub-head finishing". 3.7 Finishing After the plaster is thoroughly cured and dried the surface shall be white washed or colour washed to suit the existing finishing as required unless specified.

8.8 Measurements

Length and breadth shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. Patches below 0.05 square metre in area shall not be measured for payment. Pre-measurements of the patches to be plastered shall be recorded after the old plaster has been cut and wall surface prepared.

8.9 Rate

The rate includes the cost of all the materials and labour involved in all the operations described above including lead as described in the item for disposal of old dismantled plaster /material.

SECTION - H
FLOORING & WALL FINISHES

1.0 INDIAN STANDARDS

All relevant standards as specified in elsewhere in this volume are also applicable.

1.1. The Indian Standards to be followed are
1. IS 777 Specification for glazed earthen ware tiles.
2. IS 1237 Specification for cement concrete flooring tiles.
3. IS 1443 Code of practice for laying and finishing of cement concrete flooring tiles.
4. IS 2114 Code of Practice for laying in situ terrazzo floor finish.
5. IS 2571 Code of practice for laying in situ cement concrete flooring.
6. IS 4457 Specification for ceramic unglazed vitreous acid resisting tiles.
7. IS 5318 Code of practice for laying of flexible PVC sheet and tile flooring
8. IS 5491 Code of practice for laying in-situ granolithic concrete floor topping.

2.0 MATERIAL

2.1 Cement, sand, aggregate, lime, water shall conform to concrete and mortar section of this volume.

2.2 Stone

Stone for soling shall be hard, sound, durable and free from defects like cavities, cracks, sand-holes, flaws, injurious veins, patches of loose or soft materials and weathered portions etc.

2.3 Terrazo aggregates

2.3.1 The aggregates used in topping shall be marble chips only. The type of marble shall be as specified or as approved. It should be hard, sound, dense and homogenous in texture with crystalline and coarse grains.

2.3.2 Marble powder used along with chips must pass through IS sieve Terrazo 30.

2.3.3. Pigments

Pigments used in the mix shall conform to Appendix 'A' of IS 2114.

2.3.4. Dividing Strips

Dividing strips used in flooring shall be of brass or aluminium or glass as specified in the BOQ or as approved by the EIC. Strips shall be at least 45mm wide and 3mm thick or as specified in the BOQ/drawings.

2.4 Glazed tiles

Glazed earthenware tiles shall be of specified size and make or equivalent but shall conform to ISS 777. Tiles shall be free from cracks, grazes, spots, chipped edges and corners. Variation in size shall be limited to +/- 1.5mm. Thickness shall be as specified in BOQ, but in no case shall be less than 6mm.

2.5 Marble

The marble used shall be as approved by the EIC and shall be hard, sound, free from cracks, cavities, holes, patches of injurious veins, weathered portions, flaws, etc. 4 nos. of 300 x 300 mm sized marble pieces shall be submitted for approval. Material received shall conform to the said approval group 4 marbles and no other type shall be accepted. Colour, grain, vein, etc. must conform to the approved sample only. Size and thickness shall be as specified. The marble may be ordered in various sizes to suit the pattern selected by the Architect/ EIC. Required pattern matching of marble shall be carried out by the contractor while cutting the marble.

2.6 Kota Stone

Kota stone shall be of approved size to achieve the pattern to be approved by the EIC/Architect. Thickness shall be as specified. Stone shall be dense, hard and free from cracks, decay, weathering and flaws.

3.0 SUB-BASE

Sub-base for all flooring shall be prepared and kept ready for further applications. All items shall be defined and detailed on the drawing. Measurements shall be as per the BOQ of these items.

Preparation of sub-base may be by doing excavation or back filling in plinth. Back filling shall be with the selected earth in layer of 150mm to 20mm maximum and adequately watered and well-compacted to achieve 90% compaction at optimum moisture content.

In case of excavation, the base shall be well-dressed to the desired level and inspected. All loose spots shall be excavated till the hard surface is reached and then filled as directed by the EIC. Surface shall be watered with just sufficient water and rolled and compacted with vibratory compactor.

3.1 Rubble soling

Good quality 150mm to 230mm thick rubble soling shall be carried out depending upon the grade of soil. Rubble used shall be at least 100mm for 150mm thick soling and 150mm for 230mm thick soling. Stone shall be hand packed as close as possible and bedded firmly with the broadest face downwards and the greatest length across, voids filled with chips and small stones. These shall be hammered down to achieve packing and the complete filling of interstices. To achieve the desired levels and slopes. Pegs at suitable intervals (about 12m) shall be fixed.

Soling shall be watered and again packed with sand or murum to fill interstices created by watering. Then it shall be rolled with vibratory compactor. Filling sand or murum, watering and compaction shall continue till full compactness is achieved to the satisfaction of the EIC.

3.2 Metal packing

3.2.1 Coarse aggregate used for metal packing shall be crushed or broken stone, hard, durable and free from excess of flat, elongated, soft and disintegrated particles, dirt and other objectionable matter Grading shall be as referred in table 16 of the Annexure.

3.2.1 Prepared sub-base surfaces as detailed in 3.0 above shall be uniformly spread with well-graded metal. Templates shall be used for leveling. Leveling shall be true and checked with 3m straight edge. Any raised areas or depressions of more than 12.5 mm shall be corrected. This shall be rolled with power wheel roller of 6 to 10 tons as required or as asked by the EIC for the intended purpose. Rolling shall continue till aggregate is thoroughly keyed and the creeping of the aggregate ahead of the roller is no longer visible. The rolled surface shall be checked and all irregularities corrected by loosening the surface, adding or removing necessary amounts of aggregate and rerolling until the complete area conforms to the required datum.

3.2.3. After the coarse aggregate has been thoroughly keyed and set by rolling, screening shall be carried out to fill the interstices. This shall be in 3 to 4 layers. Material shall be dry and no sprinkling of water shall be allowed.

3.4 Base floor

This shall be regular reinforced concrete floor or plain cement concrete floor as specified. Its thickness shall vary from 50mm to 150mm as the case may be. In case of RCC floor concrete this may be nominally reinforced with reinforcement bars.

All specifications of concreting shall be the same as per concrete and reinforcement section of this volume (Section II and Section III).

4.0 **FLOOR FINISHES**

4.1 Indian patent stone.

4.1.1. Cement concrete floor of specified grade of 40 to 75mm thickness shall be laid in panels. Cement concrete shall conform to concrete and mortar section II specifications.

The concrete surface finish may be monolithically laid with structural slab or laid over hardened structural slab. For convenience and to protect final finish in the period of construction laying of concrete over-hardened structural slab shall be preferred.

a) Hardened structural slab shall be thoroughly wire-brushed, hacked with mechanical scabbler to remove all scum, laitance of cement mortar and allowed to expose coarse aggregate. Surface shall be wetted and cleaned thoroughly.
b) Concrete shall be laid in panels. Panels shall be such as to minimise shrinkage and curling. Their length to breadth ratio shall be 1:5:1 It is advisable to keep the maximum length of each panel as 2.0m. Panels shall be formed by providing shuttering of timber or steel angles to dead accurate level. They shall be rigid and watertight.
c) In case dividing strips are to be provided, the same shall be fixed to dead accurate level and concrete poured into them (not required to be in alternate bays).

4.1.3

a) The concrete mix used shall be as stiff as possible yet sufficiently workable When mix is held in hand it shall form a ball but when released will crumble by itself.
b) All excess water from the surface shall be mopped up by tremix machine keeping surface just wet.
c) Thick cement plaster/ slurry shall be brushed into the surface just prior to laying of the concrete. It must be noted that slurry shall not be brushed over area where concrete laying is likely to be delayed.
d) Concrete laid shall be vibrated and compacted as required. It shall be levelled with 3m straight edge.
e) Surface shall be well trowelled and rubbed smooth to the satisfaction of the EIC.
f) No additional dry cement or cement mortar shall be sprinkled on the stiffened concrete surface to achieve smoothness.
g) Concrete shall be kept moist for 14 days.
h) Edges of panels shall be well-compacted to minimize liftings and curlings.

4.1.4 IPS-laid monolithic with structural concrete shall be carried out as under:

a) Floor concrete slab shall be allowed to stiffen enough but still be in a plastic stage.
b) Mix shall be laid in position and well-compacted with wooden float and levelled with 3m straight edge.
c) After the surface has become slightly hard, steel trowelling shall be carried out to achieve smooth, levelled surface.
d) No additional dry cement of cement mortar shall be sprinkled on the stiffened concrete surface at any stage.
e) The concrete shall be wet cured for 14 days.

4.1.5 Measurement shall be square meter for specified thickness and for specified mix.

4.2 Pre-cast terrazzo tiling.

4.2.1 Tiles shall conform to IS 1237.
Metric size of tiles as per IS 1237 are:

Nominal Size	Actual Size	Minimum Thickness
200mm x 200mm	198.5mm x 198.5mm	20mm
300mm x 300mm	298.5mm x 298.5mm	25mm
250mm x 250mm	248.5mm x 248.5mm	22mm

Tolerances on length and breadth shall be maximum 1mm and in thickness 3mm.

Tiles shall be hydraulically pressed with a minimum pressure of 140 kg.sq,cm. Tiles shall be single coat polished prior to receipt at site. Backing of tiles shall be in ordinary cement aggregate in proportion of 1:3 by weight. Top wearing course shall be minimum 6mm at any point in the tiles.

4.2.2. Bedding

It is advisable to provide a lime mortar bed. This gives workability and helps achieve dead accurate levels. Lime mortar in a ratio of 1:2 (1 lime putty: 2 coarse sand) shall be provided for bedding.

Structural concrete or base slab shall be cleaned, wetted, and mopped as detailed in 4.1.2 a of this section. Mortar shall be spread uniformly, tamped and levelled with a 3m straight edgy. The bed shall be keyed prior to finishing of the day's work. Thickness shall be as specified but at no point shall the bed be less than 10mm.

4.2.3 Laying of tiles.

A thick cement slurry/paste shall be spread over the bedding and cleaned tiles laid over this grouted area. Grouting shall be such that the area is covered within 15-20 minutes. Joints shall be as thin as possible and limited to 2mm at the maximum.

Laying shall start after due consideration is given to following points and approved by the EIC.

1. Datum levels of floors in rooms, adjacent rooms, passages, etc.
2. Slopes, if provided, the flooring should be given by adjusting thickness of mortar.
3. Tiles in openings and doors are equally placed.
4. Passage may be laid first to achieve evenness in doors.
5. Tiles in room shall be symmetrical and equal cut tiles shall be around the edges.
6. In case of differently coloured tiles in passages and rooms, a dividing strip shall be provided and changeover of colour shall be under the shutter.

7. In case there is any other architectural or structural feature, the same shall be considered and the pattern adjusted accordingly.
8. Tiles may be allowed to go under plaster or dado about 10mm.

4.2.4 After the tiles are laid, surplus cement slurry from the joints shall be cleaned. The following day the joints shall again be cleaned, washed and wire brushed.
Grouting of joints shall be carried out with coloured (pigmented cement) cement or gray cement that matches the colour of tiles. Grout shall be worked into joint. Excessive grouts shall be cleaned off.
4.2.5 The floor shall be kept wet for a period of 7 days. No traffic shall be allowed on the bedding and bedded tiles for atleast 2 days.
4.2.6 Polishing

Polishing and grinding shall be done only after 14 days. Machine cutting or grinding shall be carried out. At first the grinding shall be with rough stone of grade 48 to 60. All chips shall be visible and grinding shall be uniform. It shall be cleaned with water. All pin-holes and opened out joints shall be grouted with matching coloured cement grouts supplied by the tile manufacturer. It shall be cured for a period of 7 days by keeping it moist.

Second coat cutting/grinding shall be done with carboundum stone of grade 120. The same procedure as for the first coat shall be repeated till curing is completed.

The final cutting/grinding shall be with a fine stone of 220-320 grade and shall be done with ample water.

Oxalic acid powder shall be spread 33 gm/sq.m. and polished by machine fitted with hessian bobs. The floor shall then be washed, cleaned and dried with a soft cloth or linen. Wherever corners of tiles are slightly low and remain unpolished, they should be hand polished by using rubbing stone.

In case of wax polishing, wax polish shall be applied to the surface. It shall be rubbed with machine. Then clean saw-dust shall be spread over the floor and rubbed with polishing machine. This will remove wax, leaving a glossy surface underneath.

4.2.7 Precast terrazzo tiles are measured in square metres. Their rate shall include all material and labour costs required to complete the item to the satisfaction of the EIC. No extras shall be admitted on account of cutting of tiles in shape, preparing a pattern from different coloured tiles or a special border or a band. Landing of staircase shall be paid for in square meters. Treads and risers shall be measured in running meters for a particular width of tread and height of riser.

4.4.1 **KOTA STONE FLOORING**

Machine cut Kota stone slabs used shall be of 20, 25, 30 thickness. As far as possible colour shall be uniform. Tiles used at site shall be machine-cut.

4.4.2.1 In machine-cut edge tiles, edges shall be protected from any damage in transit. No breakage shall be permitted. All edges shall be sharp, perfectly rectangular and all tiles otherwise shall be rejected outright. Edges shall be pencil-rounded and polished for exposed corners and faces.
4.4.3. Bedding shall be of lime mortar or cement sand mortar as detailed in clause 4.2.2. of this section. In all cases of cement-sand-mortar mix, a ratio of 1:6 will be maintained unless specified otherwise in the BOQ/drawings.

4.4.4 Laying of kota stone flooring shall be as in clause 4.2.3., 4.2.4 & 4.2.5 of this section.

4.4.5. Polishing and grinding shall be carried out as in 4.2.6 of this section.

4.4.6 Measurement shall be in square metres. Steps and risers for specified width and height shall be measured in running metres or as detailed in BOQ. Rates shall include costs for all labour, material, cutting, dressing, polishing of exposed faces and edges, wastage etc. including laying in pattern and polishing to the required standard. No extras shall be permitted on any account.

4.5 **Marble Flooring/Granite Flooring**

4.5.1 Machine cut marble/granite stone slabs shall of 20, 25, 30, thickness as specified by the Architect, Colour shall be uniform and the slabs free from all defects. Tiles used at site shall be machine-cut.

4.5.2 In machine-cut tiles, edges shall be protected from any damage in transit. No breakage shall be permitted. All edges shall be sharp, perfectly rectangular. Edges shall be pencil-rounded and polished for exposed corners and faces.

4.5.3 Bedding shall be of lime-mortar or cement-sand-mortar as detailed in clause 4.2.2. of this section. It shall in all cases be in cement-sand-mortar mix in a ratio of 1:6 unless specified otherwise in the BOQ/drawings.

Laying of marble stone flooring shall be as in clause 4.2.3, 4.2.4 & 4.2.5 of this section.
Polishing and grinding shall be carried out as in clause 4.2.6 of this section.

4.5.5. Measurement shall be square metres. Steps and risers for specified width and height shall be measured in running metres or as detailed in BOQ. Rates shall include costs for all labour, material, cutting, dressing, polishing of exposed faces and edges, wastage etc. including dry laying in pattern, providing dividing strips, special cut pieces of various sizes to create the pattern as shown in the drawing and polishing to required standard etc. No extras shall be permitted on any account.

4.6 Glazed ceramic tiles.

4.6.1. Glazed ceramic tiles shall be laid on structural concrete slab or floor concrete slab. Tiles shall be laid in accordance to IS specifications and instructions of manufacturer.

4.6.2 Tiles do not require any special bedding as for Terrazzo and stone floor tiles. But to achieve the required slopes, an average 30 to 40 mm thickness bedding of IPS as under layer should be provided. Over this, tiles shall be laid in a cement mortar ratio of 1:4 on a bed of 12mm thickness.

4.6.3. Sub-grade shall be cleaned, wetted and mopped. IPS shall be laid in required slope/gradients. It shall be cured for 7 days and the surface shall be kept rough to achieve key with bedding of cement mortar. Cement mortar of about 12mm shall be spread over the area uniformly and compacted with 3 meters straight edge to achieve dead uniform levels. Surface shall be allowed to harden but in plastic state a thick cement paste by using cement @ 4.4. kg/sq.m shall be worked into the bedding. Cement paste shall be applied to the area only where immediate laying of tiles is carried out. Wetted tiles shall be cleaned and fixed in the thick cement pasted bedding. Tiles shall be positioned by tapping with wooden hammer and level checked with straight edge 2-3 metre long. Joints shall be as specified or as thin as possible. Points to be noted prior to start are as under:

1. Dry laying of tiles should be done first in a nearby place and should be got checked and approved by the Engineer.

2. Tiles of the same solour and shade should be grouped together.
3. End cut tiles are more than half.
4. Floor and wall tiles are in the same line.
5. Change of tiles is below the door shutter.
6. Dividing strip is provided.
7. Cutouts of floor drains are in line with the tiles. Tiles around cutouts are greater than 50mm or half the tile whichever is greater.
8. Joints should be very thin and in any case not more than 2 mm width.
9. Joints shall be cleaned thoroughly and grouted with colour or white cement as specified. White or colour grout shall be prepared with colour pigments added to cement as per colour of tiles or as directed by EIC. Grout shall be a thick paste and tooled into joints and area of the tile cleaned with a damp cloth. Grouting shall be cured by wet curing for 7 days. Grouting material fallen on the tiles should be immediately wiped out by using clean cloth. It should be ensured that no stins are left on the tiles.
10. After 24 hours of grouting, tiles shall be cleaned with water and after 7 to 10 days or prior to handing over, tiles shall be washed with mild acid. Care shall be taken that grout does not develop any stain mark.
11. All expansion joints shall be carried out right through and finished by sealing with silicon sealant.

4.6.4 Tiles shall be measured in square metres. Rate shall include for all material, labour, cutting, fixing, grouting, cleaning etc. completed to the satisfaction of the EIC.

5.0 **SKIRTING/DADO/STEPS/RISERS**

5.1 Material for skirting, dado, steps, risers shall be as specified in 2.0 above.

5.1.1. Surface preparation shall be same as for flooring for each type. Backing coat, plaster for dado and skirting shall be done as detailed in the plaster section. It shall be combed for creating a key and better adhesion with skirting material.

In case of steps, bedding shall be laid exactly as flooring and all operations described therein shall be carried out.

5.1.2. External and internal facings shall be fixed with adequate provision for expansion and compression joints.
The contractor shall supply and fix all necessary supports, anchor slots, anchor cramps and dowels required for the satisfactory completion of all vertical marble or any other stone cladding work. Fixing will be made from suitable non-ferrous metal stainless steel. They shall be in such shape and dimension that they are adequate to carry the loads to be imposed upon them.

Notwithstanding the above stipulation, the contractor shall be entirely responsible for the sufficiently of fixing.

All anchors and other fixing shall be concealed when the work is completed.
Great care shall be taken to protect delivered and laid marble/granite and other stones from dripping and staining during the course of work.

5.1.3. Skirting or dado tiles shall be fixed as under:
1. Sufficiently hardened backing/undercoat must be damp.
2. Tiles shall be buttered with gray/white or pigmented cement paste on the back side as directed.
3. Tiles shall be fixed on the undercoat and tamped with wooden mallet or rubber mallet to achieve full adhesion to the undercoat. Edges shall be tamped to secure line and level.
4. Care shall be taken to achieve pattern of laying with respect to floor or ceiling.
5. Tiles shall be mopped with wet cloth to remove grout coming out from joints.

5.1.4 Polishing and cleaning shall be as described in type of tile referred above, except that the operation shall be manual.
5.1.5 Measurement shall be in square meters for skirting, steps, risers for specified width. Dado shall be measured in square meters.
Rates shall include material and labour required to complete the item as specified and approved by the EIC. It shall include dividing strips, treating expansion joints, sealing corners and edges around fittings and fixtures etc. all completed as approved by the EIC.

DOORS, WINDOWS & STRUCTURAL GLAZING

I.1 Aluminium windows and doors: IS: 1948 & IS: 1949.

Aluminium alloy shall conform to IS: 733 and IS: 285. Contractor shall submit for approval a sample of section he is proposing to use for the frame. He shall also indicate weight of section per one meter length. he shall also submit for approval the sample of hinges, handles, peg stays or any other item that may require the approval of the Engineer.

The glass panes, unless otherwise specified, shall be of a thickness for windows and 5.5mm thickness for doors and shall be free from flaws, specks and bubbles. They shall have proper squared corners and straight edges. Fixing to frames shall be done with approved glazing pins and approved quality rubber beading.

Corners of frames consisting of extruded hollow tube sections or other profiles shall be to a true right angle. The hinges shall be either projection type, or friction hinges. Necessary coupling of approved shape shall be provided for composite windows. All holes required for fixing frame and for fixing glazing shall be provided. Only brass screws shall be used for fixing the frame to concrete members.

Vertical and horizontal members shall be of adequate rigidity to resist lateral forces. Design calculation shall be submitted for deflection of members.

All the fixtures for centre hung shutters, top and bottom hung shutters, or side hung shutters shall be got approved before they are used. The fixtures used should be such that it should be possible to open the shutter to any angle.

Unless otherwise specified, aluminium doors shall be provided with floor springs of approved quality and make.

All aluminium members shall be supplied in either matt or polished finish including anodising them by electrochemical process to an approved colour and to a thickness of average of 0.25mm. The frame shall be protected with a layer of clear transparent lacquer based methacrylates or cellulose butyrate. Temporary coating on Aluminium Sections. The coating shall be removed after installation is completed and after completing finishing work in the adjoining area.

The erection of frame shall be same as detailed under steel windows. Where aluminium frames come in contact with steel members, they shall be separated by either a 3mm thick rubber gasket for full width of aluminium member or any other approved film so as to avoid metallic corrosion.

I.2 SPECIFICATIONS FOR ED-4 SERIES ALUMINIUM DOORS

The outer frame shall be made out of 101.60mm x 44.45mm x 3.18mm rectangular tubular sections weighing approx. 2.508 kgs/rmt.

The outer frame for fixed glazing shall be of size 101mm x 44.45mm x 2mm thick weighing 1.7 kg/rmtr for single leg and 1.8 kg/rmtr for double leg.

The shutters shall be made out of specially extruded tubular sections provisions for weather stripping shall be made in the vertical jambs. Vertical shutter frame shall be of size 48.44mm x 44.45mm x 44.45 x 3.18 mm weighing 1.542 kg/rmtr. Beading shall be of size 15mm x 15mm weighing 0.130 kg/mtr.

Bottom cill shall be 44.45 mm x 99.24 mm 3.18 mm and shall weigh 2.579 kgs/rmt and the top cill shall be of size 48.44 mm x 44.45 mm x 3.18 mm and shall weigh 1.490 kgs/rmt.

The cleats for mechanical horizontal/vertical joints of the fixed frame and shutters shall be of specially extruded aluminium sections so as to avoid any play between jointed members.

Single action doors shall be fixed by heavy duty aluminium hinges.

Single action doors shall be provided with overhead door closer.

Double action doors shall be provided with floor spring.

Inactive leaf shall be provided with concealed shootbolt.

The active leaf shall have a unity lock, the active leaf shall also have one concealed shootbolt which can be operated from inside.

Shutters shall be provided with PVC/EPDM weather stripping.

The glazing beads, both on shutters as well as fixed glazing, shall be of screwless type.

EPDM/PVC gasket shall be used in the glazing beads for shutters.

For fixed glazing, the glass shall be encased in PVC channel so as to avoid metal to glass contact.

The aluminium sections shall be anodised in natural matt finish. Thickness of anodic film shall be minimum 15 microns (+/- 3 microns).

I-3 **Rolling shutters (IS: 6248)**

Rolling shutters shall be as per the size to suit the dimensions of the openings shown in the drawing. Unless otherwise specified, they shall be fabricated out of 18 gauge thick mild steel laths of convex corrugation with rolling centre 65mm and width minimum 12mm corrugation depth. The laths shall be interlocked by alternate and clips.

The side guides shall either be of rolled section or one piece pressed construction and shall be of size 25mm wide, 75mm deep. Thickness shall not be less than 3mm.

The shutter shall be provided with bottom lock plate 3mm thick and reinforced by an angle iron stiffener at the bottom and MS flat at the top.

The suspension shaft shall be of adequate design and unless otherwise specified shall be formed from 8 gauge seamless tube 6mm).D. with suitable flange coupling.

The springs shall be of approved high tensile steel flat or coil spring hardened and tempered. These shall be fitted inside the fabricated housing.

The ball bearings shall be double self aligning ball bearings fitted inside CI housing fixed on side brackets holding the suspension brackets at either end.

The suspension of the shutter shall be bolted in specially fabricated cages formed from MS flats and plates all arc welded.

The hood cover shall be made of 20 gauge MS sheets with necessary stiffeners and framework.

The locking arrangement shall consist of hoop and start on the bottom plate, lockable from both the sides,

Unless otherwise specified, for overall area of rolling shutters upto 5 sq.mtrs pull and push type hand operated shutters shall be provided, for area from 5 sq.mtrs to 10 sq.mtrs pull and push type with ball bearings shall be provided and area larger than 10 sq.mtrs mechanically operated gear and/or electrically operated shutters shall be provided.

The shutters, hook covers, etc. shall be given 2 coats zinc chromate primer after thorough surface preparation and further 2 coats of paint of approved quality and colour.

The erection of these shutters shall be carried according to manufacturer's specifications. While fixing concrete members, only shell anchors shall be used. Chiseling of concrete for fixing bolts will not be allowed.

I-4 **Mode of payment and measurement:**

Wooden doors and windows: the rate quoted shall include the cost of all frames, shutters, glass panes, if any and the necessary fixtures, wooden preservatives, fixing them in position and embedding the holdfasts in concrete and /or fixing the frame to concrete members with rawl plugs, screws, surface preparation either applying specified number of coats of approved paint/ polishing complete, and shall be paid on square meter basis.

For measurement of doors, the width shall be overall width of the frame measured prior to plastering, and height shall be measured from finished floor level to the top of topmost frame prior to plastering.
For measurement of windows, the width and the height shall be overall frame size measured prior to plastering.

Where only door shutters are to be paid separately as in the case of partition walls, they shall be paid on actual dimension of shutters.

For woodwork other than doors, shutters: unless otherwise specified, the woodwork shall be measured in cubic meter basis.

The length, breadth and depth of the member shall be measured after planning.

Steel Doors & Windows: The rate quoted shall include the cost of supplying fabricating and fixing in position frames, putty, glass panes, all necessary fixtures, applying paints as specified, embedding holdfasts in concrete or fixing to concrete members with rawl plugs and GI screws etc. complete and shall be paid on square meter basis.

For measurement for windows, the width and height shall be the overall dimension measured prior to plastering.

For doors, the width shall be the overall width prior to plastering and the height shall be from finished floor to the top of top frame measured prior to plastering.

Aluminum doors and windows: The rate quoted shall include the cost of supplying, fabricating and fixing in position frames, glass panes, rubber beading, all fixtures including floor springs, hinges, etc. anodising, applying protective cover embedding the holdfasts in concrete and/or fixing the frames to concrete members with rawl plugs and brass screws and where necessary the cost of rubber gasket (3mm thick) barrier between aluminium member and steel member etc. complete.

Measurement shall be on square meter basis for the actual work provided.

Rolling Shutters: The rate quoted shall include the cost of supplying, fabricating, fixing in position with shell anchors, or rawl plugs, bolts, all necessary fixtures including surface preparation and applying paint as specified and shall be paid on square meter basis for the area of clear opening.

SPECIFICATION FOR ALUMINIUM WORKS

1. The Doors, windows, partitions etc. shall be made out of extracted aluminium section only & of Jindal or Hindalco or Bhoruka make. Weight of the sections shall be as per detailed Architectural drawings.

2. All sections shall be anodized in any colour & thickness of anodizing shall be between 18 to 20 microns in matter or smooth finish & directed as per I.S.

3. The rate includes the cost for fabrication, erection on site, anodizing glass, beading, EPDM Rubber Gasket fixtures, fastening etc. everything ready to use. The mode of measurement shall be carried out through the agency of fabricators as per their specification.

4. Aluminium doors & windows etc. shall be used of approved fabricators only & fixing shall be carried out through the agency of fabricators as per their specification.

5. Aluminium doors & windows etc. shall be completely water & air tight.

6. EPDM gasket should be used for all doors & windows.

7. Aluminium doors & windows etc. shall be confirmed to I.S. specification I.S.1948 of 1961 & amended up to the date in general.

8. As the sizes & weight of the aluminium extruded section varied from manufactures to manufactures +5% tolerances is allowed in weight & sized for which no rebate or extra payment will be made.

SPECIFICATION FOR ALUMINIUM CASEMENT WINDOWS & VENTILATORS

1. The window shall be made of extruded aluminium section hollow section.

2. The corner joints shall be mechanical & the joining cleats shall be made out of aluminium extrusions with minimum 2mm except for the doors, where the angle cleats should be strong enough to take the load.

3. The openable windows shall be made of double weather stripped .One weather strip shall be provided in the outer frame & the other in shutter frame. The weather strip shall be good quality natural rubber & of the size to make the window completely weather tight. The peg stays shall be made out of aluminium extruded sections only.

4. The hinges of openable shutter shall be strong & made out of aluminium extruded sections & pin of hinges shall be non corrective material preferably stainless steel. Alternatively the openable shutters shall be provided with bar arm S.S.hinges.

5. The window shall be provided with handle for single point locking. The handle shall be made out of 6 thick aluminium alloy flat.

6. The aluminium Sections shall be suitable for glazing 4 mm. to 5mm thick flat glasses.

Outer frame of openable window shall be 33.33mm X 3.33mm X 4.26mm section weighing 0.758 Kg/Rmt.

a) Shutter frame shall be 33.33mm X 47.62mm X 3.18mm section weighing 0.826Kg/Rmt.
b) Outer frame for fixing glazing shall be 33.6mm X 26.0mm X 3.18 section weighing 0.526 Kg/Rmt.
c) Beading shall be 15.08mm X 12.70mm X 1.6mm section weighing 0.16 Kg/Rmt.
d) Intermediate mullion shall be 33.33mm X 58.8mm X 3.1mm weighing 1.01 Kg/Rmt.
e) Intermediate coupling TEE shall be 44.45mm X 19.05mm X 4.76mm weighing 0.928 Kg/Rmt.

SPECIFICATION FOR SLIDING WINDOW

Note: - The windows shall be made out of extruded aluminium sections.

	SECTION DETAILS
1)	2 TRACK (Top) SECTION NO. 20839 Weight – 0.784 Kg/per m
1)	2 TRACK (Bottom) SECTION NO. 20830 Weight – 0.909 Kg/per m
2)	3 TRACK (Top) SECTION NO. 20831 Weight – 1.060 Kg/per m
2)	3 TRACK (Bottom) SECTION NO. 20832 Weight – 1.248 Kg/per m
3)	4 TRACK (Top) SECTION NO. 20833 Weight – 1.398 Kg/per m
3)	4 TRACK (Bottom) SECTION NO. 20834 Weight – 1.648 Kg/per m
4)	Top / Bottom – 20736 Weight – 0.547 Kg/per m
5)	Handle – 20738 Weight – 0.547 Kg/per m
6)	Interlock - 20737 Weight – 0.607 Kg/per m

1. Shutters shall be provided with two ball bearing rollers & 2 antiratting pieces/guides one each at top & bottom & weather strip all around

2. All joints shall be mechanically jointed.

3. Window shutters shall be provided with special locking arrangement.

4. 4mm X 5.5mm thick glass shall be fixed in shutter by means of rubber gasket.

5. The additional outer frame for fly mesh shutter shall be 188mm X 16.8mm X 1.5mm weighing 0.16 Kg/Rmt

6. Architect sections if required shall be 30mm X 75mm X 1.2mm weighing 0.163 Kg/Rmt

7. The aluminium sections shall be anodized in natural matt finish Thickness of anodic film shall be is microns (+3Microns)

6 (2) ALUMINIUM WINDOW & GLAZING WORK

1.0 STANDARDS

1.1 Work under this contract shall be carried out to following Indian or International Standards. Any conflicts noticed in various standards & building regulations shall be reported to the Architect & his direction & approval to be obtained. However it shall be noticed as a general rule that the more stringent specification shall apply. All standards shall be the latest revisions.

1)	IS 456-2000	plain & reinforced concrete
2)	IS 875 (Part 1,2,3)	Designed loads for building structures
3)	HE9 WP(IS63400 WP)	Aluminium Extrusion
4)	IS 1608	Tensile Strength
5)	IS 2853	Specification for toughened glass
6)	CP 118	Structural use of Aluminium
7)	ASTM 1046 C	Standard specification for heat treated float glass FT & HS coated & uncoated glass
8)	IS 3548	Glazing in building

1.2 Quality Assurance

1. Manufacturer shall certify that sections extruded conforms IS/ BS/ ASTM standards specified.
2. Manufacturer shall have minimum ten years experience in extrusion.
3. The design engineer of the contractors shall have minimum sufficient experience in designing similar work
4. The contractors design engineer shall certify that design meets standards, are safe & acceptable to local authorities.
5. Obtain aluminium through one source for each type.

1.3 Submittals

1. The contractor shall submit detail literature, catalogue along with certification that material meets or exceeds standards specified.
2. The contractor shall submit design calculations for unit & shall include method of statement for fabrication, installation.

3. Shop drawing shall be complete with following

a) Fully dimensioned plans & elevations with detail co-ordination keys.
b) Location of exposed fasteners & joints.
c) Indicate fabrication, installation & finish of specified system.

Details shall be complete with following: -

a) Members dimensioned
b) Joint connections for framing systems for doors, windows, louvers etc.
c) Anchorage
d) System reinforcement if any
e) Expansion & contraction provisions if any
f) Hardware including locations, mounting heights, reinforcement & special installation provision if any.
g) Glazing methods & accessories.
h) Notes on internal sealant requirements & recommended types.

4. The contractor shall submit Performa of warranty from various manufacturers / suppliers for approval.

1.4 Delivery, Storage & handling

1. Doors & frames cardboard wrapped & crated to provide protection during transit at site store. Additional care shall be taken to prevent factory finish surface.

2. Inspect doorframe & shutter on receipt at site to notify damage to supplier if found. Minor damages shall be repaired at site provided refinishes items match new work & acceptance to the Architect. Remove & replace damage item that cannot be repaired.

3. Store all material in dry lockable, ventilated shed it shall be stored on wooden runners / packing & shall be off the ground minimum 150mm.In case of package damaged & wet during transit replace with new dry once.

2.0 MATERIAL

2.1 Aluminium

2.1.1 Aluminium Extrusion shall be fully heated treated aluminium alloy conforming to IS (63400WP/HE9WP) or equivalent standards 6063-T5. Framing material shall comply as under.

For extrusion Alloy to BS 6063- T5 or T6 & ASTM B221.

For sheets alloy to BS 5005-T5& ASTM B-209

Other alloys & Temper recommended by the manufacturer appropriate for specific finish.

Minimum thickness 2.0mm for framing members & rails, 1.8 mm for sheets & for glazing stops & similar components. Glazing beads shall be screw less type fitted into frames.

2.1.2 The extrusions shall be clean straight & sharply defined lines. It shall be free from distortion & defect s impairing strength, durability & appearance. Profiles shall be able to meet required strength in respect or tensile, shear & bending stresses. They shall be rigid & capable of providing local & lateral stability.

2.1.3 Internal reinforcement if any shall be hot dip galvanized steel bars / pipes with separators to withstand design criteria.

2.1.4 All aluminium material used shall be anodized for protection against corrosion in marine atmosphere. A thick coating of 20 Microns from sulphuric acid bath shall improve its corrosion.

Resistance. Further, anodized sections should be double sealed or alternatively, sealed by exposure to steam.

2.2 Fasteners

2.2.1 All fixing anchor, bolt, screws, nuts, washers, or other miscellaneous anchoring / fixing devices shall be of non – magnetic stainless steel or other non corrosive materials compatible & approved by Architect. These materials shall be compatible aluminum used in work & shall provide adequate strength.

1. Exposed Condition: - Stainless Steel with EPDM Gasket.

2. Concealed Condition: - Steel or Cadmium Plated.

2.2.3 All Concealed fastening that is not required to be stainless steel shall not hot dip galvanized steel.

2.3 Separators

Separators between steel & aluminum members where required shall be rigid type, high impact resistance, smooth both sides Teflon with minimum thickness of 0.8 mm as approved by Architect.

2.4 Sealant

2.4.1 Sealant shall be silicon sealant manufactured by Dow Corning Corporation compatible with aluminium, glass & adjoining work.

2.4.2 All sealant applications must be clearly designated on the applicable shop drawing details & referenced to a master sealant. Schedule specifying materials, special instruction & application procedures.

2.4.3 The sealant shall be quality controlled one part low module silicon confirming to BS 5889.Structural silicon shall only be factory applied selected colour silicon to Architects approval.

2.4.4 Runs of sealant to joints between frames & structure shall not be less than half of width.

2.4.5 Joints filter & back-up material shall be polyethylene foam, sponge neoprene as per the written recommendations from the approved sealant manufacturer for each specific application. Shape, size, hardness, compatibility & bond breaking requirements are all factors to be considered.

2.4.6 All sealant must be non – staining & compatible with adjoining & / or adjacent Sealant, back – up, materials, substrate materials & their respective finishes & / or applied coating.

2.5 Aluminum Flashing

Aluminum sheets confirming to BS & ASMT shall be minimum 1.012 mm thick, prepressed, cut to correct length flashing for each location of window sills shall be factory coated in approved shade & colour.

2.6 Ironmongery

2.6.1 Fitting & fixtures (Ironmongery) shall be installed with all necessary / required best quality hardware. It shall be matching to adjacent powder coated finishes. All Ironmongery used shall be approved by the Architect prior to being installed & shall be noted accordingly in shop drawings. The contractor along with shop drawing shall submit all samples & catalogues for ironmongery.

2.6.2 All locks to be used shall be with arrangement to receive master key cylinders & contractor shall co – ordinate with the employer prior to window being notched & back body being provided for approval of Architect.

2.7 Glass

2.7.1 Glass shall be single.

2.7.2 Glazing shall be as follows:

- Windows

Glazing for windows shall be single of 5 mm Clear float glass or as given in BOQ.

- **Louvers**

5.0 mm obscure glass or as given in BOQ

- Sliding door

5mm clear float glass or as given in BOQ

2.7.3 Acceptable glass manufacturers are

- Saint Gobain
- Float Glass (ASAHI)
- Gujarat Gordian

2.8 Gasket

The gasket shall be high resistance to aging, prolong periods of compressive stress, ability to recover from compression deformation to allow joint movements.

3.0 SCOPE OF WORK

3.1 The contract is for & the contractor shall be responsible for design, prepare shop drawings based on actual site measurement, fabricate, supply, install of all items based on concept architectural drawings & specification given for guidance. It shall be responsibility of contractor to propose his own design which meets the requirements & passes the tests specified. Further he shall take responsibility to complete work & guarantee as per approved design, shop drawing by the Architect.

3.2 In brief list of items to be included are summarized but should not be taken as complete & conclusive.

- Design aluminium window, door etc.
- Glass & glazing as specified.
- All anchor fixing, attachments, reinforcement for mullions & transoms.
- Sealant within & around perimeter of all work.
- Interface with adjacent system.
- Heavy-duty hardware with friction stay hinges for hold open facility as required.
- Weather stripes as requirement.
- EPDM Gasket.
- All labour, supervision & quality control.
- Scheduling & monitoring the work.
- Coordination of work with main contractor & other trades.
- Storage & handling, protection & cleaning.
- Guarantee the work & material.

3.3 Design Criteria

3.3.1 The various aluminium extruded sections shall be designed as per IS code.

- ❖ Wind pressure at 150 Kg/Sqmtr.
- ❖ Dead loads
- ❖ Live loads
- ❖ Loads due to climatic conditions.
- ❖ Maximum deflection of exterior member shall not exceed 1/200 of the span of the member or 19mm whichever is less.

❖ Make provisions for water entering at joints & condensation occurring within wall construction to drain to exterior surface.

3.4 Submittals

3.4.1 Contractor shall submit design calculation along with method of statement & shop drawings meeting criteria specified.

3.4.2 Shop Drawings

Shop drawing shall be complete with following

1. Fully dimensioned plans & elevations with detail co – ordination keys
2. Location of exposed fasteners & joints.
3. Indicate fabrication, installation & finish of specified system.

❖ Details shall be complete with following
❖ Dimensioned members
❖ Joint connections for framing systems for doors, windows, louvers etc.
❖ Anchorage
❖ System reinforcement, if any
❖ Expansion & contraction provision if any.
❖ Hardware including location, mounting heights, reinforcements & special installation provision if any.
❖ Glazing method & accessories.

4.0 WORKMANSHIP

4.1 On approval of shop drawing the contractor shall check actual site dimensions of opening on site & accordingly manufacturing shall be carried out in consultation of Architects. He shall prepare shop drawing to these dimension & get approved coordination required to suit condition.
Approval of shop drawing does not absolve the contractor of his responsibility nor fulfilling his obligation in meeting requirements as specified as specified & performance with guarantee a required.

4.2 All joints in frames shall be machined & fitted to form hairline joints prior to assembly, electrically welded joints shall be prepared but mechanical joints shall be permitted. All corners, junctions shall be mechanically cleated & assembled to provide strong & rigid framework. Joints shall be sealed. Required permissible tolerance for expansion & contraction shall be provided. The jointing accessories such as cleats, brackets, etc. shall be of such material as not to cause any bimetallic action. All accessories shall be such that they are fully concealed.

4.3 The fabrication of windows shall be done in suitable parts/sections to facilitate easy transportation; handling & installation. Adequate provision shall be made in the window members for anchoring to supports & fixing of hardware & other fixtures as approved by architect.

4.4 GLASS

4.4.1 The contractor shall cut glass size by field measurements or dimensionally approved shop drawings. The responsibility for correct glass sizes shall rest with the contractor. No cracked, chipped or disfigured glass shall be acceptable.

Glazing work shall be carried out with following precautions.

1. Glazing work shall be carried out through experienced skilled workmen conforming to beast practices. All instructions of glazing manufacturer shall be followed.
2. Tongs marks shall be concealed within rabbet.
3. Glazing rabbet shall be clean, dry & free from any material that might adversely affect the bond seal of glazing materials of the drainage.
4. Glass shall be centered in each opening to provide recommended clearances. Setting blocks shall be at least 10 mm in thickness & full width of rabbet. & placed at glass quarter points.
5. Exposed sealant shall be tooled smooth & top surfaces sloped to drain water away from glass.
6. Beads sealant, tapes, etc. used shall be mitered at each corner.
7. Glasses shall have safety marking as approved by Architect at eye level.

8. Installation completed shall be sound, watertight, & free from defects & to acceptable standard of Architect.

4.5 Joints around aluminium work & building such as at head, jams, sills between masonry & concrete etc. shall be grouted with silicon sealant.

4.6 Doors shall be fitted with approved hardware & operating devices. Mechanisms shall be such that they operate smoothly & free without noise & excessive friction & shall be adequate for intended purpose. Doors & sashes be hung on aluminium butt hinges. Lock set shall be of approved quality & with provision to receive master key cylinder if to be provided by the employer. They shall be with required type of handle.

In sliding units, adjacent aluminium members shall not slide upon each other. They shall be seerated by material which doesn't interfere with sliding action.

All external shutters shall be watertight. Glazing of shutters shall be from inside, secured by aluminium beads fitted into extruded frames & sealed with EPDM gasket in vertical & horizontal direction.

Spring shutters shall be hung on pivot/ floor spring. Springs can be single or double action as required. For double leaf shutters one shutter must be provided with concealed two tower bolts.

4.7 Fixed glazing shall be from outside & shall be secured with aluminium beads fitted into extruded frames & EPDM gasket. It shall be ensured that it is fully water tight & secured.

4.8 Louvers shall be as per design & shall be such that it prevents any back flow of rain water into the interior of the building under any conditions. Provide mosquito & bird screen.

4.9 ANTIGALVANIC ACTION

4.9.1 Isolate dissimilar metal surfaces to prevent galvanic action. Materials used for this purpose shall be non – absorptive.

4.9.2 All steel parts shall receive a protective treatment commensurate with their respective functions. The treatment shall be one or more of those described above, and approved by architect.

4.9.3 Aluminium surface is contact with mortar, concrete fireproofing, plaster, masonry & absorptive materials shall be coated with an anti – galvanic. Moisture – barrier material.

4.10 Sealant & Gasket Application

4.10.1 Sealant & gaskets shall be provided where shown on the drawing or required for permanently watertight installation.

4.10.2 The design of all sealed joints shall be in accordance with the recommendation of the sealant & / or other method.

4.10.3 Protect all adjoining surfaces not to receive sealant & gasket against by masking & / or other methods.
4.10.4 Joints & joint surfaces shall be clean, dry & free from any material that may have an adverse effect on the bonding & / or seal of the sealant & gasket materials.

4.10.5 Apply sealant & gaskets under the conditions recommended otherwise. In writing, by the manufacturers. Use no sealant that has started to set in its container or sealant that has exceeded the shelf life published by the manufacturer.

4.10.6 Fill all joints continuously & completely with sealant, forming a neat, uniform concave bead. Finish the material flush with adjoining flush surfaces unless otherwise shown on the drawing.

4.11 GASKETS
Provide & install EPDM gasket of approved size & profile at all locations as called for to render the windows absolutely airtight & weather tight. Produce samples of the gaskets for approval & procure after approval only.

4.12 Storage & Handling

4.12.1 Wherever possible all material shall be stored in dry, well ventilated conditions prior to fabrication.

4.12.2 No material or glass shall be left exposed to the external elements prior to fabrication.

4.12.3 Adequate storage facilities must be provided for all materials prior, during & Following Fabrication. The contractor is to submit full details of these facilities for the approval of Architect.

4.12.4 No materials or assembled units are to be left exposed to adverse weather conditions prior to erecting at site.

4.12.5 Handling of the glass shall be kept to a minimum & all glass shall be carefully protected from soiling & from condensation & other alignment.

4.13.1 All work shall be erected / installed to correct line, level, & Plumb & fastened securely in correct vertical & horizontal alignment.

4.13.2 Full survey record shall be submitted to Architect & required measures if any taken shall be noted on shop drawings with approval of Architect.

4.13.3 Proper lighting & safety equipments such as belts, helmets etc. shall be provided & strict observation shall be done.

4.13.4 Contractor shall apply suitable tools to enable the installation to proceed safety & to the highest standards.

4.14 Double legged, self supporting & accessible at all location. Scaffolding as required for the work shall be provided by the contractor to the approval of the Architect.

5.0 INSPECTION

All shop & field materials & workmanship shall be subject to inspection by Architect at all time. These inspections shall not relieve the contractor from the obligation to provide materials confirming to all requirements of the contract document matching approved samples. The contractor / specialist shall promptly correct any deficiencies reported & carryout his own control measure for all, materials weather inspected or not.

6.0 CLEANING

- The contractor shall ensure that all actions are taken during installation. To eliminate the effects of corrosive substances on the finishes.
- The contractor shall clean both and external surface to remove corrosive substances, dust or cement / mortar dropping the installation as may be directed and instructed by the Architect.
- The contractor shall provide written verification that cleaning agents are compatible with aluminium, stainless steel glass coatings, granite, glazing materials and sealants.
- Prior to snagging inspections the contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all the glass and aluminium.
- The contractor shall also make good any physical damage to the structural including scratches, dents, abrasions, pitting, and recto the satisfaction of the Architect.
- Manufacture's delivery or job markings on glass and adhesive for Manufacture's labels shall be either neutral or slightly acidic material . In no case shall such material be alkaline: any staining of glass by alkaline material will be cause for rejection of the glass.
- After the installation of each pane of glass all markings and labels of any sort shall be placed on the glass.
- Glazed openings shall be identified by suitable warning tapes or flags attached with a no staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.
- As soon as it is practically possible after issuance of the occupation for the Building, the Contractor is to carry out complete cleaning of the external face.

7.0 WARRANTY

Prepare and submit in accordance with contact for

1. Warranty jointly signed by the manufacturer, installer and contractor agreeing to Repair and / or replace assemblies which fall in material or workmanship during Warranty period of 10 years.

8.0 MEASUREMENTS

8.1 Measurements shall be in Sq m of actual area covered.

9.0 RATE

9.1 Rate shall include all required labour, material, designing, drawing Conveyance, breakage, wastage, supervision, protection till handover and free Maintenance during defect liability etc. complete.

STRUCTURAL GLAZING
TECHNICAL SPECIFICATIONS

1. SCOPE OF WORKS

The scope of works under this contract includes design, supply, installation, protection, guarantees, testing and maintenance upto he defects liability period for Curtain Wall, Aluminium Cladding, Doors, Windows and Louvres.

The work under this specification includes all Labour, materials, equipment and services as required for the complete design, engineering, testing, fabrication, assembly, delivery, anchorage, installation, protection and waterproofing of the Aluminium curtain wall / structural glazing system, cladding and louvres and all in accordance with the true intent and meaning of the specifications and drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings or described in the specification provided that the same can be reasonably inferred therefrom. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required to secure Aluminium structural glazing system, cladding and louvres to the building structure.

The detailed scope of works consists of:-

1. The Aluminium structural glazing system, cladding and louvres described hereafter shall include but will not necessarily be limited to the follows:-

a. Frames, vision panels, spandrels, doors and ventilators.
b. Openable panels where indicated, inclusive of all accessories, fittings, etc.
c. Copings, soffit trimmers, and external metal cladding panels for both the wall cladding and the curtain walling system.
d. Aluminium louvres wherever indicated.
e. Al caulking, sealing and flashing including sealing at junctions with roof waterproofing and exterior wall, flashing at doorway, raised kerbs and in window surrounds.
f. Sealant within and around the perimeter of all work under this section.
g. Separators, neoprene / EPDM and silicone gaskets, trims, etc.
h. All steel structural framing and beam supports, anchors and attachments as required for the complete installation of the whole system, wherever specified.
i. Inserts in concrete, anchor fasteners etc. for the anchorage of all work under this section.
j. Isolation of all dissimilar metal surfaces as well as moving surfaces similar or dissimilar.
k. Fire-stops, Flashings, Sealing of all interfaces with buildings, etc.
l. Protection during storage and construction until handing over.
m. Engineering proposals, drawings and data.
n. Shops, drawings, engineering data and structural calculations of all systems including framing, fasteners and cladding.
o. Scheduling and monitoring of the work.
p. Co-ordination with work of other agencies / contractors employed on site.
q. All final exterior and interior cleaning of the Aluminium structural glazing system, cladding, doors louvres, and window, etc.
r. Specified tests, inclusive of necessary reports.
s. Maintenance manuals,
t. Design and Performance guarantees.
u. Period inspection, supervision and advice by tenderer's Principal as well as a back-up guarantee in approved Proforma from the Principal for the quality and performance of works.

v. Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the shop drawing details (including any modification made during testing) and acceptable standards of quality.

2. REFERENCES AND STANDARDS

2.1 The provisions of the latest Standards listed below, but not restricted to form part of these specifications:

ANSI Z97.1.84	Safety Glazing material used in Buildings.
ASTM C 1036-90	Specifications for float glass.
ASTM C 1948-90	Specifications for Heat treated Float Glass.
ASTM E 774-88	Specifications for sealed Insulating Glass Units.
ASTM C 1172-91	Specifications for Laminated Architectural Glass.
ASTM C 864-90	Specifications for compression Seal Gaskets.
ASTM C 115-89	Specifications for Silicone Rubber Gaskets
ASTM C 920-87	Specifications for Sealants.
ASTM C 509-90	Specifications for sealing material.
CPSC 16 CFR 1201	Specifications for Safety of glass.
GTA Specifications No. 89-1-6	Specifications for environment durability for heat strengthened Spandrel Glass with Applied pacifiers.
BSCP 118	Structural use of Aluminium.

2.2 Building Regulations

Design of the Aluminium structural glazing system shall comply with all Government codes and regulations. For wind design, all calculations shall comply with the requirements of the relevant National Building Code and Indian Standard Code, unless specified otherwise.

3. GUARANTEE

The Contractor shall be fully responsible for and shall guarantee proper design and performance of his installed system for a period of 10 years from handing over of works.

The design and installation shall be to the best international standards and shall specially take account of wind and seismic loads, storms, air pollution, thermal stresses, building movements and the like.

4. CONTRACTOR'S RESPONSIBILTIES

4.1 The Contractor's responsibilities include but are not necessarily limited to the following items:

a. The Contractor shall provide and install all supplementary parts necessary to complete all items generally implied in the drawings and in the specifications though not specifically shown or mentioned. This shall include the design and sizing of all sections and anchor assemblies to to meet the performance and design requirements, furnishing and installation f all inserts, fasteners, clips, bracing and framework as required for the proper anchorage of the structural glazing system elements to the structure, unless otherwise noted or specified to be furnished / installed by another contractor. Alternate anchorage proposals will be considered, if the specifications are maintained.

b. Design Responsibility:

Drawings and specifications indicate the required basic dimensions, profiles and performance criteria. The Contractor shall have the option of modification and addition of details provided the visual concept and performance requirements are fulfilled. Proposed modifications shall be clearly shown on shop drawings as "Design Modifications" and acceptance of the same will not relieve the Contractor form sole responsibility for performance of the Aluminium structural glazing system and cladding. The Contractor shall be solely and fully responsible for due performance of his installation based on his own design and details.

c. In-plant and job site inspection: The Contractor shall afford the Employer / Architect their authorized agent full access to plants, shops and assembly points to view and inspect the processes and methods employed in the fabrication, assembly and finishing of the Aluminium structural glazing system and cladding for this project.

The Employer / Architect will have the right to reject any and all Aluminium structural curtain wall / structural glazing system and cladding components and assemblies during assembly and erection if he workmanship and intent are not in strict conformity with the approved shop drawings, structural calculations, documentation, certifications, samples and mock-up.

d. Glass, sealants and other items or materials procured by purchase shall be back to back guaranteed by the manufacturer.

5. SHOP DRAWINGS

5.1 Within one month from the award of contract, the contractor shall prepare all necessary shop drawings based on the preliminary drawings and two (2) copies of all shop drawings shall be submitted to the Employer / Architect for review and approval. The review of all shop drawings will be limited to their conformity to the design concept % specifications. Approval of the shop drawings will not relieve the contractor form any of the responsibilities and requirements as stated drawing s and all other related submissions, documentation, certifications, samples and the mock-up for that work have been reviewed and approved.

5.2 Shop drawings shall incorporate scaled and dimensioned plans, elevations, sections and full size details for all work in this section.
Shop drawings shall indicate the desired dimensional profiles and modules, function, design and performance standards and, delineate the scope of work. The contractor shall verify and co0ordinate these items with all applicable and/or related trades, contract drawings and specifications. Since the dimensions and modular references shown on the drawings are for specified and/or typical details the shop drawings shall include a full complete layout of all modular and referenced dimensions for all the Aluminium structural glazing, cladding, doors, windows and louvres and their related elements. All dimensions / modules, etc. shall be filed checked as required.
The full size details shall show and specify all metal sections, types of finishes; areas to be sealed and sealant materials; gaskets, direction and magnitude of thermal expansion; direction and magnitude of all applicable construction including fasteners and welds; all anchorage assemblies and components; the fabrication and erection tolerances for all the work x applicable related works adjoining, attached to or in some way related to the work covered by these specifications. The location of all static and dynamic anchor assemblies, the direction of thermal and other applicable building movements, co-ordination with concrete works and the sequence of installation shall be designated on the applicable plan, elevations and / or sections.
5.3 shop drawings shall indicate the desired profiles, dimensions, details of metal finish and in general delineate the scope of the work. Profile adjustments in the interest of economy, fabrication, erection, weather-ability or ability to satisfy the performance requirements may be made only with the written approval, provided that the general design and intent of the drawings and specifications are maintained.

6. STRUCTURAL CALCULATIONS
6.1 the Contractor shall employ a competent design engineer to design his systems and components. During the design stage, the Contractor shall interact actively concerning all aspects of design and shall obtain all the information from the concerning the structure, probable deflections and other building movements etc. The Contractor shall take full account of all possible building movements as well as the movements of his curtain wall and cladding systems in his design. The Contractor shall submit his detailed structural calculations for the system and each of their components and shall guarantee that his design will ensure the structural safety and integrity of the curtain wall, cladding and glass panels against all natural forces, superimposed loads, environment and consequent movements.

The Contractor shall obtain approval to his design calculations and to the provisions made in his design for all the building movements, and be jointly responsible to the Employer for the correctness of the fixing and interaction of the curtain wall with the structure so as to ensure that all the movements envisaged between the structure and the curtain wall area are fully taken care of. However, the Contractor alone shall be responsible for the workmanship of fabrication and installation and shall indemnify the Employer against all claims due to defects or non-performances during the specified 5 year Guarantee period. The provisions of this clause shall not in any way limit the Employer's rights under other clauses of the Contract.

6.2 The R.C.C. in the building structure is Grade M25 / M30. The Contractor shall design anchorages for this grade of concrete with adequate safety factor.

7. DOCUMENTATION AND CERTIFICATION

7.1 Glass and Glazing Documentation:

The applicable glass manufacturer(s) shall submit written certification for review and approval stating that all glass and glazing requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and/ or design parameters, compatibility to adjacent materials and in conformity with all requirements as detailed and specified in the Contract Documents. Certification shall further state that the proposed glass and glazing materials are most appropriately suited for the use or uses intended and recommended for the specific use or the selection of the glass and the glazing materials including, but not limited to, gaskets, setting blocks, sealant, the design and dimensional parameters of the glass pockets and the compatibility of materials. Test Certificate form approved laboratories for You-values and shading factor claimed by the Manufacture shall be submitted.

7.2 Sealants Documents:
All sealant applications must be clearly designated on the applicable shop drawing details and referenced to a master sealant schedule specifying materials, special instructions and application procedures. The applicable sealant manufacturer(s) shall submit in writing that all the sealant requirements as detailed and specified on the shop drawings have been reviewed and approved for use relative to their specific application and / or design intent, compatibility to adjacent materials and in conformity with all the requirements as detailed and specified in the contract documents. The manufacturer's certification shall specify the optimum life expectancy, in years, for the proposed sealant materials as detailed and specified on the shop drawings and / or master sealant schedule and shall state that the proposed materials are most appropriately suited for the use or uses intended and recommended for the specific use or uses.

7.3 Quality Control Documentation:
In-plant and job site quality control procedures shall be documented in writing for review and approval to ensure the design integrity and performance of the as-built product. Documentation shall include schedule, details, isometric and / or schematic explanatory sketches cross-references to the shop drawings, data sheets, etc., all as required to intelligently witness and assess methods and materials; and to ensure that both the fabrication and installation are in accordance with the contract documents.

The Employer / Architect shall, if required, be given free access to the plant to inspect fabrication procedures.

a) The in-plant quality control procedures shall include but not necessarily be limited to the following items:
Fabrication :Tolerances, Joinery, Sleeves, etc.
Finish Match :Approved finish controls required for matching the exposed surfaces.
Assembly :Welds, fasteners, sealants, gaskets, separators, glazing, etc.
Protection : Handling, protection, shipping, etc.

b) The job site quality control procedures shall include, but not necessarily be limited to the following items:
Anchorage :Lines, grades and related building tolerances.
Installation :Tolerances, finish, match, joinery,sleeves, flashing, welds, fasteners, sealants, etc.
Sealing : As recommended by the applicable sealant manufacturer(s).
Protection & Cleaning : As recommended by the applicable sealant manufacturer(s).

8. SAMPLES AND MANUALS:
8.1 After issue of Work Order, the following samples of actual job site materials together with detailed technical data / catalogues shall be submitted in duplicate, unless otherwise noted, and in the sizes noted, for review and approval. Any omission of an item, or items which require the contractor's compliance with these documents does not relieve him from such responsibility.

(a) Aluminium sheet panel: Each type and thickness; 600 x 600 mm of the specified thickness.
(b) Aluminium extrusions; one only of each section; 300 mm long of specified thickness.
(c) Glass; Each type and kind, 300 x 250 mm of specified thickness and including frame.
(d) Glazing gaskets, tapes, separators, glass setting blocks, etc. each section or unit, 300 mm long or unit.
(e) Fasteners and connections devices: Each type and size.
(f) Finish Samples: After approval of the final finish coating, six (6) approved samples are to be provided.
(g) Window and door ironmongery and accessories, as applicable.
(h) Flashings and finish samples.
(i) Cladding.

8.2 Maintenance Manual:
Submit Maintenance Manuals approved in one / two copies each indicating the detailed procedures for the periodical inspection maintenance and cleaning of all structural glazing, cladding, doors, windows and louvre elements, finishes, etc.

9 WORK SCHEDULE:

9.1 Immediately on receipt of the Work order the Contractor shall submit the final programme of work schedule for the completion of the whole of the works including submittals, approvals, fabrication, supply at site & installation. The \time schedule shall be got approved.
9.2 The time schedule shall be prepared in consultation to suite the overall project schedule and shall be updated from time to time to suit prevailing conditions and co-ordination with other contractors employed on site.

10 INSPECTION OF COMPONENTS:

The Contractor shall submit a schedule of material specification and procedure for inspection of the quality of components of the metal wall cladding / curtain walling the fabrication in the plant.

11. STORAGE, PROTECTION AND PROGRAMME

11.1 The Contractor shall submit a schedule on the procedure for inspection during installation so as to maintain quality control on the job site.

11.2 The Contractor shall submit a detailed method statement for the protection of the surface of the Aluminium structural glazing & cladding members during delivery and erection, with description as to when the protection can be removed.

11.3 Delivery and Storage and Materials: All materials delivered to site shall be stored in allocated spaces where the stored materials will not be exposed to rainwater, moisture or damage, and shall permit easy access to and handling of the materials. Materials shall be stored neatly and properly stacked.

a) Aluminium wall cladding / factory made structural glazing units and / or their components shall be transported, handled and stored in a manner to preclude damage of any nature.

b) Accessory materials, required for erection at the site shall be delivered to the site in labeled containers by the manufacturer.

c) Remove al units or components which e cracked, bent, chipped, scratched or otherwise unsuitable for installation and replace them properly.

12. PERFORMANCE REQUIREMENTS

All components, assemblies and completed work including in or permit to the work of this section shall conform to or exceed the following performance standards and comply with all applicable and governing building codes and regulations.

12.1 Thermal Movement: Provide for noiseless contraction and expansion of component materials for an ambient temperature range of +10°C to 70°C and a material temperature range of 100°C without buckling, opening joints, glass breakage, undue stress on fasteners, or other detrimental effects. Make allowance for vertical and horizontal expansion. For fabrication, assembly and erection, procedures shall take into account the ambient temperature range at the time of respective operations.

12.2 Building Movement and Related Building tolerance. The design and installation of the structural glazing system shall accommodate all inherent building movements and / or deflections and the fabrication and installation tolerances of al related wok not involved in this section without the loss of, or any detrimental effect to the performance requirements herein specified. The Contractor shall verify and co-ordinate all such movements and / or tolerances before designing al the components of structural glazing and Aluminium cladding so that movements and deflections in the structure do not at any time affect the integrity and safety of curtain wall and Aluminium cladding and vice versa.

12.3 Thermal property:

All insulation materials, fire-stops and smoke seals shall comply with the current requirements of the Chief Fire Officer, GOA, Fire Brigade and other authorities.

12.4 Structural Properties:

a) The design of curtain wall / structural glazing system and Aluminium cladding and all related components shall comply with the requirements of National Building Code I.S.875 and Indian Standard Code I.S. 456.

b) No curtain wall / structural glazing system and Aluminium cladding elements including sealants and sealed joints shall sustain permanent deformation or failure under loading equivalent to 1.5 times the design wind pressure herein specified.

c) Deflections: The specified deflections must be reduced if they are in any way detrimental to the Aluminium structural glazing and cladding elements and sealants.

- The maximum deflection on design wind pressure shall not exceed 1/240 of height or 15 m whichever is lesser for mullions.
- No vertical deflection shall exceed 1/300 or span of transom / sill / head members.
- Under 1.5 times design wind pressure there should be no permanent deflection of framing member exceeding 1/1000 of span length.
- Maximum deflection of glass under design wind pressure at centre of any panel shall not exceed 15mm r as recommended by the manufacturer whichever is less.

12.5 General

a) All braces, supports and connections for the Aluminium curtain wall / structural glazing and cladding shall be designed, provided and installed complete as required.

b) Anchors for curtain wall shall be located within a maximum distance of 500mm above or below the R.C.C. floor slab unless specifically approved.
c) Variations from schematic layouts indicated on the drawings may be permitted but only if a proposed revision does not deviate from the design intent, cause excessive stress in the structure, cause excessive defection, inhibit thermal and building movement or conflict with other requirements.
d) Member shapes and / or profiles if schematically shown on the drawings are not necessarily the exact shapes required or best suited for the particular condition. Final shapes and locations shall be as designed by the contractor and are subject to review and approval.
e) The height from the finished floor level to the top of the window sill shall not be less than as shown in the drawing.
The horizontal or lateral load on such transom / railing (where not backed by an R.C.C. parapet) shall be designed in accordance with the following criteria i.e. a horizontal UDL at 0.74 KN/m run, UDL supplied to the infill of 1.0 KN/m2 and a point load applied to part of the infill at 0.5 KN.
f) no holes shall be buried, filed or drilled in any structural steel members unless approved.
g) The contractor shall provide detailed layouts, alignment jigs etc. for the proper and exact placement of all welded anchor studs, anchorage components, embedded anchor assemblies etc.
h) All metal structural glazing and cladding elements and their applicable anchorage assemblies shall be designed to accommodate all thermal and building movements without any harmful effect to the structural glazing and cladding.
i) No field forming, cutting and/or alternations of primary wall elements will be allowed. All framing members shall be shop fabricated and finish coated. No unfinished surfaces will be permitted on exposed surfaces.
j) All structural glazing and aluminium composite panel cladding framing shall be supported by stainless steel brackets of 316 grade and the thickness shall not be less than 5mm.

12.6 Concrete Tolerances:

a) The contractor shall take into account tolerance in concrete and masonry surfaces to which the structural and glazing framework is fixed.
b) In general, the construction tolerances in the building will be attempted as follows: (The actual tolerances may exceed these figures by 75%):

- Surface level of floor slab, sills and lintels ±10mm
- Plumb in a storey height ±10mm
- Plumb in full height of building ±14mm
- Cross-diagonal distortion between columns ±14mm
- Max. displacement of any point on External Fascia from its true location ±14mm

12.7 Lightning protection
The whole of the curtain wall when having insufficient clearance from the lightning protection system shall be bonded as directly as possible to the lightning protection system. At each end of each continuous length of curtain wall, cladding or louvres, provision shall be made at top and bottom for bonding by the electrical contractor engaged by the Employee. The exact locations and details of the bonding points shall be as determined by the Electrical Contractor.
12.8 Fire-stop and Interface with building.
Joints in the curtain wall / structural glazing system between successive floors shall have the required fire resistance of at least 2 hours and shall comply with requirements of C.F.O.
A fire-stop-cum-smoke seal shall be provided at each window-head level. In addition the contractor shall provide an Aluminium flashing to approved design at the window sill level and on 2 sides of the vision panels.
All interfaces with building structure and other elements shall be sealed / flashed / provided with expandable gaskets.
12.9 Sound Control
Provisions shall be made (e.g. capping of all ends of mullions) to prevent sound transmission through the system. Provisions shall also be made to prevent metal to metal rubbing noise due to thermal changes and wind pressure.

MATERIALS

13. GENERAL:

13.1 Materials and components used shall be of the best quality and suitable for the purpose under the approval received and shall have been tried and tested in environments similar to that of Mumbai.
13.2 Aluminium panels shall be of a minimum thickness of 2mm and of max. 3mm for solid sheets, and 4mm for insulated composite units.

13.3 All materials shall be free from any defect that may impair the strength, functioning or appearance of the glazing and cladding system or adjacent construction.
13.4 Testing by independent testing laboratories or review of data shall not relieve the Contractor's responsibility to verify for himself that the work conforms to the intent of the contract documents.

14. METALS
14.1 In general, metals shall comply with relevant Indian and International Standards.
14.2 Aluminium Wall Cladding
The Aluminium cladding shall be fabricated with a minimum of 4mm thick aluminum composite panel of approved make comprising of a thermoplastic resin core sandwiched between two skins of Aluminium alloy. The panels shall be PVDF coated to minimum 35mm thickness in approved metallic colour. The resin content of the PVDF shall be 70% or more. The back of the panel shall be grey-coated. The insulation in-fill of the composite panel shall be LDPE.
14.3 Fasteners: The type, size, alloy, quantity and spacing of all fasteners and / or anchorage devices shall be as required for the specified performance standards.

a) Bolts, anchors and other fastening devices shall be of approved types as required for the strength of the connections, shall be self-locking, unless otherwise noted, shall be suitable for the conditions encountered, and shall be torque tightened, where required, to achieve the maximum torque tension relationship in the fasteners. Washers, nuts and all accessory items shall be of the same material as fasteners.
b) Fastening devices between aluminium and aluminium shall be AISC Type 302 (18-8) stainless steel unless otherwise approved.
c) Fastening devices between Aluminium and dissimilar materials shall be 300 series non-magnetic stainless steel unless otherwise approved.
d) Exposed fasteners are subject to approval and shall be stainless steel.
e) Self-locking fasteners shall stainless steel with nylon inserts or patches.

14.4 Extrusions:

All aluminium extrusions shall conform to the system principal's specifications for tolerances which shall, in any case, be better than DIN standards. Any section not conforming to the tolerances shall be rejected.
In general Aluminium alloy for extrusions shall be 6063 T5 or T6 as per NB.S. 1474. However, the grade and tempering specifications shall be as recommended by the supplier for each application and shall be approved by the system principal.
All Aluminium sections shall be either anodised in approved colour to a minimum thickness f 15 microns or coated with Polyester Powder coating to a minim of 50 microns as specified (except for sections concealed from view behind cladding which may be mill-finished).
All surfaces abutting the parent sections and designed to receive sealants shall have adequate sealant contact and adhesion. They shall be finished to match parent sections.
14.5 Aluminium Flashing
Flashings concealed from view shall be made form mill-finished Aluminium sheets . visible flashings (e.g. on periphery of vision panels) shll be anodised / powder-coated.
14.6 Capping
Top cappings shall be from 4mm Aluminium Composite Panels sheet coated with PVDF in approved colour.
14.7 Soffit and Suspended Ceiling System
Soffit and suspended ceiling system if required shall be of similar metal of the Aluminium wall cladding with a similar finish. Colour and shape shall be selected.
14.8 Fire stops-cum-smoke seals.
Fire stops-cum-smoke seals shall be provided at successive floor levels and shall be two hour fire resistant.
Metal sections shall be in galvanized steel sections. All details shall be approved.
14.9 Protection:
Materials used as permanent or temporary protection for metals shall conform with relevant Indian / International Standards.
14.10 Brackets:
Brackets shall be SS 316 grade approved. Slots in brackets shall be pre-drilled / punched and not flame-cut.
14.11 Hardware and Fittings:
All hardware and fittings such as patch fittings, handles, locks, stay-arms, floor springs, etc. for doors windows and openable panels shall be to best International standards and to approval. Hinges for openable panel shall be stainless steel friction hinges / stays selected for specified wind load and dead loads or specifically extruded in-built hinges. All fittings and locks shall be approved.

15. SEALANTS & GASKETS

15.1 All sealant applications must be clearly designated on the applicable shop drawings details and reference to a master sealant schedule specifying materials, special instructions and application procedures.

15.2 The compatibility and sequence of installation for all sealants must be carefully considered in all proposals in order to ensue the required cure and optimum performance. Sealants must not be degrade and / or fail under all design conditions including but not limited to thermal movement, water, ultraviolet exposure and/or other adverse environmental conditions. The following sealant material are specified for performance standards only. All proposals must be equal to or better than the material herein specified the designation of sealant types noted on the drawings is intended for general design guidance. Final selection by the contractor for the sealant types shall be based on their conformity with the Performance Requirements herein specified and meets with the approval. Maximum precautions shall be taken to prevent failure of sealant.

15.3 Structural Sealant: Structural sealant shall be Dow Corning sealant 995 / 983 / 795, Wacker Elastosil 500s, GE ultraglaze 4000, or approved equivalent recommended by manufacturer. All exposed and concealed metal to metal (including tight or butt type metal to metal assembly prior to assembly), perimeter metal to concrete joints shall be silicone base sealant, preferably 2 component, in approved colour, conforming to the manufacturer's recommendations for the specific uses and performance criteria. The manufacturer shall conduct laboratory test for adhesion for each lot of Aluminium sections and glass. Laboratory reports shall be submitted.

15.4 Weather Sealant: The grades of sealants for concealed metal to metal and metal to concrete joints such as embedment and lapping of flashings elements are to be installed or embedded in a full bed sealant shall be the lest recommended by the manufacturer for the application. (Dow Corning, GE, Wacker or equivalent).

15.5 Joint fillers and back-up materials shall be non-gaseous polyethylene foam, sponge neoprene as per written recommendations form the applicable sealant manufacturer for each specific application. Shape, size, hardness, compatibility and bonded breaking requirements are all factors to be considered.

15.6 All sealants must be non-staining and compatible with adjoining sealants, backup materials substrate materials and their respective finishes and / or applied colour coatings.

15.7 Exposed assembly sealant will not be permitted at any wall area.

15.8 All sealants shall be given 10 years Guarantee for materials, workmanship and performance from the date of completion of Contract.

15.9 Gaskets:

Gaskets and seals shall be extruded EPDM of approved quality, compatible with substrates, finishes and other components they are in contact with. All gaskets exposed directly on the exterior face shall be silicone gaskets.

Extruded EPDM sections shall have the following properties:

Shore Hardness	70 ± 5A
Tensile strength	Min. 70 Kg/cm2
Elongation	300%
Ozone Resistance	No crack at 50 ± 5 pphm, test temp. of

40 ± 2°C, test duration of 96hours and 20% strain.

16. SEPARATORS

16.1 Separators between steel and Aluminium members and wherever required shall be rigid type, high impact, smooth both side Teflon with a minimum thickness of 0.8mm or other non-conducting materials as approved.

17. GLASS

17.1 All glass and glazing materials shall be verified and co-ordinated with the applicable performances requirements.

17.2 Finish and install glass and glazing work as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and ready for glazing. Any pane which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the contractor's expense. All glass shall be of accurate sizes with clear undamaged edges and surface which are not disfigured.

17.3 Glass shall conform to the quality, thickness and dimensional requirements specified.

17.4 Heat strengthened glass shall not deviate in surface flatness by more than 0.23mm within 260 m of leading or trailing edge, or 0.076mm in centre. Direction of ripples shall be consistent and extent shall be acceptable. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be uni-directional. Surface compression stress of heat strengthened glass shall be within 320 – 450 Kg/cm2.

17.5 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved. All glass shall be delivered to site with the manufacturer's label of identification attached.

17.6 Submit for approval a complete list of materials to be used, including the sealants proposed and such samples. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall be as

approved and recommended in writing by the applicable glass and sealant manufacturers. A sealant substrate test report shall be submitted for each type of sealant for adhesion and compatibility.
17.7 Sealants in factory-glazed panels shall be fully cured prior to shipment to projects site and installation.
17.8 All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the contractor at his own expense without delay to the project completion.
17.9 The contractor shall be responsible to deliver to the Employer without charge replacement for any unit of glass and glazing that fails within the Guarantee period of Ten (10) years from date of completion of contract.
17.10 The glass glazed panels / structural glazing frame for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirements of local building codes.
17.11 Glass thickness should be selected in accordance with AS 1228 – 1989 "Glass in Buildings Selection and Installation" to satisfy design performance requirements and of local building codes.
17.12 Glass shall be free from defects or impurities detrimental to its performance. Defects such as bubbles, waves, spots, scratches, spalls, discolouration, visibly imperfect coating, chipping, and bubbles or delamination of opacifier film shall be limited in accordance with the Manufacturer's trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour.
17.13 Manufacturer's glazing instructions regarding installation, clearance, dimensional tolerance, bite edge clearance etc shall be followed.
17.14 All solar control glass panels shall be stored with particular care and protected against abrasion, sun and moisture prior to installation.
17.15 Precautions specified by glass manufacturers to minimize thermal stress must be followed. A thermal stress analysis shall be obtained from glass manufacturer prior to fabrication and their recommendations shall be followed. Allowance shall be made for thermal movements due to an air temperature range of 60°C and a material temperature range of 100°C.
17.16 Glass panels shall be selected / rejected on the basis of product quality standards specified by the manufacturer concerning scratches, pinholes, clusters, distortion, colour variations, flaws in coating and other defects.
17.17 Each type of glass shall be obtained from only one manufacturer and one lot. Adequate spare quantity shall be ordered to cover for breakage and for replacement during maintenance period.
17.18 Double glazed units shall be procured only from approved manufacturers. Quality control tests shall be performed by mixing, curing, adhesion, dewpoint and grammage for molecular sieves and DELTA T. the spaces shall be of black colour. Capillary tubes shall be provided for pressure equalization during transit. The units shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.
17.19 Setting blocks for glass shall be extruded neoprene with minimum 80 durometer hardness.
17.20 VISION GLASS PANELS:

Characteristics of each type of glass are given elsewhere.

18. GLAZING COMPOUNDS:

18.1 Setting blocks used to support the dead load of the glass shall be extruded in a neoprene / EPDM compound or silicone material conforming to the design criteria, all as recommended by the glass manufacturer.
18.2 Jamb shims used to centre and station the glass shall be extruded in a neoprene / EPDM compound or a silicone material conforming to the design.
18.3 Fixed compression and roll-in glazing gaskets shall be extruded in an EPDM compound as recommend by the glass manufacturer. Gaskets for any one light shall be one piece with injection molded corners free of all flashings and burrs.

19. METAL COATINGS:

19.1 Aluminium shall be stain finished in natural colour matt anodised to minimum 20 microns or powder-coated to a minimum of 50 microns.
19.2 coatings to Aluminium sections and cladding where specified shall be fluoropolymer formulated and will consist of a 2 coat system comprising primer, and colour coat. The coating system shall meet or exceed all the requirements of AAMA 605 - Voluntary specs for high performance organic coatings on Architectural extrusions and panels.
19.3 After selection of colour the Contractor shall prepare two(2) sets of two (2) samples of each which shall define the colour and gloss range and submit them for approval.
19.4 All sample shall be identified and have a full colour report attached.
19.5 The coating system, including materials and application shall conform to the requirements and recommendations of the paint manufacturer.
19.6 Testing and Sampling Procedures
In-process testing shall be performed on test specimens of equal metal thickness pre-treated and finished along with the production metal, specimen shall exhibit & test of at least 75 mm x 300 mm to permit instrument readings. In addition to

running in-process tests to assure high quality production, additional finished extrusions or panels are to be submitted to the coating manufacturer's laboratory for extended exposure testing.
All test samples shall be properly identified with date, batch number and shift indicated.
The following tests shall be conducted atleast once during production and submitted to the Employer when required.
(i) Dry Film Thickness – evaluated with a Permascope, Iroscope or Dermatron instruction.
(ii) Film Hardness
(iii) Dry Cross batch Adhesion
(iv) Boiling Water Adhesion Test
(v) Gloss Measurement
(vi) Colour Examination Against Standard
(vii) General Appearance – Smoothness, free of blisters, sags, pinholes and other surface imperfections.
Testing reports shall be certified by the testing agency, manufacturer and the Contractor.

Process :
i)Dry Film Hardness – The coating shall have a hardness of H minimum when tested with "Eagle Turquoise Pencil"
ii) Film Adhesion – The costing system shall withstand the following adhesion tests:

DRY: Make ten (10) parallel cuts 1.25 mm apart through film and ten (10) more cuts 90 degrees and crossing first ten cuts. Apply Scotch Transparent #710 Tape, 18m wide, over area of cuts, pressing down firmly against coating. Pull tape off sharply.

WET: Make ten (10) parallel cuts as above. Immerse samples in boiling water for 5 minutes. Remove sample, dry, cool and tape-test the cross-hatched area as above.
iii) Gloss Measurement – Measure gloss at various locations on painted metal with a 60- "Glossmeter".
iv) Colour Uniformity – Check random samples of painted production metal under a uniform light source, such as natural North daylight against standard panels approved by the Employer.
v) Test for cure of coating using 100 double rubs with several thickness of cheesecloth wet with MEK solvent. Slight dulling of the film is considered normal, but softening shall not be permitted.

Performance Requirements :
i) Salt Spray resistance – withstand a minimum of 3000 hours exposure to 5% salt solution at 95% R.H., 37.5 degrees C with no more than 1.25 mm creepage or loss of adhesion from scribed line or cut edges.

ii) Humidity Resistance – Withstand a minimum of 3000 hours exposure to 100% R.H. 37.5 degrees C with no more than a few blisters, size no. 8 (ASTM D714 – 56).
iii) Abrasion Resistance – Withstand abrasion of sand with an abrasion coefficient value of 65 minimum when evaluated as per ASTM D 968-51 test method.
iv) Mortar Resistance – Withstand we mortar, 24 hour part test at 100% RH without gaining adhesion or any visual effect on the painted surface of solid colours.
v) Detergent Resistance – Withstand immersion in 3% synthetic detergent solution for 72 hours at 37.5 degrees C with no loss of adhesion no blistering and no visible change.
vi) Colour Retention – Withstand maximum chalk rating of No. 8 for colours and No. 6 for white per test method ASTM D659-44 (1970)

Field Touch-up and Repair – The contractor and coating manufacturer shall recommend materials for air dry touch up for spray or brush application as per instruction of manufacturer. Touch up shall be held to an absolute minimum.

STRUCTURAL GLAZING AND CLADDING SYSTEMS

20.1 The method of assembly, reinforcing and anchorage of the aluminium structural glazing / cladding system, where indicated, is schematic. Locations and method of providing same shall be the Contractor's responsibility, who shall design the assembly, reinforcing and anchorage to suit each specified conditions in an acceptable manner complying with the requirements specified hereinafter.
20.2 Visible joints shall be as shown in the drawings.
20.3 All parts shall be secured by concealed means wherever possible and where exposed to view, screw positions are to be indicated on the preliminary drawings. Exposed screws shall be of the countersunk type coloured in same finish as of aluminium or non magnetic stainless steel and shall be evenly and neatly located in an approved manner.

20.4 All components shall be assembled, secured anchored, reinforced, sealed and made weather-tight in a manner not restricting thermal or wind movements of the structural glazing. Sealants shall be concealed wherever possible.
20.5 All fastening into or through aluminium shall be stainless steel as approved.
20.6 Free and noiseless movement of all the components of the Curtain Walling system due to thermal effect, structural effect, wind pressure, seismic forces, erection or dead loads, shall be achieved without strain to the glass, without buckling of any components and without excessive stress to any members or assemblies.
20.7 Aluminium surfaces in contact with mortar, concrete, plaster, masonry, wet application of fire-proofing and absorptive materials shall be coated with an antigalvanic, moisture barrier material.
20.8 Waterproofing :

a) A complete drainage system must be incorporated into the structural glazing framework. Water leakage and condensation shall be drained or discharged to exterior face of the wall and all internal spaces vented by acceptable means to ensure air pressure equalization wherever possible.
b) Drainage system will be sealed off at every floor to prevent infiltrated water from leaking to lower floors.
c) Movement of water behind and on exposed surfaces musts be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapped water.

20.9 Anchorage System and Building Frame
Each glazed unit shall be fixed to the structural slab at each floor level. All fasteners shall be M. S. with epoxy coated as approved. The contractor shall also make necessary modifications to the anchor fasteners to suit existing site conditions of steel reinforcement without additional charge.
20.10 Mullions and Transoms

a) The sections of mullions and transoms shall be designed to restrict deflection under wind pressure as specified and shall be rigid enough to support and retain the glass spandrel under all conditions.

20.11 Window units (Vision Panels)
All windows shall be glazed from inside where possible. All cladding as well as internal glazing beads, if any (unless otherwise specified) shall be in anodised aluminium

20.12 Spandrel Units
a) Spandrel shall be of glass having equal colour matching with vision areas after using a shadow box or as specified.
b) Structural spandrel beam, structural glazing fasteners and other construction shall not be seen through the glass from the exterior and shall be fully concealed behind the shadow box.
c) A shadow box shall be provided a distance behind the spandrel glass panel. It shall consist of an approved fiberglass / glasswool. The periphery shall be properly sealed. Surface # 1 shall be adequately protected against damage until spandrel glazing is done.
d) Fire stops-cum-smoke seals shall be constructed continuously at the spandrel to the approval.

20.13 Ventilators, Openable Windows and Doors
a) Ventilators, windows and doors shall be provided at positions as shown on the drawings. The ventilators when in closed position shall remain watertight under all weather conditions and pass the water tightness tests as specified.
b) All hardware and accessories shall be supplied by the contractor and when exposed shall be of stainless steel or approved aluminium alloys in approved finish.
c) Minimum aggregate openable area of the ventilator shall be as given in the drawings.
d) The detailed system of the ventilators and doors must be proposed by the tenderer keeping the position as shown on the drawings.

20.14 Coping and Soffit Trimmer
a) All coping and soffit panels shall receive frame reinforcement and be fixed rigidly to the structure.
b) All joints between coping / soffit panels and between coping / soffit panels to structural glazing frame and other sections of the work shall be tightly sealed up. Effective drainage system shall be provided to drain out the water that may penetrate through the joints.

20.15 CLADDING
Cladding shall be non-toxic composite aluminium panels (ALPOLIC / ALUCOBOND / ALUKBOND / REYNOBOND / ALUCOMAT or approved equivalent)of adequate strength with approved aluminium details. The panels shall be 4 mm thick composite units finished with PVDF coating overall 35 microns thick of approved metallic

colour. The resin content of the PVDF coating shall be 75% to 80%. The back of the panel shall be grey coated 3-4 micron thick, compatible with adhesives for stiffeners if any or given a polymer coating.
The fabrication and installation of the cladding systems shall be carried out as per manufacturer's instructions with invisible / concealed fastenings, aluminium sub-structure, silicon sealants properly tooled etc.
All cladding panels of one kind shall be obtained preferably in one lot from the manufaturers.
Each panel shall be guaranteed for a minimum flatness of 1mm from the true face after installation under no-wind conditions.
Deviations from the true alighment of adjoining panels shall be not be cumulative.
Full load deflections shall be kept to the minimum possible. Each panel shall be capable of withstanding 200 Kg/Sq.m wind pressure without any permanent deformation.
The cladding system shall be adequately ventilated. The air-gap between the cladding panels and the concrete / block wall shall be atleast 15 mm to allow proper ventilation of the rainscreen system. The cavity shall be closed by a perforated bird / vermin-proof closer at bottom and by a flashing a top.
The fabrication processes including cutting, grooving, benching, folding, joining, routing as well as installation shall be performed as per manufacturer's instructions. The panels shall be backed by approved aluminium supporting framework, fixed to walls with aluminium brackets.

21. LOUVERED PANELS

21.1 Louvered panels shall be provided at positions as shown on the drawings.

21.2 Louvres shall be of approved anodised aluminium with an assumed efficiency of 50% unless otherwise specified and shall be complete with stainless steel bird-proof wire fixed internally.

21.3 All hardware and accessories shall be, when exposed, of non-magnetic stainless steel and/or coloured aluminium to match that of structural glazing / cladding wherever possible.

22. FABRICATION

22.1 General: All assemblies shall be fabricated and assembled in accordance with the drawings and the requirements of these specifications. Deviations of any nature, without approval shall not be permitted.

22.2 Tolerances : Furnish a schedule of fabrication tolerances for all major wall cladding components. In addition to the fabrication tolerances, provide for and schedule thermal movement including assembly and installation tolerances for all major and/or applicable wall cladding components and/or assemblies.

22.3 Workmanship

1) All work shall be performed by skilled workmen, specially trained and experienced in the applicable trades and in full conformity with the applicable provisions of the listed References and Standards and/or otherwise noted on the drawings or as specified herein.
2) All work shall be carefully fabricated and assembled with proper and approved provisions for thermal expansion and contraction, fabrication and installation tolerances and design criteria.
3) All forming and welding operations shall be done prior to finishing. Unless otherwise noted.
4) All work shall be true to detail with sharp, clean profiles, straight and free from defects, dents, marks, waves or flaws of any nature impairing strength or appearances; fitted with proper joints and intersections and with specified finishes.
5) All work shall be erected true to plumb, level, square to line, securely anchored, in proper alignment and relationship to work of other trades and free from waves, sags or other defects.

22.4 Joints in Metal Work

1) All exposed work shall be carefully matched to produce continuity of line, design and finish. Joints in exposed work, unless otherwise shown or required for thermal movement, shall be accurately fitted, rigidly secured with hairline contacts and sealed watertight.
2) Where two or more sections or metals are used in building up members, the surface in contact shall be brought to a smooth, true and even surface and secured together so that the joints shall be absolutely tight without the use of any point materials. Extrusions shall be tolerated to eliminate any edge projection or misalignment at joints.
3) Furnish physical samples of all joinery elements as for comparative appraisal and approval of the production materials. Physical samples of all typical wall intersection assemblies shall be colour coded on surfaces and/or areas to receive sealants.

22.5 Shop Assembly

As far as practicable, all fitting and assembly of the work shall be done in the shop. Work than cannot be permanently shop assembled shall be temporarily assembled in the shop and marked, before disassembly to ensure proper assembly later in the building.

22.6 Sleeves

Unless otherwise noted, all aluminium sleeves shall be extruded sections designed to accurately interlock with adjacent sections and incorporate serrated surfaces for the secure bedding of sealant between the parent metal and the sleeve.

22.7 Fasteners

1) All fasteners shall be of MS powder coated with self locking devices, unless otherwise specified, and of sufficient size and strength to withstand the applicable design wind load and dead load forces with safety allowance factors as required for the specific materials. The spacing and quantities of fasteners shall be as required to develop the maximum strength of the member they secure or support. Washers and/or other accessory items shall be of the same material as thee fastener. Torque tighten all assembly fasteners to achieve the maximum torque tension relationship in the fastener.

2) All fasteners shall be concealed unless otherwise shown or approved. The head style for all exposed fasteners shall be countersunk oval head unless otherwise specified on the drawings. Exposed fasteners shall be finished to match surrounding metal finish.

3) All fasteners including washers and accessory items shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all fasteners conform to the designated and approved type, size, material, spacing., etc. When certain items are not readily apparent, such as material and alloy or torque tightening requirements, special instructions for the identification and appraisal of such items shall be issued.

22.8 Protection of Metals

1) Protection against galvanic action shall be provided wherever dissimilar metals are in contact.

2) Aluminium which is to be in contact with cured concrete, mortar or plaster shall have the contact surfaces protected wherever crevices between the contact surfaces may entrap moisture and corrosive elements. All metals, except stainless steel, which are to be in contact with fresh concrete, mortar or plaster, shall have the contact surfaces protected with epoxy paint.

3) Furnish a schedule of all protective coatings and related item including the designation of area and/or specific locations, materials used, special instruction, specification data sheets, etc.

22.9 Welding

1) All welding in aluminium work shall be done by the inert gas shielded are or fluxless resistant techniques and with electrodes and/or by methods recommended by the suppliers of the metals being welded. Type, size and spacing of welds, shall be as shown on approved shop drawings.

2) Welds in galvanized metal shall be touched up with zinc rich paint.

3) Welds behind finished aluminium surfaced shall be so done as to eliminate distortion and/or discolouration on the finished side. When weld spatter and welding oxides on finished surfaces shall be removed by de-scaling and/or grinding. Provide low heat filled welds using chill bar on finished side to eliminate dimpling, distortion and/or discolouration on the finished or exposed surface. Plug, puddle or spot-welding are not permitted. If weld beads are shown on exposed finished surfaces, the surfaces shall be ground and polished to match and blend with finish on adjacent parent metal.

4) Structural welds shall be made by certified welders and shall conform to the general recommendations and regulations of AWS Specification D1.0-46.

a) Dirt grease, lubricant, or other organic material shall be removed by vapour degreasing or suitable solvent.

b) Joints rejected because of welding defects may be repaired only by rewelding. Defective welds shall be removed by chipping or machining. Flame cutting shall not be used.

5) Wherever welding is done in proximity to glass or finished surfaces, such surfaces shall be protected from damage due to weld sparks, spatter or tramp metal.

6) All welds shall be scheduled and designated on the shop drawings so that anyone can witness and assess the assembled units to ensure that all welds conform to the designated and approved type, size, spacing, etc.

22.10 Soldering

All soldering and/or brazing shall be done as recommended by the suppliers of the metals involved.

22.11 Shop painting of Carbon Steel

Item of carbon steel, unless galvanised or scheduled for other finish, shall be thoroughly cleaned of all loose scale, filings, dirt and other foreign matter and shall be painted with zinc chromate primer.

22.12 Factory Application

As much work as possible shall be carried out in the factory.
All glazing shall be done in the factory. Gaskets shall be pre-positioned and welded in the factory as far as possible.
Site work shall be kept to a minimum.

23.GENERAL EXECUTION

23.1 The drawings supplied shall be considered essentially schematic, except of profiles of exposed surfaces which shall be as indicated. If, in the opinion of the contractor, a change of profile is required in order to meet the specifications, he shall consult for a review of the conditions.
23.2 The method of assembling, reinforcing and anchorage of the aluminium structural cladding system, were indicated is schematic. Location and method of providing same shall be the Contractor's responsibility, who shall design, assemble, reinforce and anchor to suit each specified condition in an acceptable manner complying with main building structure. Site work shall be coordinated with the Main Contractor's programme.

23.3 Visible joints shall be as shown on the drawings.
23.4 All parts shall be secured by concealed means and screws exposed to view shall not be allowed.
23.5 All components shall be assembled, secured, anchored, reinforced, sealed and made weather tight in manner not restricting thermal or wind movement of the metal wall cladding / curtain walling system. Where possible, sealants shall be concealed.
23.6 Free and noiseless movement of all components of aluminium structural glazing and cladding system due to thermal, structural, wind pressure, or dead loads shall be achieved without strain to glass, without buckling of any components and without excessive stress to any members or assemblies.
23.7 The entire aluminum structural glazing and cladding system shall be assembled and installed so that all leakage and condensation shall be drained and discharged to the exterior face of the wall.
23.8 Movement of water behind and on exposed surfaces shall be controlled to ensure that water is not retained and that elements will not be damaged or corroded by water and to minimize the potential for algae and fungus growth as a result of standing or trapping water.
23.9 Measurements :
The measurements given on drawings shall not be used by the Contractor for preparing his shop drawings and for executive the work. All dimensions shall be actually measured on site and in case of any discrepancy between measurements on site and in drawings, modules shall be decided in consultation.

24. INSTALLATION
24.1 Qualification of workmanship
All work shall be performed by skilled workmen, especially trained and experienced in the applicable trades employed and in full conformity with applicable provisions of the listed References and Standards and/or as otherwise noted on the drawings or as specified herein. The qualification of the Contractor's installation workmen shall first be filled with and approved.
24.2 Setting out
Bench marks for elevations and building line offset marks for alignment shall be established on each floor level by the main contractor. Should any error be found in their location, the Contractor shall notify the Owner / Architect and the Main Contractor in writing and installation work shall not proceed in the affected area until the errors have been corrected. Within 2 weeks on the award of the contract, the Contractor shall submit the structural glazing anchorage plan for endorsement by Owner / Architect and approval. The Contractor shall co-ordinate his system of anchorage with Owner / Architect /Civil Contractor according to site conditions.
24.3 Prior Inspection of the Structure
After the setting out has been established and before beginning installation in any area, the Contractor shall examine all parts of the structure on which the curtain walling system / metal wall cladding are to be placed in that area. Should any conditions be found which, in his opinion, will prevent the proper execution of his work or endanger its permanency, he shall report such conditions in writing to the Owner / Architect and the Civil Contractor. Installation work shall not proceed in that area until such conditions are corrected or adjusted to the satisfaction of the Owner / Architect.
24.4 Workmanship
All parts of the aluminium structural glazing and cladding system shall be erected true to plumb and in proper alignment and relation to established setting out, as shown on approved shop drawings.
24.5 Erection Tolerances
The installed metal wall cladding / curtain walling system components shall conform to the following erection tolerances under no-wind conditions :
a) Amount of total deviation and/or misalignment in any direction for vertical members: 3 mm maximum in a height of 4 m (non-cumulative) and maximum 7 mm in full-height of cladding/curtain walling.

b) Amount of total deviation and/or misalignment in any direction for horizontal members: 3mm max. in a length of 7 m.
5mm in full length
c) Maximum offset from the true alignment between two abutting members shall be 1 mm. No edge projection or misalignment will be permitted.
d) Maximum joints, gaps or openings between removable glazing stop and adjacent member shall be 1mm and/or a maximum 1 mm cumulative opening at both ends of removable members (0.5 mm each end)
e) Deviation in spacing of brackets 3 mm.
f) Allowances for the cumulative effect of all tolerances (fabrication, assembly, thermal and erection) must be made to ensure a workmanlike installation. The documentation and distribution of this information to all applicable installation and inspection personnel is essential in order to ensure the standard of quality and workmanship required.
24.6 Installation within and/or adjacent to concrete: Where work is to be installed within and/or adjacent to concrete, no aluminium structural glazing and cladding system components other than built in anchor devices shall be put in place until the concrete work is completed, including the removal of all forms, shoring, etc.

24.7 Anchorage :
a) Anchorage of the aluminium structural glazing and cladding system to the structure shall be by approved methods and in strict accordance with approved shop drawings. After the aluminium structural glazing and cladding system are properly positioned, all connections so designated on approved shop drawings shall be rigidly fixed by welding or other positive means.
b) All anchorage assemblies and their related components shall be thoroughly scheduled and described on the shop drawings so that anyone can evaluate an installation and ensure its compliance with the contract documents. Designate trades responsible for furnishing and/or installing materials if other than the Sub-Contractor. Descriptive items shall include the access removal movement and tolerances of related building and the aluminium structural glazing and cladding system direction and magnitude or thermal expansion, materials, sizes, quantities and any special instruction as may be required. All primary aluminium structural glazing and cladding, anchorage assemblies inclusive of frame/structural mullion shall receive a 100% inspection.

24.8 Welding
All welding shall be done by skilled mechanics qualified or licensed in accordance with local building regulations. Welds and adjoining burnt area in prime coated surfaces shall be thoroughly cleaned and painted with one coat of primer. Welds in galvanised steel shall be coated with one coat of zinc rich paint. Special care shall be taken to protect glass and other furnished surfaces from dame and to prevent causing fires.

24.9 Use of sealing materials

a) Sealing materials shall be used in strict accordance with the Manufacturer's printed instructions and shall be applied only by workmen specially trained or experienced in their use. Before applying sealant, all mortar, dirt, dust, moisture and other foreign matter shall be completely removed from surfaces it will contact. Adjoining surfaces shall be masked when required to maintain a clean and neat appearance. Sealing compounds shall be tooled to fill the joint and provide a smooth finished surface.
b) The manufacturer(s) of the applicable materials shall, when required render, technical assistance prior to the application of any sealant and witness the first applications as well as periodic site inspections thereafter. The contractor shall witness and document all inspections performed by the sealant manufacturer and provide close supervision of all workmen.

24.10 Coping and soffit trimmer

Installation of coping and soffit panels and field sealing between the copings and other trades shall be performed by the Contractor.

24.11 Tensioning of Bolts

All bolts shall be correctly tensioned. The tension shall be specified on shop drawings. At least 10% of bolts shall be mechanically checked for corrected tension.

24.12 Sequence of Installation.

If so directed by the Owner / Architect, installation of the aluminium structural glazing and cladding shall be postponed in areas as designated by the Owner / Architect for a specified period of time so as to facilitate moving material / equipment into and out of the building and installation of M&E (Mechanical & Electrical) fittings during construction. The Contractor's work is to proceed along guidelines and schedule as directed by the Owner / Architect.

24.13 Removal of Debris

All debris caused by or incidental to the installation work shall be promptly removed from the job site as the work progresses. Weep holes and drainage channels shall be unobstructed and free of dirt, rubbish and sealant.

24.14 Protection and Cleaning

a) The Contractor shall adequately protect all aluminium sections, glazing, cladding sheets, components and accessories from damage during shipment, storage, erection and after completion of the work by use of protective film / foil of approved non-staining quality.

b) At such time as may be directed by the Owner / Architect, the Contractor shall remove all protective coverings and/or coatings and clean surfaces free of all soil and discoloration. All cleaning agents shall be acceptable to the applicable aluminium, glass and coating manufacturers, and where doubt exists, spot tests shall be made to satisfy the Owner / Architect.

PART – II

GLASS

1. GLASS

1.1 All glass and glazing materials shall be verified and coordinated with the applicable performance requirements. Vision and spandrel glass shall have characteristics close to those specified in PERFORMANCE CHARACTERISTICS OF GLASS, subject to aesthetic requirements and specified relative heat gain, all to Architect's approval.

Samples of glass shall be submitted with the tender. Minor variations in the characteristics of glass shall be made, if requested, without extra cost.

Samples of glass are available in the Architects office. The contractor shall offer glass which is nearest to the sample in colour and tint subject to Architect's approval.

1.2 Furnish and install glass and glazing work as indicated on the drawings and as specified herein. All glass shall be cut to required sizes and ready for glazing. Any pane, which does not Fit any section of the curtain wall and shop front will be rejected and replacement made at the Contactor's expense. All glass shall be of accurate sizes with clear undamaged edges and surfaces which are not disfigured.

1.3 Glass shall conform to the quality thickness and dimensional requirements specified in US Federal specifications DD-G0451C.

1.4 Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm within 260mm of leading or trailing edge, or 0.076mm in center. Direction of ripples shall be consistent and extent shall be acceptable to Architect. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be uni-directional as per Architect's option.

1.5 Permanent identification marking on glass shall be accomplished by a technique selected by the manufacturer. The location of the marking shall be proposed by the Manufacturer and approved by the Architect. All glass shall be delivered to site with the manufacturer's label of identification attached.

1.6 Submit for Architect's approval a complete list of materials to be used, including the sealants proposed and such samples as the Architect may require. All glass and glazing methods and materials including the design and profile dimensions of glazing pockets shall be as approved and recommended in writing by the applicable glass and sealant manufacturers. A sealant substrate test report shall be submitted for each type of sealant for adhesion and compatibility.

1.7 Sealants in factory-glazed panels shall be fully cured prior to shipment to project site and installation.

1.8 All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

1.9 The Contractor shall be responsible to deliver to the Employer without charge replacement for any unit of glass and glazing that fails within the Guarantee period of Ten (10) years from date of completion of Contract.

1.10 The glass glazed panels / structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirements of local building codes.

1.11 Glass thickness should be selected in accordance with AS 1288 – 1989 "Glass in Buildings Selection and Installation to satisfy design performance requirements and local design codes.

1.12 Glass shall be free from defects or impurities detrimental to its performance. Defects such as bubbles, waves, spots, scratches, spells, discoloration, visibly imperfect coating, chipping, and bubbles or delaminating of pacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass shall be consistent in colour.

1.13 Manufacturers' glazing instructions regarding installation, clearance, dimensional tolerance, bite edge clearance etc. shall be followed.

1.14 All solar control glass panels shall be stored with particular care and protected against abrasion, sun and moisture prior to installation.

1.15 Precautions specified by glass manufacturers to minimize thermal stress must be followed. A thermal stress analysis shall be obtained from glass manufacturer prior to fabrication and their recommendations shall be followed. Allowance shall be made for thermal movements due to an air temperature range of 60°C and a material temperature range of 100°C.

1.16 Glass panels shall be selected / rejected on the basis of product quality standards specified by the manufacturer concerning scratches, pinholes, clusters, distortion, colour variations, flaws in coating and other defects.

1.17 Each type of glass shall be obtained from only one manufacturer and in one lot. Adequate spare quantity shall be ordered to cover for breakage and for replacement during maintenance period.

1.18 Double glazed units shall be procured only from approved manufacturers. Quality control tests shall be performed for mixing, curing adhesion. Dew point and gram mage for molecular sieves and DELTA T. The spacers shall be of black colour. Capillary tubes shall be provided for pressure equalization during transit. The unit shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.

1.19 Setting block for glass shall be extruded neoprene with minimum 80 durometer hardness.

1.20 Float Glass :

- Quality and Finishes: q3 unless otherwise indicated. ASTM C 1036 Type I
- Heat strengthening: ASTM 1048 HS type I

Surface compression 320-450 Kg/cm²

- No long marks permitted.

1.21 Insulating Units :

- Insulating units to be factory assembled multiple panes separated by and sealed to spacers forming airtight dehydrated airspace as per ASTM E 774 Class I
- Spacer seal: Dual seal

Primary seal: Poly isobutylene sealant

Secondary seal : Silicone sealant

- If the sealed insulating units are fabricated at an elevation significantly different from that of the project site provide temporary venting of internal airspace and subsequent sealing of vents.

1.22 Laminating units.

- Laminate lites with interlayer in autoclave with heat plus pressure
- To comply with ASTM C II 72
- Interlayer material to be clear or as specified of no tendency to bubble discolor or lose physical and mechanical properties after laminating glass lites.
- Laminated panels should be free of foreign substance, air or glass pockets

1.23 Material Procurement: To be only from one manufacturer, for each type of glass panels and where match between vision and spandrel panels is required.

1.24 Glass analysis:

- A Glass analysis report showing the manufacturer's wind pressure and thermal analysis for specified maximum deflections and specified probabilities of breakage to be submitted for approval.

1.25 Glass submittals

- A Product data: Submit product with specific instructions and recommendations for maintenance procedures.

1.26 Glass certifications

- Manufacturer to certify Glass thickness and heat strengthening
- Sealant substrate test report to be submitted
- Insulating unit Warranty by the manufacture to be submitted

1.27 Quality assurance:

- Certified Safety Glazing from Safety Glazing Certification Council (SGCC) or approval equivalent
- Insulating unit to comply ASTM E 774 with compliance certified by independent Certification program, Insulating Glass Certification Council (IGCC) Class CBA or approved equivalent
- Label each unit on spacer and on one pane.
- Certify laminated glass to comply with ASTM C 1 172

1.28 Guarantee:

- Submit written guarantee from the manufacturer to correct failure in coating, insulation and lamination, which occur within the period of Guarantee after virtual completion. This is in addition to the Performance Guarantee to be given by the Contractor.

1.29 Glass shall meet inspection and acceptance criteria as per ASTM-C 1376

1.30 All structurally glazed panels shall have their edges matt finished-und not highly polished-to avoid internal reflection of light around the edges.

Glass edges shall be protected against damage at all stages from manufacture to handling over the works. Panes with damaged edges shall be rejected.

1.31 Double glazed unit shall be stacked vertically after manufacture.

PART – III

Scope of Glazing, Cladding and Structure Works :

Introduction:

The scope of work can be defined as follows. The contractor to consider all the aspects mentioned hereunder while quoting the rate for this job.

1.0 Basic Scope of Works:

1.1 Design, Engineering Supply and installation of various architectural featured glazing system to provide proper elevation treatment on all four walls envisaged by Architect and client.
1.2 You shall coordinate with our Architect / structural consultant to provide and collect all required information to ensure that you have designed the system which is approved and accepted for its structural stability by the structural consultant and its finishes by the architect.
1.3 Your endeavor will be provide various types of glazing which shall be adequate and suitable for its function to reduce heat load, cut the glare effect, provide transparency as desired and shall be easy to maintain.
1.4 All the opening especially for the exterior glazing should be matching to the requirement of owner / architect as well as local rules, regulations and shall be worked out in concurrence with the Architect.
1.5 You will organize the complete basic design / concept in presentation form for us to ascertain your capability and submit your technical / commercial offer separately based on the basic details provided.
1.6 You will confirm the proper (adequate measures have been taken by your design to take in to account the wind pressure, total sealing against rain, earthquake resistance suitable linear expansion against all weather conditions.
1.7 The system should be designed / erected to avoid any replacement of sealant, gasket or hardware other than glass (which may need replacement due to breakage for any reason not attributed to your supply / erection defects) for a period of 10 years.

2.0 Technical bid:
2.1 You will submit your technical bid based on the data provided.
2.2 You will work out the supporting details to incorporate your anodizing aluminium frame work to the existing / proposed frame work.
2.3 You will prepare the basic drawing to confirm the bracket location / size which shall confirm and match the curved / segmented glazing.

2.4 You will provide the details of the aluminium section extruded as per the specification given by us. You will also provide the relevant literature / technical data for various items / load details for our review and acceptance.
2.5 You will submit all your technical data of the structural performance, wind pressure, water infiltration and other parameters.
2.6 You will conduct proper test for all performances to ensure that your confirmations are in the line with agreed parameters. In case you have to be paid for any performance test, you have to confirm the same, as it will be added to your total quoted price.
2.7 You will organize proper scaffolding, safety equipments and final cleaning of the total structure / glass etc. before final handing over.
2.8 You will confirm all the items which you have excluded in your scope of work.
2.9 The measurements will be based on the actual area covered by your system.

PART - IV
STRUCTURAL CALCULATIONS
1.0 STRUCTURAL CALCULATIONS
1.1 The Contractor shall engage a professional engineer duly approved by the Architect to submit structural calculations of the external glazing systems, taking into consideration structural loading permitted by the structural design of the building and all other relent data. He shall be responsible for obtaining all necessary approvals from the government authorities. All his designs shall be endorsed and signed in accordance with the Building Control Act and must be accompanied by details of the cladding, method of fixing and design calculations.
1.2 All panels used for these external façade elements and their system of fixing shall be designed based on criteria specified in point 6, 7 hereof to take into account wind load, deflection, relative movements of the panels water tightness and the building form as well as long durability and integrity of the panels and the fixing system without any water tightness leakage.
1.3 2 sets of structural calculations shall be prepared, certified by a professional Engineer and submitted to the Architect. They shall include, but shall not be limited to, computations for the justification of all external glazing sections and connections including fasteners, welds and anchorage assemblies. Structural calculations shall be cross – referenced to the applicable shop drawings details. The Engineer responsible for the calculation shall review the shop drawings and issue a certificate of compliance stating that the final approval shop drawings are in conformance with the calculation or vice versa.
1.4 The contractor shall provide a complete structural analysis showing the resultant effect of force on all applicable structural components including anchors, welds, fasteners etc.
1.5 The contractor shall submit for the Architect's / Structural Consultants approval all calculations in reference to structural properties of external glazing, windows and frameless glass walls construction and all connections, die dimensions of all extrusions, and complete data as to alloys proposed for use.
1.6 All structural calculations shall be in compliance with the applicable or relevant Indian / British or other International codes and standards.
1.7 The structural calculations submitted are subject to the approval of the Architect / Structural Engineer. Approval of the structural calculations shall not relieve the Contractor from any of the responsibilities and requirements as herein specified.

2. VERIFICATION OF DESIGN
2.1 Approval of the design shall be confirmed in writing by the Architect / EIC before commencement of any installation. The Contractor shall also verify the quantities, extent and location of all elements set out in the Specifications, Contract Drawings, etc. before the commencement of any design and installation works. No claim for extra works arising from failure to comply with this requirement shall be entertained. The approval by the Architect / Structural Consultants of the Contractor's Engineer or amended design shall not absolve the contractor's design engineer of their responsibilities and obligations with regard to the entire design.
2.2 Materials and methods of engineering development other than indicated or implied by the drawings and specifications may be employed when such materials and methods conform to all the specifications.
2.3 All such engineering development proposals must be submitted for review with full supportive documentation, for approval by the Architect / Structural Engineer in writing at no extra cost.

PART – V
1. SCOPE OF WORK

The scope of work under this contract is limited to design, engineering, manufacturing including installation and maintenance including defect liability period of the Frameless Suspended Glazing system in the form of toughened glass assemblies, most of which are fixed panels but some of which may be with doors. These glass assemblies are to be fully

suspended from the building structure and are to be designed as load bearing material withstanding the stresses inherent in such assemblies for the proposed project building. The scope includes:

Preliminary Works Such As Making Layout

The work under this section includes all labour, materials, equipment and services as required for the complete design, engineering, fabrication, assembly, delivery, anchorage and installation of the suspended glazing in accordance with the true intent and meaning of the specifications and drawings taken together, regardless of whether the same may or may not be particularly shown on the drawings or described in the specifications provided that the same can be reasonably inferred therefrom. Anchorage includes all primary and secondary anchor assemblies and supportive structural framing as required to secure the system.

Frameless Suspended Glazing System

This shall comprise of the following elements:

Factory fabricated suspended glazing system consisting of SS Suspension brackets with neoprene separator between glass and SS brackets.

Stainless Steel 316 L grade Spider Fittings of Imported approved for the 12mm & 19mm glass components.

12mm & 19mm Toughened Indian Clear glass of approved make with countersunk predrilled holes to accept the through bolts of the Spider fittings.

Chemical inserts in concrete for the anchorage of all work under this section.

All steel structural brackets and beam supports, anchors and attachments required for the complete installation of the whole system.

All caulking, sealing and flashing including sealing at junctins wherever required.

Doors where indicated, inclusive of all accessories, iron mongeries, etc.

Sealants within and around the perimeter of all work under this section.

Separators, neoprene gaskets, trims, etc.

Isolation of dissimilar metals and moving parts.

Engineering proposals, drawings and data.

Shop drawings, engineering data and structural calculations of the framing, fasteners and claddings stamped by a professional structural engineer approved by the Employer / Architects.

Scheduling and monitoring of the work.

Co-ordination with work of other trades.

All final exterior and interior cleaning of the Suspended systems.

Cost of all hoisting, staging and temporary services.

Guarantees.

Maintenance manuals.

2. GENERAL SPECIFICATIONS

The contractor for the Suspended System shall fabricate, supply, erect and install in position the glazing forming uninterrupted structural glazed surface in accordance with architectural elevation and layout drawings. The glazed surface shall be formed by a frameless system which shall be of structurally and mechanically designed technology for fabrication and erection with grid sizes indicated in the drawing and of full window width. Each Panel is to be suspended with adjacent panes being jointed at the panel corners by spider fittings bolted together through specially designed holes or notches in the glass. Each tier of panel except the top is to be suspended from the tier above, and the whole assembly, except the doors, is to be suspended form and rigidly connected to a substantial structural member of the building, which is capable of fully supporting the dead weight of the assembly in addition to the forces due to wind load.

The perimeter of the frames shall be structurally integrated to for air and waterproof movement joint on all four sides of each panel. Design and sealing of such joints shall ensure that there is no penetration of rain water through these joints under heavy wind pressures.

The accredited Suspended Glazing manufacturers having "proven experience in various systems of Suspended Glazing having executed similar jobs are eligible to quote for this work".

The contractor must comply with all relevant Indian Standards, Code of Practice and technically literature relating to best practice pertaining to frameless suspended glazing. The equivalent International Standards may be used where these are not lower. Nothing in this clause shall relieve the contractor of his obligation to provide a higher standard where required and directed.

3. GLASS

The façade shall be of toughened glass not less than 12mm tick and shall be supported against wind loads by fins, stiffeners, of toughened glass of 19mm thick clear flat make. The fins shall be attached to the façade glass by spider fittings, and shall be attached to the building structure in such a way as to provide the façade with support against wind loads.

Toughening of Glass: The rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

4. PERFORMANCE CRITERIA

The Contractor shall be responsible for the quality and efficiency of the design and application of the technology offered. The system offered shall be structurally sound, capable of withstanding loads and thermal and structural movements indicated with failure, aesthetically pleasing and pretested in accredited overseas laboratories certifying performance of the whole skylight system in accordance with Internal Standards.

The contractor shall submit detailed calculations of the structural design of main system, holding brackets, factory formed glazed units and fixing by nuts / bolts and with standing strength of glass to meet with all the design parameters and requirements contained in these specifications.

5. LIMITING FACTOR ON HEIGHT

The main limiting factor t be considered on the height of the suspended assembly is the "Pullout strength" of the holes of the Top tier panels.

It is the responsibility of the Contractor to adequately check the Limiting conditions prior to fabrication and approval on the same is to be acquired from the architect in this regard.

6. FAIL-SAFE REQUIREMENTS

The design of the toughened glass assembly shall be such that the breakage of any component of the assembly will not initiate progressive collapse of the remainder.

7. GLASS DESIGN STRESS

The glass façade panels and the stiffener fins and the fixing points to the building shall be designed to withstand wind loading in accordance with A.S. 1170.2 or equivalent approved I.S. codes.

The maximum design for the toughened glass fins for wind loading shall be as per the codes.

To prevent bucking, an analysis of the fin stability is carried out. The fin width shall not exceed 18 times the glass thickness.

8. COMPONENTS OF ANCHOR FASTNERS, BOLTS, ETC.

Fixing bolts, anchors, screws and nuts shall be manufactured from stainless steel grade 316L Rivets, pins to be of Aluminium alloy of appropriate grade as required. All bolts, anchors and other fastening devices shall be self locking unless otherwise noted and shall be torque tightened to achieve maximum torque tension where required. Brackets shall be SS of adequate size to meet design parameters. The bracket joint shall be flexible to allow for all movements, deflection and expansion / contraction. All metal to metal joints shall be separated by tough high impact and both side smooth membrane of Teflon of minimum 1.0mm thickness.

Alloy: Aluminium Extrusion of 6063 T6 quality shall be used.

9. SEALANTS

Imported silicone adhesive sealant having excellent properties of adhesion, elasticity, long life (more than 30 years) and of approved make Dow Corning (USA) one part silicone shall be used. Directions of the manufacturer of the sealant shall be strictly followed.

The tenderer shall furnish details and technical information on all the above requirements.

Contractor shall study carefully and provide report on all materials that will be in contact with the imported silicone sealant and provide for compatibility testing and report of proper adhesion. (Adhesion with materials like glass in double-glazing, finished metal, surfaces, masonry, spacers, etc.). Adhesion testing and compatibility tests shall be carried out by the imported sealant manufacturers on prototype to ensure fulfillment of values and quality required for approval prior to use with corresponding materials and surfaces finishes in the beginning. As it is expected that the entire materials required will be supplied in lots at regular intervals of times, the Contractor is required to state in detail how it will be ensured by them that the samples of every lot undergo the adhesion and compatibility test meeting with the requirement of the imported sealant manufacturer and approval.

The Structural Glazing contractor will ascertain from the manufacturer of structural silicone adhesive sealant, the sealant selection procedure and obtain their services for exercising the following controls:

(i) Water absorption.
(ii) Resistance to water, fungi and oxidation.
(iii) Density and hardness.
(iv) Compressible stress and tensile stress.

10. INSTALLATON OF SUSPENDED GLASS ASSEMBLY

Frames shall be installed from external scaffolding or from a mobile scaffold provision of which shall be he responsibility of the Glazing contractor including dismantling on completion of work. Tenderer shall submit details of proposed method of installation. Removable protective peel off film should be provided to exposed surfaces on inside and outside faces of the glazing surfaces wherever necessary and should be removed and cleaned by the Glazing contractor when instructed on completion of work. No separate payment will be made for the same.

11. SUSPENDED ASSEMBLY PERFORMANCE CRITERIA

The Structural Glazing contractor shall be responsible for the quality and efficiency of the design and application of the Structural Glazing technology offered. The system offered shall be structurally sound, aesthetically pleasing and the Structural Glazing contractor shall submit detailed calculations of the structural design of main framing system, holding brackets, factory formed double glazed units and fixing by nuts / bolts and with standing strength of glass to meet with al the design parameters and requirements contained in these specifications.
The following criteria shall be fulfilled for performance:

a) Movement
The system shall be capable of accommodating all stresses and movements that are likely to occur during normal life of 20 years of the Structural Glazing members and no less than 10 years for structural silicone sealant.
b) No Distortion
Composition of members shall be fully adequate to totally resist distortion such that no distortion takes place.
c) Deflection
Deflection shall not be more than 1/175 of the span of the members.
d) Plumb & Alignment.
All the members at each joint shall be in perfect line and alignment. Tolerances for plumb of Structural glazing installed shall be within ± 3mm.
12. FRAMELESS SUSPENDED GLAZING WITH SPIDER FITTINGS.
Design, manufacture, supply and installation of frameless glazed façade suspended from the top of the opening provided with finishing / shading as per Architect approval incorporating glass panes 12mm thick clear flat of Modi, Aashi or equivalent make duly toughened and 19mm toughened fins as stabilizers used at each vertical joint to provide lateral stiffness against wind loading, deflections and other specified loads expected including Aluminium frame work structural supports wherever necessary and hardware all other accessories in the glazing with al extrusions, fittings, Aluminium suspension, brackets, spider fittings stainless steel bolts, screws, all weather elements such as flashing, coping, approved Dow corning sealants, etc. to make the system completely waterproof. All spider fittings should be designed to support the weight of the glass by direct bearing on the blots wherein the structure should be designed as per the relevant codes and should be able to withstand the relevant thermal, wind and seismic forces.
Rate also includes all accessories, hardware, etc. complete as required and directed in strict adherence to the technical specifications and should also include and provide for openable frameless door 3 no. of units within the system in view with the Architectural intent required.
13. ALUMINIUM EXTRUSIONS :
All Structural glazing / panels would have Aluminium extruded sections. The primary extrusion would be fabricated from robust purpose made Aluminium alloy as per Indian Standard 733 – 1983 and 1285 – 1975. this would bear a temperature of 6063T6. the tolerance supplied will be as per the Indian standards 6477 – 1972. theses sections would be suitable to permit the rapid drainage of water using the pressure equivalent principle. These systems are designed to resist winds / seismic loads in compliance with the requirements pertaining to heights of building, the thermal movements between infill panels, grid frames and vertical structure frame.

13.1 Mullions
Mullions shall be solid profile for structural stability, thermal and sound insulation. The expansion joints between 2 mullions would be closed by a moulding which will conceal the expansion joint and also will act as a buffer and sound barrier by not allowing mullion to carry the sound from on floor to the other floor. The top and bottom ends of mulloion would be closed by mouldings.
13.2 TRANSOMS :
The transoms shall be hollow and joined to the mullions by a thermoplastic moulding buffer. The moulding will allow thermal movements of individual transom and will also avoid metal to metal friction.

FINISHES :
13.3 ANODIZING :
The Aluminium extrusions shall be anodized of approved finishes with coating of 20 microns of average thickness with uniform degree of colour as per ISI specification no. 1948 – 1961.

13.4 GLASS :
Glass shall be 100% imported Hermetically sealed double glazed unit comprising of 6mm thick solarbel blue reflective, heat strengthened glass with 12mm air gap and 6mm clear float glass shall be provided.

13.5 GASKETS : (Curtain walling work)
The outer Aluminium frame and glass layer should be fully insulated from inner grid with EPDM compressive gaskets for thermal and sound insulation (E.P.D.M stands for Ethylene Propylene Diene Methylene). These extruded gaskets should

be designed to withstand temperature upto 11 dig. C and should have very good elasticity and tensile strength with no effect of UV light, acids of chemicals.

STRUCTURAL GLAZING (DOUBLE GLAZING)

14. OTHER ACCESSORIES :

a. SS Brackets 316 grade
b. Stainless steel bolt of 20mm dia and 100mm long
c. Clear glass thick to be 6mm
d. Stainless steel screws
e. Center to center distance screws of 250mm
f. Type of screws (Stainless Steel)
g. Dia and length of screws 10/25 nos. screws.

STRUCTURAL GLAZING :

Structural glazing system should have a unique anchoring method to neutralize inaccuracies resulting from the construction. The mullions for the gird work shall be fixed to the building structure by means of aluminium extruded hangers which in turn are hooked on SS brackets, fixed to the building structure. Design of the brackets should be such that if facilities the adjustments of individual aluminium mullion in all the 3 directions for perfect alignment. Then would be no metal to metal contact between the aluminium hangers and MS brackets; then should be no rubbing noise during the structural glazing movements induced by thermal changes / seismic conditions.

FIXING DETAILS OF GLAZING SECTIONS TO MULLIONS :

i. Through stainless steel screws inserted through stainless steel retainers.
ii. The sections would also be secured through compatible screws from outside and the capped.

FIXING DETAILS OF GLASS : (STRUCTURAL GLASS)

Glass is to be fixed into the secondary sections with the help of spacer and structural siico sealants. The secondary structure would be fixed to the Primary Structure with the help of stainless steel screws and stainless steel retainers.

Thickness of silicon sealant considered at vertical and horizontal joints of Aluminium and RCC Structure would be 2mm.

EQUIPMENT PROTECTION & WORKMANSHIP

Keep all pipe and conduit openings closed by means of plugs or caps to prevent the entrance of foreign matter. Protect all piping, conduit, fixtures, equipment or apparatus. Any such items damaged prior to final completion or work shall be restored to its original conditions or replaced at no expense to the Owner.

ACCESSIBILITY:

The installation of valves, thermometers, cleanout fittings and other indicating equipment or specialities requiring frequent reading, adjustment, inspections, repairs, removal or replacement, shall be conveniently and accessibly located with reference to the finished buildings. Thermometers and gauges shall be installed so as to be easily read from the floor. For floor cleanouts minimum distance of 600mm shall be available from any wall.

INSERTS & SLEEVES

General: Layout work in advance of placing of concrete slabs or construction of walls, furnish and set inserts and sleeves necessary to complete the work. Cost of cutting or patching made necessary as a result of this operation shall be at no expense to the Owner. Openings shall be as per structural Consultants approval.

CUTTING, PATCHING, REPAIRING & MAKING GOOD

Cutting, Patching and repairing required for the proper installation and completion of the work, specified in each division, including chasing, plastering, masonry work, concrete work, etc. and making good shall be carried out by the contractor wherever required. Holes which are cut oversize shall be refilled, with concrete so that a tight fit is obtained around the pipe or other passing through.

Any damagesto water proofed location should not be patched up, without rectification by the water proofing agency (specialist contractor) to ensure his guarantee.

EQUIPMENT, MATERIAL & WORKMANSHIP

Determine that each piece of equipment meets the detailed requirements of the contract documents and that it is suitable for the installation shown. Notify the Architect of any shortcomings found during the tendering period. Each piece of equipment furnished shall meet all detailed requirements of the contract documents. Equipments not meeting all requirements will not be acceptable, even though specified by name along with other manufacturers.

Where two or more units of the same class of equipment are furnished use product of the same manufacture, component parts of entire system need not be product of the same manufacturer. Furnish all materials and equipment, new and free

from defects and of size, make, type, and quality herein specified or approved by the Architect of consultant. All shall be installed in a neat and workmanlike manner.

WATERPROOFING

J.1 Bitumen felts based waterproofing and damp-proofing:

IS - 1322 Specification for bitumen felts for waterproofing and damp-proofing.
IS - 1346 Code of practice for waterproofing of roofs with bitumen felts.
IS - 1609 Code of practice for laying damp-proof treatment using bitumen felts.
IS - 3067 Code of practice for general design, details and preparatory work for damp-proofing and waterproofing of building.
IS - 1580 Specifications for bituminous compounds for waterproofing and caulking purposes.

J.2 The waterproofing work shall be got carried out by approved contractors/Agencies who have experience in doing waterproofing work and shall give a guarantee on a stamped paper for good performance of the waterproof treatment for a minimum of **seven years period** and shall, at their own cost, rectify the defects if any found during the guarantee period.
If approved by the Engineer, in situ fibre glass tissue reinforced bitumen layers equivalent to bitumen felt may be used.

J.3 Surface preparation:
Concrete and masonary surface:

Any cracks in the surface (other than hair cracks) shall be cut to V-shape, cleaned and filled with cement mortar 1:2 or with bitumen conforming to IS-702 as dircted by the Engineer.
All fungus growth, if any, moss, dust shall be removed by wire brushing.
Masonary drain mouth shall be widened to two and a half times the diameter of the drain and rounded with cement mortar.
When a pipe passes through RCC slab a cement concrete fillet shall be built around the pipe and waterproofing taken over the fillet.
In brick parapet walls a chese shall be made in the parapet wall to terminate the bitumen felt. No chasing shall be made in the RCC parapet walls.

J.4 Bitumen based waterproofing shall consist of either Normal Treatment or Heavy Treatment or extra heavy treatment as specified.

J.5. Waterproofing of roof, bathroom, water tanks etc. by cement based waterproofing compounds and by injection grouting or as specified in BOQ:

Where specified this work shall be carried out by the Contractor who has specialized in carrying out this work. The contractor shall give a 15 year guarantee on a stamped paper for good performance of his work and shall undertake to rectify the work at his own cost if any defects are observed during the guarantee period.

In general the waterproofing shall be carried out as per specification of the specialist but duly approved by the Engineer.

The roof surface before waterproofing shall be cleaned throughly and watered and shall be kept wet at least 12 hours proir to carrying out of waterproofing. If any leakage is observed the source of leakage shall be located and it shall be treated either by injection grouting or by closing of the cracks with application of cement mortar 1:2 after cutting a V-shape groove. The treatment shall be continued till the leakage is stopped.

Brick-bat coba in special waterproof cement mortar shall be laid to required slope, and shall be well compacted. A 40mm thick IPS type finishing using waterproof extensive trowelling. A flase square shall be provided by pressing string, 3 mm dia, on the surface. The top finish shall be continued upto 300 mm height in the parapet wall (in the case of bathroom it shall be carried out upto 1000 mm high without fillet). Necessary grooves shall be provided in the walls to terminate the waterproofing treatment. At the junction of the wall and the floor a round or triangular fillet of size 200 mm x 200 mm

shall be provided. The entire surface shall be cured for minimum 14 days, by storing water to a depth of at least 150 mm in the entire area. During this period if any leakage is observed the same shall be rectified.

J.6 Underground water tanks, basements, subways and service ducts:

Waterproofing shall be carried out by boxing including injection grouting as specified.

1. P.C.C. to be laid using super plasticizer and W.C. ratio as given in the 'Specification'.
2. The P.C.C. surface shall be thoroughly prepared, cleaned and scrubbed dry with wire brushes etc. Loose material will be removed and the surface finished smooth.
3. Apply minimum three coat of proprietary brand waterproofing coating using acrylic latex copolymers free from SBRs or modified SERs mixed and well stirred with cement in the ratio specified by the manufacturer. The thickness of the three coats should be as specified by the manufacturer but not less than 500 micron in any case. An interval of 24 hours to be kept between successful coats, first being the primer coat.
4. After two days of applying the third coat, provide a 1:3 waterproof cement mortar 20mm thick plaster using approved integral waterproofing compound in specified proportion and cure as per relevant IS Specification.
5. Place steel of raft and RCC walls as required and concrete as per specifications.
6. Carry out injection grouting at 1 mtr. centre to centre in both direction and at all construction joints using cement slurry with polymers based acrylates free from SBRs or modified SBRs.
7. Clean the external side of the retaining wall surface and scrub dry with wire brushes etc.
8. Apply to the external side of the retaining wall minimum three coats of proprietary brand waterproofing coating using acrylic latex copolymers free from SBRs or modified SBRs mixed and well stirred with cement in the ratio specified by the Manufacturer. The thickness of the three coats should be as specified by the Manufacturer but not less than 500 micron in any case. An interval of 24 hours to be between successive coats, first being the primer coat.
9. After two days of applying the third coat, provide a 1:3 waterproof cement mortar 20mm thick plaster using approved integral waterproofing compound in specified proportion and cure as per relevant IS specification.
10. Complete back filling

Notes:

a) The waterproofing course shall be continued without break along the external surface after the vertical elements are constructed.

b) If any honeycombing is noticed, the same shall be prepared good by injection grouting.

c) The bonding coat of approved material to be applied at construction joints to old concrete before commencing fresh concreting operations.

J.7 Track slabs/Roof slabs/Deck slabs:

Waterproofing shall be carried out as follows:

1. Surface should be thoroughly prepared, cleaned and scrubbed dry with wire brushed etc.

2. Apply minimum three coats of proprietary brand waterproofing, coating using Acrylic Latex Copolymers free from SBRs or modified SBRs mixed and well stirred with cement in the ration specified by the Manufacturer. The thickness of the three coats should be as specified by the Manufacturer but not less than 500 micron in any case. Any interval of 24 hours to be kept between successive coats, first being the primer coat.

3. After completion of work, the deck salb shall be tested for water tightness by ponding water for 48 hrs at a head of 5cms and observing if there are any leakages through joints of the track/roof/deck slab. If any leakages are observed at this stage, the same shall be stopped by injection grouting with cement slurry comprising of cement and polymer based acrylates free from SBRs or modified SBRs and making good the surface of the drill portion on the slab by additional waterproofing coating.

4. Apply mastic asphalt or other coating as specified.

J.8 Test on materials and waterproofing:

Test will be carried out on material and waterproofing as per IS 2645-1975, Din 1048 and as specified by Engineer-in-charge and should meet the IS & Din specification. The following tests to be carried out:

a) Impermeability Test - Will be carried out as per Din 1048 for every 500 M2 of waterproofed surface. Field permeability test will also carried by permeability cup measurements for every 500 M2 of waterproof surface. The permeability results should be 0.0mm.

b) Salt spray test on MS panel: The coating should meet IS2074 - 1962 requirement for 100 hours. A minimum of 1 test should be carried out for every 3000 M2 of waterproofed surface.
c) Infra red analysis: Infra read analysis result would have to be submitted along with the sample of acrylic latex copolymer. The test results should prove that the material is free from SBRs or modified SBRs. Thereafter, one test is required to be carried out for every batch of material supplied or every 500 kg.of materials whichever occurs earlier.
d) Solid contend test - One test required to be carried out for every batch of material supplied or every 500 kg of materials whichever is earlier. The soild content of active polymer (acrlyate) should not be less than 40 % by weight of the overall material.

J.9 Mode of measurement and payment:
The rate shall be inclusive of cost all material and labours including testing samples in laboratory and site as specified testing the slab for water tightness before and after the waterproofing, injection grouting as specified, rectifying defects if any by injection grouting, applying of plaster with waterproofing compound as specified and giving 10 year guarantee in prescribed format. It shall be measured and paid on Sq. M. basis of the concrete surface.

WATERPROOFING ROOFS WITH BITUMEN FELTS:

A. **PREPARATION OF SURFACE AND PRIMING COAT.**

In general, the work shall be carried out as per I.S. Code of Practice for 'Waterproofing' roofs with bitumen flats (I.S. 3146)
The surface to be treated shall have a minimum scope of 1 in 120. This grading shall be obtained with lime concrete, cement concrete or cement plaster with coarse sand, as specified, to the average thickness required and finished smooth and such grading shall be paid for separately.
Junction between the roof and the vertical faces of parapet walls, chimneys etc. shall be eased by running triangular fillets of 3" size in cement concrete 1:2:4 (1 cement : 2 sand : 4 stone ballast 1/4" gauge). The provision of fillets shall be deemed to be covered by the item of water proofing and shall not be measured and paid for separately.
Where the parapet walls exceeds 18" in height, the waterproofing felt shall be tucked into a horizontal groove of 3" x 3", cut in the wall at a height of not less than 6" from the graded roof surface. After tucking in of the felt, the groove shall be finished smooth with the cement plaster 1:4 (1 cement: 4 sand). Such cutting of the groove and its finishing smooth shall be deemed to be a part of the waterproofing item and shall not be measured or paid for separately. Where the height of the parapet wall is 18" or less, no groove will be required and the waterproofing treatment shall be carried over the top of the parapet wall to its full thickness.

The graded surface of the roof, concrete fillets and the faces of walls shall be thoroughly cleaned with wire brushes and all loose scales etc. removed. The surface shall then be dusted off. Any cracks in the roof shall be cut to 'V' section cleaned and filled up flush with cement mortar slurry 1:4 (1 cement: 4 sand). Such cleaning of the surface or treating the cracks shall not be paid for separately.

A priming coat with a bituminous solution of suitable viscosity shall then be applied with brush on the roof and wall surface at the rate of 0.8 gallon/100 sft. to assist adhesion of the bonding material (i.e. bitumen). Such application of primer shall not be measured and paid for separately.

B. **WATERPROOFING TREATMENT**

The waterproofing treatment shall consist of a four or six course treatment as specified in the description of the item, each layer of bonding material, self-finished bituminous felt or stone grit being counted as a course. The primer cost shall not count against the number of courses specified.

A four course treatment shall consist of:
i) Initial layer of bonding material applied hot at specified weight per unit area.
ii) Second layer of self-finished bitumen felt of specified brand and manufacture conforming to the type and grade given in the description of the item.
iii) Third layer of bonding material.
iv) Fourth and final layer of stone grit or peagravel spread at specified volume of material per unit area.

In a six course treatment, the first, second and third layers shall be the same as in the four course treatment. The fourth and fifth layers shall consist of self finished felt and bonding material respectively. The sixth layer shall consist of stone grit or peagravel.

The bonding material (Bitumen) shall be max phalt. R 85/25 or equivalent grade or as specified. This shall be heated to 350 degree for as recommended by the manufacturers for a particular grade and conveyed to the roof in buckets or pouring cans in weighed quantities. This shall be applied hot at the rate of 30 lbs/100 sft, in first and third layers of four course treatment. The quantity of bitumen to be applied for the first, third and fifth courses in six course treatment shall be 30, 25 and 35 lbs respectively per 100 Sft. of area.

The self finished bituminous felt shall be type 3 grade 1 (Hessian base) unless otherwise specified. This shall be of approved make and shall conform to the requirements of IS: 1322-1959. This shall be used in second course of four course treatment and second and fourth courses of six course treatment.

The felt shall be cut to required lengths and laid on the roof together with bonding material as per the procedure laid down by I.S. Code of practice for 'Waterproofing roofs with bituminous felts". Each strip shall overlap the preceeding one by at least 3" at the longitudinal edges and 4" at the ends.
All overlaps shall be firmly bonded with hot bitumen. In a six course treatment, care shall be taken that the overlaps of felt in fourth layer are stagger from those in the second layer.

Stone grit shall conform to specifications as described under 'Material - Coarse aggregates' & shall be 1/4" and down size. Where peagravel is used, it shall be hard, round and free from dust, dirt etc. The stone grit or peagavel shall be spread uniformly over the hot bonding material at 2 cft./100 sft. in 4th layer of four course treatment and at 2.25 cft./100 sft in 6th layer of six course treatment and shall be pressed into hot bitumen with wooden roller. Stone grit or peagravel shall not be spread over vertical and sloping faces of flashings, and at drain mouths. At those places, the surface shall be painted with two coats of bituminous emulsion.

Waterproofing of roofs with bitumen felts shall be measured in sq.ft./sq.m Measurements shall be taken over the entire exposed are of roofing and flashing treatment. Overlap and tucking into flashing grooves shall not be measured. The rate shall include the cost of all labour and materials involved in all the operations described above.

WATERPROOFING WITH CHINA-MOSAIC FLOORING.

- The mosaic shall consist of broken, flat pieces of glazed tiles, 1/4" thick and of approved colour and quality. All pieces of tiles shall be of overall uniform size but not uniform in shape.
- The bedding for the tiles shall be with lime mortar 1:2 (1 lime putty: 2 surkhi) or as specified in the description of the item. The average thickness of the bedding mortar shall be 1/4" to 1".
- Graded brick bat coba on which the tiles are to be laid shall be cleaned, wetted and mopped, Specified mortar bedding shall then 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 .
- Cement slurry of paste like consistency shall be spread over the bedding at the rate of 1/4 cft. of cement/100 sft.
- Immediately on application of cement grout, assorted pieces of coloured/white, China, previously soaked in water shall be set closely on the fresh surface and properly tamped to the requried grade. The cement grout freshly laid shall work its way to the top surface.
- The surface, after completion of work shall be finally cleaned with saw dust and waste and if so directed by the Architect, with diluge acid.
- China mosaic shall be taken up the parapet walls to a height of 6". Necessary water shall be provided towards drain pipes as shown on drawings or as directed by the Architect.
- China mosaic shall be cured for at least ten days. The entire surface of the floor, after curing, shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallat.

- The Contractor shall give a guarantee for all types of waterproofing for a minimum period of ten years against bed or faulty material/construction and shall rectify the work at his own cost during the guarantee period.
- Payment for work executed shall be made for projected area only between the inside of plastered walls. No payment shall be made for rounding off at corners or for work carried on vertical faces of walls, column projections, etc.

WATERPROOFING BY APPROVED AGENCY

Basement Waterproofing

The underground structures shall be treated by 'Box Method' 15cms. thick layer of 1:3:6 cement concrete using No. 2 metal shall be laid with smooth surface finished. With trowel on well compacted soil or rubble soling or plum concrete in accordance with the soil strata.

On this 'Certroof' or equivalent waterproof layer on cement base and about 7.5 cm. thick shall be laid, using 1 layer of shahabad stone placed diagonally with cut joints. After the R.C.C raft is laid this treatment shall be carried along the outer surface of the wall and upto a height of 30cm. above ground level. The thickness of the treatment to vertical sides is about 4 cms.

Waterproofing of Water Storage Tank:

In case of water storage tank, after the plumbing work is complete, the outer surface of the walls is plastered & surface methods to floor and walls including partition walls which includes the internal plaster finished smooth with trowel. The thickness of treatment of the floor shall be 6.5 cms, and on the walls 2.5 cms. and finished smooth with the help of trowel. The tank shall be filled immediately after the treatment is completed or should be executed as per the BOQ item description & manufactures specification.

Lawn Terrace

The terrace shall be treated with "Surface" method which after the slab shall be very through cleaned and brickbat coba with necessary gradient shall be laid for the easy flow of rain water. The coba shall be finally covered with pointless waterproof plaster, finished smooth with trowel in cement colour with false markings of 30 cms. square. The treatment shall be carried along the vertical surface of the parapets of adjoining walls upto a height of 30 cms. in the shape of a round vata. The average thickness of the treatment shall be 11.5 cms. thickness and at the rain water outlet it shall be 7.5 cms.

The treatment on the walls in this case will be for height of 300mm. above the final level.

Waterproofing to Toilet Blocks:

All toilet blocks shall be treated with waterproofing on floors including 12 cm. brick bat coba, in lime mortar 1:2 laid to slope and upto 1M. height of wall dado and shall be made properly watertight around all plumbing work.

Terrace Waterproofing:

The terrace shall be first treated with waterproofed brick bat coba in cement mortar 1:2 laid to slope and of thickness as per the detailed drawings. the slopes shall be properly graded for even flow of water towards the down take pipes.

The junction of the slab and the parapet wall shall be treated with waterproof flashings or fillet. The treatment of waterproofing shall be carried over to the parapet wall.

Guarantee for all waterproofing work:

The item of waterproofing shall be carried out by M/s. India Waterproofing company or equivalent to be approved by the Consultants and to their specifications.

A written guarantee in approved form shall be furnished to certify that the waterproofing shall be free from defects of materials and workmanship for a period of 15 years. The leakage, failure to stay in place, splitting, pulling loose, illegatoring, tearing, undue expansion and contraction shall be judged as defective work.

PAINTING & FINISHING

Painting (General)

All paints shall be of the make approved by the Architect ready mixed paints as received from the manufacturer without any admixture shall be used. If thinner is necessary in the case of ready mixed paints, the name shall be as recommended by the manufacturers.

The Contractor shall bring all the approved paints to the site of work in their original containers in sealed condition. Paints which will be sufficient for the entire work or at least for a fortnight's work shall be brought in at a time. The empties shall be removed from the site only when the item of work has been completed and permission obtained from the Architect.

Paintings shall be started only when the Engineer has inspected the items of work to be painted, satisfied himself about their proper quality and given his approval to commence the painting work.

Painting, except the priming coat, shall be taken in hand only after all other builder's work is practically completed. The entire building cleaned up at least one day in advance of the paint work being started.

The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt scales, grease etc. shall be removed before painting is started. The prepared surface shall be got approved by the Engineer before painting work is commenced.

The paint shall be thoroughly stirred in their original containers before pouring them into smaller tins for use. While applying also, the paint shall be continuously stirred in the smaller tins so that the consistency is kept uniform. If required, a thinner shall be used to bring the paint to the required consistency.

Two or more coats of painting shall be done either with brushes or by spraying as stipulated in the items of work.

Each coat shall be allowed to dry out thoroughly before the next coat is applied. Each coat except the last coat shall be thoroughly rubbed down with sand paper or fine pumice stone and cleaned of dust before the next coat is applied. The finished surface shall present a smooth and even surface without any hair marks from the brush or clogging of paint puddles.

White painting doors and windows, the putty round the glass panes shall also be painted. Tops of shutters and other similar hidden locations shall not be left out in painting. After painting the glass panes shall be thoroughly cleaned. By using solution available in market specially made for cleaning glasses
All painting work shall be measured in sq.m. unless otherwise specified. In measuring painting of joinery and steel work, etc., the co-efficient as given in IS: 1200 - 1964 shall be used to obtain the area payable, unless otherwise specified in the description of the item.

All furnitures, fixtures, glazing, floors, etc. shall be protected by covering and stains, smears, splashings if any shall be removed and any damage done shall be made good by the Contractor at his own cost.

The rate shall include the cost of all labour and materials involved in all the operations described above and any other specifications given under the relevant item.

PAINTING PRIMING COAT ON WOOD, IRON OR PLASTERED SURFACE

The priming coat shall be as specified in the description of the item. The primer shall be prepared at site or ready made paint of approved brand and manufacture.

At site, the primer for wood work shall be prepared from a mixture of red lead, white lead and double boiled linseed oil in the ratio of 7 lbs: 7 lbs: 1 gallon. For iron work, the same shall be prepared from a mixture of red lead, raw linseed oil and turpentine in the ratio of 29 lbs: 1 gallon: 1 gallon. All the ingredients of primer shall conform to Indian Standard specifications and shall be of approved manufacture and shall be brought to site in their original pickings in sealed condition. the primer for the plastered surface shall be either distemper primer or cement primer of approved make.

The surface shall be prepared to receive priming coat as follows:

WOOD WORKS: The surfaces to be painted shall be dry and free from moisture. All unevenness shall be rubbed down smooth with sand paper and shall be well dusted. Knots, if any shall be covered with a preparation of red lead made by grinding red lead in water and mixing with strong, hot glue. The surface treated for knotting shall be dry before the primer is applied.

After the priming coat is applied, the holes etc. on the surface shall be stopped with glazier's putty or wood putty. Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the later is therefore liable to crack.

IRON AND STEEL WORK: All rust and scales be removed by scrapping or by brushing with steel wire brushes. All dust and dirt shall be wiped away from the surface. If the surface is wet. It shall be dried before the priming coat is applied.

PLASTERED SURFACE: Ordinarily, the surface shall not be painted until it has dried completely. Trial patches of primer shall be laid at intervals and when drying is satisfactory, painting shall be taken in hand. Before primer is applied, all holes and undulations shall be filled up specification for doing POP to obtained.

When the surface to be primed is finally okayed the primer shall be applied with brushes, worked well into the surface and spread over and smooth.

PAINTING WITH READY MIXED PAINT:

All ready mixed paints shall be of approved brand and manufacture and of the required shades. The different surfaces to be painted shall be prepared in the same way as described under 'Painting Priming coat in wood, iron or plastered surface". The priming coat shall have dried up completely before painting is started.

The number of coats to be applied shall be as stipulated in the description of the item. the painted surface shall present uniform appearance and glossy finish, free from streaks, blisters etc.

WHITE WASHING WITH LIME:

Double scaffolding or stage scaffolding shall be provided for white washing to walls or ceiling as the case may be. Where ladders are proposed to be used, their tops shall be tied with pieces of old gunny bags to avoid scratches to walls.

Before white washing the new works, the surface shall be properly brushed free from mortar droppings and other foreign matter.

The wash shall be prepared from fresh stone white lime. The lime shall be well slaked, mixed and stirred with sufficient water to make a thin cream. This shall be allowed through a clean coarse cloth. 4 oz. of gum dissolved in hot water, shall be added to each cft. of cream. For making the cream one gallon of water shall be added to 2 lbs of lime.

No. of coats to be seen in description of item shall be applied with brushes on new work till the surface presents a smooth and uniform finish. Each coat shall be allowed to dry before the next one is applied. Further each coat shall be inspected and approved by the Architect or his representative before the subsequent coat is applied.

The finished dry surface shall not show any signs of cracking and peeling nor shall it come off readily on the hand when rubbed.

White washing shall be measured in sq.m of the finished area. The deductions for openings etc. shall be regulated as per IS: 1200 - 1964. The rate shall include the cost of all materials and labour involved in all the operations described above.

WATERPROOF CEMENT PAINT

Water proof cement paint of the brand, make and shade approved by the Architect shall be used.

The surface shall be thoroughly cleaned of all mortar droppings, dirt, dust, algae, grease and other foreign matter by brushing and washing. The surface shall be thoroughly wetted with clean water before the paint is applied.

Waterproof cement paint shall be mixed in such quantities as can be used up within an hour of its mixing. It shall be mixed with water and applied strictly as per manufacturer's instructions. The lids of cement paint drums shall be kept tightly closed when not in use.

The paint solution shall be applied on the clean and wetted surface with brushes or spraying machine. The solution shall be kept well stirred during the period of application. The completed surface shall be watered after the days work.

The second coat shall be applied after the first coat has set for at least 24 hours. before application of the second or subsequent coats, the surface of the previous coat shall not be wetted. Three or more coats as found necessary to get a uniform shade shall be applied on new work.

The specifications for scaffolding, measurements, etc. shall remain the same as described under 'white washing with lime.

DISMANTLING WORKS

GENERAL

Precautions

All materials obtained from dismantling or demolition shall be the property of the Government unless otherwise specified and shall be kept in safe custody until they are handed over to the Engineer-in- Charge/ authorized representative.

The demolition shall always be well planned before hand and shall generally be done in reverse order of the one in which the structure was constructed. The operations shall be got approved from the Engineer-in-Charge before starting the work.

Due care shall be taken to maintain the safety measures prescribed in IS 4130 and construction and demolition waste management rules 2016 shall be followed.

Necessary propping, shoring and or under pinning shall be provided to ensure the safety of the adjoining work or property before dismantling and demolishing is taken up and the work shall be carried out in such a way that no damage is caused to the adjoining work or property. Wherever specified, temporary enclosures or partitions and necessary scaffolding with suitable double scaffolding and proper cloth covering shall also be provided, as directed by the Engineer-in-Charge. It shall be ensured that no dust is generated while demolishing. Demolition Rules – 2016 shall be followed.

Necessary steps shall be taken to keep noise and dust nuisance to the minimum. All work needs to be done under the direction of Engineer-in-Charge. Helmets, goggle, safety belts etc., should be used whenever required and as directed by the Engineer-in-Charge. The demolition work shall be proceeded with in such a way that it causes the least damage and nuisance to the adjoining building and the public. Barricading shall be provided as per NGT guidelines.

Dismantling shall be done in a systematic manner. All materials which are likely to be damaged by dropping from a height or by demolishing roofs, masonry etc. shall be carefully removed first. Chisels and cutters may be used carefully as directed. The dismantled articles shall be removed manually or otherwise, lowered to the ground (and not thrown) and then properly stacked as directed by the Engineer-in-Charge.

Where existing fixing is done by nails, screws, bolts, rivets, etc., dismantling shall be done by taking out the fixing with proper tools and not by tearing or ripping off.

Any serviceable material, obtained during dismantling or demolition, shall be separated out and stacked properly as directed by the Engineer-in-Charge within a lead of 50 meters. All unserviceable materials, rubbish etc. shall be disposed offat authorized locations by urban local bodies as directed by the Engineer-in-Charge.

The contractor shall maintain/disconnect existing services, whether temporary or permanent, wherever required by the Engineer-in-Charge.

No demolition work should be carried out at night especially when the building or structure to be demolished is in an inhabited area.

Appropriate screens shall be placed where necessary to prevent injuries due to falling pieces.

Water spray shall be used to reduce dust while tearing down plaster from brick work.

Safety belts shall be used by labourers while working at higher level to prevent falling from the structure. Wherever, possible mechanized working platform shall be used.

First-aid equipment shall be made available at all demolition works of any magnitude.
Flooring and Pavings
Dismantling of floors (except concrete and brick floors) shall be measured in square metres. Supports such as joints, beams etc. if any shall be measured Supporting members, such as rafters, purlins, beams joists, trusses etc. of wood shall be measured in cubic metres and steel or iron sections, in quintals

Doors and Windows
Dismantling of doors, windows, clerestory windows, ventilators etc. (wood or metal) whether done separately or along with removal of wall by making recess in the wall shall be enumerated. Those exceeding 3 sqm each in area shall be measured separately. The item shall include removal of chowkhats architraves, holdfasts and other attachments.

If only shutters are to be taken out it shall be measured separately.

MISCELLANEOUS WORKS

M.1 ANTI-TERMITE TREATMENT

1. Guarantee Period and Periodic Inspection:

Contractor should note that the work done is subject to free service guarantee from the date of completion of Treatment for a period of TEN YEARS against any infestation/and/or damage due to white ants. This guarantee shall be for non-appearance of termites and shall include periodical (once in 3 months) inspection and treatment if necessary to check the damage due to infestation. Amount equivalent to 10% of the cost will be retained from the final bill for a period one year during the defects liability period. The guarantee shall be in favour of employers by specialised termite-proofing agency.

2. The work shall be taken up in stages and contractors shall carry out the work in bits as and when he is called upon to do so by clerk of works/any other authorised period. there shall be no claim whatsoever on account of carrying out the work in stages.

3. Supervision:

The entire work of termite treatment at various stages of general work building shall be carried out under supervision of clients' representative. The Contractor shall employ experienced staff approved by the Architects to carry out such work. Further, the termite proofing agency shall appoint an experienced representative permanently posted at work site right from the commencement of treatment upto its completion of treatment.

PRE-CONSTRUCTION SOIL TREATMENT:

General:

The formation of the chemically treated soil barrier shall be accomplished in stages as the building construction work progresses and due care shall be exercised to ensure that each stage of treatment is well integrated with that previously applied stage so that unprotected avenues of entry are not left open to the termites.

Chemicals

The Chemicals used for the soil treatment will be any one or of combination of the following with the concentration shown against each in aqueous emulsion.

Treatment to Foundation and Plinth:

a. Treatment to sides of Col. pits/trenches/basement:

The bottom surface of the excavations made for column pits, trenches and basements shall be treated with the chemical emulsion mentioned at 5 litres per 10 sft.

b. Treatment to backfill to Col. pits/Trenches/Basement:

The return earth in foundations in layers of 6 inches shall be treated as the layers are filled in, in stage at the rate of 20 litres per 10 sft. of the vertical or inclined surfaces of the concrete/masonry foundations. The chemical emulsion should be directed towards the concrete/masonry surface of the columns and foundations walls so that the earth in contact with these surfaces is well treated with the chemical.

c. Treatment to natural soil surfaces:

Areas other than those occupied by the plinth beams and masonry walls within plinth area of the building shall be treated with chemicals at the rate of 5 litres per 10 S.F.

d. Plinth Filling:

Surface of the earth filled within the plinth shall be treated with chemical emulsions at 5 litres per 10 S.F.

e. Forming of barrier around the external perimeter of the Building:

Earth around external perimeter of the building upto a depth of half metres shall be treated at the rate of 1.67 litres per sft. of the plinth wall. In order to create a direct barrier to the path of the pests treatment shall be carried out by driving in 1" solid M.S. rods as close as possible to the plinth walls

at intervals of 12" and upto a depth of 18" and roads moved backwards and forwards in a direction parallel to the wall to break up to the earth so that the chemical emulsions poured into the holes formed mixed intimately with the soil.

f. Treatment to critical areas:

Areas such as opening of the trenches made for soil pipes electrical cables, floor draining etc. shall be well soaked with the chemical emulsions.

Measurements:

The rate quoted by the contractor for the item in the Schedule of Quantities for treatment to foundations & plinth shall include for all items specified in clause 3 above. Payment shall, however, be made on the measurements of plinth area (Horizontal plane) i.e. area covered by the depth of foundations excluding areas open sky.

PLUMBING SERVICES

SECTION A: PLUMBING SERVICE.

1. GENERAL.

In case where the specification given below are found wanting the latest I.S. Specifications, shall hold good.

Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specifications irrespective of any particular edition of such specifications being mentioned in the specifications below or Schedule of Quantities.

2. WORKMANSHIP.

The workmanship shall be best of its kind and shall conform 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. All materials and/or workmanship which in the opinion of the Engineer is defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and workmanship forthwith.

3. MATERIALS.

All materials shall be best of their kind and shall conform to the latest Indian Standards.

All materials shall be of approved quality as per samples and origins approved by the Engineer/Consultants.

As and when required by the Engineer, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. if after tests any materials, work or portions of work are considered defective or unsound by the Engineer the Contractor shall remove the defective material from the site, pull down and re-execute the works at his own cost to the satisfactions of the Architects. To prove, that the materials used are as specified, the Contractor shall furnish to Engineer with original vouchers on demand.

SECTION B : SANITARY FIXTURES & C.P. FITTINGS.

1. **Vitreous China Sanitaryware.**

All glazed Vitreous China Sanitaryware fixtures shall conform to Indian Standard IS:2556. The details, make and type to be provided are given in the Schedule of Quantities. The Vitreous China Sanitaryware shall be of first quality only. They shall be non-porous and fully vitreous, with all the visible portions perfectly glazed and should be absolutely free from hairline cracks, pin-holes and local depressions. it shall be perfectly symmetrical, uniform and smooth on curves. All sanitary fixtures and fittings shall be stored under covered roof and handled carefully to prevent any damage.

2. **Chromium Plated Fittings.**

All Chromium plated fittings shall be of brass, heavy chromium plated, of the make and design approved by the Engineer. The fittings shall be cast fittings of screw type, machined and threaded properly for fixing to the supply pipes.

The plating shall conform to Indian Standard IS:482 (Electroplated coating of nickel and chromium of copper and copper alloys).

The fittings shall be supplied complete with chromium plated matching flanges, wall cover plates, nuts and extension pieces of required lengths. Metallic washers where required shall also be of chromium plated brass. All bib cocks and stop cocks shall conform to Indian Standard IS:781. Brass screw down pillar taps to IS:1701 and all other accessories shall match the plated fittings in construction and appearance. All fixing accessories and screws shall be similar to fittings. All washers shall conform to Indian Standard IS:4346.

All waste fittings (Waste, Chain, Overflow, Spreaders, Caps etc.) shall be of brass heavy chromium plated of the make and design specified and match the plated fittings. They shall conform to Indian Standard IS:2963.

Bottle traps (for wash basins, sinks, urinals etc) shall be deep seal (Min. 6 cm seal) cast brass bottle traps, heavy chromium plated. All bottle traps shall be provided with suitable cleaning eye, extension piece, flare nuts, all chromium plated.

Wall flanges shall be provided on walls, floors columns etc. wherever supply and disposal pipes pierce through them. These wall caps shall be of chromium plated brass snugly fittings the receiving pipes and shall be large enough to cover the punctures properly.

3 **INSTALLATION OF SANITARY FIXTURES AND FITTINGS.**

3.1 **General Requirement.**

The fixtures and fittings shall be provided with all such accessories as are required to complete the item in satisfactory working conditions, whether specifically mentioned or not in the schedule of quantities, specifications and drawings.
The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the Engineer, and shall fully meet with the asthetic and symmetrical requirements as demanded by the Engineer.
All the fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architect's requirements. Wherever necessary, the fittings shall be centered to dimension and pattern as called for.
Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice. Manufacturer's instructions shall be followed for the installation of fixtures. Fixtures in all toilets shall be standard height mounting as called for on the drawings. Fixtures shall be mounted rigid, plumb, and true to alignment.

3.2 **Mock up and Trial Assembly.**
The installation of the Sanitary fixtures and fittings shall be as per the shop drawings approved by the Engineer.

The contractor shall have to assemble at least one set of each type of sanitary fixtures and fittings in order to determine precisely the required supply and disposal connections. Relevant instructions from manufacturers shall be followed as applicable. This trial assembly shall be developed to facilitate determining the location of puncture holes, holding devices etc. which will be required for final installation in position of all sanitary fixtures and fittings. The above assembly shall be subject to final approved by the Engineer.
The fixtures in the trial assembly can be re-used for final installation without any additional payments for fixing or dismantling of the fixtures.

3.3 **Supporting and Fixing Devices.**
The Contractor shall provide all supporting and fixing devices necessary to install the sanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The devices shall be rust resistant and shall be so fixed that they do not present an unsightly look in the final assembly, where the location demands. The Engineer may instruct the contractor to provide chromium plated or other similarly finished fixing devices. In such circumstances the contractor shall arrange to supply the fixing devices and shall in stall complete with appropriate vibration isolating pads, washers and gaskets.

3.4 **Final Installation.**

The Contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies and as shown on drawings. The installation shall be complete with all supply and waste connections. the connection between building and piping system and the sanitary fixtures shall be through proper unions and flanges to facilitate removal/replacement of sanitary fixtures without disturbing the built in piping system. All unions and flanges shall match in appearance with other exposed fittings.

Fixtures shall be mounted rigid, plumb and to alignment. The outlets of water closet pans and similar appliances shall be examined to ensure that outlet ends are butting on the receiving pipes before making the joints. It shall be ensured that the receiving pipes are clear of obstruction. When fixtures are being mounted, attention shall be paid to the possibility of movement and settlement by other causes. overflows shall be made to ensure that necessary anchoring devices have been provided for supporting water closets, washbasins sink and other appliances.

4. PROTECTION AGAINST DAMAGE.

The Contractor shall take every precaution to protect all sanitary fixtures against damage, misuse, crazing, staining,scratening, breakage and pilferage by providing proper wrapping and locking arrangement till the completion and handing over. At the time of handing over, the contractor shall clean, disinfect and polish all fixtures and fittings. Any fixtures and fittings found damaged, cracked, chipped, stained or scratched shall be removed and new fixtures and fittings free from defects shall be installed at his own cost to complete the work.

SECTION – C: WATER SUPPLY

1. PIPING MATERIAL.

1.1 **Galvanized Iron Pipes**

The pipes shall be galvanised mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS: 1239. the Galvanising shall conform to IS:4736, the zinc coating shall be uniform, adherant reasonably smooth and free from such imperfections as flux, ash and drops, intrusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised 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 pipe.

The fittings shall be malleable iron and comply with all the requirements that of pipes. The sizes of pipes and fittings are as specified in the schedule of quantities.

1.2 Valves & Controls.

All valves (gate, globe, check, safety) shall be of gun metal non rising spindle valves suitable for the particular service design & duty as called for. Valves shall either be of screwed type or flanged type, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied alongwith valves. Gate, globe and check valves shall conform to Indian Standard IS: 778 and non-return valves to swing check type reflux to IS: 5312.
Sluice valves, where called for shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be of gunmetal. They shall generally have non-rising spindle and shall be of the particular dot, and design called from. The valves shall be supplied with suitable flanges non-corrosive bolts and asbestos fibre gaskets. Sluice valve shall conform to Indian Standard IS: 78 and IS: 2906.
Ball valves with floats to be fixed in storage tanks shall consist of cast brass lever arm having copper balls (26 SWG) screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the position and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves shall be supplied with brass Hexagonal backnuts to secure them to the tanks and a socket to connect to supply pipe.

	Type of valve	Size	Contraction	Ends.
a.	G.M. Valve	15mm to 50mm	Gun Metal	Screwed.
		50mm and above	Gun Metal	Flanged.
b.	Sluice valve & butterfly valve.	65mm and above	Cast iron/steel	Flanged.
c.	G.M. Non return valve.	15mm to 50mm	Gun Metal	Flanged.
		50mm and above.	Gun Metal	Flanged.
d.	Flap type Non return above.	65mm and above.	Cast iron	Flanged.

1.3 **Ferrules.**

The ferrules for connection with C.I. main shall generally conform to IS: 2692. it shall be of non-ferrous materials with a C.I. ball mouth cover and shall be of nominal bore as specified. The ferrule shall be fitted with screws and plug or valve capable of completely shutting of the water supply to the communication pipe, if and when required.

1.4 **Water Meters.**

Water meters of approved make and design shall be supplied for installation at location as shown. The water meters shall meet with the approval of local supply authorities. Suitable valves and chambers or wall meter box to house the meters shall also be provided alongwith the meters.

The meters shall conform to Indian Standard IS: 779 and IS: 2373. Where called for the water meters shall be located in masonry chambers of appropriate size.

Provision shall also be made to lock the water meter. The provision shall be such that the lock is conveniently operated from the top. Where the provision is designed for use in conjunction with padlocks, the hole provided for padlocks shall be a diameter not less than 4mm.

3. **Laying and Jointing of G.I. Pipes**

All pipes and fittings shall be fixed truly vertical and horizontal unless unavoidable. The pipes shall be fixed to walls with standard slotted angles 'U' shape threaded bolts & nuts for clamping pipes to angles. Slotted angles shall be grouted to R.C.C. work with fasteners of size so as to fit tightly on the pipes when tightened with screwed bolts. These slotted angles shall be spaced at regular intervals in straight lengths and heights.

The galvanised pipes and fittings shall run in wall chase or on ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1:5 cm clear of the wall when to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted or pipes fixed in the shafts, ducts etc. provided there is a sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be burried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Architect. Pipe sleeves shall be fixed at a place where the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case pipe is embedded in walls or floors it should be painted with anticorrosive bitumastic paint of approved quality. Under the floors the pipes shall be laid in layer of sand filling.

Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer's instructions, with alongwith a few strands of fine yarn while tightening, compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.

4. **Piping Installation**

Tender drawings indicate schematically the site and location of pipes. The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-section, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves and all pipe supports. He must keep in view the specific openings in building and other structure through which pipes are designed to pass.

Piping shall be properly supported on, or suspended from, on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural sufficiency.

Piping supports shall be steel, adjustable for the height and primer coated with rust preventive paint and finish coated back. Where pipe and clamps are of dissimilar materials, spacing of the supports shall not exceed the following:

Pipe Size	Spacing between supports.
Upto 12 mm	1.5 meter
15mm to 25mm	2.0 meter
30mm to 50mm	2.0 meter
above 50mm	2.5 meter

Vertical risers shall be parallel to walls and column lines and shall be straight and plumb. Risers passing from floor to floor shall be supported at each floor by clamps or collars attached to pipe and with a 15mm thick rubber pad or any resilient material. Where pipes pass through the terrace floor, suitable flashing shall be provided to prevent water leakage. Risers shall have suitable clean out at the lowest point and air vent at the highest point.

Pipe sleeves, of 50mm larger diameter than pipes, shall be provided wherever pipes pass through walls and slabs, and annular space filled with Fiberglass and finished with retainer rings.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge sheet shall be provided between the insulation and the clamp, saddle or roller, extending at least 15cm. on both sides of the clamps saddles or roller.

All pipe work shall be carried out in a workmen like manner causing minimum distrurbance to the existing services, buildings, roads and structures. The entire piping work shall be organized in co-ordination with other agencie's work, so that complete work in the area shall be carried out in one stretch. Contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be provided in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

Flanged inspection pieces 1.5 meters long, with bolted flanges on both ends, shall be provided no more than 30 meter centers future cleaning of all welded pipes.

All burried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet.

Air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size gate valves. There mostmatic air V/Vs shall be provided towards drain points.

Pressure gauges shall be provided at the suction and discharge of pumps as included in schedule of quantities. Care shall be taken to protect pressure gauges during pressure testing.

4.1 **Fixing Ferrules**

For fixing ferrule the empty main shall be drilled and tapped at 45% to the vertical and the ferrule screwed in. The ferrule must be so fitted that no portion of the shaft shall be left projecting within the main into which it is fitted.

4.2 **Cutting Chases in masonry Walls**

The chases upto 7.5 x 7.5cm shall be made in the walls for housing GI pipes etc. These shall be provided in correct positions as shown in the drawings or directed by the Architects. Chases shall be made by chiselling out the masonry to proper line and depth. After GI pipes etc. are fixed in chases, the chases shall be filled with cement mortar 1:4 or as may be specified made flush with the masonry surface.

4.3 **Water Fittings**

Unless otherwise specified all Gunmetal fittings such as gate, globe, check & safety valves shall be fitted in pipe line in workman like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak-proof when tested to pressure. The defective fittings and joints shall be replaced or redone.

4.4 **Making Water Connection**

A pit of suitable dimension shall be dug at the point where the connection is to be made with ring main and earth removed upto 150mm below the main. The flow of water in main shall be disconnected by operating the nearest sluice valve on the main. The main shall be drilled and sloped at 45% to the vertical and the ferrule of required size shall be screwed in. The ferrule shall be fitted in a manner so that no portion of projection of the shank shall be left projecting within the main into which it is fitted. Ferrule shall be non-ferrous material with a C.I. bell mouth cover and shall be of nominal bore as required.

4.5. **Installation of Water Meter and Stop Cock**

The G.I. lines shall be cut to the required lengths at the position where the meter and stop cock are required to be fixed. Then end of the pipe shall be threaded. The meter and stop cock shall be fixed in a position by means of connecting pipes G.I. jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. And the meter installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken that the factory seal of the meter is not disturbed.

Wherever the meter shall be fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fittings the meter.

4.6 **Connections to RCC Water Tanks**

The Contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator to water storage tanks as called for. All pipes crossing through RCC work shall have puddle flanges fabricated from MS/GI pipes of required size and length and welded to 6mm thick MS plate. All puddle flanges must be fixed in true alignment and level to ensure further connection in proper order. Suitable float controls of approved make, securely fixed to the tank independent of the inlet pipe and set in a position that water inlet into the tank is cut off when filled upto the water line. The water level in the tanks shall be adjusted to 25mm below the lip of the overflow pipe. Fullway gate valves of approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof coupling.

The overflow pipe shall be so placed to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning.

5. **Disinfection of Piping System and Storage Tanks.**

Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph.

The water storage tanks and pipes shall first be filled with water and then thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water. If ordinary bleaching powder is used, the proportions will be 150gms of powder to 1000 liters of water. The powder shall be mixed with water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be specified by the makers. When the storage tank is full, the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

6 **Protection Against Corrosion.**

All embedded piping material and accessories shall be suitably protected against corrosion. All embedded GI pipes shall be wrapped throughout with 2 layers of 400 micron Polythene sheet with two coats of bitumen paint. Where G.I. pipes are laid under floors, trenches etc. shall be encased with 100mm thick fine sand all round.

7. **Shifting of Excavated Surplus Material.**

Contractor shall make his own arrangement to shift the surplus excavated material directed by Engineer.

8. **Testing.**

a. All water supply system shall be tested to hydrostatic test pressure of at least two and half line the maximum pressure but not less than 10 kg/sq.cm. for a period of not less than 24 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site.
b. Piping required subsequent to the above pressure test shall be tested in the same manner.
c. System may be tested in sections and such sections shall be entirely retested on completion.

SECTION – D : INTERNAL DRAINAGE (SOIL, WASTE & VENT PIPES)

1. **Basic Piping System.**

Soil, waste and vent pipes in shafts, ducts and in corrossion areas i.e. false ceiling etc. shall consist of cast iron pipes & fittings as called for in general. Where pipes are smaller than 50mm dia they shall be of medium class Galvanised MS.

The soil pipes shall be circular with a minimum diameter of 100mm Pipes shall be fixed by means of stout cast iron clamps in two sections, bolted together, built into the walls, wedged and neatly jointed as directed and approved by the Engineer. All bends, branches, swan necks and other parts shall conform to the requirement and standards as described for the pipes.

Where indicated, the soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the height shown in the drawings. Joints throughout shall be made with molten lead as described under jointing of cast iron pipes. Soil pipes shall be painted as provided under painting. The soil pipes shall be covered on top with cast iron terminal outlets as directed and as approved. All vertical soil pipes shall be firmly fixed to the walls with properly fixed clamps, and shall as far as possible be kept 50mm clear of wall. Waste pipes and fittings shall be of cast iron or galvanized mild steel pipes. Pipes shall be fixed jointed and painted as described in installation of soil, waste & vent pipes.

Every waste pipe shall discharge above the grating of properly trapped gully. The contractor will ensure that this requirement is adequately met with. Wherever floor traps are provided, it shall be ensured that at least one wash is connected to such floor traps to avoid drying of water seal in the trap. Ventilating pipes shall be of cast iron or galvanized mild steel pipes, conforming to the requirements laid down earlier. Anti-syphon vent pipes/relief vent pipes where called for on the drawings shall be of cast iron or galvanised mild steel pipes as specified. The pipes shall be of the diameter shown on the drawings.

All traps on branch soil and waste pipes shall also be ventilated at a point not less than 75mm or more than 300mm from their highest part and on the side nearest to the soil pipe or waste pipe.

All connections, between soil, water and ventilation pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. The doors shall be provided with 3mm thick rubber insertion packing and when closed and bolted shall be air and water tight.

Where soil, waste and ventilating pipes are accommodated in shafts ducts, adequate access to cleaning eyes shall be provided,

2. Piping Materials

2.1 Cast Iron Pipes.

Cast iron pipes and fittings shall be of good tough quality, dark grey on fracture. 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 nicely cast, shall be free from cracks, taps, pinholes and other manufacturing defects.

The pipes and fittings shall conform to IS:1729 or IS:3989 as called for. All fittings shall conform to IS:1729 or IS:3989. Fittings shall be of required degree with or without access door. All access doors shall be made up with 3mm thick insertion rubber gasket, white lead, and tightly bolted to make the fittings air and water tight. The fittings shall be of the same manufacture of the pipes used for soil and waste.

All HCI pipes and fittings shall bear the manufacturer's name and ISI specification to which is conforms.

All pipes and fittings shall be coated internally and externally with the same material at the factory, the fittings being preheated prior to total immersion in a bath containing a uniformly heated composition having a tar/other suitable base. the coating material shall have good adherence and shall not scale off. The coating shall be smooth and tenacious and hard enough not to flow when exposed to a temperature of 77 degree C but not so brittle at a temperature of 'O' degree C as to chip off when scrubbed lightly with a pen knife.

All pipes and fittings before installation at site shall be tested hydrostatically to a pressure of 4.0 Kg/sq.cm without showing any sign of leakage, sweating or other defects of any kind. The pressure shall be applied internally and shall be maintained for not less than 15 seconds. All these tests shall be carried out in the presence of the representative of the Engineer. Alternatively a test certificate from manufacturers be obtained before despatch of material to site.

All cast iron watermain pipes, and fittings shall be manufacturered to IS: 1536 of tested quality. The pipes and fittings shall either be spigot and socket type or as called for. The pipes and fittings shall be of uniform material throughout and shall be free from all manufacturing defects.

2.2 **Cast Iron Specialities.**

Cast iron speciality item such as deep seal floor traps, urinal traps, trap integral pieces with integral inlet/outlet connections, manhole cover with frame, chamber cover etc. shall be fabricated to suit individual location requirements. The contractor shall arrange the fabrication of these items from an approve source. All traps shall be minimum 6cm deep seal shall be supplied with cast iron caps and collars capable of receiving screwed grating.

2.3 **Galvanised Iron Pipes.**

Waste pipes below 50mm dia and where called for shall be galvanised iron pipes screwed and socketted conforming to the requirements of IS:1239 of medium grade. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. All pipes and fittings shall bear manufacturer's trade mark and conform to the IS as specified.

3. **Installation of Soil, Waste & Vent Pipes.**

Soil, waste & vent pipes in shafts, under the floors shall consist of cast iron pipes as described earlier. Waste pipes from bottle traps to floor/urinal traps. For wash basin, urinal and sink medium class GI pipes and fittings shall be used.

All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, of sturdy design. The pipes shall be laid in uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means of stout clamps in two sections, bolted together, built into the walls, wedged and neatly jointed. The branch pipes shall be connected to the stack at the same angle as that of fittings. All connections between soil, waste and ventilating pipes and branch pipes shall be made by using pipe fittings with inspection doors for cleaning. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts. All cast iron pipes and fittings shall be jointed with soft pig lead of 99% purity and free from all impurities.

Before joining, the interior of the socket and exterior of the spigots shall be thoroughly cleaned and dried. The spigot end shall be inserted into the socket right upto the back of the socket and carefully centered by two or three laps of threated spun yarn, twisted into ropes of uniform thickness, well caulked into the back of the socket. No piece of yarn shall be shorter than the circumference of the pipe. The jointed pipe line shall be at required level, and alignment. The reminder of the socket is left for lead caulking. Where the gasket has been tightly home, a jointing ring shall be placed round the barrel against the face of the socket. Molten pig lead shall be poured to fill the reminder of the socket in one pouring. the lead shall then be solidly caulked with suitable tools by hammering right round the joints to make up for the srinkage of the molten metal on cooling and preferably finished 3mm behind the socket face. the depth of the lead joints for the cast iron pipes shall be 45mm for the pipes upto 100mm dia and 50mm for the pipes beyond 100mm dia respectively. Twenty percent variations shall be permissible in accordance with IS:3114.

The joint shall not be covered till the pipe line has been tested under pressure. Rest of pipe line shall be covered so as to prevent the expansion and contraction due to variation in temperature.

4. **Inspection and Testing.**

Before the appliances are connected all opening pipes shall be inspected and tested. All opening of pipes shall be sealed with plugs. Water test in small sections of pipes shall be carried out to a static head of 4.5 meters.

The contractor shall give a smoke test to the drains and sewers at his own expense and charges as directed by the Engineer.

After installation of all the appliances, discharge test shall be conducted singly and collectively. Obstruction in any of the pipe lines shall be traced and whole system examined for hydraulic performance, including the retention of adequate water seal in each trap. Any defect revealed by the tests shall be made good and the tests repeated until a satisfactory result is obtained.

5. **Pipe Protection.**

Where pipes are embedded in floor, slabs, columns, beams etc. they shall be given protection by encasing them with 100m thick cement concrete all round the pipes and fittings as specified in BOQ.

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SECTION – E
EXTERNAL DRAINAGE & SEWAGE DISPOSAL.

1. GENERAL SCHEME.

The contractor shall install drainage system to effectively collect, drain and dispose all soil and waste water from the various parts of buildings, The piping system shall finally terminate and discharge into the sewage treatment plant. If provided at site. The piping work mainly consists of laying of salt glazed stoneware pipes, reinforced cement concrete pipes and cast iron soil pipes as called for on the drawings. To be shown on drawings. All piping shall be installed at depth greater than 80 cm below finished ground level. The disposal system shall include construction of gully traps, manholes, intercepting chambers as indicated. The piping system shall be vented suitably at the starting point of all branch drains, main drains, the highest/lowest point of drain and at interval as shown. All venting arrangement shall be unobstructive and concealed. The work shall be executed strictly in accordance with IS:1742. The sewerage system shall be subject to smoke test for its soundness as directed by the Engineer. Wherever the sewerage pipes run above water supply lines, same shall be completely encased in cement concrete of M-20 grade all round with the prior approval of the Engineer.

2. PIPING MATERIAL

2.1 Stoneware Pipes.
Stoneware pipes shall be perfectly salt glazed, sound, free from cracks, deformities and imperfections in glazing. They shall be cylindrical, straight and of standard nominal diameter, length and depth of socket. They will be made of hard burnt stoneware of dark grey colour and thoroughly glazed and shall give a sharp clear note when struck with a light hammer. The pipe shall conform to the requirements of Indian Standards IS:651 and the sizes and make specified in the Schedule of to appear in BOQ Quantities.

2.2. S.W. Gully Trap.
Gully trap shall be stoneware conforming to IS:651. These shall be sound and free from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free from crazing. They shall give a sharp clear note when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one CI grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight CI cover with frame inside dimensions 300 x 300mm the cover weighing not less than 4.5 kg and the frame not less than 2.7kg. The grating cover and frame shall be of good casting and shall have truly square machined seating faces.

2.3 Cast Iron Pipes.
Cast iron pipes and fittings shall conform to IS:1729/3989 or IS:1536 as called for in the documents.

2.4 Cast Iron Manhole Cover and Frame.
The Cast Iron Manhole Cover and Frame shall conform to IS:1726 and of the grade and types to appear in BOQ specified in the schedule of quantities. The cover and frames shall be cleanly cast and they shall be free from air and sand holes and from cold shuts. They shall be neatly dressed and carefully trimmed. All castings shall be free from voids whether due to shrinkage, gas inclusion or other causes. Covers shall have raised checkered design on the top surface to provide an adequate non-slip grip.
The sizes of covers specified shall be taken as the clear internal dimensions of the frame.
The covers and frames shall be coated with a black bituminous composition. The coating shall be smooth and tenacious. It shall not flow when exposed to a temperature of 63 C and shall not mbe so brittle as to chip off at temperature of 0 C.

3. LAYING AND JOINTING OF PIPES.

3.1 General.
All the material shall be new and of best quality conforming to specifications and subject to the approval of the Engineer. Drainage lines shall be laid to the required gradients and profiles. All drainage work shall be done in accordance with the local municipal by-laws.

Contractor shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority. Location of all manholes, catch basins etc. shall be got confirmed by the Engineer before the actual execution of work at site. All work shall be executed as directed by the Engineer.

3.2 **Alignment and Grade.**

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients shown in the plans and sections but subject to modifications as shall be ordered by the Engineer from time to time to meet the requirements of the works. Great care shall be taken to prevent sand soil consures etc. from entering the pipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall, for its entire length, rest on an even bed of the trench and places shall be excavated to receive collor for the purpose of jointing. No deviations from the lines, depths of cuttings or gradients called for on the drawings shall be permitted without the written approval of the Engineer. All pipes shall be laid atleast 60cms below the finished ground level or as called for on should be shown on drgs.

3.3 **Setting out Trenches.**

The contractor shall set out all trenches, Manholes, chambers and such other works to true grades and alignments as called for. He shall provide the necessary instruments for setting out and verification of the same. All trenches shall be laid to true grade and ins straight lines and as shown on the drawings. The trenches shall be laid to proper levels by the assistance of boning rods and sight rails which shall be fixed at intervals not exceeding 10 meters or as directed by the Architect.

3.4 **Trench Excavation.**

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as shown on the drawings or as directed by the Architect. In soft and filled in ground the Architect may require the trenches to be excavated to a greater depth then the shown on the drawings and to fill up such additional excavation with concrete (1:4:8) consolidated to bring the excavation to the required levels as shown on the drawings.

All excavation shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the Architect. All timbering and sheeting when withdrawn shall be done gradually to avoid falls. All cavities be adequately filled and consolidated. No blasting shall be allowed without prior approval in writing from the Architect. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities taking full precaution connected with the blasting operations, all excavated earth shall be kept clear of the trenches to a distance equal to 75 cms.

3.5 **Obstruction of Roads.**

The contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit. he shall remove the excavated maaterials and bring them back again when the trench is required to be refilled. The contractor shall obtain the consent of the Engineer in writing before closing any road to vehicular traffic and the footpaths must be clear at all times.

3.6 **Protection of Pipes etc.**

All pipes, water mains, cables etc. met in the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the cables, the removal of which shall be arranged by the contractor with the written consent from the Owner.

3.7 **Trench Back Filling.**

Refilling of the trenches shall not be commenced until the length of pipes therein has been tested and approved. All timbering which may be withdrawn safely shall be removed as filling proceeds. This should be included in BOQ it has heavy financial implications. Where the pipes are unprotected by concreted haunching selected fine material shall be carefully hand-packed around the lower half of the pipes so as to buttress them to the sides of the trench.

The refilling shall then be continued to 150mm over the top of the pipe using selected fine hand packed material, watered and rammed on both sides of the pipes with a wooden hammer. The process of filling and temping shall proceed evenly in layers not exceeding 150mm thickness, each layer being watered and consolidated so as to maintain an equal pressure on both sides of the pipe line. In gardens and fields the top soil and turf if any, shall be carefully replaced.

3.8. **Contractor to ensure Settlement and Damages.**

The contractor shall at his own costs and charges, make good promptly during the whole period for the works in hand, any settlement that may occur in the surface of roads, beams, footpaths, garden, open spaces etc. whether public or private, caused by his trenches or by his other excavations and he shall be liable for any accident caused thereby. He shall also, at his own expense and charges, repair and make good and damage done to building and other property. If in the opinion of the Engineer the Contractor he fails to make good such works with all practicable dispatch, then the Engineer shall be at his liberty to get the work done by other means and the expenses thereof shall be paid by the contractor or deducted from any money that may be or become due to him or recovered from him in any other manner according to the law of the land.

The contractor shall at his own costs and charges disposal of all surplus materials not required to be used on the works. As directed by the Engineer as each trench is refilled in the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

3.9 **Removal of water from Sewer, trench etc.**

The contractor shall at all times during the progress of work keep the excavations free from water which shall be disposed by him in a manner as will neither cause injury to the public health nor to the public or private property not to the work completed or in progress nor to the surface of any road or streets, nor cause any interference with the use of the same by the public.

If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer then no extra payment shall be made to refilling and it compaction for the additional exeution, Cross sections of the sewers to be specified.

3.10 **Route Markers.**

Markers indicating the particulars service shall be provided along the routes of pipe trenches. Markers shall be of mild steel indicating the type of service installed and the direction of flow painted on it. the markers shall be set firmly in a concrete base and installed at all corner and turning points. Over straigth runs, market's shall be spaced at 50 meter centre generally.

3.11 **Laying and jointing of Cement Concrete Pipes.**

Cement concrete pipes shall be laid and jointed as described in IS:783.
After setting out the pipes, the collars shall be centered over the joints and spun yarn soaked in a neat cement wash shall be inserted in the groove at the end of the pipe and two adjoining pipes butted against each other. After setting out the pipes, the collar shall then be slipped over the joint, covering equally both the pipes. Spun yarn soaked in neat cement wash shall be passed round the pipes and inserted in the joint by means of caulking tools from the ends of the collar. More skins of yarn shall be added and well rammed above. The object of the yarn is to centre the two ends of pipes within the collar and to prevent the cement mortar of the joints penetrating into the pipes.

Cement mortar with one part of cement and two parts of sand shall be slightly moistened (they must on no account be soft or sloppy) and shall be carefully inserted by hand into the joint and more cement mortar added until the space of the joint has been filled completely with tightly caulked mortar. The joint shall be finished off neatly outside the collar on both sides at an angle of 45 degree. Any surplus mortar projecting inside the joint is to be removed and to guard against any such projections sack or gunny bags shall be drawn past each joint after completion. Cement mortar joint shall be cured for seven days.

4. **FIXING OF S.W. GULLY TRAP.**

The excavation for gully trap shall be done true to dimensions and levels as indicated on plans or as directed by the Engineer. The gully traps shall be fixed on cement concrete foundation 65cm square and not less than 10cm thick. should appear in BOQ. The grade of the concrete will be M-10. The jointing of gully outlet to the branch drain shall be done similar to the jointing of S.W. Pipes describe earlier. After fixing and testing gully and branch drain, a brick work of specified class in cement mortar 1:5 from the top of the bed concrete upto ground level should appear in BOQ. The space between the chamber and trap shall be filled in with cement concrete of M-10 grade. The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside with cement mortar 1:3 finished with a floating coat of neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

CI cover with frame 300 x 300mm (inside) shall then be fixed on the top of the brick masonry with cement concrete M-15 grade and rendered smooth. The finished top of cover shall be so as to exclude the surface water from entering the gully trap.

5 5. CONSTRUCTION OF MANHOLE.

Where manholes are to be constructed, the excavation, filling back and ramming, disposal of surplus earth, preparation of bottom and sides etc. shall be carried out as described earlier under trench excavation. Manholes shall be of sizes and depths as called for in the drawings and Schedule of Quantities should appear in BOQ. The manhole shall be built on a base concrete of grade M-10 of 150mm thickness for manholes upto 1500mm depth and 250mm thickness for manholes from 1500 to 2500mm depth and 300mm thickness for manholes of depth greater than 2500m. Reinforcement as shown shall be provided in the base slabs. The walls shall be of brick work of thickness as shown in drawings built in cement mortar 1:5. the joints of brick work shall be raked and plastered internally and externally with cement plaster 1:3 to a thickness of 20mm and finished with a coat of neat cement. In the bottom of the manholes, semi circular channels of the same diameter as the pipes shall be provided with neat smooth finish of cement plaster 1:3.

Above the horizontal diameter the sides of channel 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 the main channel an appropriate fall suitably rounded of in the direction of flow in the main channel shall be given. Rungs of cast or mild steel of suitable dimensions shall be provided in all manholes over 800mm depth. These rungs shall be set at 30cms interval in two vertical runs at 300mm apart horizontally. The top rung shall be 450mm below the manhole cover. Unless otherwise mentioned, manholes shall be constructed to requirements of Indian Standard IS:4111 (Part I). All manholes shall be constructed so as to be water tight under test. All angles shall be rounded to a 75mm radius with cement plaster 20mm thick. The benching at the side shall be carried out in such manner as to provide no lodgment for any splashing in case of accidental flooding. Manhole cover with frame shall be cast iron of an approved make. The covers and frame shall generally be double seal as specified in the Schedule of Quantities.

6. DROP CONNECTION.

Drop connection of required size shall be provided between branch sewer and main sewer in the main sewer itself in steep ground when the difference in invert level of two exceeds 45cms . Drop connections from gully traps to main sewer shall be made inside the manholes and shall have HCI special types door bend on to top and heel rest bend at bottom connected by a HCI pipe. The pipe shall be supported by holder bat clamps at 180 cms intervals with atleast one clamp for each drop connection. All joints shall be lead caulked joints 25mm deep.

Drop connection from branch sewer to main sewer shall be made outside the manhole wall with HCL/CI class LA pipe connection, vertical pipe and bend at the bottoms. the top of the tee shall be finished upto the surface level and provided with a CI hinge type frame and cover 30cms x 30cms. Drop connection made from vertical stacks directly into manholes shall not be considered as drop connections. They shall be paid for under the relevant soil and waste pipes.

7. MAKING CONNECTIONS.

Contractor shall connect the new sewer line to the existing manhole by cutting the walls benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connection. Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

8. GREASE TRAP.

a. SIZE OF GREASE TRAP.

The size given in Bill of Quantities and drawings shall be internal size of chamber. The work shall be done strictly as per standard drawing and following specifications.

b. BED CONCRETE.

Shall be in M-10 grade cement concrete 100mm thick.

c. BRICK WORK.

Brick-work shall be with best quality bricks in 1:6 CEMENT MORTAR,

d. Baffle walls shall be of R.C.C and of size as mentioned in schedule of quantities. brick partition constructed of best quality bricks in cement mortar 1:6 shall be provided for the entire height of chamber.

e. PLASTER.

Inside of the walls of chamber shall be plastered with 15mm thick cement plaster 1:3 and finished smooth with a floating coat of neat cement.

f. CHAMBER COVERS.

Covers shall be of size and duty as mentioned in Schedule of Quantities. Covers shall be of cast iron as per the details given in the drawing and shall be fixed on M.S. frame embedded in concrete.

g. C.I. steps shall be provided at two corners of the chamber.

h. All Cast Iron and M.S. items shall be given two coats of bitumastic paint.

9. **SHIFTING OF EXCAVATED SURPLUS MATERIAL.**

Contractor shall make his own arrangement to shift the surplus excavated material directed by Engineer.

10. **TESTING.**

All lengths of the sewer and drain shall be carefully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subject to a test pressure of 1.5 metre head of water. The test pressure will however, not exceed 6 metres head at any point. the pipes shall be plugged preferably with standard design plugs with rubber plugs on both sides, the upper end shall, however, be connected to a pipe for filling with water and getting the required head poured at one time.
The contractor shall give a smoke test to the drains and sewer lines at his own expenses and charges as directed by the Engineer.
Sewer lines shall be tested for a straightness by :
a. Inserting a smooth ball 12mm less than the internal diameter of the pipe. In the absence of obstruction such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end.
b. Means of a mirror at one end and a lamp at the other end. If the pipe is straight the full circle of light will be seen otherwise obstructions or deviations will be apparent.
c. The Contractor shall give a smoke test to the drain and sewer at his own expense and charges, as directed by the Engineer.
d. A test register shall be maintained which shall be signed and dated by contractor, Engineer and representative of consultants.

TECHNICAL SPECIFICATIONS FOR PLUMBING DRAINAGE AND WATER SUPPLY WORKS

1.0 GENERAL

1.1 Completeness of Contract

1.1.1 Contractor shall be deemed to have carefully examined the specifications, general conditions and tender drawings etc. and to have been fully informed and have satisfied himself as to the nature and character of the work to be executed, site conditions and other relevant matters and details.

1.1.2 Contractor shall provide all terms whether specifically mentioned or not but which are usual or required to make a complete working system and to ensure safe and satisfactory operation. All apparatus, appliances, material or labour

which may be necessary to complete the work in accordance with the intent or purpose of these specifications shall be considered to be in the scope of work of the contract and shall be furnished without extra charge, as if fully described and called for in these specifications. In case of doubt or doubts, the tenderer shall clearly point out his understanding of the specifications, before award of contract.

1.1.3 Contractor shall study the site conditions before tendering and shall satisfy himself before submitting his Tender as to the nature of the ground and subsoil, form and nature of the site, the hydrological, climatic and physical conditions at the site, the quantities and nature of work and materials necessary for the completion of the work and means of access to the site, the proneness of site to floods as also the highest flood levels, recorded, observe or found in the past, as also accommodation required by him, and, in general, shall himself obtain all necessary information as to the risks, contingencies, and other circumstances which may influence or affect his tender.

1.1.4 Unless otherwise agreed in writing, these specifications, drawings and general conditions etc. form the contract documents and all clauses and conditions specified by the contractor stands null and void.

1.2 References

1.2.1 References to standards, code, specifications, recommendations shall mean the latest edition of such publications adopted and published at date of invitation to submit proposals.

1.3 Drawings and Literature

1.3.1 Before proceeding with the work, the contractor shall submit general layout and working drawings for approval as are necessary to demonstrate fully that all parts of the materials to be furnished will conform to the specifications.

1.3.2 Within 30 days of the acceptance of the tender the contractor shall furnish three (3) prints of layout, assembly and erection drawings for approval. If any modifications are proposed by the owner / Consultant, six (6) further prints of the modified drawings shall be submitted. No modifications shall made in drawing after it has been approved by the Consultant/Owner without prior consent.

1.3.3 Approval by the owner/Consultant of the drawings shall not relieve the contractor of any part of his obligation to meet all the requirements of the Contract or of the correctness of his drawings. The contractor shall be responsible for and pay for all alterations of the works due to discrepancies or omissions in the drawings or other particulars supplied by him, whether such drawings have been approved or not.

1.3.4 After execution of works, contractor shall furnish a set of original tracings of as built drawings incorporating the modifications if any during execution.

1.4 Inspection and Testing at Contractor's premises

1.4.1 Owner or its authorised representative shall have full power to inspect drawings of any portion of the work or examine the materials and workmanship of the plant at contractor's works or at any places from which the material is obtained. Acceptance of any material shall in no way relieve the contractor of his responsibility for meeting the requirements of the specifications. The cost of any special tests and/or analysis not called for in this specification shall be borne by the owner in case the material proves satisfactory but shall have to be paid by the contractor in case the material or work is found defective or of inferior quality.

1.5 Material Availability

1.5.1 The successful contractor shall ensure that all materials are processed well in advance to avoid any delay in completion of the project. They will intimate in writing to the consultant in the daily report proforma.

1.5.2 In case of non availability of any particular material the contractor shall procure next best available material and install the same at no extra cost to the Owner after written approval of the Engineer – in – charge..

2.0 BASIS OF TENDERING

2.1 The tender shall be complete covering the entire work of plumbing & Sanitation system and ancillary services including all building system and outside utilities as shown in drawing and specified in the tender documents.

2.2 The contractor shall consult specification & drawings which give an idea on these system and seek clarifications from the Engineer – in – charge. Where ever found necessary before quoting and before executing the work.

3.0 DRAWING

3.1 The drawings accompanying these specifications are design drawings and generally are schematic. They do not show every off set, T's, cross, Y's, Junctions coupling/flanges etc. which are required for installation in the space provided. The contractor shall show the drawings, as closely as is practicable and install additional bends, elbows or junctions, etc

of required type and size. where required to suit local site conditions, from actual site measurement taken, subject to approval and without additional cost of the Owner. The Engineer – in – charge. reserves the right to make any reasonable change in outlet location prior to roughing in. All connections and appurtenances, shown in the various diagrams, shall be included in the finished job.

3.2 It shall be the contractor's responsibility to coordinate with all others, for proper and adequate installation clearances.

4.0 ORDINANCE, CODE AND REGULATIONS

4.1 It shall be the contractor's responsibility to provide complete system, as indicated and as required by applicable code of practice / Local bye laws etc. All clarifications, which have to be cleared with appropriate authorities shall be carried out without additional cost, to owner. Unless otherwise approved, the product shall bear the mark of approval of I S, as required, by the governing bodies, code and ordinances and local authorities whose permission are required for occupation of the building on completion.

5.0 SHOP DRAWINGS

5.1 The contractor shall prepare and submit for approval, detailed shop drawings of all items, not detailed on the drawings, setting drawings, clearance drawings where required, for proper coordination and all changes to the drawings. It shall be the contractor's responsibility to see that all deviations from drawings and specifications, noted on the drawings and brought to the attention of the consultants, otherwise approval shall be automatically voided.

5.2 The Contractor shall prepare plumbing and water supply shop drawing coordinating with Electrical and HVAC layouts to avoid any conflict at the time of execution of work.

5.3 The Contractor shall prepare a shop drawing for sanitary ware, fixtures and fittings showing positions planned with reference to tile line, height & all other aspects for approval of Engineer – in – charge.

6.0 MEASUREMENT LINES AND LEVELS

6.1 Before proceeding of with the work check, dimension of the building site and establish lines and levels for the work specified.

6.2 All inverts, slopes and manholes elevations shall be established by instruments, working from an established datum point. Elevation markers and lines shall be provided for consultants' use, to determine that slopes and elevations are in accordance with the drawings and specifications and local bye laws.

6.3 Established grid and area lines shall be used for location of trenches in relation to building and boundaries. Trenches shall be carried out to the true alignment and to required levels. No refilling will be allowed for the purpose of making up the bed of trenches, but to make the same with lean concrete mix 1:4:8.

6.4 Use of sight rails, boning rods shall be adopted during the whole process of excavation and laying of the pipes.

6.5 Sight rails shall be fixed at suitable intervals which shall not exceed twenty metres before the excavation is begun. No extra charges will be paid for excess excavation.

6.6 Sufficient width shall be available in the trenches to allow a space of 300 mm. on the either side of the body of drain pipe to facilitate laying of the pipes and jointing.

6.7 When the trenches are in deep or bad ground, the sides of the trenches shall be supported with suitable timbering.

6.8 All pipes, water mains or gas mains, telephones and cables etc. met within the course of excavation, shall be carefully protected and supported without any extra charges.

7.0 STONEWARE PIPES, BENDS, JUNCTIONS, JOINTING AND TESTING.

7.1 All stoneware pipes, bends, junctions, gully traps, intercepting traps shall be salt glazed inside and outside and shall conform to the specifications of IS 651.

7.2 The pipes shall be 1st grade hard, sound, truly circular in cross Section, perfectly straight, free from all flaws and projections.

7.3 Before being laid, the pipes shall be thoroughly cleaned specially from the inside. Cracked or chipped pipes shall not be used on the work.

7.4 WORKMANSHIP

Tarred gasket or hemp yarn soaked in thick cement shall first be placed round spigot of each pipe and the spigot then be placed well home into the socket of the pipe previously laid. The pipe shall then be adjusted and fixed in the correct position and the gasket caulked tightly home so as to fill more than 1/4 of the total depth (13 mm. in depth) of the socket.

7.5 The remaining space in the socket shall then be tightly and completely filled with cement mortar comprised of one part of cement and one part of sand, and shall be neatly leveled off, outside the socket of the pipe at an angle of 45 . A wooden caulking tool shall be used for forcing the mortar home into the socket. The inside of each pipe shall then be carefully wiped with the mop or scraper, sufficiently long to pass two joints from the end of each pipe and any projecting or extra cement shall be removed to leave the inside of the pipe clean as the work proceeds. All the joints shall be kept moist by means of wet Hessian bags to protect them from the sun or wind. All pipes entering manholes shall be set in cement mortar to effect a complete water tight junction.

All around the pipe, there shall be a joint of cement mortar 13 mm. thick between it and the bricks. The end of all pipes shall be properly built in and neatly finished with cement mortar with the manhole/ancillary structure.

The approximate quantity of cement and spun yarn per joint shall conform to IS 4127.

7.6 After sufficient interval has been allowed for the joints to set and before filling the trench, the joints of the pipes and drains shall be proved water tight by filling the pipes with water in between two successive manholes to a level above the top of the highest pipe in the length to be tested, closing the ends of the sections and maintaining the water level for a period of one hour with a water head of 1500 mm. and water level dropping not more than 25 mm. during that hour.

7.7 All such testing shall be done wholly at the Contractors' expenses, inclusive of apparatus, provision of water, etc., and the rate covers all the above work.

7.8 The pipes shall be laid to the alignment and gradient shown on the plan. The maximum permissible slopes to the various diameters of pipes are as follows:

100 mm dia. pipe ... 1 in 40
150 mm dia. pipe ... 1 in 60
200 mm dia. pipe ... 1 in 80
230 mm dia. pipe ... 1 in 90

7.9 Where necessary, pipes shall be laid on a bed of plain cement concrete 1:3:6 and minimum 150 mm. thick, and shall be projected by providing haunching upto half the diameter of the pipes. The width of the concrete bed for various diameters shall be as follows:

100 mm. dia. pipe ... 380 mm. wide
150 mm. dia. pipe ... 450 mm. wide
200 mm. dia. pipe ... 600 mm. wide
230 mm. dia. pipe ... 700 mm. wide

7.10 BED CONCRETE FOR SEWER LINES

7.11 Where the pipes are laid on a soft soil, with the maximum water table level, lying at the invert level of the pipe, the pipe shall be bedded in concrete.

7.12 Haunching

Where the pipes have to be laid in a soft soil with maximum water table level above the invert level of pipe, but below the top of the barrel, the pipe sewers shall be haunched.

7.13 Encasing

The sewer pipes shall be completely encased or surrounded with concrete.

a) Where the maximum Water table level is likely to rise above the top of the barrel.

b) Where the sewers are to be laid adjacent to growing trees, to avoid damage or displacement to pipe joints or to the pipe likely to be caused by the roots of the trees.

c) Where the top (Overt) of the pipe is less than 1200 mm. under the road surface.

d) Wherever the intensity of loading on pipes are expected to exceed the normal limit of 1600 kg per metre length for stoneware.

8.0 CONCRETE PIPE DRAINS, LAYING, JOINTING AND TESTING

8.1 Cement concrete pipes, where called for on the drawings, shall be centrifugally spun reinforced cement concrete pipes of an approved manufacture. Pipes shall be true, perfectly sound, free from cracks, cylindrical, straight with a uniform

bore throughout. Cracked or warped pipes with uneven texture shall not be used. These pipes shall conform to Indian Standard 458 NP2 Class.

8.2 The pipe shall be straight and free cracks.The end of the pipe shall be square to their longitudinal axis, so that when placed in a straight line in the trench, no opening ends in contact shall exceed 1/8" (3 mm.) from 6" (150mm.) including and upto 24" (600 mm) dia.

8.3 The outside and inside surface of the pipes shall be smooth dense, and hard, and shall not be coated with cement wash or other preparation. The pipes shall be free from local dents and bulges greater than 1/8" (3 mm.) in depth and extending over a length in any direction greater than twice the thickness of the barrel.

8.4 The pipes, before being laid, shall be brushed throughout to remove any soil or stone, that may have accumulated therein, the inside of the socket and outside of the project being carefully cleaned. For small pipes, they should be titled up to remove any accumulations.

8.5 The pipes shall then be carefully laid in position.

8.6 Concrete Pipe Shall be jointed as described in I.S. 783. After setting out the pipes, the collar shall be centered over the joint and filled in with tarred gaskin, till sufficient space is left on either side of the collar to receive the mortar (1:2 1 cement :2 washed coarse sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 to the longitudinal axis of the pipe on both sides of the collar. The joint shall be cured for at least 4 days with wet Hessian bags.

9.0 Cast iron pipes & fittings

C I L A to IS 1536 and 1538 for laying, jointing and testing and for application in water main- embedded in foundation or through building drain lines above false ceiling, or below slab in horizontal position.

9.1 C I Spun pipes as per IS 3989 and Sand cast pipes as per IS 1729 for laying, jointing and testing and for application in Soil Waste Vent and Roof drain system – Fixed vertically of hanging pipes below floor slab.

9.2 The fittings shall be medium type cast iron conforming to the latest I.S. Specification 1538.

9.3 The pipes shall be lowered into the trench by means of suitable pulley blocks, shear legs, chain, ropes, etc. After lowering the pipes they shall be arranged to coincide the centre line with the centre line of alignment. The pipes shall be laid in position Socket and of all pipes facing the direction of flow. (This shall also apply to double socketed specials as per IS).

9.4 Preparing the Joint

The interior of the sockets and exterior of the spigots shall be thoroughly cleaned and dried. The yarn shall be placed around the spigot of the pipe, and shall be of proper dimensions, to centre the spigot in the socket. Making up of required length by knotting of strands of yarn shall not be allowed. Required length of yarn strands shall be in one place. When a single yarning material is used it shall have an over lap at the top of not more than 50 mm. When more than a single strand is required for a joint, each strand shall be cut to sufficient length so that the ends will meet on opposite sides of the pipe and not on top or bottom. When the spigot is shoved home, the yarning material shall be driven tightly against the inside base or hub of the socket with suitable tools.

9.5 Leading

The leading of pipes shall be made by means of ropes covered with clay or by using special leading rings. Lead shall be heated to proper temperature in a melting pot kept in easy reach of the working area so that molten metal will not be chilled on being carried from the melting pot to the joint (Molten lead at proper pouring temperature when stirred shows a rapid change of colour). The lead used shall be pig lead with 99.8% purity and shall conform to latest I.S. specification.

Before pouring, all scum or dross which may appear on the surface of the lead during melting shall be skimmed off. Each joint shall be filled in one continuous poured or imperfectly filed joints shall be burnt out and repoured.

9.6.1 Precaution shall be taken for melting the lead as under :

i) The pot and the ladle in which lead shall be put shall be clean and dry.

ii) Sufficient quantity of lead shall be melted.

iii) Lead shall not be overheated.

9.6.2 The approximate depth of pig lead for each joint of Cast Iron pipes and fittings shall be as under with a tolerance of + 5% :

Dia of pipe	Depth of lead (Min)
80 mm. to 125 mm. dia.	45mm.
150 mm. to 250 mm. dia.	50mm.

300 mm to 450 mm dia. 55mm.
500 mm and 600 mm. dia. 60mm.

9.6.3 Quantity of lead and spun yarn for each joint in cast iron pipes and fittings shall be as under, unless otherwise indicated.

Nominal dia.	Lead required		Spun yarn		
	of pipe(in mm.)	per joint	required per	[in kg.] (Min)	Joint (in Kg) (Min)
80	1.8	0.10			
100	2.2	0.18			
125	2.6	0.20			
150	3.4	0.20			
200	5.0	0.30			
250	6.1	0.35			
300	7.2	0.48			
350	8.4	0.60			
400	9.5	0.75			
450	14.0	0.95			
500	15.0	1.00			
600	19.0	1.20			

9.6.4 After the joints have been run, they must be thoroughly bulked until they are perfectly watertight. Caulking of joints will be done after a convenient length of pipe has been laid and leaded. The leading ring shall first be removed with a flat chisel and the joint caulked round three times with caulking tools of increasing thickness and hammer 2 to 2.5 Kg. weight. Lead joints shall not be covered till the pipe lines are tested under pressure, but the rest of the pipe lines many be covered to prevent expansion and contraction due to variation in temperature.

9.6.5 Lead wool joint

Wherever it is impracticable or dangerous to use cast molten lead, such as inverted joints or in wet drainages or under water where there is a need for cold application, joints may be made with caulking lead wool or lead yarn. Joints caulked with lead wool or lead yarn shall withstand greater displacement than cast lead joints.

9.6.6 i] Approximate weights and depths of lead wool required for each joint of various dia. of Cast Iron pipes and fittings shall be as given in the following table. Just sufficient quantity of spun yarn shall be put so as to give specified depth of lead wool. A allowance of five percent variation in the specified weights and depths shall be permissible.

Diameter of pipe in mm. [min]	Wt. of lead wool in kg required [min]	Depth of lead wool spun yarn in mm. [min]
80	0.80	19
100	0.90	19
125	1.25	20
150	1.60	23
200	2.05	23
250	2.95	25
300	3.50	25
350	4.65	29
400	5.70	31
450	6.70	32
500	8.30	33
600	10.00	35

9.6.6 ii] Jointing shall be made of with caulking lead wool or yarn inserted in strings of not less than 5mm. thick and the caulking shall be repeated with each turn of lead wool or yarn. The whole of the lead wool or yarn shall be compressed into a dense mass. When working with lead wool, it is very important to use caulking tools of appropriate thickness to fill the joint space to thoroughly consolidate the materials from the back to the front of the socket.

9.7 Jointing Flanged Pipe

The pipes and fittings shall be accurately aligned in the back. The jointing materials shall be inserted in between the flanges and the nuts shall be carefully tightened, in opposite pairs, until the joint ring is only just sufficiently compressed between the flanges to ensure water tightness of the joint under the desired water pressure.

The packing used should be rubber insertion cloth three-ply and of approved thickness. The packing should be of the full diameter of the flange with proper pipe hole and bolt hole neat and even at both the inner and outer edges. Where the flange is not fully faced, the packing may be of the dimension of the facing strip only. Its proper placing should be tested before another pipe is joined on.

9.8 The led joints shall be tested to a pressure of 150 1bs/sq. inch minimum [10.54 kg./sq.cm] or such head as otherwise specified after being caulked and should any leakage occur, the leaking joints shall be remade and section re-tested at contractor's expenses, until satisfactory results are established.

9.9 Water Pressure Mains

Shall conform to IS 1538 1967 Class LA as specified in the schedule. They shall be laid, jointed, and tested along with Cast Iron pipes as described in the specification for Cast Iron S/S pipes.

After each section of the pipe line has been completed it shall be tested for water tightness before being covered. This can be done by closing each end, by means of a valve or blank flange, or plug and fill the pipe with water. The pressure should then be raised by means of a small hand operated pump till it registers fifty percent more than the 150 p. s. i. [10.54kg./Sq. cm] and the test pressure should be ascertained by means of a reliable gauge. When the pipe is laid on any appreciable gradient, the test should be carried out at the lower end of the section with an air vent at outer end. Any leaking joint should be made good and the above test reapplied until no further leaks are apparent.

10.0 SOIL, WASTE, RAIN WATER, VENT AND ANTI SYPHONAGE PIPES & FITTINGS.

10.1 Material and Fixing

All soil, waste and anti syphonage pipes and fittings with in toilet areas or within plumbing shafts vertical run, shall be centrifugally cast iron socket and spigot conforming to IS 3989 or its subsequent revision. All cast iron pipes and fittings shall be of the best approved Indian make of soil variety and free from flaws, air bubbles, cracks, sand holes and other defects , truly cylindrical and in uniform thickness. They shall not be brittle but shall allow for heavy cutting, chipping and drilling, and shall not be less than the diameter, mentioned in the Drawing and shall be fixed against the wall or on M S brackets & `U' Bolts & painted with two coats of paint.

10.2 JOINTS

Jointing shall be carried out with molten lead. The spigot of the pipe must be forced well home into its socket and must be entered, so that the joint may be of even thickness all round. At least, one complete lap of clean white hemp spun yarn shall be drawn into the bottom of the socket without being forced through the joint into. As many laps as may be needed to leave the space of not less than 25 mm. for the lead shall than be poured into the joint and caulked tight. The joints shall then be run with molten lead in sufficient quantity so that after being caulked solid, the lead may project 3 mm. beyond the face of the socket against the outside of the spigot but must be flush with the outside edge of the socket.

10.3 Clean outs at the head of cast Iron horizontal pipes running under the floor shall be of cast Brass screwed in type. Floor and wall clean outs shall be of cast brass screwed type. The connection pieces shall be of G.I. threaded to suit the clean out with lead caulked joint.

10.4 Inspection chambers, gully traps, etc. , within the building shall be of `Patel Pattern' cast iron with bolts, nuts to close the cover, all to be fabricated as per actual requirement, if so specified.

10.5 Supports, pedestals and base for inspection chambers gully traps and pipes shall be in 1:3:6 cement concrete mix.

10.6 Pipe sleeves and inserts, etc., through RCC walls either external or internal shall be of G I. provided with M S water bar flange.

10.7 During installation openings of pipes shall be plugged with wood cut into required shape of gunny bags and to be maintained free from dirt.

10.8 G.I. waste pipes and fittings shall be of heavy class with G.I. unions, tail pieces, reducers and connections to be provided between joints to either lead or Cast Iron pipes.

10.9 The size of branch waste pipes for different fittings shall be as follows:

Wash Basin	32 mm. dia.
Urinal	40 mm. dia.
Sink	40 mm. dia.
Nahani Trap	80 mm. dia.
P Trap	80 / 100mm. dia.

Special Floor Trap 80 or 100 mm.as required with bolted aluminium grating in 25 x 25 M.S. angle.

10.10 W.C. pan connectors shall be to suit the requirements as per drawing, with 40 mm. Vent horn for connection to the anti syphonage pipe with pan connector of cast iron or lead.

10.11 Connection to the sewage or storm water collection sumps to be perfectly water tight and as specified.

10.12 Rainwater flashing shall be made as per details with cast Iron dome shape grating and extension piece .

10.13 All Roof drain pipes and fittings shall be soil pipe variety conforming to IS 3989 / IS- 1729. This shall apply to pipes outside building or within the building or separate shafts.

10.14 The floor traps for toilet blocks shall be cast iron deep seal with C.P. brass grating, bolted down design.

10.15 Bathroom C. P. grating shall be of bolted down design out of heavy cast brass with the chromium plating of the best approved standard.

10.16 Cast iron gratings shall be flat with perfect edge of the best quality procurable of the specified width and thickness and in the available lengths.

10.17 Spigot and socket. cast iron pipes shall be of heavy pattern for the portion below the floor and embedded and laid over 150 mm. cement concrete 1:4:8, the width of the concrete being :

80 mm. dia. ... 320 mm. wide
100 mm. dia. ... 400 mm. wide
150 mm. dia. ... 450 mm. wide
200 mm. dia. ... 600 mm. wide

10.18 The connection between the main pipe and branch pipes shall be made by using branches and bends with access doors for cleaning.

10.19 Floor trap shall be provided with 25 mm. dia. puff pipe where the length of the waste is more than 1.80 meter or the floor trap is connected to a waste stack through bends.

10.20 The waste from lavatories, basins, sinks, baths and other floor traps shall be separately connected to respective waste stack of upper floor. The waste stack of lavatories will be connected directly to manhole while the waste stack of others shall be separately discharged over gully trap.

10.21 The main anti syphonage pipe shall be of 80 mm. internal diameter. When more than one branch from water closet, sink are connected with soil pipe and discharged into it anti syphonage from the lowest one should pass through and be carried up parallel to the soil for a point 1.5 metres minimum above the highest branch. It can then be connected to the soil pipe or it can be carried independently. The anti syphonage pipes of all the intermediate floors water closets should be joined with main anti syphonage pipe. The ventilating pipe shall have internal diameter of not less than 80 mm. in all parts and shall be connected with arms of soil pipe on trap through a 45□ branch, at a point not less than 75 mm. and not more than 300 mm. from the highest part of the trap and on the side of the water seal which is nearest to the soil pipe. The jointing shall be done according to the specifications for piping materials used in soil, vent or connected to the drain. On no account should lime or lime concrete come in direct contact.

11.0 G.I. PIPES AND FITTINGS

11.1 All pipes shall be " C " class (heavy) I.S. quality and out of the specified make to the requirement of the local authorities unless specified otherwise.

11.2 Pipes shall be galvanised inside and outside treated and fixed in accordance with the Municipal requirements. The joints shall be distributed in strict conformity with the regulations. They shall be secured clear of the wall surface by means of G.I. holder bats. All control values, stop cocks, ball valves, bib cocks shall be of the best approved quality

procurable, of heavy cast drawn brass. All branches shall have individual control arrangement with fullway [peet] valves, to enable regulation and cut off as required. They shall be of best Indian manufacture specified in the schedule of quantities and of tested stampings and bear I. S. I. markings. all fittings shall be either `RR' or Ring & Cross make.

Laying and fixing

Where pipes have to be cut or re-threaded, ends shall be carefully filled out so that no obstruction to bore is offered. In joining the pipes, the inside of the socket and the screwed ends of the pipe shall be rubbed over with zinc and few turns of hemp yarn wrapped round the screwed and of the pipe which shall then be screwed home in the socket with a pipe wrench. Care must be taken that all pipes and fittings are kept at all times free from dust and dirt during fixing.

11.2.1. The water tightness of joints shall be assured by approved methods of jointing material.

11.3 Internal Work

All internal water supply pipes should be concealed pipes of GI C class.For fittings outside the walls shall be fixed either visible by means of standard pattern holder bat clamps, keeping the pipe clear off the plastered wall by 15 mm. for cold water and 38 mm. for hot water. Wherever indicated on the drawing or as directed by the Consultants, chasing of walls shall be done to embed pipes. All pipes and fittings shall be fixed truly vertical and horizontal or as directed by the Engineer-in-charge. All embedded cold water pipes are to be covered with bituminous polyethylene wrapping or equivalent approved by local regulations and National Building code. All embedded hot water pipes are to be painted with at least three coats and wrapped as above and then wrapped with three ply asbestos twine wrapped tightly around the pipe.

11.3.1 External Work

For external work, G.I. pipes and fittings shall be laid in dug or prepared trenches as called for or directed by the Engineer-in-charge. They should be wrapped, as specified above. The width of the trench shall be of minimum width required for working. The pipes laid underground shall not be less than 600 mm. from the ground level. They shall be surrounded on all sides by soft earth. The work of excavation and refilling shall be done in accordance with the general specification for earth work.

11.3.2 The wrapping of pipe shall be with 0.3 mm. thick FRP tissue as per manufacture's specifications.

11.4 All G.I. pipes and fittings are to be tested to a pressure of 10.54 kg/cm2 for 2 hours to ensure that pipes have proper threads and that proper materials [such as white zinc and hemp] have been used in jointings. All leaky joints must be made leak proof by tightening or redoing at Contractor's expense.

11.5 All water fittings shall be of approved make and shall in all respects comply with the latest Indian Standard Specification I.S.1239 [part II] The brass fittings shall be fixed in the pipeline in a workman like manner. Care shall be taken to see that joints shall be repaired, redone or replaced.

11.6 Wherever a G. I. pipe crosses a floor, the H D P E sleeve with 15 mm. all round clearance and projection by 80 mm. and below the floor should be provided. On no account should lime or lime concrete come in direct contact with G.I. pipe and fittings. This important condition shall not be waived under any circumstances.

12.0 MANHOLE, INSPECTION CHAMBERS, GULLY TRAPS, INTERCEPTING CHAMBERS, DROP CHAMBERS ETC.

12.1 General: Unless otherwise specified, manholes or inspection chambers of required depth shall be provided on all external drains, at all change of direction of the drain and where branch drain meets the main drain. They shall be of rectangular shape with a clear opening of 900 x 450 mm. Manholes shall be constructed of 230 mm. thick brick over P.C.C. bedding extending 230 mm. beyond the external face of the brick wall. Manholes beyond 1500 mm. depth shall be conical in section and circular at top with clear opening of 600 mm. diameter.

Masonry chambers shall be of such size as will allow necessary examination and clearance of drains. The minimum internal bases as per the requirement of MCGM and their bye laws if any, shall be adhered to.

In the absence of local bye laws, the requirements stipulated in I.S. 4111 [Part-I] code of practice for ancillary structures on sewerage system, shall be followed.

12.2 Excavate to the sizes and depths required for the manholes. Construct the manholes and refill outer space with selected excavation materials and dispose off surplus earth, as specified in "Excavation" 14.3 The specified size of manholes and chambers refers to inside dimensions. Build the manholes and chambers to the sizes and depths specified with brick wall in cement mortar as specified.

12.3 The manhole shall be built on a base of concrete of thickness of at least 150mm. for manholes up to 1000 mm. depths, 230mm. for manholes from 1000mm. to 2000 mm. depth and 300 mm. for manholes of greater depths. For special soil conditions, the thickness has to be as per structural design.

12.3.1 The thickness of walls shall be 230 mm. brickwork up to 1500 mm. depth and 350 mm. for depths greater than 1500 mm. The actual thickness for deeper manholes shall be based on structural requirements.

12.3.2 In the case of manholes deeper than 1500 mm. but up to 1800 mm. where conical manholes have been specified, the inside shall be 1200 mm. Up to 900 mm. below G.L./R.L and then taper off to 600 mm at the top, to conform to regulations. For greater depths, the internal dia. shall be increased as directed as per drawings.

12.3.3 Benching in manholes shall be in P.C.C. 1:2:4 and formed in position with necessary channels as required.

Bench up bottoms in fine cement rising 80mm. above the entire channel with rounded edge and launched up to the sides, at an angle of 45 degree and rendered in cement and sand [1:3] trowelled smooth.

Proper cement concrete channel shall be provided at the bottom and the branches from the various pipes shall discharge in the chamber with a suitable slope.

12.3.4 In all manholes over 900 mm. in depth, provide and build into walls approved cast Iron catch ring and steps at 300mm. interval beyond 450 mm. depth and make good cement rendering around as per I.S. 1742.

12.4 Cover the manholes with single seal cast iron heavy Duty manhole cover and frame(135 kg for 900 x 450 mm size & 225 kg for conical chamber) of approved make. Fill the seal with prepared manhole grease.

12.5 The top level of the manhole with the cover on must be in line with the finished ground level. However, if required and the finished ground level is not ascertained during construction of the manhole, the contractor shall temporarily fix the manhole cover till such time the final/paved ground level is established, or temporarily cover the built up manhole at no extra cost to owner. In case of any damage to the covers due to traffic or any other reasons during the course of the project, or in the maintenance period attributable to the negligence of the contractor, the same shall be replaced immediately by the contractor at his own cost. The frame and the cover shall be painted with black Bitumen Anti-corrosive paint.

12.6 Drop Connections: In case the difference in invert levels between main drain and branch line requires a drop more than 600 mm., a drop connection should be provided generally as described below.

Cast iron or stoneware four way junction shall be fixed in position, at right angle to the drop pipe, at the level where branch pipe enters the manholes; provide suitable height of vertical drop pipe terminating into a plain bend, duly benched into the cement concrete [1:2:]. Access for cleaning the bend should be provided at finished ground level.

12.7 Gully traps in all waste pipes shall be of best quality 150 x 100 or 230 x 150 as indicated and laid on a 150 thick 1:3:6 cement bedding. They shall be enclosed in brick and cement mortar masonry with cement plaster forming as inspection chamber with full size 230 x 300 cast iron frame and cover (15 kg) or open grating 300 x 300 as required. Location and details will be indicated in the drawing.

12.8 There shall be 100 mm. dia vent pipes at the sewer trap chamber and 100 mm. ventilating pipe at the manhole at the head of the drain to be routed aesthetically as directed.

12.9 TRAPS

Exposed trap for all wash basin and urinal in public area shall be chromium plated cast brass.

12.10 Traps installed in connection with cast iron pipe shall be of the same quality and grade of the pipe; the size of outlet all correspond to the socket of the pipe receiving it.

12.11 Provide 150 x 100 size heavy cast iron sealed gully trap with extension piece having single or double inlet as shown. where required provide cast iron sealed cover, for such trap, secured with threaded gun metal bolts and felt gaskets.

12.12 An intercepting trap of required size shall be installed in the last inspection chamber prior to connecting with the public sewer or disposal system. this chamber shall be about 2000 mm. within the boundary of the property.

13.0 SANITARY FITTINGS

All sanitary fittings shall be as specified in drawings and as approved by the Engineer- in- charge

13.1 All setting and bedding of sanitary fittings shall be done carefully to suit the required levels. Mortar drops, paint splashes etc. shall be removed from fittings, walls and floors immediately before these get dry.

13.2 Wooden plugs

The plugs shall be of hard wood and of size 50 mm. x 38 mm. at a top and of length 50 mm. These shall be fixed on wall in cement mortar 1: 3 (cement : 3 sand), after the plugs are fixed in wall, the mortar shall be cured till it is set.

13.3 Wall Hung Water Closets

Wall hung box rim closets in pastel shades of approved make having back inlet and "p" trap outlet shall be fixed an appropriate cast iron or M S Brackets of suitable design to suite the thickness of toilet wall and ensure that the chair is self supporting and independent of the wall.

13.4 Plastic Seat and Cover

The Seat shall be fixed to the pan by mean of two 8 mm. dia corrosion resistant C.P. hinge bolts with a minimum length of shank of 65 mm. and threaded to within 15 mm. of the head. Each bolt shall be provided with two suitably shaped washers of rubber of or of other similar material for adjusting the level of the seat while fixing it to the closet. In addition one 8 mm. non/ferrous metal of stainless washer shall be provided with each bolt. The maximum external diameter of the washers fixed on the underside of the pan shall not be greater than 25 mm. One arm of the hinge in each bolt shall be fixed to the underside of the seat by three nos. 20 mm. long C.P. screws. The other arm of the hinges shall be fixed to the underside of the cover flush with the surface by means of 3 nos. 10 mm. long C. P. Screws.

13.5 Flush Valve: The Brass C P / S .S concealed Flush valve shall be of approved make and shall be fixed as per tile pattern as shown in detail drawing

13.6 Health Faucets: The Health faucets (Jet spray) shall be of approved make along with C P angle cock and wall flange and shall be fixed as per tile pattern as shown in detail drawing

13.7 Coat Hook: The Brass C P coat hooks shall be of approved make along with S.S screws and shall be fixed as shown in detail drawing.

13.8 Toilet Paper Holder: The S S Concealed / Open Toilet paper holder of approved make shall be fixed in position by means of C.P screws embedded in the wall to suit tile pattern

14.0 Half stall Urinals : Urinals shall be Large flat back in pastel shade fixed in position by using screws, and shall be at a height of 600 mm. from the floor level to the top of the lip of urinal, unless otherwise directed.

14.1 Each urinal shall be connected to 32 mm. dia G I waste pipe which shall discharge into the channel or floor trap. The connection between the urinal and flush or waste pipe shall be made by means of C.P. Bottle Trap heavy type.
14.2 All urinal pans will have individual Auto flush electronic sensing system of approved type and make complete, including all accessories / wiring etc..
14.3 C P Spreaders, Intel, outlet connections shall be prepared to actual site measurement, to ensure proper verticality and elegance. These shall be full bore and shall not form any dents.

15 Wash Basin : The basin shall be Oval / Round below counter type in pastel shade of approved make supported on a pair of concealed cast iron brackets

15.1 Each Wash Basin shall be connected to 32 mm. dia G I waste pipe which shall discharge into the floor trap. The connection between the wash basin and waste pipe shall be made by means of C.P. Bottle Trap heavy type.
15.2 C P Single leaver Pillar cock , C P Angle cock with wall flange, C P flexible connection shall be of approved make and range and fixed as per tile pattern as shown in detail Drawing.
16 S. S. Sink
The Sinks shall be of large size with bowl and single drain board of approved make supported on a pair of concealed cast iron brackets

16.1 Each Sink shall be connected to 40 mm. dia G I waste pipe which shall discharge into the floor trap. The connection between the sink and waste pipe shall be made by means of C.P. Bottle Trap heavy type.

16.2 C P Single leaver swinging sink cock , C P Angle cock with wall flange, C P flexible connection shall be of approved make and range and fixed as per tile pattern as shown in detail Drawing.

17.0 HANGERS AND SUPPORTS
17.1 General:
Provided proper solid angle iron/channel section. supports for all pipes complete with clamps. Wherever insulation comes, provided wooden guide to support pipe on the angle iron hanger / supports. In general where a bunch of pipes run as far as possible MS plates inserts are provided in the beams / slabs to facilitate welding of angle iron supports. For attachment in concrete, use "DASH" fasteners or Anchor plug type inserts or equivalent. Provide hangers within 1 mtr. of all changes in direction of mains and a minimum of 3 hangers per expansion bend. provide all additional structural steel angels, channel or other members not specifically shown but are required for proper support.
17.2 Where necessary additional hangers to be provided to arrest water hammers or hydraulic resonance with proper rubber padding.
17.3 Space hangers, as noted below, except on all soil pipe which shall have a hanger of multiple fittings, sufficient hangers shall be provided to maintain proper slope without sagging; in case of angle suspended lines, the following is suggested :

A) Pipe sizes	Hanger Road Dia
20 mm. through 50 mm.	10 mm.
63 mm. through 125 mm	13 mm.
150 mm. and over	16 mm.

B) Pipe Sizes	Spacing of supports
13 mm. to 20 mm.	1500 mm. apart

25 mm. to 38 mm.	1800 mm. apart
50 mm. and above	2000 mm. apart as per I.S.

17.4 Provided floor stands, wall brackets or masonry piers etc. for all lines running near the floor near walls so that those lines can be properly supported or suspended from the walls or floors. pipe lines, near concrete or masonry walls may be hung also by hangers carried from wall brackets at a higher level than pipe. Hanging of one pipe from another is prohibited.

18.0 VALVES AND PRESSURE GAUGES

18.1 Pressure gauges shall have not less than 115 mm. dial, 10 mm gas threads, brass body syphon and gauge cock of 10 mm. size. Dial ranges shall be adequate for the pressures encountered and as specified.

18.2 Provided valves on branch pipe connection to mains and at connection to equipment where indicated. All valves are to be located for easy access and are to be full bore of pipe connected together. Support all valves wherever necessary. Valves are to be as per I.S 780 (Class I) for cast iron sluice valves and to I.S 778 for G. M valves and tested and approved by local authorities as per bye laws in force.

18.3 All globe and check valves shall have working parts suitable for cold water, as required. Valves shall be tagged with permanent label under hand wheel indicating type and duty.

18.4 All valves over 150 mm. dia. in equipment rooms located over 2000 mm. above floor shall be provided with chain wheels with chains extending upto 1800 mm. above floor.

18.5 Where indicated and specified, angle pattern stop cocks, at each cold water inlet to be provided. They should be anti scalding pattern same as faucets of approved manufacture.

18.6 Provide C.I. body with brass disc spring loaded & straineof approved quality.

19.0 Strainers :

Cast iron pot strainer with G.M. mesh screen in perforated brass strainer body of approved manufacture are to be provided before valves. Provide each Strainer with a cock for blowing down. Screening area of the strainer shall be minimum of 5 times more than pipe area, with 1 mm. maximum size holes.

20.0 CLEANING, OPERATION AND TESTS

20.1 Plumbing equipment fixtures, piping etc. shall be free of stampings, markings (except those required by codes) iron cuttings and other foreign materials.

20.2 cold and drinking water systems shall be cleaned thoroughly, filled and flushed with water.

20.3 The entire mechanical apparatus shall operate at full capacity without objectionable noise or vibration.

20.4 The system has to be periodically given the tests specified in the presence of site engineer and the client's representative as herein specified.

All test equipments, accessories, materials and labour necessary for conducting the tests and for inspection and repair work shall be arranged well in advance of the test date.

After shortcomings are repaired or defective items replaced the test will be repeated until the entire system found satisfactory. If the local regulations insist on similar tests before approving authorities, the same shall be complied with and acceptance from the authorities lodged with the Consultants/Owner.

20.5 The entire system of soil, waste and vent piping to be tested with water after the roughing in is completed and before the fixture are set. After setting the fixtures, provide smoke test, after sealing all types.

20.6 Water Test entire system or sections of system by closing all openings in piping except the highest opening and filling system with water to the point of overflow. If the system is tested in sections, plug each opening except the highest opening of the section filled with water. Keep the water in system or in the specific section under test for atleast 45 minutes before inspection starts with test pressure/head lasting for two hours. The system must be tight at all joints.

20.7 Final Test : After fixtures are set, test system with smoke as follows:

Smoke Test :

Fill traps with water, then introduce into system a pungent thick smoke produced by one or more smoke machines. When smoke appears at stacks on the roof, plug, stacks and allow pressure of 25 mm. water column to build up in system. Maintain pressure for 15 minutes before inspection starts. The system shall be tight at all joints. Sulphur smoke shall not be allowed.

20.8 Test all down spouts or rain headers and their branches within the building by water as described for the above soil, waste and vent system.

20.9 All Water Piping :

Hydro static test 10.54 Kg/cm2 for a minimum of two hours without drop in pressure as required.

20.10 On completion of the works, the following tests shall be performed to the satisfaction of the consultants/client's representative before issue of Virtual Completion Certificate, if so required.

a) Smoke test.
b) Hydraulic test.
c) Self induced test for fixtures.
d) Tests for anti syphonages system.
e) Pump rating and output.
f) Inspection of all units and fixtures.

20.11 The contractor shall arrange on his own initiative for similar tests during the progress of works, to ensure that there are no defects in material/workmanship in portions of work to be concealed or embedded under the floor or walls in ceiling.

20.11.1 Air or Smoke Test :

A uniform gauge pressure of 0.5 Kg/cm2 or sufficient to balance a column of mercury 250 mm. in height. This pressure will be held for a period of at least 15 minutes without any loss of pressure.

20.11.2 Hydraulic Test :

i) All underground drains for a static head of 2 metres with the down stream and plugged.
ii) All vertical drains also for a static head of 2 mtrs.
iii) Water lines for 11.25 Kg/cm2 test pressure for minimum 24 hours.
iv) Section wise isolation and test.
v) Air locks.

20.11.3 Manholes : Clean the manhole free from all dirt, soil and other extraneous material and wash it with water to clear all mortar, mud etc. The pipe outlets to be plugged with gunny bags or wooden stopper to ensure proper closure. Clean water from an approved source shall be filled into the manhole to depth not exceeding 1.2 mtrs, as directed by the Engineer In Charge and the same is kept for about 2 hours. Test should be conducted early in the morning before 9 a.m so that tendency for evaporation losses are minimum.

20.11.4 Self induced test for fixtures: All units will be operated individually and the flow checked.

20.11.5 Inspection of individual units and fixtures for visible defects in shape etc.

20.11.6 Test for anti symphonage system : Units on a single system will all be operated to check up the effect on symphonage.

20.11.7 Pump rating and output : Checking discharge and terminal head both at the free end as well as the overhead storage tank.

21.0 PAINTING

21.1 Equipments :

After complete installation and testing all the equipments including mounting frames etc. shall be painted with 3 coats of paints, as per colour code required by the client or a directed by the consultants.

21.2 Piping :

After all the piping has been installed and tested, the piping shall be given one coat of anti corrosive paint followed by two coats of paint as per colour code required by the client or as directed by the consultants.

21.3 Colour code :
Identification of the pipe lines shall be as per standard colour prescribed by IS : 2379.

22.0 EQUIPMENT AND PIPING IDENTIFICATION

22.1 Pipe Markers :
Each piping system shall be provided with a name plate properly clamped or stenciled. Letters are to be 80 mm. if 3 mtrs. above the floor and 50 mm. minimum if below that height. Name plates on parallel groups of pipes etc. shall be neatly lined up. Wording of lettering shall correspond to the equipment designations used in piping legend and shall be as approved. Name plate to be of G.I sheets (gauge 20 SWG on 25 x 25 mm. angle) secured on to sheet metal and angle iron to be welded on main pipe. In case of insulated pipe the 25 x 25 mm. angle bracket should be projecting beyond insulation thickness.

22.2 Valve Register :
To be submitted in triplicate along with location and identification number in final drawing to be furnished by contractor.
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23.0 TOOLS AND MATERIALS AND STORAGE
23.1 The Contractor at his own cost and charge shall provide all materials, tools, tackles, measure, scaffolding, labour and water, necessary for the completion of the whole work in all respect.
23.2 The contractor shall pay the fees for testing the materials to local authorities, or other statutory authorities.
23.3 The Contractor will obtain, from time to time various permissions and the completion certificates as per rules of all local and statutory authorities.
23.4 The Contractor shall insure the work against damages, for such sum as the Engineer - in - charge may, from time to time, direct.
23.5 All the brackets and hangers for pipe shall be fixed to the wall or R.C.C slab using `Dash' fasteners, wherever necessary. Exposing reinforcement bars for hooking will not be permitted.

24.0 GENERAL SERVICES
The Contractor shall pay the fees for testing the materials by the Municipal Corporation.

The Contractor will process and arrange from time to time various permissions and obtain the drainage completion certificate, storm water drainage completion, rain water harvesting and adequate water supply certificate will be obtained by Owner / Architect, under the rules of the local authorities.
24.0 BUREAU OF STANDARDS, COLOUR CODE
In industrial and multi disciplinary installations like Hotels and Hospitals, additional item may be added for other systems. To indicate the class of its contents, each pipe and appurtenances connected therewith shall be marked as under.

i]	Water Drinking	Sea Green
ii]	Non Potable Water	orange
iii]	Treated effluent	Admirably Blue
iv]	Fire installation	Fire Red
v]	Steam & Hot water	Silver Gray
vi]	Compressed Air	Sky Blue
vii]	Vacuum	Canary Yellow
viii]	Liquified petroleum Gas	Red
ix]	Diesel oils	Light Brown
x]	Sprinkler pipes	Dark Violet

Charts showing the colours for primary identification should be displayed at points where they are likely to be needed for reference.

NOTE :

a) To comply with the Bureau of Standards Act enacted by Parliament the fixtures selected should have ISI making along with brand name of manufacturer.

b) Fittings without ISI make if selected as a Functional/aesthetic requirement should be got tested in an approved test House prior to installation.

c) The Engineer-in- charge will have the discretion to select from the above list, in consultation with the Architect./ consultants .

LANDSCAPEING WORKS

SPECIFICATIONS FOR BASE PREPARATION FOR PLANTATION

A. All the plantation shall be done in a well mixed composition of the following ingredients:-

[1] Garden Earth

Garden earth shall be loamy, properly screened of granulometry to suit the type of plant (coarser for trees & shrubs and finer for lawns) containing adequate amount of humus friable and free from perennial weeds, stones and pebbles

[2] Farmyard Manure

Farmyard manure shall be well decomposed cow dung or horse dung manure in dry condition and free from straws, soil and pebbles

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B. Rough dressing the trenched ground including breaking clods, filling up the trenched area to proper levels by filling with approved quality clear red soil mixed with sludge or/and manure before and after flooding the trench with water (including cost of imported earth, sledge or manure and stacking and mixing all complete)

C. Preparation of beds for hedging and shrubbery by excavating 60cm deep and trenching the excavated base to be further depth of 30 cm, Filling up the trenched area to proper levels by filling with approved quality clear red soil mixed with sludge or/and manure before and after flooding trench with water (including cost of imported earth, sludge or manure and stacking and mixing all complete), and finally fine dressing, leveling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and levelling as directed, within a lead of 50m lift up to 1.5 m complete (cost of sludge, manure or extra earth included)

D. a) Providing and planting tree saplings / full grown plants at specified locations as per horticultural specifications

b) Providing and planting shrubs and hedges at specified locations indicated in the Plantation Plan as per horticultural specifications.

c) Providing and laying lawn in various areas as indicated in the Plantation Plan as per horticultural specifications.

TYPES OF PLANTS AND THEIR GROWTH CHARACTERISTICS

Shrubs: - Shrubs are woody or semi woody plants growing to a height of 1.0m to about 4.0m, attaining considerable growth and maturity over a period of 6 months to a year, depending on the species. So they are to be planted in pits. The pits of 60x60x60 cm are to be dug two to three weeks in advance. The soil and the pit should be exposed to the sunlight at least for two weeks. The soil should be mixed with well rotten farm yard manure. Tall and bushy shrubs should be planted at a distance of 2 to 3m while small and less spreading shrubs should be planted at a distance of 1 to 1.5m. Plants should be watered daily. For better growth of the plants it is better to manure them before monsoon.

Hedges: - The plants which are woody and semi woody, forming a border and growing to a height of about 1m are called hedges. Soil layer of 1ft depth should be put after digging the hedge strip and exposing it to sunlight for a couple of weeks. The soil supplied should be loose and clean and should be free from foreign particles such as stones, sticks, and plastic papers etc. The soil should be mixed with half quantity of well rotted farmyard manure. The hedges are planted at a distance of 9 inches to 18 inches. The watering should be done daily.

Trees: - Trees are to be planted 5 to 15m apart depending upon the growth and spreading of the tree. The pits of 1x1x1 mt are to be dug two to three weeks prior to planting. The pit and the soil both should be kept exposed to sunlight for

these two to three weeks. The soil from the pits should be mixed with well rotten farm yard manure in the proportion of 3:1. For longer and better favourable conditions it is suggested to plant at the beginning of monsoon. For proper and strong growth of the plant staking and pruning should be done at a regular intervals at an early stage of the plant growth. Manuring is necessary and should be done atleast once in 6 months. Trees need generous watering for thier initial growth and should be done one time daily till the plant is fully mature

Lawn: - Good quality lawn depends on the soil and the drainage conditions. The soil supplied should be loose and clean. It should be free from the foreign particles such as stones, sticks, plastic papers etc. It should be mixed with well rotted farm yard manure at a proportion of 70:30(soil: manure). For drainage first a layer of bricks is to be laid to slope after necessary consolidation of the ground. The approved quality of lawn should be supplied. After the completion of planting at least two doses of urea should be given at an interval of 15 days. The lawn is to be planted at a distance of 3-4 cm

Additional Technical Specifications:

1. POLYMER MODIFIED MORTAR/CONCRETE

Carefully breaking & removing the existing damaged / corroded R.C.C. Columns, beam, slabs, chajjas, paradis, fins etc including disposal & cating away of the debris, cleaning etc in the patches or long stretches by means of light chisel upto 50mm depth, upto the level of reinforcement without damaging brickwork, plaster in the vicinity, including supplying, providing & erecting in position the necessary scaffolding, cleaning, disposing of debris etc complete & then providing and applying polymer modified cementitious mortar treatment upto 50 mm thk. comprising of following operations:

a) Reinforcement treatment coat

Scrapping reinforcement with wire brush and cleaning the same from all sides by light tapping, wire brushing and emery paper.

applying Rusticide Rustprime/Ruskill A or approved equivalent in one or more coats as directed as per manufacturers specification, washing with water.

b) Bond coat

Providing & applying Polyalk Fixoprime or equivalent and Cement (1:1.25) to exposed steel bars in two coats as per manufacturer's specifications and brushable consistency for bonding old and new concrete surfaces.

Providing and applying bonding coat of POLYALK EP or equivalent and Cement (1: 1.25) to the entire concrete surface.

c) Mortar application

"Applying Polymer modified mortar/concrete treatment as per manufacturer's instructions in layers of thickness not exceeding 20 mm (applying bonding coat at every layer) upto profile of concrete in the vicinity by applying Hand pack Polymer Modified Mortar by mixing 1 part by weight of "POLYALK EP" or equivalent with 5 parts by weight of cement and

15 parts by weight of well graded sand and water to achieve the desired consistency [Sand Grading IS383, Zone II, Silt content <6%]"

Including curing, scaffolding, cleaning etc. complete

Note: If the depth of polymer modified mortar/concrete exceeds 50 mm, then quantity shall be paid by considering multiplication factor = (actual depth) / 50mm for additional thickness.

At a time apply mortar layer not more than 20 mm thick. The mortar should be prepared using mechanical mixers / stirrers & should be well compacted and finished using appropriate methods. The rate to include for necessary compaction with mechanical plate vibrator etc. complete to the satisfaction of the EIC.

Note: 1. Quoted rate shall be inclusive of additional concreting done and applying protection coat of polymer + cement (1:1 by volume) to existing reinforcement, which will not be paid seperately.

2. Hammers weighing more than 2 kg shall not be used. The rate shall also include the replacement of the totally corroded and damaged reinforcement steel bars wherever necessary & directed including welding, lapping, clening etc complete.

2. MIRCO CONCRETE

Providing and laying M-35 Grade of 75 mm thk. prepacked dual shrinkage compensated polymer modified microconcrete like Master Emaco S346 of BASF /Renderoc LA55 of Fosroc/ Sikarep Microcrete -4 of Sika or equivalent material, Pouring in narrow location for column, beam, slab. (Rate includes scaffolding,shuttering with the marine plywood/M.S. sheets/plates to be fixed in true line and level as required as per site condition. materials, labour etc. Measurement on the basis of actual consumption of micro concret on square feet area)

The rate is inclusive of chipping of the loose concrete and its disposal away from the site. (The rate should include 8a,b,c and 10) AVERAGE THICKNESS 75 MM (Polymer treatment for damaged R.C.C column/ beams/ slabs/ chajja etc. only upto 50 mm thicknes and microconcrete for entire thickness of damaged area upto only 75 mm-100 mm), core cutting, bond coatetc complete the work as per instruction of the architect / Bank's Engineer**.**

3. CRACK FILLING WITH PMCM

Carefully removing the existing plaster / mortar / loose concrete, chasing the cracks, including supplying, providing & errecting in position the necessary scaffolding, disposal & cating away of the debris, cleaning etc & sealing the separation cracks between R.C.C. and brickwork by raking, open the crack by electrically operating groove cutter as directed, insertion of 20 mm downgraded aggregates by hammering as per the instructions of the

consultant, sealing with polymer modified cementatious mortar (25mm width x 25mm depth) using Polyalk EP or equivalent as per the specification of item polymer modified cementatious mortar/concrete, application of chicken mesh (200mm wide, 200mm overlapping length) along the crack by 'U' nails spaced at 300 mm c/c, including necessary breaking plaster, concrete, brickwork, washing with water, curing, cleaning etc. complete

4. GROUTING

Drill the holes of 12mm dia for depth upto 30mm to 50mm inside the damaged or honey combed concrete areas at spacing as instructed by consultants. Clean the holes by blast of air or by jet of wate. Insert the PVC nipples into pre drilled holes and seal peripherally by "M Seal". After 24 hours, injet the "Polymer Cementaceous slurry mix" in the proportion as under into the nipples, at a pressure of 2 kg / Sq. cm using gum pumps of capacity not less than 30 PSI in the rato of (1 kg polymer EP: 3 KG cement: 2 litres of water). After two days of curing, cut the nipples and seal it with polymer modified mortar.

5. JACKETTING

Providing & fixing shear keys upto 12 mm dia and 175 mm long bent to required shape at regular intervals including drilling holes in concrete, dipping ends in epoxy, fixing etc complete for column jacketting etc as directed.
Providing and laying ready mixed Reinforced cement concrete of M-25 grade for jacketting using approved plasticizer etc, including waterproof shuttering, mixing, pouring, temping, consolidation, curing, chemicals & compounds of approved make etc complete. Reinforcement shall be paid for seperately under relevant item.

6. AAC Block Partitions

Providing and constructing autoclaved 100 mm thick wall of 100mmX 240mm X 600mm Siporex Block in proper line and levell, at all levels in cement mortor 1:4 (1 cement and 4 river sand) using standard size of blocks, including all scaffolding, staging, curing, all lifts, raking of joints, all labour, hire and fuel charges for all tools and plants employed etc. complete as directed. rate shall include providing concrete binders in proportion 1:2:4, 75mm thk reinforced with 4 nos of 8mm dia Fe 415 bars, RCC binder to be at every 1mtr interval from floor level. the rate to be inclusive of cost of reinforcement and formwork, cover block for reinforcement and all other incidental charges etc., all complete and as directed.
The rate shall also include closing the gap between the masonary and rcc beam/ slab finished to required slope as directed by engineer in charge. Note : - the width of joints not to exceed 10mm. The Siporex block to withstand the standard fire for 240mins under uniform compressive load of 15 kg/m2 as per IS: 3809, BS : 476 part 20 and ISO 834 with certification. (Siporex/ Godrej/ Ultratech/ equivalent)

7. WATERPROOFING OF CHAJJAS, FINS, PADADIS ETC

Carefully removing the entire water proofing treatment on the chajjas, fins, paradis etc of any thickness including disposal & cating away of the debris, cleaning etc and Providing and applying water proofing treatment of upto any thickness with average 150mm thickness for chajjas, fins, padadis etc consisting of 12mm thick layers in 1:4 cement mortar with water proofing compound comprising of the following operations: - Two coats of "POLYALK WP" or equivalent of M/s. Sunanda Speciality Coatings Pvt. Ltd or equivalent and cement in 1:1.25 ratio, constructing and laying brick bat coba in cement mortar 1:5 including the water proofing compound upto the desired thickness as directed at an interval of 24 hours on the surfaces and extending it upto 1'0" over the side walls. Air cure the same for 24 hours and damp cure for next 4-5 days. Providing and applying single coat of bonding agent HACK-AID-PLAST or equivalent of M/s. Sunanda Speciality Coatings Pvt. Ltd or equivalent on the POLYALK WP coating by spray and providing wet on wet a chat/dash coat of 1:4 cement mortar in 12 mm thickness including all leads, lifts and laid to proper slope to drain off water entirely
The rate shall include watta at the junction of wall as directed and including finishing the top layer of water proofing treatment with IPS or as directed and covering the whole waterproofing treatment with ten year's guarantee on requisite stamp paper etc complete as directed by Consultant in line with the technical specifications.

All mortar mix to be necessarily added with "SUNPLEX" or equivalent 330 gms pouch per 50 Kg bag of cement. All coats of POLYALK WP or equivalent to be inspected using a Magnifying glass by the EIC to satisfaction to ensure pinhole free coating. Ensure mechanical mixing of "POLYALK WP" or equivalent and cement slurry using stirrers and check that cement particles do not settle down in the prepared mix. Consume the prepared mix within 30 minutes. Payment will be made as per the plan area. Lay small sized well soaked brick bat metal coba in cement mortar 1:3 to proper level and slope as per instructions adding "SUNPLEX" - 330 gms pouch per 50 Kg bag of cement to the mortar mix.
Fill up the joints adding SUNPLEX or equivalent 330 gms pouch per 50 Kg bag of cement to the cement mortar 1:3 mixed and finished smooth with neat cement on top so as to drain water smoothly. Provide about 9" to 12" watta along the walls with cement mortar 1:3 small brick bats. Rate to include for making border at the junction of watta and wall plaster, ponding for seven days by closing the RW outlets and making watas etc. complete to the satisfaction of the EIC.

8. ALUMINIUM WORKS

8.1 Providing and fixing in position U.P.V.C.(Unplasticized Poly VinylChloride) having multi-chambered outerframe section (73x50mm with anouter wallthickness of 2mm & steel reinforcement, multi-chambered slider frame (73x60)mm with steel reinforcement, multi-chambered slider sash(46x82) mm with steel reinforcement designed to give optimum strength, 5mm thick toughened double glass with12mms pacer of good quality including alluminium track, Inter-locking profile, coextruded beadings, EPD Mgaskets, silicon sealent, sliding handle, fixtures and fastenings (couplings, hinges) including with all required screws and nuts with all necessary U.P.V.C. sections as per the detailed drawing and as directed by Engineer-In-Chargeetc. complete.

8.2 Do-Same as above but Providing and fixing **aluminium powder coated window frames for the toilet windows** including 5mm thk. louvered frosted glass panes with proper twisting arrangement and smooth movements including necessary fixing arrangements, hardware, necessary fittings, fixtures, arrangements for exhaust fans etc complete as per instructions. aluminium sections shall be of Jindal or equivalent make. All specifications as detailed above

8.3 Designing, Supplying, Assembling / fabricating, Installation, finishing, testing and fixing in position of **Spandrel Glass Panels** comprising of 6 mm thick heat strengthened monolithic float glass of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade so as to match the colour and shade of the IGUs in the vision panels etc. ,all complete for the required performances as specified, as per the Architectural drawings, as per the approved shop drawings, as specified, and as directed by the Engineer- in-Charge."For payment, only the actual area of Panel with Spandrel glass on face # 1 of the glass panels (Not considered under quantification in Item No 1 above) (but excluding the area of grooves and weather silicone sealant) provided and fixed in position, shall be measured in sqm. (i) Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, 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 K etc. The properties of performance glass shall be decided by the Architect & Engineer in charge as per the site requirements.

8.4 Designing, Supplying, Assembling / fabricating, Installation, finishing, testing and fixing in position **Curtain Wall** with 2 Hours Fire Rated **Aluminium Composite Panel Cladding** in combination of solid/Metallic colours, including all necessary frame work and complete weather sealing, with open grooves for linear as well as curvilinear portions of the building , for all heights and all levels etc. including: Structural analysis & design and preparation of shop drawings for pressure equalisation or rain screen principle as required, proper drainage of water to make it watertight including checking of all the structural and functional design.
Providing, fabricating and supplying and fixing panels of aluminium composite panel cladding in pan shape in metalic colour of approved shades made out of 4mm thick aluminium composite panel material consisting of 3mm thick FR grade mineral core sandwiched between two Aluminium sheets (each 0.5mm thick). The aluminium composite panel cladding sheet shall be coil coated, with Kynar 500 based PVDF / Lumiflon based fluoropolymer resin coating of approved colour and shade on face # 1 and polymer (Service) coating on face # 2 as specified using stainless steel screws, nuts, bolts, washers, cleats, weather silicone sealant, EPDM, Neoprene, backer rods etc.

The fastening brackets of Aluminium alloy 6005 T5 / MS with Hot Dip Galvanised with serrations and serrated washers to arrest the wind load movement, fasteners, SS 316 Pins and anchor bolts of approved make in SS 316, Nylon separators to prevent bi-metallic contacts all complete required to perform as per specification and drawing. (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 item includes cost of all material & labour component, 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 curtain wall with aluminium composite panel cladding, cleaning and protection of the curtain wall with aluminium composite panel cladding till the handing over of the building for occupation. Base frame work for ACP cladding is payable under the relevant aluminium items.
The Contractor shall provide curtain wall with aluminium composite panel cladding, having all the performance characteristics all complete, as per the Architectural drawings, as per item description, as specified, as per the approved shop drawings and as directed by the Engineer-in-Charge. However, for the purpose of payment, only the actual area on the external face of the curtain wall with Aluminum Composite Panel Cladding (including width of groove) shall be measured in sqm. up to two decimal places."

8.5 Designing, Supplying, Assembling / fabricating, Installation, finishing, testing and fixing in position of Storm Resistant Rain Defence Performance Double Bank Louvers as per manufacturers standards and specifications to the utility areas, Services etc and to be made up of Aluminium Extrusion of 6063 T6 alloy tested by AMCA/BSRIA to maintain the pressure drop below 8 mm and the airflow co-efficient to be not more than 0.28 to provide good airflow and excellent Rain defense of Class A including necessary ventilation to exhaust out the AC return. The panel size should be as per the directions of the Architect or Engineer in charge and as per drawings & details issued and shop drawings duly approved and should sustain the wind pressure of minimum of 2.0 Kpa and shall be designed in accordance with the I.S codal provisions and all the applicable codal standards and applicable Structural designing practices. The Elevation should be continuous line with Powder coating finish to stand a warranty of 20 years.

9. STRUCTURAL GLAZING SYSTEM ELEMENTS & SYSTEMS WITH SPECIFICATIONS: -

Providing and fixing Structural glazing system with Single Glass of approved make having aluminium minimum main frame size of vertical of 100mm X 55mm x 2mm thick and aluminium horizontal minimum size of 75mm x 65 x 2mm made out of specially designed extruded aluminium sections to withstand wind pressure as per BIS code and fabricated, fixed at all levels, elevation and heights to the Masonry / RC walls / RC supporting elements with necessary clamps, brackets and anchor fasteners. All clamps and brackets shall be Mild Steel Hot dip galvanized minimum 80 microns thick and shall conform to IS: 4759-1996. The extruded aluminium section shall be powder coated in approved colour with a anodic coating of minimum 15 microns. Extruded section shall be of 6063 T5 or T6 alloy conforming to ASTM B 221. Any other fastening straps, nuts, bolts, rivets, washers, etc. shall be in stainless steel SS 304 grade. All tapes shall be of Norton make. Vendor to prepare detailed shop drawings, fabrication drawings based on elevation / architectural drawings, with all details and submit for obtaining necessary approval prior to commencement of work and execute as specified and as directed by the Engineer-in-Charge. The Glass panels shall be assembled in the factory/ workshop of the glass manufacturer / processor. "(Payment for fixing of Glass Panels in the curtain glazing is included in cost)" etc all complete for the required performance, as per the Architectural drawings, as per the approved shop drawings,

The rate shall also include the Aluminium framework sections, transomes, mullion sections & supporting grid / framework as required to support the glass and for errection of structurally safe & sound glazing system. For payment, only the actual elevational area of glass on the face of the glass panels (excluding the areas of the grooves and weather silicone sealant) provided and fixed in position, shall be measured in sqm."

Rate for provide Fire stops at all floor levels. Rate including EPDM gaskets, open cell polyethylene backer rods etc. The Structural glazing sealant shall be Dow Corning / GE / Mecoy and weather sealant shall be Dow Corning / GE / Mecoy. All sealants shall be black in colour etc., complete all as directed.

Providing 6 mm thick toughened reflective soft coated Advantage Blue / green low E hard coated glass having Light Transmission (VLT) Not more than 35 to 40 %, Reflectance 10 to 20% outside, Direct Solar Energy Transmittance - 35%, Solar Heat Gain Coefficient – 0.45 Shading Coefficient – 0.53 ,U – Factor 3 W/m2 deg K, Sound Insulation – 31db outer lite)

The supporting framework shall have the following specifications: -

- 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).
- Note:- As mentioned above, the Architect will decide the duration & magnitude of testing on the basis of the milestones achieved in the work. Performance Testing of Structural glazing system Tests to be conducted in the NBL Certified laboratories are as follows: -
- 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
- Static Water Penetration Test. (50pa to 1500pa) as per ASTME- 331-09 testing method for a range up to 2000 ml.
- Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml
- Structural Performance Deflection and deformation by static air pressure test (1.5 times desing wind pressure without any failure) as per ASTME-330-10 testing method for a range upto 50 mm
- Seismic Movement Test (upto 30 mm) as per AAMA 501.4-09 testing method for Qualitative test. Tests to be conducted on site.
- On site Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml

10. False Ceiling

- Providing and Fixing 12 mm Thk. Gypsum board on metallic grid, conforming to IS: 2095: :1982. The metallic grid shall consists of the following :
- Gl Perimeter channels of size 27mm and 0.5mm thk. having one flange of 20mm and another flange of 30mm.
- Gl intermediate channel of size 45mm 0.5mm thk. With two flange of 15mm each at 4'-0" centre to centre.
- Gl Hanger of size 1"x1", 0.5mm thk. A 4'-0" centre to centre distance.
- Gl Cleat and Steel Expansion Fasteners.
- Ceiling section of 0.5mm thickness having curled wedge of 51.5 mm and two flanges of 26mm each with lips of 10.5mm at 450mm center to center. Connecting clips & 12.5 mm dry wall screws at 230 mm center to center.

The metallic grid shall be installed as follows :

- The perimeter channel along the perimeter of the ceiling with screw fixed to brickwall / partition with the help of rawlplugs and screws.
- The intermediate channels shall be suspended from the ceiling with steel Gl hanger fixed to the slab soffit with Gl cleat and steel expanation fasteners.The intermediate channels shall be at 4'-0" centre to centre distance.
- The ceiling section placed in a direction perpendicular to the intermediate channel at 1'-6" C/C distance shall be fixed to the intermediate channel with the help of connecting clips and 12.5 mm dry wall screws at 230 mm centre to centre distance.
- Finally, the 12mm thk. Gypsum boards shall be fixed to the metal frames and the tapered/square edges of the boards shall be finished to a flush joint with requisite filler, paper tapes, finisher and primer suitable for Gypsum plaster boards, (as per recommendations of manufacturers, Indian Gypsum or equivalent) including Acrylic Emulsion Paint of approved make and shade and colour.

The rate shall include the cut-outs to be made for light fittings, grills, diffusers, speakers, smoke detectors, sprinklers etc. with provision of the frame along perimeter of the cut outs/ opening with channels/ ply to support the ceiling adequately as per the directions of Architect. The rate shall include necessary shapes, designs, patterns in curvature, sloping, dome, oval & eliptical shaped etc including the necessary provisions of coved lighting scheme etc complete as per the designs, drawings and instructions of the Architect.

11. Doors & Partitions

1) P/f frosted 12mm thk toughened glass partitions with full length L bracket complete with all accessories. max size 1200 x 700mm (as per dwgs).
2) Providing and erecting in position trap door in 12mm thk Marine Plywood to house, A.C. ductable units to be made out of 2" x 11/2" t.w. frame with openable shutter in ply with necessary hinges, tower bolts, locks, painting etc. finished as per the instructions and design.
3) Providing & Fixing in position Steel work in built up tubular (round, square or rectagular hollow tubes of any shapes & sizes etc) sections, riveted, bolted or welded in built-up sections, trusses and framed work including plates of any size & shape etc including cutting, binding, hoisting, fixing in position and applying a priming coat of approved steel primer including welding and bolted with special shaped washers, all asessories required for errection etc complete including three coats of enamel paint of approved colour & shade etc as per standard technical specifications, instructions of Architect / Engineer-in-charge on site & codes. Item to be operated for any Civil works wherever directed including Services such as HVAC mounting works
4) Providing and fixing in position, plumb and line **75 mm thick fire rated partition using 12 mm thick gypsum board on one side and 9mm thk Promatect – H or equivalent approved Calcium Silicate Board on the other side** (Fire side) with GI steel metal stud frame of size 48/70 mm thick using floor and ceiling channels of 50/72 mm thick ie. 0.55mm thick and having equal flanges of 34/36 mm with GI stud 48 mm thick i.e. 0.55 mm thick and have one flange of 36 mm placed @ every 600mm c/c mm intervals. The joints shall be finished with joint paper tape by using jointing compound and applying over it 3 layers of the filler compound, POP punning as directed to provide a smooth surface ready to accept paint. The rate shall include the 3 coats of approved acryllic emulsion paint including making cutouts for switch board, sockets, grill etc. for which no extra will be paid separately. The rate shall Include for preparing the surface smoothly and all as per manufacture's specification etc complete to the satisfaction of the Architect / Engineer in charge.
N.B: - The plywood considered in this estimate shall be IS 303 MR grade Commercial Plywood for all the items of Interior & Furniture works. The rate shall be inclusive of anti termite coating on all sides to plywood, teak wood & all the other wooden components of Asian paints or equivalent approved make.
All internal woodwork / Plywood shall be treated with antitermite preservative. All internal framework shall be of Aluminium unless otherwise specified as Teakwood. AII exposed edges of Plywood shall be fixed with C.P. Teak Lipping of size as directed by Architect. The skinning shall be in 303 MR grade Commercial Plywood unless otherwise specified. All exposed veneer surfaces shall be finished with melamine polish. The thickness of the veneer shall be 4.0mm & that of laminate shall be 1.5mm thk. The approved veneer shall be finished with natural melamine polish of minimum 2 coats to have desired matt melamine finish where ever specified. The rates quoted for the item of Partitions & Panelling shall be inclusive of providing & fixing in between the aluminium frames, 50mm thk Rockinsul Slabs of Rockwool India Ltd of density 96 kgs / cu.m of standard width as per the available clear distances between the existing frames as directed wherever required & instructed including above false ceiling framework.
Rate for full height partition to include the cost of framework above false ceiling as required to fix the same to the ceiling

slab for which no extra payment shall be made and the rate quoted shall be inclusive of the same. Measurement of Partition & Panelling shall be limited upto the False Ceiling level. However the cost towards frameworks to be continued upto the main ceiling shall be deemed to have been considered in the quoted rates and no separate payment shall be made for the framework or supporting elements of partitions / panelling items, above the false ceiling level.
The rate shall be all inclusive of the necessary hardware, fittings, fixtures & including glass & finishing for the same. The rate shall be also inclusive of pattas & bands, grooves at any level, any design in veneer, textures etc including the necessary framing/ openings for Electrical, Telephone & AC outlets. Further it is important to note that the Glasses wherever specified for the items of Partitions & Panelling if any shall have bevelled edges as per the direction & thickness as indicated by the Architect or Engineer in charge
The rates quoted for the Items of Partitions & Panelling of any / all types shall include the cost towards Providing and fixing additional 75mm wide Patta over and above the particle board / gypsum board or any / all types of skinning provided for the items of Partitions & Panelling to be provided in 12mm thk MDF board including 3.0mm thk approved Veneer with high end & high gloss melamine polish including designer grooves etc complete as per the instructions and to the complete satisfaction. Nothing additional would be paid on account of any pattas / bands provided for the said items.
50mm Glass wool slab of density 20kg/m³ shall be placed in metal framework. Glass wool holding clip should be used to hold Glass wool slab in its position.

5) PARTITIONS / PANELLING: Main frame -Aluminium sections of 16 Gauge mentioned are out of size 2"x2" Aluminium section verticals at minimum 1' 6"-2'-0" Centre-Centre spacing approx. and 2" X 1" size Aluminium sections horizontal at 1' 6"-2-'0" Centre-Centre spacing approx. Extra frame below slab soffit for conduit to run above. All verticals shall be secured to the ceiling.
SKIN: - 303 MR grade Commercial Plywood shall be screwed to frame work on both sides with joints as shown or directed.
SKIRTING : In the same alignment, 3" high in 303 MR grade Commercial Plywood with a groove finished with laminate / veneer as the case maybe, or as directed by the Architect.
Finishing :-
VENEER:- 4mm thk natural venner with matching superior approved grade to be fixed to the plywood having joints as shown or directed complete with melamine polish finish.
LAMINATE:- Approved laminate shall be of 1.5 mm thick. Internal Laminate shall be fixed on plywood skins with glue having grooves as shown or directed. Internal surfaces at specified places shall be 0.8 mm thick as directed by Architect.
The rates quoted for the items of partions & paneling shall be inclusive of providing & fixing M.S. plate & brackets over & above the aluminium frame work as directed & wherever instructed for mounting the TV units & screens etc complete.
IMPORTANT NOTE ON THE DESIGN REQUIREMENTS APPLICABLE IN CASE OF ALL THE ITEMS OF PARTITIONS & PANELLING: - The design & the elevation of the various items under the heads: Partition & Panelling shall be at the complete discretion & directions / instructions of the Engineer in charge & Architects on site. Wherever instructed & directed, the rate shall include providing & fixing additional 6mm thk plywood backing over and above the 303 MR grade Commercial plywood so provided in the items of partition / panelling to form raised panel design at regular intervals as directed and to be finished with high end approved 4.0 mm thk veneer with high end melamine polish (proportion of gloss and matt as directed) with uniform shade & texture. Incase of 9mm thk plywood used instead of 6mm thk plywood for the raised panels for the items of Partition or Paneling works, the difference between the cost of 9mm thk plywood and 6mm thk plywood for the actual quantity of plywood used for the said partition or panelling items shall be measured and paid.
The level difference between the said raised panels and recessed panels shall be finished with approved designer moulding to be finished with high end (proportion of gloss and matt as directed) melamine polish and shall also include designer inlays to be finished with high end veneer with high end melamine polish, pattas & bands at various levels etc in veneer and melamine polish and combinations of raised and recessed panels with inlays etc complete to the complete satisfaction of the Architect and Engineer in charge.
For all items of Interior Furnishing works & Furniture works, the basic rate of Laminate considered for all the specifications / BOQ items herein shall be Rs. 65 / Sq. Fts plus taxes (GST) whereas the basic rate of Veneer, which shall be high end, uniform and without any variations, 4.0 mm thk considered for all the specifications / BOQ items herein shall be Rs. 110 / Sq. Fts plus taxes (GST). Basic rate for Frosted / Designer film of 3M, Llumar or equivalent approved wherever mentioned separately shall be Rs. 90 / Sq. Fts plus taxes (GST). The basic rate would be the rate offered to the bidder by the vendor / supplier after discounts and excluding the cost towards transportation, freight, loading, unloading etc and also exclusive of taxes (GST). Necessary documentary evidence in the form of challans & Tax invoices, details of payments released to the vendor for the purchase of such materials & including the loading-unloading transport slips needs to be submitted at the time of billing without which the payment processing shall not be entertained.
Further, Corian wherever mentioned in the BOQ (For items of Panelling, Reception Counter, Furniture elements etc)

shall be high end, of desired and approved color and adhering to the BOQ specifications. Corian thickness shall be 6mm thk for vertical surfaces & fascias and 12mm thk for horizontal surfaces shall be provided and with a basic rate of Rs. 1500 / Sq. Fts plus taxes (GST) for 6mm thk Corian and Rs. 1800 / Sq. Fts plus taxes (GST) for 12 mm thk Corian.

6) PARTITIONS

Providing and fixing Full ht. double skin Partitions as per specifications including skirting, complete as per the design, drawings and instructions in all respects. The specifications for the said item shall comprise of the following and with varying finishes as mentioned hereinunder: -

FRAMEWORK -2"x2" Aluminium section of 16 Gauge verticals at minimum 1' 6"-2'-0" Centre spacing approx and 2" X 1" size Aluminium sections horizontal at 1' 6"-2'-0" Centre spacing approx extra frame below slab soffit for conduit to run above. All verticals secured to ceiling. Measurement of the said item shall be upto the False Ceiling level.

SKIN:- Both side with 12mm thk 303 MR grade Commercial Plywood screwed to frame work on both sides with joints as shown or directed.

SKIRTING : In the same alignment, 3" high in 12mm thk 303 MR grade Commercial Plywood with a groove finished with laminate / veneer as the case maybe, or as directed by the Architect.

The rate shall include providing & fixing t.w. beading all throughout the exposed edges & periphery, sealing all the joints, grooves in finishes, melamine polish to the mouldings & t.w members, complete as per the directions of Architect. All Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically.

The finishes for the skinning to be screwed to the framework on both the sides as duly mentioned above shall comprise of the following types: - 50mm Glass wool slab of density 20kg/m³ shall be placed in metal framework. Glass wool holding clip should be used to hold Glass wool slab in its position.

Mode of measurements for all the herein-under Items of Partitions & Panelling shall be strictly upto the False Ceiling level. Incase of differential levels of False ceiling on both the sides of the partition, the average height of the false ceiling shall be the height for the purpose of measurements of the Item of Partition. However, it may be noted that for the items of Partitions & Panelling, the framework of any nature and as provided for the same under the specifications of the relevant line items shall be continued upto the RCC slab / beam as the case may be and no extra / additional payment for the framework to be continued upto the slab / beam shall be payable. Incase if the partition requires skinning and to continue above the ceiling, under such circumstances and as per the directions and instructions of the Architect, the Item shall be quantified under the relevant line item of the BOQ.

7) Both side skins to be finished with 1.0 mm thk **Laminate** as shown in drawing or as directed by Architect.
8) Both side skins to be finished with 4.0 mm thk approved quality **veneer** finished with high-end melamine polish as shown in drawing or as directed by Architect.
9) Both sides to be directly finished with skin in 12 mm thk approved **Gypsum Board** to be screewed directly to the Aluminium framing including POP Punning, levelling etc complete. Rate to also include Providing & Fixing **Acryllic Emulsion Paint** finish to the skin in coats of desired number with minimum of two coats. Rate shall also include providing grooves design in Gypsum as per the directions and instructions of the Architect.
10) Both sides to be directly finished with skin in 12 mm thk approved **Gypsum Board** to be screewed directly to the Aluminium framing including POP Punning, levelling etc complete. Rate to also include Providing & Fixing approved **wallpaper** over the skin surface (Basic rate of Rs. 200/ Sq. Fts plus taxes {GST})
11) Finishing : Both side 6mm thk **Calcium Silicate Board/Hi-Lux Board** finished with 3 coats of approved acryllic emulsion paint including POP punning for surface preparation including necessary grooves, skirting etc complete as shown or directed by Architect.
12) One side skin to be finished with 1.5mm thk approved **laminate** & other side skin with 4.0 mm thk approved quality **veneer** finished with high-end melamine polish as shown in drawing or as directed by Architect.
13) Finishing: One side finished in 1.5mm thk approved **laminate** & other with 12 mm thk approved **Gypsum Board** to be screewed directly to the Aluminium framing including painting with Plastic Emulsion Paint in minimum of three coats of approved make including necessary grooves, skirting etc complete as shown or directed by Architect.
14) Finishing: One side finished in 1.5mm thk approved **laminate** & other with 6mm thk **Calcium Silicate Board/Hi-Lux Board** finished with 3 coats of approved acryllic emulsion paint including POP punning for surface preparation including necessary grooves, skirting etc complete as shown or directed by Architect.
15) Finishing: One side finished in 6mm thk **Calcium Silicate Board/Hi-Lux Board** & other with 12 mm thk approved **Gypsum Board** to be screewed directly to the Aluminium framing including painting with Plastic Emulsion Paint in minimum of three coats of approved make including necessary grooves, skirting etc complete as shown or directed by Architect.
16) Finishing: One side finished in 1.5mm thk approved **laminate** & other with 25mm **Accosutic Board** finished including necessary grooves, skirting etc complete as shown or directed by Architect.
17) Finishing: One side finished in 4.0mm thk approved **Veneer** & other with 25mm **Accosutic Board** finished including necessary grooves, skirting etc complete as shown or directed by Architect.

18) Providing and fixing FRAMEWORK in 2"x2" Aluminium section of 16 Gauge verticals at minimum 1' 6"-2'-0" Centre spacing approx and 2" X 1" size Aluminium sections horizontal at 1' 6"-2'-0" Centre spacing approx extra frame below slab soffit for conduit to run above including 12mm thk **designer MDF board** on both sides including finishing both sides with PU machine polish including all the necessary surface preparations, final finish etc complete of approved shade, colour & texture as shown in drawing or as directed by Architect, including necessary grooves etc complete.

19) Providing & Fixing full height **Semi-Glazed partition** as per specifications including skirting, as per the design, drawings and instructions in all respects. The specifications for the said item shall comprise of the following and with varying finishes as mentioned hereinunder: -
FRAMEWORK - 2"x2" Aluminium section of 16 Gauge verticals, not exceed 1' 6"-2'-0" centres and 2" X 1" size Aluminium sections horizontal at floor level / skirting ht, 3'-0" level and door height at 7'-0" level. All verticals secured to ceiling. Measurement of the said item shall be upto the False Ceiling level.
SKIN:- Both sides of the main frame shall be finished with 12mm thk 303 MR grade Commercial Plywood screewed to the frame with joints as directed upto 3'0" level and from 7'0" level to the top upto false ceiling level and including 6 mm thk. clear glass Straight / segmented with bevelled edges including frosted film of approved make & design and drawing to be fixed with t.w moulding all around of approved size & design including grooves, mouldings etc complete as directed by Architect & as shown in the drawing.
SKIRTING : In the same alignment, 3" high in 12mm thk 303 MR grade Commercial Plywood with a groove finished with laminate / veneer as the case maybe, or as directed by the Architect.
The rate shall include providing & fixing t.w. beading all throughout the exposed edges & periphery including fixing the glass with studs, sealing all the joints, providing grooves in the finish, melamine polish to the mouldings & t.w members, complete as per the directions of Architect. All Aluminium sections shall be smooth, rust free, straight, mitred and jointed mechanically.
The finishes for the skinning to be screwed to the framework on both the sides as duly mentioned above shall comprise of the following types: -

20) Both side skins to be finished with 3.0 mm thk approved quality veneer finished with high-end melamine polish as shown in drawing or as directed by Architect.

21) Both side skins to be finished with 1.0mm thk approved Laminate finished as shown in drawing or as directed by Architect.

22) One side skin to be finished with 1.5mm thk approved laminate & other side skin with 3.0 mm thk approved quality veneer finished with high-end melamine polish as shown in drawing or as directed by Architect.

23) Both sides to be directly finished with skin in 12 mm thk approved Gypsum Board to be screewed directly to the Aluminium framing including POP Punning, levelling etc complete. Rate to also include Providing & Fixing Acryllic Emulsion Paint finish to the skin in coats of desired number

24) **Full Height Fully Glazed partition**
Providing and erecting in position full height fully glazed partiton in 12mm thk. toughened glass fixed on Patch fittings including top patch fitting, bottom patch fitting, patch lock, Floor spring of approved make for the door and S.S handle 600mm long, 30mm dia for the door including designer decorative frosted film of approved make, shade & design on the glass. AlI damages to the floor work to be reinstated without any extra cost including the cost of other fittings & fixtures & hardware such as spider panels, glass to glass contactors etc complete, necessary holes, joints to be sealed with silicone sealant on all sides complete in all respects etc as per directions of Architect.

25) Providing and erecting in position full height fully glazed partiton in KUBIK DG 100 Black / Grey, Liko or equivalent make Aluminium Modular Glass Partition using standard track section of size 100 mm X 25 mm seal and bead profile of Kubik- DG 100 series or equivalent approved at top, bottom and sides (Only at the end of the cabin spans) upto any stud thickness as per manufacturer's standards and specifications and as directed by the Architect to comply with the standard partition suite design including double glazed 10mm thk clear toughened glass to be fixed within the frame including door frame in the same matching Aluminium frame profile and for size to allow upto 45mm thk door of any type i.e. solid flush door or glazed door (Matching the Double Glazed Partition in terms of elevation, shape, size, thickness etc) as per directions and upto any desired height of the partition as well as door, with sound insulation capacity of minimum upto 49 dB including Glass to glass joint and connectors, standard assessories as per manufacturers recommendations & standards, gaskets etc complete. The Clear toughened glass shall be of Saint Gobain / Asahi or equivalent make as approved including designer decorative frosted film of approved make, shade & design on the glass
The rate shall include providing and fixing in position clear toughened double glass glazing (Partition shall be measured including the door with matching elevation, if any, provided as per the plan), 10mm thk within the framework as provided in the partition-door system including necessary fitting, fixtures such as lock arrangement for the door as per manufacturers specifications and standards, hinges, glass door hinge, cove profile & skirting etc as per manufacturers recommendations & standards, Floor spring of approved make for the door and S.S handle 600mm long, 30mm dia for the door. All hardware to be of Kich / Hettich / Dorma / Hafele or equivalent approved makes. Rate to also include providing and fixing in position frosted film of approved make, shade & design on the glass. All damages to the floor work to be reinstated without any extra cost including the cost of other profiles, hardware, assessories, fittings & fixtures

& hardware etc complete, necessary holes, joints between door, glazed partition panels (Glasses) to be sealed with silicone sealant on all sides complete in all respects etc as per directions of Architect.

26) Double Glazed Partition - 6mm Thk two nos of Sandwiched Glass panels with silicon sealant between the glasses to make it water and air tight. Further the Kubic, Liko or equivalent make sections including the double glazed panels shall be accoustic proof and completely sound insulated and shall be as per the manufacturers specifications and standards.
27) Same as above specifications, except Single Glazed Partition with Kubic 100 Series and 10mm Thk Single Glass
28) **Partitions above False Ceiling**: Providing and extending frame works of full height partitions wherever directed and finishing with 12 mm thk 303 Commercial Ply wood on both sides and finishing the same with approved paint including insulating the same with approved insulating material upto soffit of beam or ceiling including properly anchoring the same making necessary cut-outs for AC ducts etc complete wherever directed.
29) Providing and fixing Wall & Column Panelling for the existing surfaces to be made out of 16 gauge Aluminium framework backing of size 2" X 1" at 1'6" to 2' c/c bothways to be covered with 12mm thk 303 MR grade Commercial Plywood and finished with approved 1.0mm thk **Laminate** including skirting & band at top in the same alignment with a groove and including teakwood moulding of approved size as shown in detailed drawing or as directed by Architect. {Item shall be operated on all surfaces including fixing above the storage units mounted on exterior walls within cubicles and as an partial enclosure to the exposed Glazing portion}
30) Providing and fixing Wall & Column Panelling for the existing surfaces to be made out of 16 gauge Aluminium framework backing of size 2" X 1" at 1'6" to 2' c/c bothways to be directly finished with skin in 12 mm thk approved **Gypsum Board** to be screewed directly to the Aluminium framing including POP Punning, levelling etc complete. The finishes for the said item shall comprise of the following: -
31) Providing & Fixing Acryllic Emulsion Paint finish to the skin in coats of desired number
32) Providing & Fixing Textured Paint finish finish to the skin
33) Providing & Fixing **Mirror Panelling** using 6 mm thick mirror of approved make over 19mm 710 BWP grade Marine Plywood backing. The mirror to be fixed with T.W beading of size 12.5mm X 19mm, finished with melamine polish complete as per the instructions of EIC. The rate shall be inclusive of providing & fixing S.S studs of appropriate size & diameter as directed including bevelling for the mirror
34) Providing and fixing of **WPC Rafters/Louvers** 20-25mm thk for any type of Partitions, Panelling, False Ceiling, Tables, Furniture etc as per directions for the existing raw surfaces such as plywood, partical board, MDF, Aluminium framework etc directly to be mounted over the surface or over including making provision for providing LED cove backlit lighting wherever directed, brackets, necessary hardware, fittings, fixtures etc complete as per the directions of Architect. Make - Reynobond/Reynoarch or equivalent. Rate shall be quoted for providing and fixing in position WPC Rafters / Louvers irrespective of the application area i.e. Panelling, False Ceiling or Cladding and the surface area i.e. footprint area of the same irrespective of the grooves / spacing between the rafters or louvers in terms of Square feets shall be considered for the purpose of measurements and payment.
35) 200mm x 2400mm
36) 167mm x 2400mm
37) **Solid Flush Door - 3'-0" x 8'-0":** Providing and fixing Solid Core Marine Flush door shutters 35mm thick ISI mark including providing 1 1/2" X 1/4" and 6mm thick TW lipping patti to all exterior edges, 1.0 mm thk approved laminate finish of approved shade on both sides including 125X32mm Stainless steel hinges, heavy duty round S.S cylindrical lock, 2 Nos 6" - S.S handles, S.S door stopper, door closer, rubber bush and buffer etc complete as directed at site. The rate shall be inclusive of providing & fixing 2nd class BTC frame of size 100 X 50mm including necessary polishing to the frame etc complete.
38) **Solid Flush Door - 2'-6" x 8'-0":** Providing and fixing Solid Core Marine Flush door shutters 35mm thick ISI mark including providing 1 1/2" X 1/4" and 6mm thick TW lipping patti to all exterior edges, 1.0 mm thk approved laminate finish of approved shade on both sides including 125X32mm Stainless steel hinges, heavy duty round S.S cylindrical lock, 2 Nos 6" - S.S handles, S.S door stopper, door closer, rubber bush and buffer etc complete as directed at site. The rate shall be inclusive of providing & fixing 2nd class BTC frame of size 100 X 50mm including necessary polishing to the frame etc complete.
39) **Solid door with glass vision panel / Louvers- 3'-0" x 8'-0"/2'-6" x 8'-0":** Providing and fixing Solid Core Marine Flush door shutters 35mm thick ISI mark including providing 1 1/2" X 1/4" and 6mm thick TW lipping patti to all exterior edges, 1.0 mm thk approved laminate finish of approved shade on both sides including 125X32mm Stainless steel hinges, heavy duty round S.S cylindrical lock, 2 Nos 6" - S.S handles, S.S door stopper, rubber bush, door closer and buffer etc complete as directed at site. The rate shall be inclusive of providing & fixing 2nd class BTC frame of size 100 X 50mm including necessary polishing to the frame etc complete. The rate shall be inclusive of providing and fixing within the door, vision panel or louvers of size approximately 300mm X 300 mm and with 6mm thk clear glass including wooden beading finished in 3 coats of melamine polish.
40) **Fully Glazed Door - 3'-0" x 8'-0":** Providing & Errecting in poisition Fully glazed Single leaf door & its side fixed glass in 12 mm thk Toughened Glass on Patch fittings of the size 3'0" X 7'0" each including top patch fitting, bottom patch fitting, patch lock, Floor Spring of reputed manufacturer and S.S handle 600mm long, 30mm dia including frosted

film of approved make, shade & design on the glass. AlI damages to the floor work to be reinstated without any extra cost including the cost of other fittings & fixtures & necessary hardware, necessary holes, joints to be sealed with silicone sealant complete in all respects etc directions of Architect.

41) Fire Door - Electrical Room: P/F fire door of MS Sheet of 1mm for Door, MS Sheet of 1.2mm for Frame Constructed to withstand 2 hr. fire retardent with View Panel size 200mm X 300 Mortise Lock with push down handle, Door Closure fixed on top of the door Frames will be fixed with expansion anchors Colour of client choice-powder coated Overall shutter thickness will be of 46mm standard size of the fire door 7' X 3' with Installation

42) Door Frame: Wooden Door Frame of hard wood / teak wood of section with heat activated intumescent seal strip of size 10x4 mm and one coat of Fire & anti-termite primer. Door Shutter: Asbestos free composite Fire / Smoke check shutters of 60 minutes fire rating confirming to BS ; 476 Part - 22 & IS : 3614 Part - II comprising of two 12 mm thick Calcium Silicate boards sandwiching 12mm thick proprietory fire resistance insulation Material faced with 3 mm thick commercial ply facing on both sides with heat activated intumescent fire seal strip size 10 mm x 4 mm mounted in the grooves on three sides except bottom with View Panel size 200mm X 300 and one coat of anti-termite fire retardant primer. Finished with 1mm thick Laminate with fire retardant primer with Mortise Sash Lock including Door Closure fixed on top of the door with Cylinder – Complete with Lever Handle

43) **MAIN DOOR :** Providing & Errecting in position Fully glazed Single &/or Double leaf Fully Glazed Main Entrance doors of any size & height as per plan & as directed by the Architect including its side fixed glass in 12 mm thk Toughened Glass on Patch fittings for each of the door leaf including top patch fitting, bottom patch fitting, patch lock, Floor Spring etc including all necessar hardware, fittings, fixtures etc of recommended manufacturer such as Dorma or equivalent approved including S.S handle 600mm long, 30mm dia including frosted film of approved make, shade & design on the glass. AlI damages to the floor work to be reinstated without any extra cost including the cost of other fittings & fixtures & necessary hardware, necessary holes, providing & fixing automatic acoustical drop seal on doors, joints to be sealed with silicone sealant complete in all respects etc as per drawings and directions of Architect.

44) **Box for Rolling shutter**: Providing and erecting boxing to cover the rolling shutter to be made out of 19mm thk. 303 MR grade Commercial Plywood for casing and openable shutters below for servicing to be finished with approved 4.0 mm thk exterior grade ACP including hardware such as hinges, locks etc.complete as per instructions of Architect.

45) **Rolling Shutter**: Providing and fixing new opaque rolling shutter with top box, channels, locks, sliders etc complete as per site conditions.

46) Removing & re-fixing the existing rolling shutter, repairing the same, replacing the damaged sliders, channels etc including painting with 2 coats of enamel paint etc. complete.

12. Furniture for New G+1 Building

1 SOFAS: -

- Providing & Supplying Sofas, Sofa chairs of various types & categories (Single seater, Two seater & Three seater) etc complete as per the manufacturers specifications as mentioned below. The rights to select & approve the sofas & seating shall vest with the clients. The contractor shall submit brochures of manufacturer at the time of quoting for this item etc complete as per layout. The consultants reserve the right to select the sofas in line with the technical specifications envisaged & meeting the secifications standards expected.
- The minimum standards for the Specifications of Sofas shall be as follows: - Inner solid Frame structure made of high quality wood. The wood is kiln chemical treated tropical Meranti wood. The legs are made of rubberwood having melamine matt finish. The seat cushion is made of 7 inches multi layered foam of density 32D 23D 32D and HD with polyester polyfill outer layer of 180 gsm. The polyester polyfill keeps the upholstery wrinke free and soft.
- The seating cushions have 3 inches of elastic webbing of 350 gsm with proper weave. The thread used is nylon bonded to provide lasting stitch strength. Backrest: 2" elastic webbing (250 gsm) with proper Weave and 3" foam (23D) with Polyester polyfill outer layer (180 gsm). Outer finish: stained solid wooden legs superior quality. Frame construction: Kiln seasoned mixed meranti solid tropical hard wood SEAT Webbing 3" proper webbing. Foam: 7" Multilayered foams Having 4" of High Resilience-HD Foam and 3" of HD virgin PU Foam. BACKREST: Webbing 2" elastic webbing , Foam: 18D PU foam Upholstery: semi PU with layer of polyester polywadding Stitiching Nylon thread. Legs Solid kiln seasoned and treated Solid wood with Melamine Matt Finish.

A Leather Sofas

i Single Seater Sofas
ii Two Seater Sofas
iii Three Seater Sofas

2 Corner Table (1'-6" x 1'-6")

Providing, Supply & installation of Corner table- MATERIALS & DIMENSION (+/- 2mm) - 600L x 600W x 450H. TABLE MATERIALS & SIZE : TOP : SOLID VENEERED MDF TABLE TOP in 18 mm thickness OR GLASS TOP 10mm. LEGS: SOLID RUBBER /MS understructure, WOOD. Color : As Approved. LEGS: Color : As Approved. REST ANY STD COLOUR. The rate shall include including glass top to have bevelled edges including bottom glass shelf etc complete. The rate shall also include all the necessary hardware, fittings, fixtures as per manufactursrs specifications complete.

3 Center Table (Oval / Rectangular)

Providing, Supply & installation of Centre table- MATERIALS & DIMENSION (+/- 2mm) as mentioned hereinunder. TABLE MATERIALS & SIZE : TOP : SOLID VENEERED MDF TABLE TOP in 18 mm thickness OR GLASS TOP 10mm. LEGS: SOLID RUBBER /MS understructure, WOOD. Color : As Approved. LEGS: Color : As Approved. REST ANY STD COLOUR. The rate shall include including glass top to have bevelled edges including bottom glass shelf etc complete. The rate shall also include all the necessary hardware, fittings, fixtures as per manufactursrs specifications complete.

a Size of table- 4'-0" x 4'-0" (Circular / Square)
b Size of table- 4'-0" x 2'-0" (Oval / Rectangular)
c Size of table- 3'-0" x 2'-0" (Oval / Rectangular)

4 CHAIRS

Providing & Supplying Chairs of approved make

Providing & Supplying premium class & high end Chairs for different categories with minimum technical specifications such as Gas lift, revolving type, Tilting type, castors, armrest, SS supports and all features of executive chairs as per the approved makes. The basic specifications, which are to be considered as minimum specifications are as follows: -

Chair Seat: Pneumatic seat height adjustment (16" to 25.5"). Chair padding should allow for distribution of weight to be at a maximum.

Chair Back : Upper back support should be provided with tall back chairs. The chair back should make contact with individual's upper back and lumbar (back) support as per ergonomic principles. Back and seat angle adjustment allow for neutral positioning : 90-120 degree trunk- thigh angle. Back tension adjustment. Variable back stop adjustment on back tilt mechanism with locks in place at various angles.

UPHOLSTERY : As per desired finish. The upholstering to be done bv means of pneumatic gun. The back & seat edges to be covered by PVC profile which is also stapled or ABS fibre covers fitted on the back. The fabric shall be coated with scotch guard for stain resistance. Chair fabric should have elasticity that does not restrict the foam.
Armrests : Fixed Handles of inflexible PUF with cushioned soft armrest and rounded edges.
Mechanism : Sinqle sprinq for full tilt or back tilt 360 deqrees swivel mechanisms with a locking lever. The carraige shall be fibre/metallic powder coated with five prong legs.(Synchro Gas Tilt)
Castors : 5 flange or more star base. Twin wheel nylon castor each designed to sustain weight load of 100 Kg. Hard wheel castors for carpet and soft wheel castors for hard flooring.
The rights to select & approve the chairs shall vest with the clients. The contractor shall submit brochures of manufacturer at the time of quoting for this item etc complete as per layout. The consultants reserve the right to select the chairs in line with the technical specifications envisaged & meeting the specifications standards expected.

a "Viping Dining Chairs: Providing and supplying chairs with following specifications;
Size :-(W)540mm X (D)530mm X (H)1010mm / Revolving / Mesh Back / Fixed Back Chrome frame and Cantilever Base . Basic Rate Rs.8000/-"
b "Normal Dining Chairs:

Providing and supplying cafeteria stackable chairs with Chromeplated Legs and without Arms. As approved by Client/Architect. Basic Rate Rs.3000/-"

5 **Providing** and fixing Low height Storage of ht. 2'-6" or 4'-0" as desired and depth of 16" or 18" as specified in the drawings as per specification below.

Skeleton - made out of 19 mm thk plywood at end verticals, top and bottom and verticals 450mm to 600mm Centres as shown in drawing and 6 mm thk back ply.
SHELVES - 19mm Thk. Plywood top and edges finished in 0.8mm thk. Laminate to accommodate file height removable and supported on pins.
SHUTTERS-made out of 19mm thk. ply externally finished in 3.0mm thk. Veneer with polycoat polish and Internally finished in 0.8 mm thk. Laminate as shown or directed.
HINGES - Each shutter shall have 100mm long oxidised brass butt hinges. Mimimum 4 nos. hinges for each of the shutter for Full height Storage and 3 Nos. hinges for each of the shutter for Low Height Storage to be provided.
BOLTS - Flush tower bolts from inside at top and bottom to the shutters and magnetic catch fixed top and bottom.
LOCKS - of approved make 4 -lever brass body dead lock with S.S. Key.
HANDLES - 100mm wide handles of brass as approved by the Architect.
SKIRTING -As instructed by Architect, in plywood finished in approved 3.0 mm thk veneer with polycoat polish.
BACK - Back side of storage to have 6mm thk. MR grade commercial ply with polish finish.
The finishes for the Low height storage unit as duly mentioned above shall comprise of the following types: -
Providing & Fixing for all the external surfaces and exposed woodsurfaces including the top shall be finished with 3.0 mm thk high end veneer with melamine polish. Inside visible surfaces complete with 0.8mm thk Laminate. Top to have t.w. moulding finished with high end melamine polish as instructed.

6 EXECUTIVE DINING TABLE / MULTI-PURPOSE TABLE

Providing and erecting in position Executive Dining / multi-purpose Table to be made out of 19mm thk 303 MR grade Commercial plywood top with 60 X 60mm thk t.w.moulding all round the top to be finished with approved 3.0 mm thk high end veneer with polycoat polish and to be errected on a framing of t.w 75 X 75 mm thk moulded frame vertical, horizontal at top & bottom & including bracings at a regular interval of 750 mm centres, which shall be covered with 19mm thk ply to be finished with approved 3.0 mm thk high end veneer with high end melamine polish. All the exposed middle verticals & framing (aprons) shall be finished with 19mm thk plywood and approved 3.0 mm thk veneer with high end melamine polish as per the instructions of the Architect.
The rate shall be inclusive of necessary openings & cutout in the top of the table to be filled with planters & white pebbles & 12mm thk toughened glass on t.w moulding support in the cut out area etc complete. The rate shall also include providing foot rest fixed to the central core support section of the table of projection width as directed to be finished with approved veneer with melamine polish etc complete. Elevation of the table shall be as directed by Architect on site.
Size of Table - 5'-0" x 3'-0"

7 Dining Table

Providing and supplying rectangular dining tables 3'-0" x 3'-0" made out of 10mm thk toughened Glass top with design etching pattern with bevelled edges. The table to have Stainless steel tripod stand comprising of 3 nos of 2" dia pipe with cross bracings for the entire height of the table & bottom box cylinder in approved marble as base supporting section, 2" height etc complete as per instructions. The rate shall also be inclusive of rubber supports in between the glass & SS supporting arrangement, fittings, hardware etc complete

8 Providing 2'-0" wide lunch counter in ply to be finished with 1.5mm thk laminate for all the exposed areas including the necessary supports in ply to be finished with 1.5mm thk laminate including neccesary hardware, polish for the moulding to be provided for the entire front areas of the counter & supports, hardware etc complete

9 Planter Boxes (18" Dia)

Providing and supplying 18" dia planter boxes to be made out of 19mm thk. ply to be finished with 3.0mm thk veneer with melamine polish externally & painted from inside including G.I. Tray for the base as per the drawing and instructions of the Architect etc. complete. Finished with approved 3.0mm thk veneer with melamine polish

10 **Artificial Plants:** Providing and supplying natural plants approved by Architect such as moss and including necessary stand for holding the plants as per the approved sample.

11 **Artificial Plants:** Providing and supplying natural plants approved by Architect such as moss and including necessary stand for holding the plants as per the approved sample medium size

12 **Provision for Artefacts such as water acquarium (1 No) and stain glass murals (2 Nos) in various areas of the office. The right to select & approve the artefact shall vest with the clients &** consultant. The contractor shall submit brochures of manufacturer at the time of quoting for this item. The consultants and clients reserve the right to select the artefact in line with the standard technical specifications or as envisaged & meeting the manufacturer's specification standards. Basic capping rate for all the said items clubbed together including taxes, duties etc shall be Rs. 1,00,000 / -.

13 **Providing & fixing in position high end premium collection paintings / printed decorative** metallic frames / glass paintings to be obtained in consultation with Consultants / Clients. The rights to select & approve the paintings shall vest with the clients. The contractor shall submit brochures of manufacturer at the time of quoting for this item. The consultants and clients reserve the right to select the paintings in line with the standard technical specifications or as envisaged & meeting the manufacturer's specification standards. Basic capping rate for all the said items clubbed together including taxes, duties etc shall be Rs. 1,00,000 / -.

A 6 Frames of size 3'0" x 2'0"
B 6 Frames of size 2'0" x 2'0"
C 2 Frames of size 6'0" x 3'0"

13. Furniture Works for Multi-Purpose Hall & Ground & First Floor at Pragati Vihar Building.

1. **DISPLAY RACK: -**

Providing and fixing in position Display Rack with 12mm thk glass shelves and glass shutters on heavy duty magnetic catch including provision for warm lighting arrangement to be made inside at the storage top panel. All exposed surfaces to be finished with 1.0 mm thk laminate etc complete and internal exposed surfaces shall be finished with 0.8mm thk approved laminate including heavy duty hardware, fittings, fixtures etc complete to the complete satisfaction of the Engineer in charge & Architect.

All external surface finish with 1.0 mm thk approved laminate and rear side shall have french polish including making necessary grooves in laminate, t.w.moulding wherever necessary as per drawing etc complete. Moulding shall have melamine polish.

2. **STUDY TABLES :**

Providing and supplying Study table to be made out of 19mm thk. marine ply. finished with approved 1.0 mm thk approved Laminate. The top of the table to have t.w. moulding all around. The rate shall be inclusive of providing a keyboard tray on sliding telescopic channels & a pedestal drawer unit on side with 2 nos of equal sized drawers on sliding channels & openable shutter below. All internal surfaces to be finished in approved 0.8mm thk laminate. All the external surfaces shall be finished with 1.0mm thk approved laminate including the drawer unit. The necessary hardware such as automatic locking, ball catches, wire managers etc to be provided as per the instructions of the Architect. The Elevation of the table shall be as directed by the Architect

Size: - 3'-6" X **2'-0"**

3. **COMMUNICATION / WORKING COUNTERS:**
   Providing and erecting communication cum working counter (2'-3") wide to made out of 19mm thk. marine ply. The counter to have lockable heavy duty keyboard trays with a pedestal drawer unit with 3 nos of equal sized drawers in 19mm thk. marine ply with necessary opening for electrical wiring & sockets. The counter shall be finished with approved 1.0mm thk laminate and polish internally etc. complete as per design & instructions. The rate shall be inclusive of foot rest etc complete. The rate shall also be inclusive of a overhead storage of 2'-0" height and 18" width to be finished with 1.0 mm thk laminate for all internal surfaces including soft board of approved colour in between the counter and storage unit complete as directed.

4. **RECTANGULAR EXECUTIVE DINING TABLE (6'-6" x 3'-0**
5. Providing and erecting in position Meeting table 6'-6" length and 3'-0" wide to be made out of 19mm thk Marine plywood top with 60 X 60mm thk t.w.moulding all round the top to be finished with approved 1.0 mm thk laminate and to be erected on a framing of t.w 75 X 75 mm thk moulded frame vertical, horizontal at top & bottom & including bracings at a regular interval of 750 mm centres, which shall be covered with 19mm thk ply to be finished with approved 1.0 mm thk laminate. All the exposed middle verticals & framing (aprons) shall be finished with 19mm thk marine plywood and approved 1.0 mm thk laminate as per the instructions of the Architect. The rate shall be inclusive of an cutout in the top of the table to be filled with planters & white pebbles & 12mm thk toughened glass on t.w moulding support in the cut out area etc complete. Elevation of the table shall be as directed by Architect on site.

6. **ENTRANCE LOBBY RECEPTION COUNTER:** Providing and supplying Entrance Lobby Reception counter of size 7'-0" length and 2'-6" height with chamfer edge glass 12mm thk for top on stainless steel hollow pipes 75mm dia & height below 1'-0". The table below the pipe to be made out of 19mm thk marine ply with front apron to be finished with approved 18mm thk italian marble. The top of the table shall be provided with approved 18mm thk Italian marble with a cut out for Monitor with 12mm thk glass on the top of the table with pedestal drawer unit with castors comprising of 3 nos of drawers on side to be finished with approved 1.0mm thk approved laminate externally and 0.8mm thk laminate for all internal surfaces including all the necessary hardware, fittings, fixtures. All exposed surfaces shall be finished with 1.0mm thk approved Laminate whereas internal surfaces shall be finished with 0.8mm thk laminate including making the necessary openings for wires of telephone boards, PC, grooves, mouldings, etc complete.

7. **SOFAS, CHAIRS & MISCELLANEOUS ITEMS:** Providing & Supplying Sofas of different accomodation as per the manufacturers specifications as follows: High end & premium quality ready Leather Sofas

8. Single Seater Sofa bought out from Manufacturers such as Godrej, Durian, Featherlite or equivalent.

9. Double Seater Sofa bought out from Manufacturers such as Godrej, Durian, Featherlite or equivalent.

10. Three Seater Sofa bought out from Manufacturers such as Godrej, Durian, Featherlite or equivalent.

11. **CORNER TABLE (600 x 600):** Providing and supplying in position corner table to be made out of 50 X 50mm second class teak wood frame with 12mm thk. clear glass top with bevelled edges and etching with melamine polish etc. complete.

12. **CENTRE TABLE:** Providing and supplying in position center table to be made out of 50 X 50mm second class teak wood frame with 12mm thk. clear glass top with bevelled edges and etching with melamine polish etc. complete.

13. **CHAIRS** :Providing & Supplying Chairs for different categories with Gas lift, Revolving type, Tilting type, castors, armrest, SS supports and all features of executive chairs as per the approved makes

14. Providing & supplying Medium Height Chairs with leatherite finish as per manufacturer specification

15. Providing & supplying Low height Chairs with Fabric finish for dressing as per above specification

16. Providing and Executive chromium plated metallic dining chairs with cushioned seat of approved make as per the directions of the competent authority

17. **PLANTER BOXES (18" x 18"):** Providing and supplying 18" dia readymade decorative circular planter boxes to be made out of 19mm thk. Marine ply to be finished from inside with paint, painted G.I. Tray as per the drawing and instructions of the Architect etc. complete. Finished with approved 1.0mm thk laminate externally.

18. **ARTIFICIAL PLANTS:** Providing and supplying artificial plants approved by Architect, with moss and necessary stand for holding the plants as per the approved sample.

19. Providing and supplying metallic containers for Artificial plants of approved design and make.

20. **NOTICE BOARD:** Providing and Supplying Ready made Notice Boards with felt cloth inside and glass shutter with locking arrangement in wooden frame, ornamental type etc. complete as per manufacturer standards.

21. **ARTEFACTS:** Provision for Internal fountain at various locations as per the instructions of EIC.

22. **PAINTINGS:** Providing & fixing in position paintings / printed including decorative metallic frame to be obtained with approval of EIC.

23. Frame up 3'0" x 2'0" (basic rate: Rs. 3000/-)

24. Frame up 2'0" x 2'0" (basic rate: Rs.2500/-)

25. Frame up 6'0" x 3'0" (basic rate: Rs.10000/-)

26. **PATTA & BANDS:** Providing and fixing 75mm wide Patta on the wall with 12mm thk ply including 12 mm t.w beading with polishing etc complete as per the instructions.-Finished in 1.0mm thk approved laminate finish

27. **T.V UNIT:** - Providing and fixing in position TV unit of length as desired and height of 7'-0" with base to provide for a storage unit with cabinets to be finished with approved 1.0 mm thk laminate including 12mm thk glass shutter including one number of tower type display storage units to be made out of 19mm thk plywood including Glass shutters on heavy duty magnetic catch including provision for warm lighting arrangement to be made inside at the storage top panel. The wall mounted TV unit to be provided over WPC Panels of approved size to be supplied and fixed behind the TV and adjoining the tower unit. The tower to be low height storage unit with top to be provided with 1.0mm laminate finish and front shutters with glass for providing set top box, DVD player etc complete. All exposed surfaces to be finished with 1.0 mm thk high end laminate etc complete and internal exposed surfaces shall be finished with 0.8mm thk approved laminate including heavy duty hardware, fittings, fixtures etc complete to the complete satisfaction of the Engineer in charge & Architect.

28. Supply, Installation, Testing & Commissioning of Flat Screen Type Full HD LED SMART TV with wall mounted swivel stand

29. 43" HD LED SMART TV of Samsung, LG, Sony or equivalent approved make

30. 36" HD LED SMART TV of Samsung, LG, Sony or equivalent approved make

31. **Bed Side Table (0.60 x 0.45 x 0.45m)** Providing and supplying side table in 19mm thk. ply with drawer finished with approved 1.0 mm thk high end laminate and all internal surface finished with 0.8 mm thk laminate. All necessary brass fittings such as handles channels, etc. complete as per design & instructions of Engineer in charge.

32. **Curtain with Decorative Rod** Providing and supplying fabric curtains in American plates (Basic Rate Rs.250 / - per mtr) including aluminum powder coated decorative curtain rods with approved ceramic brackets at the ends etc complete as per instructions of Engineer in charge.

33. **T.W. Moulding** Providing and fixing 11/2" x 1" t.w. moulding finished with melamine polish as per instructions of the Engineer in charge.

34. **Wardrobe** Providing and fixing wardrobe made out of 19mm thk. ply for sides, shelf, shutters, top & bottom and 6mm thk. marine ply back. 6" drawer shall be provided with sliding chanels, handle & lock. 3" x 11/2" t.w.skirting shall be provided at bottom. Shutters & exposed sides shall be finished with approved 1.0 mm thk high end laminate including 1/2" x 1/2" t.w. moulding finished with polish including hinges, handles, ball catches, tower bolt, locks etc. complete. All internal surfaces shall be finished with 0.8 mm thk laminate. S.S. hangar rod shall be provided at top of the wardrobe shall be in two compartments with shutters to each compartment.
    The double compartment to have space for hangers on drawer in the centre and space for keeping the luggage in the bigger compartment & space for small water cooler, the space for pillow linen / blankets etc & shall be accomodate vending machine within the compartment. Complete as per the drawing & instructions of Engineer in charge.

35. Providing & Fixing in position Stainless Steel Coat Hanger

36. Providing & Fixing in position 3-Tier Folding Clothes Rail Drying Rack

37. **Dressing Table** Providing and supplying dressing tables to be made out of 19mm thk. ply top and the sides including 3" high drawer. All the external surfaces finished with 1mm thk approved high end laminate with 1" x 1" t.w.beading shall be fixed on table top edges. All the necessary brass fittings such as hinges, ball catches, locks etc. complete as per instructions. Providing Mirror of size - 2' x 4' over the work table to be fixed on wall with t.w. 1" x 11/2" member having rounded edges etc. complete as per instructions of Engineer in charge.

38. **Double Bed (1.80 x 2.10m)** Providing and supplying double bed in 19mm thk. ply box all around finished with approved 1.0 mm thk high end laminate including 3" x 2" t.w. legs and 3" x 2" t.w. frame below finished with natural polish 6" thk. m.m. foam matress covered with white cloth finish etc. complete as per design / instructions of the Engineer in charge. The rate shall be inclusive of Providing and fixing head board in 19mm thk. ply 18" ht x 6" deep finished with 1mm thk approved laminate fixed on walls above the bed with t.w. turning members of 1" dia as per design & instructions of Engineer in charge to be finished with approved leatherite of approved design, texture, shade etc complete including inlays as per directions and instructions of the Architect

39. Same as above, but Single Bed of size 1.00 X 2.10 Mts

40. **Shelf For Briefcase (0.90x0.60x 0.45 deep)** Providing & fixing shelf with drawer unit in 19mm thk. ply finished with 1mm thk. approved laminate. The unit to have drawer unit below the top with 1" x 1" t.w. moulding with melamine polish.Provide necessary hardware such as handle lock, sliding channel etc. complete as per instructions of the Engineer in charge.

41. Providing & fixing Shoe Rack in ply to be made out of 19mm thk ply as a cabinet box to be finished with 1.0mm thk laminate externally and 0.8mm thk laminate internally

42. **Ironing Board** Providing and fixing, folding Iron Board of 19mm thk. Ply & asbestos sheet with 1" thk. Coir covered with white cloth & felt cloth finish etc. complete as per instructions

43. **SERVICE COUNTER:** Providing and erecting service counter (2'-3") wide to made out of 19mm thk. ply. The counter to have lockable drawers 3" deep in 19mm thk. ply and shall be finished with approved jet black granite including necessary cut outs etc comple as per design & instructions.

44. **NAME PLATE:** Providing Name Plate of size 375 X 150 mm in brass and fixing the same to the required positions.

45. **PELMETS**
    Providing and fixing 5" wide Pelmet with 18mm thk ply including t.w lippings on all edges of the plywood and finished on both sides etc complete as per the instructions. Finished in 1.0mm thk approved laminate etc complete

46. **MURALS:**
    Providing & Errecting Murals in part Plaster of Paris / Part Wooden sections and decorative materials artwork etc complete as per the detail provided by the Architect.

47. **Coffee Table with 2 Chairs** Providing supplying sypplying coffee chairs with coffee table in t.w. frame to made out of dadeli including soft foam to the seat finished in approved upholstry (basic rate of Rs.300/- per meter) including melaimne polishing etc. complete as per design & instructions of Engineer incharge. (Contractor to get approval of the said item) {1 Set = 2 Coffee Chairs & 1 Coffe Table}

48. **Head Board** Providing and fixing head board in 19mm thk. ply 18" ht x 6" deep finished with 1mm thk. approved laminate fixed on walls above the bed with t.w. turning members of 1" dia. As per design & instructions of Engineer in charge.

49. Providing and fixing **Wall & Column Panelling** for the existing surfaces to be made out of 16 gauge **Aluminium framework backing** of size 2" X 1" at 1'6" to 2' c/c to be covered with 12mm thk exterior grade Partical board and finished with high end premium quality approved 1mm thk high end approved laminate including skirting & band at top in the same alignment with a groove and including teakwood moulding of approved size as shown in detailed drawing or as directed by Architect

50. Providing & Fixing **Fabric Panelling with approved fabric** over 9 mm thk BWP ply backing. All around the panelling, decorative teak wood mouldings shall be provided and shall be finished with melamine polish complete as per the instructions of Architect.(Basic Price of fabric Rs.200/- meter).

51. RECEPTION COUNTER

Providing and supplying Reception counter of size 15'-0" in length comprising of various shapes - circular & straight length and 2'-0" width and 2'-6" height including belevved edged glass, 12mm thk on top supported on stainless steel hollow pipes, 75mm dia & height below top be minimum of 1'-0". The table below the pipe to be made out of 19mm thk Commercial ply with front apron to be in 19mm thk Commercial ply (flexible for curvature portion) to be finished with approved 18mm thk onyx italian marble including provision of warm / coloured lighting behind the onyx for glowing effect. The top of the counter shall be provided with Corian Quartz of Dupont or equivalent approved including approved Corian for sides & all other exposed surfaces.

The rate shall include 1 no of pedestal drawer units on castors comprising of 3 nos of equal sized drawers on side to be finished with 4.0mm thk approved laminate with melamine polish. The rate shall also include the elevational treatment to be provided with recessed designer corian of approved shade with backlit within laminate borders & tray at skirting level including planters, pebbles & creeper arrangement design and including heavy duty CPU trolleys & keyboard trays of standard make on sliding channels as per manufacturers specifications etc complete.

All exposed vertical fascias / surfaces of the counter shall be finished with approved 6mm thk Corian material except the top, which shall be finished with 12mm thk Corian and the front apron of the table which shall have onyx stone and inlay design as mentioned. The drawer unit shall be finished with 4.0mm thk laminate with melamine polish & internal surfaces shall be finished with 0.8mm thk laminate including making the necessary openings for wires of telephone boards, PC, grooves, mouldings, etc complete.

52. Notice Board - (3'-0 "X 2'-0")

Providing & fixing in position Notice display board. The same shall be made out of 6 mm thk commercial ply for back & soft board covered with fabric of approved shade and make as per architect's instruction. The board will have clear glass shutter openable on pivit hinges complete with lock and handle etc complete as per architects instructions.

53. Wall mounted Brochure rack.

Providing & fixing in position wall mounted brochure rack as per architect's instructions and general / standard design template of SBI General Insurance Co Ltd

54. Acrylic panel on S.S. studs (2'0"x2'6")

Providing & fixing 2 layers of sandwich 6 mm thk hard strength acrylic sheet to be fixed over S.S studs etc complete

55. Suggestion box (Size 18" x 15")

Providing & fixing 6" depth Suggestion Box in 19mm thk Commercial Ply with 1 mm laminate finished inside & outside as per Architect instruction including necessary locking arrangements, hinges of approved makes etc complete and mounting arrangement on walls as per directions of the Architect

56. Full Height Storage - Laminate Finish (450mm Deep)

Providing and fixing Full height Storage of height approximately 7'-0" and 450mm depth at locations as specified in the drawings as per specification below.
Skeleton - made out of 19 mm. thk marine ply at end verticals, top and bottom and verticals 450mm to 600mm Centres and 6 mm thk back marine ply.
SHELVES - 19mm Thk. marine Plywood top and edges finished in 1.0mm thk. Laminate to accommodate file height removable and supported on pins.
SHUTTERS-made out of 19mm thk. marine ply externally and internally finished with 0.8 mm thk laminate as shown or directed.
HINGES - Each shutter shall have 100mm long oxidised brass butt hinges. Mimimum 4 nos. hinges for each of the shutter for Full height Storage and 3 Nos. hinges for each of the shutter for Low Height Storage to be provided.
BOLTS - Flush tower bolts from inside at top and bottom to the shutters and magnetic catch fixed top and bottom.
LOCKS - of approved make 4 -lever brass body dead lock with S.S. Key.
HANDLES - Concealed handles minimum of 100mm wide as approved by the Architect.
SKIRTING -As instructed by Architect, in marine plywood finished in Laminate.

57. Pigeon coup in laminate finish.

Providing & fixing in position pigeon coup of size as per directions to be made out of 19 mm commercial ply and covered with 1 mm thk. Laminate of approved shade for aprons, top, shutter etc completed as per details & architect's instruction.

58. Overhead storage - Laminate finish Providing and fixing Overhead Storage of ht. 2'-0" or as desired and depth of 375mm as per specification below.Skeleton - made out of 19 mm thk Commercial Plywood at end verticals, top and bottom and verticals 450mm to 600mm Centres as directed SHELVES - At appropriate locations in 19mm Thk. Commercial Plywood top and edges finished in 1.0mm thk. Laminate to accommodate file height removable and supported on pins (To carry a load of 10-15 kgs). SHUTTERS- Made out of 19mm thk. Commercial Plywood externally finished with 1.0mm thk laminate and Internally finished in 1.0 mm thk. Laminate as directed.HINGES - Each shutter shall have 2-3 Nos. hinges to be provided as per directions.BOLTS - Flush tower bolts from inside at top and bottom to the shutters and magnetic catch fixed top and bottom.LOCKS - of approved make 4 -lever brass body dead lock with S.S. Key.HANDLES - Concealed handles minimum of 100mm wide as approved by the Architect.

59. Lunch counter

Providing 2'-0" wide lunch counter in ply to be finished with 18mm thk jet black granite for the top and 1.0mm thk approved laminate for the remaining exposed areas including the necessary supports in ply to be finished with 1.0mm thk laminate including neccesary hardware, half round moulding /

nosing to and for the jet black granite top to be provided for the entire front areas of the counter & supports, hardware etc complete

60. **Shutter below Granite counter - Laminate finish**
Providing & fixing shutters made out of 19mm thick marine ply (IS 303) with 19mm x 12.50mm beading all around with 1mm thick laminate finished for storage below Granite counter including melamine polish etc including all necessary hardware such as higes ,concealed handle. The rate shall be inclusive of providing & fixing modular S.S service trolleys below with standard sliding channel sections as per manufacturers specifications for the complete length and height of the counter including shutters in marine plywood including the necessary t.w frame etc complete.

61. **Pantry SS Sink bowl**
Providing & fixing of Nirali / Omni / equivalent make, Big 18"x18" bowl size SS sink bowl with all necessary acc. i.e. waste coupling, flexible drain pipe, Pillar cock, Stop Cock etc. Complete.

62. **Slotted angle storage racks**
Providing & installation of metal slotted angle racks finished with powder coated paint with all necessary hardware, etc complete. Height 7'0", Depth 15" to be considered. Loading capacity should be 80kg UDL / level

63. **Bed Side Table (0.60 x 0.45 x 0.35m)** Providing and supplying side table in 19mm thk. ply with drawer finished with approved 4.0 mm thk high end laminate and all internal surface finished with 0.8 mm thk laminate. All necessary brass fittings such as handles channels, etc. complete as per design & instructions of Engineer in charge.

64. **Wardrobe**
Providing and fixing wardrobe made out of 19mm thk. ply for sides, shelf, shutters, top & bottom and 6mm thk. marine ply back. 6" drawer shall be provided with sliding chanels, handle & lock. 3" x 11/2" t.w.skirting shall be provided at bottom. Shutters & exposed sides shall be finished with approved 4.0 mm thk high end laminate with melamine polish including 1/2" x 1/2" t.w. moulding finished with polish including hinges, handles, ball catches, tower bolt, locks etc. complete. All internal surfaces shall be finished with 0.8 mm thk laminate. S.S. hangar rod shall be provided at top of the wardrobe shall be in two compartments with shutters to each compartment.
The double compartment to have space for hangers on drawer in the centre and space for keeping the luggage in the bigger compartment & space for small water cooler (freezer - which shall however be bought out by the bank and to be paid for seperately if included under the contractors scope), the space for pillow linen / blankets etc & shall be accomodate vending machine (Vending machine which shall however be bought out by the bank and to be paid for seperately if included under the contractors scope) within the compartment. Complete as per the drawing & instructions of Engineer in charge.

65. **Dressing Table** Providing and supplying dressing tables to be made out of 19mm thk. ply top and the sides including 3" high drawer. All the external surfaces finished with 4mm thk approved high end laminate & melamine polish & internal surfaces with natural polish. 1" x 1" t.w.beading shall be fixed on table top edges. All the necessary brass fittings such as hinges, ball catches, locks etc. complete as per instructions. Providing Mirror of size - 2' x 4' over the work table to be fixed on wall with t.w. 1" x 11/2" member having rounded edges etc. complete as per instructions of Engineer in charge.

66. **Bunk Beds (0.90 x 2.00m)** Providing and supplying Bunk Beds comprising of lower and upper beds to be made out of 19mm thk ply box all around finished with approved 1.5 mm thk Laminate including 3" x 3" t.w. supporting legs to be provided for lower bed and continue on all the four corners upto the upper bed and 3" x 2" t.w. frame bothways below the lower as well as the upper bed to be covered with 19mm thk ply boxing and to be finished with 1.5 mm thk laminate including 4" thk. m.m. foam matress covered with white cloth finish etc complete as per design / instructions of the Engineer in charge for both the lower bed as well as the upper bed. The rate shall be inclusive of Providing and fixing head board in 19mm thk. ply 18" ht x 6" deep for both the lower and upper bed including T.W railing for the upper bed and all exposed surfaces to be finished with 1.5mm thk approved laminate and with polish for the T.W railing with t.w. turning members of 1" dia as per design & instructions of Engineer in charge to be finished with approved leatherite of approved design, texture, shade etc complete including inlays as per directions and instructions of the Architect

67. Providing and fixing **Low height Storage** of ht. 2'-6" or 4'-0" as desired and depth of 16" or 18" as specified in the drawings as per specification below. Skeleton - made out of 19 mm thk plywood at end verticals, top and bottom and verticals 450mm to 600mm Centres as shown in drawing and 6 mm thk back ply.
    SHELVES - 19mm Thk. Plywood top and edges finished in 0.8mm thk. Laminate to accommodate file height removable and supported on pins.
    SHUTTERS-made out of 19mm thk. ply externally finished in 3.0mm thk. laminate with polycoat polish and Internally finished in 0.8 mm thk. Laminate as shown or directed.
    HINGES - Each shutter shall have 100mm long oxidised brass butt hinges. Mimimum 4 nos. hinges for each of the shutter for Full height Storage and 3 Nos. hinges for each of the shutter for Low Height Storage to be provided.
    BOLTS - Flush tower bolts from inside at top and bottom to the shutters and magnetic catch fixed top and bottom.
    LOCKS - of approved make 4 -lever brass body dead lock with S.S. Key.
    HANDLES - 100mm wide handles of brass as approved by the Architect.
    SKIRTING -As instructed by Architect, in plywood finished in approved 3.0 mm thk laminate with polycoat polish.
    BACK - Back side of storage to have 6mm thk. MR grade commercial ply with polish finish. The finishes for the Low height storage unit as duly mentioned above shall comprise of the following types: -
    Providing & Fixing for all the external surfaces and exposed woodsurfaces including the top shall be finished with 3.0 mm thk high end laminate with melamine polish. Inside visible surfaces complete with 0.8mm thk Laminate. Top to have t.w. moulding finished with high end melamine polish as instructed.

Technical Specifications for

GENERAL INTERIOR FURNISHING & RENOVATION WORKS

1. The plywood wherever mentioned and considered in this estimate shall be Commercial ply board for all the items of Interior & Furniture works. The particle board wherever mentioned shall be exterior grade Particle board. The rate shall be inclusive of anti termite coating on all sides to plywood, teak wood & all the other wooden components of approved makes.
2. All internal frameworks shall be of Aluminium unless otherwise specified. AII exposed edges of Plywood shall be fixed with Teak Lipping as directed by Engineer-in-charge. The skinning shall be in 12 mm thk Exterior Grade Particle Board unless otherwise specified. All exposed veneer surfaces shall be finished with melamine polish of approved shade unless otherwise as specified. The minimum thickness of the veneer shall be 4.0mm & laminate shall be 1.5mm thk unless otherwise noted. The approved veneer shall be finished with natural melamine polish of minimum 2 coats to have desired finish unless otherwise as specified in the individual items.

3. Rate for partition to include the cost of framework 150 mm above false ceiling as required to fix the same to the ceiling slab for which no extra payment shall be made and the rate quoted shall be inclusive of the same. Measurement of Partition & Paneling shall however be limited upto the false ceiling level only & no separate payment shall be made for the work above the false ceiling level and the quoted rates shall be deemed to be inclusive of the same.

4. The rate shall be also inclusive of pattas & bands wherever instructed including the necessary framing/ openings for electrical, telephone & AC outlets. All the type of wall paneling enumerated below except glazed portion shall be provided & fixed in between the aluminium frames with 50 mm thk Rockwool slabs of density 96 kgs / cu.m of standard width as per the available clear distances between the existing frames as per manufacturers specifications including pins, adhesives, threads for fixing the slabs etc, sealing of joints, grooves, canvas treatment etc complete.

5. The measurements for all type of storages, wardrobes, credenzas & side units shall be measured in square metres i.e. length of the unit (Front Apron) X height of the unit. The measurements of false ceilings of all types shall be measured in terms of the total clear dimension of the false ceiling including the area of the vertical / inclined drops. No deduction for the cut-outs for lighting fixtures, smoke detectors etc shall be made upto a limit of 0.5 sq m of area. The table shall be measured in running metres length of front apron for the relevant items unless otherwise specified.

10.0 CINDER FILLING IN SUNKEN PORTIONS

Cinder shall be of best quality and shall conform to latest relevant IS specification. The material specification shall be as follows:

Cinder:

Cinder is well burnt furnace residue which has been fused or centered in to lumps of varying sizes. Cinder aggregates shall be well burnt furnace residue obtained from furnace using coal fuel only. It shall be sound clean and free form clay, dirt ash or other deleterious matter.

The average grading for cinder aggregates shall be as mentioned below:

IS Sieve Designation	% Passing	IS Designation	% Passing
20 mm.	100	4.75 mm	70
10mm.	86	2.36	52

Workmanship:

The cinder to be used for filling in sunken portions of toilets shall be free form clay, dirt ash or other deleterious matter. As soon as the work in toilet sunken portions has been completed and measured, and the sides and base has been treated for waterproofing, the sunken portion shall be cleared of all debris, brick bats, mortar dropping etc. and filled with cinder in layers not exceeding 15 cm. Each layer shall be adequately watered, rammed well and consolidated before the succeeding layer is laid. The cinder shall be rammed with mechanical rammer of different capacity as per site condition.

When filling reaches finished level, the surface shall be flooded with water for at least 24 hours and allowed to dry and then rammed and consolidated. The finished level of filling shall be kept to shape and gradient, intended to receive any floor finish.

Mode of Measurements:

The payment shall be made for filling in sunken portions of toilets and similar locations. No deductions shall be made for shrinkage or voids, if considered as instructed above. The rate includes the cost of mechanical compaction by compactors.

Rate:

The rate includes the cost of materials and labour involved in all the operations involved above including all scaffolding, staging etc. complete.

11.0 VENEER MOULDED HDF DOOR SHUTTERS

Materials:

Veneer moulded HDF door shutters shall conform to IS 15380:2003 and 35mm thick to be fitted with Stainless steel butt hinges and necessary stainless steel screws. The stiles and rails shall be chemically treated and kiln seasoned to impart strength and provide resistance from termite and borer attacks.

All Veneer moulded HDF doors shall be solid core unless otherwise specified. The Veneer moulded HDF doors shall have 4mm face veneers bonded with phenol formaldehyde synthetic resin with core made up of solid hardwood of 1st class on both sides of the shutter. The finished thickness of the shutter shall be as mentioned in the items. Face veneers shall be of the pattern and colour approved by the engineer-in-charge and an approved sample shall be deposited with the Engineer- in-charge for reference.

The under veneers shall be of good quality, durable, well seasoned and chemically treated. The face veneer shall be of minimum 1 mm thickness and of well matched and seasoned wood, laid along with grains of the core patterns. The combined thickness of all the veneers on each face shall not be less than 4 mm. thermosetting synthetic resins conforming to IS: 303 for moisture proof plywood shall be used in manufacture. In case of decorative shutter, 0.45mm selected teak veneer shall be fixed over face veneer of 1mm.

Workmanship:

Ready made shutters shall be of correct size and shall be fitted into the door frames without excessive scraping of edges. Adding of battens etc to make up to the size shall not be allowed.

The fixture and fastening shall be : 10 guage Stainless steel butt hinges of heavy quality 10 cm size – min 3 no. to be provided for 2.1m height or as recommended by manufacturer.

Other fixtures and fitting like locks, handle etc shall be paid in relevant item.

Mode of Measurements:-

The dimensions of the shutter correct to nearest cm shall be measured for both breadth and height. Square meter area of the shutter shall be calculated and rounded off to two decimal places. Area of one face shall be measured for payments. No deduction will be made for openings upto 0.40 sqm. Nor shall extra payment be made either for any extra material or labour involved in forming such openings.

Rate:

The rate includes the cost of materials and labour involved in all the operations involved above including all scaffolding, staging etc. complete.

12.0 10MM THK TOUGHENED PLAIN GLASS FOR RAILING

The SS railing shall have 10 mm thk toughened glass with frosted film as per the design and pattern approved by site in charge shall be fixed on baluster with double brackets.

Toughened glass is 4 to 5 times stronger than its equivalent thickness of normal annealed float or sheet glass. It offers great resistance to sudden temperature changes and sudden impacts.

Float glass on international quality conforming to BS 952 Part – I for clear and tinted glass and of the thickness specified in the item shall be used for manufacturing toughened glass. Toughening, which shall be carried out horizontally (without tong-marks), shall conform to ASTM 1048.

All works such as cutting, grouting, drilling etc. On glass shall be carried out prior to toughening. Once tempering is done, cutting, drilling etc. will be allowed on the glass.

Measurements:

The height and width of toughened glass shall only be measured as fixed in place correct to one centimeter and area calculated in sqm. correct to two places of decimal shall be taken for payment.

Rate:

The rate includes the cost of materials and labour involved in all the operations involved above including all scaffolding, staging etc. complete.

13.0 LIST OF INDIAN STANDARD CODES

MATERIALS

Materials used shall conform to appropriate standard specified by the Indian Standard Code (Latest IS Code) and unless otherwise specified, these standards will form apart of these specifications. In particular the following standards have been referred to.

AGGREGATE:

IS	383	Specification for coarse and fine aggregates from Natural resource for concrete
IS	515	Specification for natural and manufactured aggregates for use in mass concrete
Is	1542	Specification for sand for plaster
IS	1607	Methods for dry sieving method of test for aggregates for concrete
IS Part-I	2386	Particle size and shape
IS Part-II	2386	Estimation of deleterious material organic impurities
IS Part-III	2386	Specific gravity, density voids
IS Part-IV	2386	Mechanical properties
IS Part-V	2386	Soundness
IS Part-VI	2386	Measuring Mortar making properties of fine aggregate
IS Part-VII	2386	Alkali aggregates reactivity
IS Part-VIII	2386	Petrographic examination

CEMENT:

IS	269	Specification for ordinary rapid hardening and low heat Portland cement
IS Part I & II	1489	Specification for port land pozzolana cement
IS	455	Specification for port land blast furnace slag cement
IS	4032	Method of chemical analysis of hydraulic cement

CONCRETE:

IS	1199	Methods of sampling and analysis of concrete
IS	516	Methods of test for strength of concrete

REINFORCED CONCRETE:

IS	456	Code of practice for plain and reinforced concrete general for building construction
IS	4926	Ready Mix - Code of practice

STEEL REINFORCEMENT:

IS	432	Specification for mild steel and medium tensile steel bars and hard drawn steel wire for concrete reinforcement
IS	432	-DO- Part I
IS	432	-DO- Part II
IS	816	Code of practice for use of metal welding for general construction in mild steel
IS	1786	Specification for cold twisted steel bars for concrete reinforcement (revised)

BRICK MASONRY:

IS	1905	Code of practice for structural safety of building masonry walls

DOORS AND WINDOWS:

IS Part -I&II	1003	Specification for timber paneled and glazed doors, windows and Ventilators
IS	1081	Code of practice for fixing and glazing of metal steel and aluminum doors, windows and ventilators
IS	2119	Code of practice for construction of brick cum concrete composite (Madras Terrace) floor and roof
IS Part-I&II	2202	Specification for wooden flush door shutters (Solid core type)

FLOOR AND FLOOR FINISHING:

IS	1443	Code of practice for laying and finishing cement concrete
IS	3365	Specification for floor polishing machines
IS	15622	Specification for pressed ceramic tile
IS	13712	Specification for ceramic tiles, definition, classification, characteristic and marking
IS	1130	Specification for marble (blocks, slabs & tiles)

WATER SUPPLY PIPES AND DRAINAGE:

IS	2065	Code of practice for water supply in buildings
IS	1742	Code of practice for building drainage
IS	1172	Code of basic requirements for water supply drainage and sanitation
IS	783	Code of practice for laying concrete pipes
IS	458	Specification for concrete pipes
IS Part-I	4111	Code of practice for ancillary structures in sewerage system part I manhole
IS	4111	Code of practice for ancillary structures in sewerage system part-I flushing tanks
IS	778	Gunmetal gate, globe and check valves for water steam and oil (not intended for use in petroleum industry)
IS	2692	Ferrules for water services
IS	780	Sluice Valves for water work purposes
IS Part-I	2556	Vitreous sanitary appliance (vitreous china) Part-I general requirements
IS Part-II	2556	-do- Part-II specific requirements of wash down water closets
IS Part-III	2556	-do- Part-III specific requirements of squatting pins and traps
IS Part-IV	2556	-do- Part-IV specific requirements of wash basin
IS Part-VI	2556	-do-Part-VI specific requirements of urinals
IS	15778	Chlorinated Polyvinyl Chloride (CPVC) pipes for potable hot and cold water distribution supplies specification

Note:

1. The above list is meant for ready reference and shall not be deemed as exhaustive and complete
2. The above note applies wherever list of IS codes are given in the specifications.

ITALIAN MARBLE WORK

Italian Marble so selected shall be hard, sound, dense and homogenous in texture with crystalline texture as far as possible. It shall generally be uniform in color and free from any stains, cracks, decay & weathering. The material shall be got approved from the Engineer-in-charge.

Approval: -

Before starting the work the contractor shall get the samples of Italian Marble approved by the Consultant / Client. The approved samples shall be kept in the custody of the Engineer-in-charge and the Italian Marble supplied and used on the work shall confirm to the samples with regard to the soundness, color, veining and general texture.

Sampling: -

In any consignment all the marble slabs 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 specifications.

Dressing of the Slabs: -

Every Italian marble slab shall be cut to the required size & shape, fine chisel dressed on all sides to the full depth so that a straight edge laid along the side of the shall be fully in contact with it. The top surface shall also be fine chisel dressed to remove all waviness. In case machine slab cut are used, fine chisel dressing of machine cut surface need not be done provided a straight edge laid anywhere along the machine cut surfaces is in contact with every point on it. All angles and edges of the Italian marble slab shall be true, square and free from chippings and the surface shall be true and plane. The thickness of the slab shall be a minimum of 18mm as specified in the description of the item.

Laying: -

Base shall be cleaned, wetted and mopped. The bedding for the slabs/walls shall be with cement mortar 1:4 (1 white cement: 4 coarse sand). The average thickness of the bedding mortar under the slab shall be 25 to 30mm. The slabs shall be laid in the following manner: -

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness. The slab shall be washed clean before laying. It shall be laid on the top, pressed, tapped with wooden mallet and brought to the level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar of the same matching colour at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same. The edges of the slab already paved shall be buttered with grey or white cement or matching colour with or without admixtures of pigments to match the shade of the marble slab.

The slab to be paved shall then be lowered gently back in the position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in similar manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels and slopes as instructed by Consultant / Client.

Due care should be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of veins / streaks or as directed.

The junction between wall plaster and floor shall be finished neatly and without waviness. Seller for anti-stain shall also be added to ensure stain free slab finish.

Polishing and Finishing: -

Slight unevenness at the meeting edges of slabs shall then be removed by fine chiseling and finished in the same manner except that cement slurry with or without pigments shall not be applied on the surface before each polishing. 18mm thk POP protective cover shall be laid on the surface and removed as and when directed by the Engineer-in-charge.

Measurements: -

Italian marble with different kinds shall be measured in square meters. No deduction shall be made nor extra paid for voids not exceeding 0.20 square meters. Nothing extra will be paid for the level differences. Nosing if provide, will be paid extra on meter run for the job executed.

Rate

The rate includes the cost of materials and labour required for all the operations i/c wastage, height, cutting, finishing & polishing etc complete

LAMINATED WOODEN WORK

Providing laminated wooden Flooring with the following Specifications:

Type: -Original-Vintage
Thickness: -8 to 9mm thk
Weight: -8.2 kg/sq mts.
Core Material: -HDF regular

Backing: -Sound Bloc CS

Material Properties: -

The material shall have a wear resistance, impact resistance, indentation resistance, resistance to rolling castors, resistance to furniture legs, stain resistance, resistance to burning cigarettes, slip resistance and resistance to color fading.

Apart from the above properties, the material shall have following additional properties: -

Dimensional Stability:	Less than 0.9 mm
Surface Soundness: -	More than 1.0 N per sq mm
Impact Sound Resistance: -	17 to 19 dB
Thermal Insulation: -	0.07 sq mts
Electrostatic charge: -	4 KV and
Thickness Swelling: -	Less than 12%.

Material Storage & Pre-requisites: -

The material shall be stored in unopened packages at normal room temperature at least 0.5m from the walls, for at-least 48 hours prior to the installation. The contractor shall ensure that the boards are undamaged and free from any faults before installation. The contractor shall use felt pads and castor cups on furniture legs and provide external doormats inside all the external doorways to protect the floor at the time of handover. A maintenance guide of the approved company shall be made available any time and handed over to the client at the time of handover.

Material Installation: -

The normal method of installation of laminated wooden flooring is in a random installation pattern taking into consideration the type of installation pattern desired for the purpose of aesthetics or any technical reasons. The desired temperature in the room at the time of installation shall be at least 18 deg C and RH in the range of 30 to 80%. The joinery is tongue & grooved in an interlocking pattern including beading at the end. A teak moulding of size 45 X 45 shall be provided and installed at the joinery junction of the wall and the floor as per the approved manufacturer's specifications. The quoted rate shall be inclusive of leveling the surface, polishing etc complete to the satisfaction. Underlay shall be provided as per manufacturer specification.

MEASUREMENTS: -

Length and breadth of superficial area of the finished work shall be measured correct to a cm. The area shall be calculated in square metre correct to two places of decimal. No deduction shall be made nor extra paid for voids not exceeding 0.20 square metre. Deductions for ends of dissimilar materials or other articles embedded shall not be made for areas not exceeding 0.10 square metres.

Rate: -

The rate shall include the cost of the labour and materials involved in all the operations described above

VITRIFIED TILES /GRANITE STONE WORKS: -

These items are modified DSR items, hence CPWD specification shall be followed for the work. However the thickness of the mortar shall be as specified in the item of BOQ. Granite/Vitrified shall be hard, sound, dense and homogenous in texture with crystalline texture as far as possible. It shall generally be uniform in color and free from any stains, cracks, decay & weathering. The material shall be got approved from the Engineer-in-charge.

Approval: -

Before starting the work the contractor shall get the samples of Granite/Vitrified tiles approved by the Consultant / Client. The approved samples shall be kept in the custody of the Engineer-in-charge and the materials supplied and used on the work shall confirm to the samples with regard to the soundness, color, veining and general texture.

Measurements: -

Measurement shall be as per CPWD specifications.

MAIN FRAMELESS DOOR & FIXED GLAZING: -

Providing and Erecting in position Fully Glazed Double Leaf Frameless Door with 12mm thk clear toughened glass with Dorma patch fittings such as Bottom Patch PT 10 with SS covers-2 nos, Top Patch PT 10 with SS covers-2 nos, Patch with plate PT 30-1 no, Over Panel Patch PT 40with SS covers-1 no, Corner Lock US 10 with SS covers-2 nos, Lock keeper plate -5.190-2 nos, Floor Spring BTS 75V with standard spindle screws and SS cover plates-2 nos, Pull Handle TGDI30033S (40mm dia X Full Height of the door)-2 pairs, PFF GT1-Ceiling / Façade Bracket-14 nos, Aluminum U Channel-13 mts. Gap of 3.5mm to be maintained between every two glass panels.

Patch fittings of any approved make with similar feature may also be accepted. Gaps to be sealed with clear silicone sealant. Before sealing the gaps, masking tape to be stuck on the edge of the glass in such a way that only the gap is visible. Any spillage of the sealant while sealing the gaps is only on the masking tape which shall be peeled off after the silicone sealant in the gap between the glasses is dry. The contractors shall note that all damages to the floor work to be reinstated without any extra cost including making & filling of the necessary holes etc complete to the satisfaction.

Measurements: -

The length and breadth of the finished work shall be measured in metre correct to cm. The area shall be calculated in Sq.M. nearest to two places of decimals.

Rate: -

The rates include the cost of materials and labour required for all operations including wastage, heights, cutting, finishing etc complete.

SIPOREX MASONARY WALL: -

Providing and constructing 150 mm thk Siporex light weight concrete block masonary in superstructure, blocks conforming to BIS : 2185 (Part III), BIS 6041 having minimum crushing strength 75 kg / sq cm in cement mortar 1:6 (1 cement : 6 coarse sand) mixed with approved non shrinking compound as per manufacturer's instructions including providing RCC patli beam of 150 X 100 mm size at every 1.0 mts centres with 2 nos, 8mm dia Tor bars and 6 mm dia links at 300 mm centres in cement concrete of mix M 20 including the required formwork complete with raking out of joints, curing, double legged scaffolding as per specifications at all the heights, depths & leads & lifts as per the directions & satisfaction of Engineer-in-charge

PLASTER OF PARIS FINISH

Description:
Providing & Applying Plaster of Paris (POP) in a paste form up to average thickness of 6 mm thick and level the surface on the existing plastered surface to proper line & plumb, including making grooves etc complete. The surface of the under coat on which the POP is to be done shall be left rough. The POP paste shall be applied on dry plastered surface in two layers slightly more than 3 mm thick each between gauged pads, with which to ensure an even and uniformly thick surface of 6 mm by frequent checking with a wooden straight edge. It shall be finished to an even and smooth surface with trowels.

All corners, arises, angles and junctions shall be truly vertical and horizontal as the case may be and shall be carefully and neatly finished. Rounding or chamfering corners, arises, 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. No portion of the surface shall be left out initially to be patched up later on.

Thickness:
The thickness of the finished surface shall not be less than 6mm thick.

Precaution:
Any crack which appears in surface and all portions which sound when taped or are found to be soft or otherwise defective shall be cutout in rectangular shape & re-done as directed by Engineer-in-Charge.

Mode of Measurements:

The measurements for POP finish shall be taken over the finished work. The length and breadth shall be measured correct to a cm. The area shall be calculated in sq.m. correct to two places of decimal

Deductions in measurements for openings shall be regulated generally as per CPWD specification for measurement of cement plaster.

Rate:
The rate shall include the cost of all labour, materials scaffolding etc involved in all the operations described above.

GENERAL NOTES FOR INTERIORS AND FURNISHINGS

1 The plywood wherever mentioned and considered in this estimate shall be IS 303 MR grade Commercial Plywood for all the items of Interior & Furniture works. The particle board wherever mentioned shall be exterior grade Particle board. The rate shall be inclusive of anti termite coating on all sides to plywood, teak wood & all the other wooden components of approved makes.

2 All internal frameworks shall be of Aluminium unless otherwise specified. AII exposed edges of Plywood shall be fixed with Teak Lipping as directed by Engineer-in-charge. The skinning shall be in 12 mm thk Exterior Grade Particle Board unless otherwise specified. All exposed veneer surfaces shall be finished with melamine polish of approved shade unless otherwise as specified. The minimum thickness of the veneer shall be 4.0mm & laminate shall be 1.5mm thk unless otherwise noted. The approved veneer shall be finished with natural melamine polish of minimum 2 coats to have desired finish unless otherwise as specified in the individual items.

3 Rate for partition to include the cost of framework above false ceiling as required to fix the same to the ceiling slab for which no extra payment shall be made and the rate quoted shall be inclusive of the same. Measurement of Partition & Paneling shall however be limited upto the false ceiling level only & no separate payment shall be made for the work above the false ceiling level and the quoted rates shall be deemed to be inclusive of the same. The partitions to be erected shall be measured including the door of any desired size, shape & elevation and with all its standard fittings, fixtures, hardware etc complete. The door frame shall be measured and paid separately under the relevant item. In case of the glazed partition necessary SS hardware fittings, fixtures, floor spring, door closers, hinges, handles, locks for the door & including glass & finishing for the same are included in the glazed partition.

4 The rate shall be also inclusive of pattas & bands wherever instructed including the necessary framing/ openings for electrical, telephone & AC outlets. All the type of wall paneling enumerated below except glazed portion shall be provided & fixed in between the aluminium frames with 50 mm thk Rockwool slabs of density 96 kgs / cu.m of standard width as per the available clear distances between the existing frames as per manufacturers specifications including pins, adhesives, threads for fixing the slabs etc, sealing of joints, grooves, canvas treatment etc complete.

5 The measurements for all type of storages, wardrobes, credenzas & side units shall be measured in square metres i.e. length of the unit (Front Apron) X height of the unit. The measurements of false ceilings of all types shall be measured in terms of the total clear dimension of the false ceiling including the area of the vertical / inclined drops. No deduction for the cut-outs for lighting fixtures, smoke detectors etc shall be made upto a limit of 0.5 sq m of area. The table shall be measured in running metres length of front apron for the relevant items unless otherwise specified.

Technical Specifications for Variable Refrigerant Flow System.

1.0 SCOPE:

The scope of this section comprises the supply, erection testing and commissioning of Variable Refrigerant Flow System conforming to these specifications and in accordance with the requirements ofDrawing and Schedule of Quantities

2.0 GENERAL:

Units shall be air cooled, variable refrigerant volume air conditioner consisting of one outdoor unit and multiple indoor units. Each indoor units having capability to cool independently for the requirement of the rooms.

It shall be possible to connect minimum 10 indoor units on one refrigerant circuit. The indoor units on any circuit can be of different type and also controlled individually. Following type of indoor units shall be connected to Ceiling mounted Ductable type, High Wall Mounted type, 1 Way / 2 Way / 4 Way Cassette Type, FCU's, etc.

Compressor installed in outdoor unit shall be equipped with at least two inverter compressors up to 12.0 HP, four inverter compressors up to 24 HP and above this, six inverter compressors. The system shall be capable of changing the rotating speed of inverter compressor by inverter controller to follow variations in cooling and heating load.

Outdoor unit shall be suitable for mix match connection of all type of indoor units.

The refrigerant piping between indoor units and outdoor unit shall be extended up to 150m with maximum 50m level difference without any oil traps.

Both indoor units and outdoor unit shall be factory assembled, tested and filled with first charge of refrigerant before delivering at site.

The system selected is a modular system, with number of indoors connected to centrally locatedoutdoor units, as per detail designing given in the tender. The outdoor units for all the system shall beair cooled type and mounted on terrace of the building. Indoor units in various areas shall be as per enclosed drawings/ Bill of Quantities.

All the VRV air conditioners shall be fully factory assembled, wired, internally piped & tested. The outdoor unit shall be pre-charged with first charge of R 410A refrigerant.

Additional charge shall be added as per refrigerant piping at site. All the units shall be suitable for operation with 415 V + 10%, 50 Hz + 3%, 3 Phase supply for outdoor units & 220 V + 10%, 50 Hz + 3%, 1 Phase supply for indoor units.

The VRV system shall provide stable, trouble free & safe operation, with flexibility of operating desired indoor units. The outdoor units must be capable of delivering exact capacity proportional to the number of indoor units switched on & the heat load in the air conditioned area. The proportional operation shall be achieved by varying speed of the compressor in the outdoor units.

The operation of the VRV system shall be through independent wired/ wireless remote controllers as specified. The entire system shall be integrated with intelligent building management system of leading vendors like Honeywell/ Johnson Controls/ Staefa etc, through BACNET/LON WORKS Gateway. The detailing of operation required through BMS system are detailed under specifications of BMS system.

3.0 OUTDOOR UNITS.

Outdoors units of the VRV system shall be compact air cooled type.
All the compressors of the outdoor units must be hermetically sealed scroll type. The compressor shall be of the high efficiency complete scroll design. Each compressor shall have in-built overloads, HP andLP controllers and mounted on vibration isolators. Each module of outdoor unit must have combination of Inverter Scroll Compressor (variable speed) & Fixed Speed Scroll Compressor, suitable to operate at heat load proportional to indoor requirement. Maximum Capacity of single module shall be 18 HP and maximum number of Inverter Compressor per module shall be one.

"Coated PE Fins (with special acryl pretreatment)" for Al fins of Condenser Coils is mandatory for increased durability to salt corrosion.

The outdoor units must be suitable for up to 165 m (straight length) refrigerant piping between outdoor unit & the farthest indoor units, total piping of 1000 M for all the indoor units. Allowable level differencebetween outdoor unit & indoor units shall be 50 m in both case of outdoor unit on top and outdoor unit at bottom. Allowable level difference between various indoor units connected to one out door unit shall be up to 15 m.

Back up operation, in case of failure of one of the compressors of outdoor unit, for single module outdoor units or failure of one of the modules in case of multiple module outdoor units shall be possible. The VRV outdoor unit shall always be supplying at least 66% of the full load capacity.
The outdoor unit shall employ system of equal run time for all the compressors, inverter or on/ off type, within each outdoor unit – Single Module or Multi Module.

The outdoor units shall be suitable to operate within an ambient temperature range of – 5 Deg C to 43 Deg C, in cooling mode & -20 Deg C to 15 Deg C in heating mode.

Air cooled condenser shall have Axial Flow, upward throw fan, directly coupled to fan motors with minimum IP 55 protection. The outdoor unit condenser fan shall be able to develop external static pressure up to 7.84 mm of H2O.

The entire operation of outdoor units shall be through independent remotes of indoor units. No separate Start/ Stop function shall be required.

Inverter compressor of the unit shall start first & at the minimum frequency, to reduce the inrush current during starting.

Refrigerant control in the outdoor unit shall be through Electronic Expansion Valve.

Complete refrigerant circuit, oil balancing / equalizing circuit shall be factory assembled & tested.Noise level of outdoor units shall not exceed 65 dB (A) at a distance of 1.5 m from the unit.

The outdoor units shall confirm to Technological Guideline for Harmonic Suppression – JAEG 9702-1995.High Harmonic Environmental Target Level for Power Distribution system shall be 5%.
Outdoor units shall be complete with following safety devices:

- High pressure switch
- Fan driver overload protector
- Over current relay
- Inverter Overload Protector
- Fusible Plug

Unit shall be supplied with

- Installation manual
- Operation Manual
- Connection Pipes
- Clamps

4.0 INDOOR UNITS

Cassette type indoor units.

- These units shall be installed between the bottom of finished slab & top of false ceiling.
- The maximum allowable height for the cassette type units shall be 288 mm.
- The unit must have in built drain pump, suitable for vertical lift of 850 mm.
- The unit must have 3 – Speed fan motor
- The unit casing shall be Galvanized Steel Plate.
- The noise level of unit at the highest operating level shall not exceed 44 dB (A), at a vertical distance of 1.5

m from the grille of the unit.

- Unit shall have provision of connecting fresh air without any special chamber & without increasing the total height of the unit (288 mm maximum).
- The unit shall be supplied with suitable decorative panel. Decorative panel shall have coating that repels dirt.
- The unit shall be supplied with anti-mould and antibacterial treatment filter. The filter shall be easy to remove, clean & re install.
- The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the "Bill of quantities". The unit will be further connected to Intelligent Building Management System (To be suppliedby other vendors) & it shall be possible to operate the unit through this IBMS system.

Ceiling Mounted duct type units.

- These units shall be ceiling suspended with suitable supports to take care of operating weight of the unit, without causing any excessive vibration & noise. The cold air supplied by these unitswill be supplied to the area to be air conditioned, through duct system specified in the tender.
- Each indoor unit must have electronic expansion valve operated by microprocessor thermostat based temperature control to deliver cooling/ heating as per the heat load of the room.
- The unit casing shall be Galvanized Steel Plate.
- The noise level of unit at the highest operating level shall not exceed 46 dB (A), at a vertical distance of 1.5 m below the units with duct connected to the unit.
- The unit must be able to develop external static pressure of 25 mm, at the specified air quantities.
- The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

Wall Mounted Units.

- Each indoor unit must have electronic expansion valve operated by microprocessor thermostatbased temperature control to deliver cooling/ heating as per the heat load of the room.
- The unit must have provision of adding drain pump kit if required & specified. The drain pumpmust be suitable to lift drain up to 1000 mm from the bottom of the unit.
- The noise level of unit at the highest operating level shall not exceed 46 dB (A), at a verticaldistance of 1.5 m from the grille of the unit.
- The unit shall be supplied with Resin Net filter with Mold Resistance. The filter shall be easy toremove, clean & re install.
- The unit grille must be washable with soap solution.
- It shall be possible to set minimum 5 steps of discharge angle by remote controller.
- It shall be possible to fit drain pipe from either side of the unit (Left or right)
- The unit will be connected in series to a suitable outdoor unit & it must be possible to operate the unit independently, through corded/ cordless remote specified in the bill of quantities. The unit will be further connected to Intelligent Building Management System (To be supplied by other vendors) & it shall be possible to operate the unit through this IBMS system.

5.0 REFRIGERANT PIPING

- The indoor and outdoor units shall be connected with refrigerant piping. All piping connections for the units should be performed inside the unit. The refrigerant piping should be insulated with nitrile foam of minimum 13/19 MM thick.
- All refrigerant piping to be done with hard/soft copper pipes as per size.

6.0 DRAIN PIPING

- Condensate from the evaporator unit shall be drained through properly installed drain piping designed to prevent any accumulation of condensate in the drain pan. Drain piping of specified sizes and suitable of 6 Kg/Sq cm. pressure rating with water tight threaded connections, leading from the room unit to a suitable drain point. Complete drain piping shall be made leak proof andwater tight by means of precise installation

and the use of leak proof sealant/adhesives. Drain piping shall be insulated with 6 mm nitrile foam.

7.0 CONTROL SYSTEMS:

Wired Remote Controller.

- Wired remote controller shall be supplied as specified in the "Bill of Quantities"
- The controller must have large crystal display screen, which displays complete operating status.
- The digital display must allow setting of temperature with 1 Deg C interval.
- Remote shall be able to individually program by timer the respective times for operation startand stop within a maximum of 72 hours
- Remote must be equipped with thermostat sensor in the remote controller that will makepossible more comfortable room temperature control
- The remote shall be able to monitor room temperature & preset temperature bymicrocomputer & can select cool/ heat operation mode automatically.
- The remote must constantly monitor malfunctions in the system & must be equipped with a"self diagnosis function" that let know by a message immediately when a malfunction occurs.
- It shall be possible to wire the remote up to 500 RMT.

Wireless Remote Controller.

- Wireless remote controller shall be supplied as specified in the "Bill of Quantities"
- The same operation modes & settings as with wired remote controllers must be possible.Compact light receiving unit to be mounted into wall or ceiling shall be included.

8.0 SHEET METAL AND OTHER WORKS

Material

- Ducts shall be made of galvanized steel sheets.
- The galvanized steel sheets shall conform to I.S. 277 – 1965.
- Thickness of G.S.S. sheet shall be as given below:

Sl. No.	MAXIMUM SIZE (ANY SIDE)	THICKNESS (mm)	GAUGE
1	Under 750 (30")	0.63	24
2	(31") 750 – 1500 (60")	0.80	22
3	(61") 1525 – 2250 (90")	1.00	20
4	(91") 2275 - & above	1.25	18

Installation:

- Duct fabrication and installation shall generally conform to I.S. 655 – 1963. Contractor shall provide and neatly erect all sheet metal work as shown on drawings. Ducting over false ceiling shall be supported from the slab or from beams. In no case shall the duct be supported form theceiling hangers or be permitted to rest on a suspended ceiling.
- All ducts shall be rigid and shall be adequately supported and braced where required with standing seams, tees, or angles of ample size to keep the ducts true to shape and toprevent buckling, vibration or breathing. All joints shall be made tight and all interior surfaces shall be smooth.

Duct Design:

- Bends shall be made with center line radius not less than one half the width of the duct or with scientifically designed interior curved vanes, or air foil type turning vanes in square elbows, as approved. The vanes shall be so spaced that the aspect ratio of each of the individual elbows formed by the vane will be about five. All tapers to be at 15 deg angle, preferably, or at worst, 1:4 ratio.
- Supply and return air branches shall be provided with manually operated dampers.

GRILLES & DIFFUSERS

- All air terminal devices mentioned in tender documents shall be made out of extruded Aluminum with high quality finish and powder coated with approved make color. Similarly the volume control damages shall also be made out of heavy guage aluminum sections joined perfectly at 45 deg. Angle without any gap.
- All supply/return air grilles and diffusers shall be as per the approved list with powder coated paint of approved color. Further the successful contractor shall submit a sample of grille/diffuserfor the approval of the owners before undertaking the manufacturing of the total required number of pieces. These shall be sized within limits of sound pressure level NC-32 curve is typical room having average alternation of 8 dB. Each supply air diffuser shall be complete with flow equalizer and separate volume control damper operable from ceiling level.
- Continuous grilles shall butt with hairline joints and be provided with interlocking splines.

Installation of Grilles:-

- Installation of grilles / diffusers shall be done by the air conditioning contractor irrespective of the type/model of false ceiling systems the diffusers will have to be individually suspended from the ceiling slab an aligned to match the ceiling line level.

FRESH AIR / EXHAUST AIR LOUVERS

- Extruded Aluminum construction duly anodized (20 microns and above) fresh air louver withbird screen, with aluminum damper shall be provided in the clear opening of the masonry walls. Gravity shutters made out of heavy guage (1.2 mm) aluminum frame and blades of samematerial shall be provided with every wall-mounted fan.

TESTING & BALANCING

- After completion all duct systems shall be tested for air leakage. The entire air distribution system shall be balanced to supply return or exhaust the air quantities as required in the various regions to maintain the specified room conditions.

9.0 INSULATION

General:

The insulating materials shall be manufactured by the approved manufacturers and specifically intendedfor the services specified.
The thickness of insulation shall be as specified. When thickness specified are more than 60 mm, thenmultilayer insulation with inner layer of 50 mm thickness is to be applied.

Recommended Thickness-

Thickness of insulating Material will be as under

Ducts	Material
Unconditioned Area	FR, Chemically Cross – Linked, PE Sheets of 19 mm Thickness – Factory laminated with Aluminum Foil, and Adhesive Backing.
Conditioned Area	FR, Chemically Cross – Linked, PE Sheets of 13 mm Thickness – Factory laminated with Aluminum Foil, and Adhesive Backing.
Exposed Duct	FR, Chemically Cross – Linked, PE Sheets of 25 mm Thickness – Factory laminated with Aluminum Foil, and Adhesive Backing.
Air Plenums	Fiberglass (density 48 kg/m3) thickness 25 mm + FRP Tissue Paper + Aluminum Perforated Sheets
Acoustic Lining	Fiberglass (density 48 kg/m3) thickness 25 mm + FRP Tissue Paper + Aluminum Perforated Sheets

Technical Specifications for Electrical works

A. GENERAL

1.0 The following Technical Specifications are made applicable for the Stated Job and shall be rigidly adhered to while supplying and installing the materials at site.

1.1 Codes and Standards:

1.1.1 The following Codes and Standards shall be applicable for continuous performance of all electrical equipment's to be supplied, delivered at site, erected, tested and commissioned. The Electrical equipment's offered shall comply with the relevant IndianStandard Specifications, Fire Insurance Regulations, Tariff Advisory Committee's Regulations, and in particular to Indian Electricity Rules in all respects with all its latest amendments up-to-date.

1.1.2 For guidelines to the tenderers, few of the Indian Standards are indicated below:

IS 8084 / 1976	Interconnecting bus-bars for A.C voltage above1KV up to & including 36KV.
IS 13032 / 1991	A.C miniature circuit breaker board for voltagenot exceeding 1000V specification.
IS 3043 / 1987	Code of practice for earthing.
IS 3427 / 1997	A.C metal enclosed switchgear & control gearsfor rated voltage above 1KV up to & including 52KV.
IS 3837 / 1976	Accessories for rigid steel conduits for electrical wiring.
IS 13947 / Part3 / 1993	Specification for low voltage switchgear & control gear.
IS 13947 / Part1 / 1993	Specification for low voltage switchgear & control gear.
IS 4615 / 1968	Switch socket outlets (Non-Interlocked type).
IS 5216 / Part1, 2 /1982	Guide for safety procedures & practices in electric work.
IS 5578 / 1984	Guide for marking of insulated conductors.
IS 5820 / 1970	Specification for precast concrete cable covers.
IS 6381 / 1972	Specifications for construction & testing of electrical apparatus with type of protection 'e'.
IS 10322/ Part1, 2/1982	Specification of luminaries.
IS 10322 /Part3, 4/1984	Specification of Laminaries.
IS 10322/Part5 (Sec1,2)/1985	Specification of Luminaries.
IS 10322/Part5 (Sec3 to 5)/1987	Specification of Luminaries
IS 13947 / Part1 / 1993	Specification for low-voltage switchgear & control gear.
IS 13703 / Part4 / 1993	Specification for low voltage fuse for voltages not exceeding 1000V AC or 1500V DC.
IS 2551 / 1982	Danger notice plates.
IS 2268 / 1994	Call bells / Buzzers.
IS 732 / 1989	Code of practice for electrical wiring installation.
IS 3854 / 1997	Switches for domestic & similar purpose.
IS 2312 / 1967	Exhaust fans.
IS 2309 / 1989	Code of practice for lighting production.
IS 2418 / Part1 to 3/1977	Tubular fluorescent lamps for general lighting service.

IS 1937 / Part3 / 1983	Conduits for electrical installations.
IS 13032 / 1991	AC miniature circuit breaker board for voltagenot exceeding 1000V.
IS 2667 / 1988	Fittings for rigid steel conduits for electrical wiring.
IS 2675 / 1983	Enclosed distribution fuse boards cutouts for voltage up to 1000V.
IS 2706 / Part1 to 5/1992	Current transformers.
IS 15086 / Part1 / 2001	Surge arresters.
IS 13925 / Part1 / 1998	Shunt capacitors for AC power systems having a rated voltage above 1000V.
IS 13118 / 1991	Specification for HVAC circuit breakers.
IS 374 / 1979	Ceiling fans.
IS 5578 / 1984	Guide for marking of insulated conductors.
IS 418 / 1978	Tungsten filament general service electricallamp.
IS 694 / 1990	PVC insulated cable & cords for power / lighting.
IS 13010 / 2002	A.C watt-hour meters.
IS 732 / 1989	Electrical wiring installation (up to 650V).
IS 10870 / 1984	Code of safety for hexane.
IS 1248 / Part1 / 1993	Direct acting indicating instruments & their accessories.
IS 1248 / Part2, 6 /1983	Direct acting indicating instruments & their accessories.
IS 1248 / Part7, 8/1984	Direct acting indicating instruments & their accessories.
IS 1248 / Part9/1983	Direct acting indicating instruments & their accessories.
IS 1293 / 1988	3 pin plugs & socket outlets.
IS 1554/Part1 to 3/1988	PVC insulated cables – heavy duty.
IS 13947/Part 1 to 5/1993	Low voltage switchgear & control gear.IS
1651 / 1991	Lead acid cell batteries.
IS 9537 / Part 5 / 2000	Conduits for electrical installation.

The entire electrical installation work shall be strictly complied with the Codes Standards, Rules and Regulations framed under the Indian Electricity Act. Further, itshall be carried out as per the Regulations and Rules set out by "Tariff Advisory Committee and/or Fire Insurance Regulations".

Any other IS Codes As applicable at the time of execution over and above whateverstated above. Some of the Rules framed under Indian Electricity Rules of 1956 andall amendments thereof more particularly complied to :-

35, 43, 44, 44-A, 45 (Part-I), 50, 51, 59, 61 (a), 61 (c), 62, 63 (2), 65, 66, 67, 68, 69 and 92 (2).

B. TECHNICAL SPECIFICATION FOR 33kV INDOOR VCB SWITCHGEAR

1.1 General requirements:

The manufacturer, whose 33 kV Indoor switch gear panels are offered should have designed, manufactured, type tested as per relevant IEC/IS, supplied and commissioned the Panels of similar rating. These Panels should have been in operation for at least two years as on the originally scheduled date of bid opening.

In addition to the requirements above, the Vacuum circuit breaker, CT, PT and relaysshould have been designed, manufactured and type tested as per relevant IEC/IS and should have been in satisfactory operation for at least two years as on the date of bid opening.

1.2 The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification but which are necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment/accessories shall be supplied without any extra cost. Also all similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.

Specific reference in this specification and documents to any Material by trade name,make, or catalogue number shall be constructed as establishing quality and performance requirements.

Equipment shall be installed in neat workman-like-manner so that it is levelled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established on Contractor's drawings or as stipulated by Employer. No equipment shall be permanently bolted down/ tag welded to foundation until the alignment has been checked and found acceptable by the Engineer. Contractor shall furnish all supervision labors, tools, equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time, required to completely install, test and commission the equipment.

Manufacturer's and Employer's instructions and recommendations shall be correctlyfollowed in handling, erection, testing and commissioning of all equipment.

Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No parts of structure shall beutilized to lift or erect any equipment without prior permission of Engineer.

Switchgear shall be installed on finished surfaces, concrete or steel sills. Contractor shall be required to install and align any channels sills, which form part of foundations. Circuit breaker trolley wheels shall move on channels, which shall formpart of floor. The channel length shall be minimum of 1 meter from the door of switchgear panel. Power bus enclosure, ground and control splices of conventional nature shall be cleaned and bolted together with torque wrench of proper size or by other approved means. Tape or compound shall be spilled where called for in drawings. Contractor shall take utmost care in handling instruments, relays and otherdelicate mechanisms. Wherever the instruments and relays are supplied loose alongwith switchgear, they shall be mounted only after the associated switchgear panels have been erected and aligned. The blocking materials, employed for safe transit of instrument and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Anydamage shall be immediately reported to Engineer.

Foundation work for all switchgear panels will be carried out by contractor.

1.3 Switchgear panel

1.3.1 The switchgear boards shall have a single front, single tier, fully compartmentalized, metal enclosed construction complying with IS: 3427:1997, comprising of a row of free standing floor mounted panels. Each circuit shall have a separate vertical panelwith distinct compartments for circuit breaker truck, cable termination, Main bus barsand auxiliary control devices. The adjacent panels shall be completely separated by steel sheets except in busbar compartments where insulated barriers shall be provided to segregate adjacent panels. However, manufacturer's standard switchgear designs without internal barriers in busbar compartment may also be considered.

1.3.2 The circuit breakers and Bus VTs shall be mounted on withdrawable trucks which shall roll out

horizontally from service position to isolated position.

1.3.3 For complete withdrawal from the panel, the truck shall rollout on the floor or shall rollout on telescopic rails. In case the later arrangement is offered, suitable trolley shall be provided by the Bidder for withdrawal and insertion of the truck from and into the panel.

1.3.4 Testing of the breaker shall be possible in isolated position by keeping the control plug connected.

1.3.5 The trucks shall have distinct SERVICE and ISOLATED positions. It shall be possibleto close the breaker compartment door in isolated position also, so that the switchgear retains its specified degree of protection. While switchboard designs withdoors for breaker compartment would be preferred, standard designs of reputed switchgear manufacturer's where the truck front serves as the compartment cover may also be considered, provided the breaker compartment is completely sealed from all other compartments and retains the IP-4X degree of protection in the Isolated position. In case the later arrangement is offered, the Bidder shall explain how this sealing is achieved and shall include blanking covers one for each size of panel per switchboard in his total bid price.

1.3.6 The truck in any position SERVICE, ISOLATED or removed, and all doors and covers closed. All doors, removable covers and glass windows shall be gasketted allround with synthetic rubber or neoprene gaskets.

1.3.7 The bus VT/ relay compartments shall have degree of protection not less than IP:4X in accordance with IS:13947. However, remaining compartments shall be dust, moisture, rodent and vermin proof, with degree of protection of IP:4X. All louvers if provided, shall have very fine brass or GI mesh screen. IPH-2 degree of protection as per IS: 3427:1997 to all live parts shall (whether isolated or removed from panel) even when the breaker compartment door is open. Tight fitting garments/gaskets areto be provided at all openings in relay compartment.

1.3.8 The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panelsshall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of its spreading to other compartments and panels. The pressure relief device shall not however reduce the degree of' protection of panels under normal working conditions. The bidder shall ensure satisfactory operation of pressure relief device in accordance with relevant IEC. The test reports for internal arc fault test forall HT chambers shall be submitted.

1.3.9 Enclosure shall be constructed with rolled steel sections and cold rolled steel sheetsof at least 2.0 mm thickness, Gland plates shall be 2.5mm thick made out of hot rolled or cold rolled steel sheets and for non-magnetic material it shall be 3.0 mm.

1.3.10 The switchgear shall be cooled by natural air flow and cooling by any other method shall not be accepted.

1.3.11 Total height of the switchgear panels shall not exceed 2450 mm. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800 mm and shall not be less than 700 mm.

1.3.12 Necessary guide channels shall be provided in the breaker compartments for properalignment of plug and socket contacts when truck is being moved to SERVICE position. A crank or level arrangement shall preferably be provided for smooth and positive movement of, truck between Service and Isolated positions.

1.3.13 Safety shutters complying with IEC-298 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position. The shutters shall move automatically, through a linkage with the movementof the truck. Preferably it shall however, be possible to open the shutters of busbar side and cable side individually against spring pressure for testing purpose after defeating the interlock with truck movement deliberately. It shall also be possible to padlock shutters individually. In case, insulating shutters are provided, these shall meet the requirements of Clause 3.102.1 Note-2 of IEC-298 and necessary tests asper IEC-298 Clause 5.103.1 shall be carried out. A clearly visible warning label "Isolate elsewhere before earthing" shall be provided on the shutters of incoming andthe connections which could be energized from other end.

1.3.14 Switchgear construction shall have a bushing or other sealing arrangement betweenthe circuit breaker compartment and the busbar/cable compartments, so that there isno air communication around the isolating contacts in the shutter area with the truckin service position.

1.3.15 The breaker and the auxiliary compartments provided on the front side shall have strong hinged doors, busbar and cabling compartments provided on the rear side shall have bolted compartment covers with self retaining bolts. Breaker compartmentdoors shall have locking facility.

1.3.16 In the Service position, the truck shall be so secured that it is not displaced by short circuit forces. Busbars, jumpers and other components of the switchgear shall also. be properly supported to withstand all possible short circuit forces corresponding to the short circuit rating specified.

1.3.17 Suitable base frames made out of steel channels shall be supplied alongwith necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled whenthe flooring is being done, welding of base frame to the insert plates as per approved installation drawings. The bidder may offer panels with built in base frame ready for dispatch and suitable for installation on indoor cable trenches.

1.3.18 The switchboard shall have the facility of extension on both sides. Adopter panels and dummy panels required to meet the various bus bar arrangement, cable/bus ducttermination and layouts shall be included in Bidder's scope of work.

1.3 Circuit Breakers

1.4.1 The circuit breakers shall be of vacuum type and shall comprise of three separate, identical single pole interrupting units, operated through a common shaft by a sturdyoperating mechanism.

1.4.2 Circuit breakers shall be suitable for switching lines at any load.

1.4.3 Circuit breaker shall be restrike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. An antipumping device shall be provided for each breaker; even it has built-in mechanical anti- pumping features. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable.

1.4.4 During closing, main poles shall not rebound objectionably and mechanism shall notrequire adjustments. Necessary dampers shall be provided to withstand the impact at the end of opening stroke.

1.4.5 Plug and socket isolating Contacts for main power circuit shall be silver plated, of self-aligning type, of robust design and capable of withstanding the specified short circuit currents. They shall preferably be shrouded with an insulating material. Plug and socket contacts for auxiliary circuits shall also be silver plated, sturdy and of self
-aligning type having a high degree of reliability. Thickness of silver plating shall notbe less than 10 microns.

1.4.6 All working part of the mechanism shall be of corrosion resisting material. Bearings which require greasing shall be equipped with pressure type grease fittings. Bearingpins, bolts, nuts and other parts shall be adequately secured and locked to prevent loosening or change in adjustment due to repeated operation or change in adjustment due to repeated operation of the breaker and the mechanism.

1.4.7 The operating mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and shall not lead to closing or tripping of circuit breaker. Failure of any auxiliary spring shall also not cause damage to the circuit breaker or endanger the operator.

1.4.8 Mechanical indicators shall be provided on the breaker trucks to indicate OPEN/ CLOSED conditions of the circuit breaker, and CHARGED/DISCHARGED conditionsof the closing spring. An operation counter shall also be provided. These may be visible without opening the breaker compartment door.

1.4.9 The rated control supply voltage shall be as mentioned in Section-GTR. The closingcoil and spring charging motor shall operate satisfactorily at all values of control supply voltage with specified variation mentioned in Section-GTR. The shunt trip coilshall operate satisfactorily under all operating conditions of the circuit breaker up to its rated short circuit breaking current at all values of control supply voltage between70 and 110 percent of the rated voltage. The trip Coil shall be so designed that it does not get energised when its healthiness is monitored by indicating lamps (Red)and trip coil supervision relay.

1.4.10 The time taken for charging of closing spring shall not exceed 30 second. The springcharging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor, which shall only chargethe closing spring. Operating spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor a continuous sequence of closing and opening operations shall be possible. One open-close-openoperation of the circuit breaker shall be possible after failure of power supply to the motor.

1.4.11 Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable Winding temperature when the control supply voltage is anywhere between 85% and 110% of the rated voltage.The initial temperature shall be as prevalent in the switchgear panel during full load operation with 50 deg. C ambient air temperature. The motor shall be provided with short circuit protection.

1.4.12 Motor windings shall be provided with class E insulation or better. The insulation shallbe given tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate.

1.4.13 Circuit breaker may be provided with inter pole barriers of insulating materials, if thesame is standard design of the manufacturer. But use of inflammable materials like Hylam shall not be acceptable.

1.5 Control and interlocks

1.5.1 The control switch located on the switchgear would normally be used for operation ofcircuit breaker in service/isolated position, and for tripping it in an emergency.

1.5.2 The Bidder shall study the basic control scheme as proposed to be adopted and clearly state in his bid the extent to which it can be complied with.

1.5.3 Facilities shall be provided for mechanical tripping of the breaker and for manual charging of the stored energy mechanism for a complete duty cycle, in an emergency. These facilities shall be

accessible only after opening the compartment door.

1.5.4 Each panel shall have two separate limit switches, one for the Service position and the other for isolated position. Each of these limit switches shall have at least four (4)contacts which shall close in the respective positions

1.5.5 Auxiliary Contacts of breaker may be mounted in the fixed portion or in the with drawable truck as per the standard practice of the manufacturer, and shall be directlyoperated by the breaker operating mechanism.

1.5.6 For Employer's use six (6) normally open (NO) and six (6) normally closed (NC) auxiliary contacts shall be provided for all feeder and shall be wired out to the terminal blocks.

1.5.7 Contact multiplication, if necessary to meet the above contact requirement, shall be done through suitable latch relay.

1.5.8 The contacts of all limit switches and all breaker/auxiliary contacts located on truck portion and fixed portion shall be silver plated, rated to make, carry and break 1.0 Amp 220 V DC (Inductive) 10 Amps. 240V AC. Contacts of control plug and socket,shall be capable of carrying the above current continuously.

1.5.9 Movement of truck between SERVICE and ISOLATED positions shall be mechanically prevented when the breaker is closed. An attempt to withdraw a closedbreaker shall not trip it.

1.5.10 Closing of the breaker shall be possible only when truck is either in ISOLATED or inSERVICE position and shall not be possible when truck is in between. Further, closing shall be possible only when the auxiliary circuits to breaker truck have been connected up, and closing spring is fully charged.

1.5.11 Mechanical (Castle key) or a full proof electrical interlock shall be provided between the isolator and associated circuit breaker such that the former cannot be operated unless the later is open.

1.5.12 It shall be possible to easily insert breaker contactor of one feeder into any one of thepanel meant for same rating but at the same time shall be prevented from inserting itinto panels meant for a different type of rating.

1.5.13 Indicating lamps shall be provided in the panel front as brought out in Clause 16.13.It shall be possible to easily make out whether the truck is in SERVICE or ISOLATEDposition even when the compartment door is closed.

1.6 Bus bars and interlocks:

1.6.1 All busbar and jumper connections shall be of high conductivity aluminium/ copper ofadequate size and the bus bar size calculation shall be submitted for approval. Theyshall be adequately supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.

1.6.2 Busbar cross-section shall be uniform throughout the length of switchgear. Busbarsand other high voltage connection shall be sufficiently corona free at maximum working voltage.

1.6.3 Contact surfaces at all joints shall be silver plated or properly cleaned and no oxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All connection hardware shall havehigh corrosion resistance. Suitable bimetallic connectors shall be used for aluminiumto copper connections.

1.6.4 Busbar insulators shall be of arc and track resistant high strength, non-hygroscopic, non-

combustible type and shall be suitable to withstand stresses due to over- voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic insulator partial discharge shall be limited to 100 Pico coulomb at rated voltage xl.1/□ 3. Use of insulators and barriers of inflammable material such as Hylam shall not be accepted.

1.6.5 Successful Bidder shall furnish calculation-establishing adequacy of busbar sizes forthe specified continuous and short time current ratings.

1.6.6 All busbars shall be colour coded for phase identification.

1.6.7 The temperature of the busbars and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Indian Standards, duly considering the specified ambient temperature (50 deg. C). The temperature rise of the horizontal and vertical busbars when carrying the rated current shall in no case exceed 55 deg.C for silver plated joints and 35 deg.C for allother type of joints. The temperature rise at the switchgear terminals intended for external cable termination shall not exceed 35 deg. C. Further the switchgear parts handled by the operator shall not exceed a rise of 5 deg.

1.7 Earthing and earthing device

1.7.1 A galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.

1.7.2 The earth bus shall have sufficient cross section to carry the momentary short circuitand short time fault currents to earth as indicated under switchgear parameters without exceeding the allowable temperature rise.

1.7.3 Suitable arrangement shall be provided at each end of the earth bus for bolting to earthing conductors. All joint splices to the earth bus shall be made through atleast two bolts and taps by proper lug and bolt connection.

1.7.4 All non- current carrying metal work switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure frame work and the truck shall be maintained even after painting.

1.7.5 The truck and breaker frame shall get earthed while the truck is being inserted in thepanel and positive earthing of the truck and breaker contactor frame shall bemaintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position.

1.7.6 All metallic cases of relays, instruments and other panel mounted equipment shall beconnected to earth by independent stranded copper wires of size not less than 2.5 sq.mm. Insulation colour code of earthing wires shall be green. Earthing wires shallbe connected to terminals with suitable clamp connectors and soldering shall not beacceptable. Looping of earth connections, which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earthbus is acceptable.

1.7.7 VT and CT secondary neutral point earthing shall be at one plate only on the terminalblock. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.

1.7.8 Built-in /Trolley mounted earthing facilities for the busbars and outgoing incoming connections shall be provided. However, there should be facility for alarm before engagement of earthing

contacts, in case of feeder/incomer being in energized condition.

1.7.9 Interlocks shall be provided to prevent:
Closing of the earthing switch if the associated circuit breaker truck is in Service position.

Insertion of the breaker truck to Service position if earthing switch is in closed position.

Closing of the earth switch on a live connection. Three nos. voltage capacitive dividers shall be provided on each phase of the section intended for earthing and three nos. "RED' Neon lamps connected to these on the panel front for visual indication.

1.7.10 Energising and Earthed Section: Complete details of arrangement offered shall be included in the bid describing the safety features and interlocks.

1.7.11 The earthing device shall have the short circuit withstand capability equal to that of associated switchgear panel suitable number of auxiliary contacts of the earthing device shall be provided for interlocking purpose.

1.7.12 All hinged doors shall be earthed through flexible earthing braid.

1.8 Painting

All sheet steel work shall be pretreated in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed bypickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphated coatingshall be Class 'C' as specified in IS: 6008. The phosphated surface shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied.. The inside of the panels shall preferably be glossy white. Each coat finishing shall beproperly stoved. The paint thickness shall not be less than 50 microns. Finished partsshall be coated by peel able compound by spraying method to protect, finished surfaces from scratches, grease dirts and oily spots during testing, transportation, handling and erection. Electrostatic painting shall also be acceptable.

1.9 Instrument transformers

1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulationshall be E or better.

1.9.2 All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time rating at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stressproduced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

1.9.3 The parameters of instrument transformer specified in this specification are tentativeand shall be finalised by the Employer in due course duly considering the actual burden of various relays and other devices finally selected. In case the Bidder finds that the specified ratings are not adequate for the relays and other devices offered by him he shall offer instrument transformer of adequate ratings and shall bring outthis fact clearly in his bid.

1.9.4 All instrument transformers shall have clear indelible polarity markings. All secondaryterminals

shall be wired to separate terminals on an accessible terminal block.

1.9.5 Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be drawout type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable.

1.9.6 All voltage transformers shall have suitable HRC current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in ISOLATED position. The secondary fuses shall be mounted on the fixed portion andthe fuses replacement shall be possible without drawing out the VT, truck from Service position.

1.10 Relays and protections

1.10.1 In addition to the requirements specified hereunder the relays, indicating instruments,recorders, transducers, terminal blocks, Mimic diagram, Name Plates, switches, indicating lamps, position indicators shall also meet the requirements of corresponding clauses in Section Control and Relay Panels.

1.10.2 General Features

a) All relays and timers in protective circuits shall be flush mounted on panel frontwith connections from the inside. They shall have transparent, dust tight cover, removable from the front. They shall either have built-in test facilities, orshall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases. The contact multiplying auxiliary relays if anymay be located inside.

b) All relays and timers shall be rated for control supply voltage as mentioned in Section – GTR with specified variation. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Auxiliary seal in units if provided shall be of shunt reinforcing type.

c) The protective relays and timers shall have atleast two potential free output contacts in addition to scheme requirement for owner's use. Auxiliary relays, shall have contacts as required. Adequate number of terminals shall beavailable on the relay cases for applicable relaying schemes.

d) All protective relays, auxiliary relays and timers. shall be provided with hand reset operation indicators (flags) for analysing the cause of tripping.

e) Timers shall be of electromagnetic or static type.

f) Failure of a control or auxiliary supply and de-energisation of a relay shall not initiate any circuit breaker contactor operation.

h) The relay and timers used in protective circuits shall be of reputed makes and proven types which have been in successful operation for atleast three (3) years and shall be subject to Employer's approval before procurement by the Contractor.

1.10.3 Special Protection Features

33 kV feeders shall have three over current and one earth fault element which shall be either independent or composite units. And shall meet the following requirements.

a) Non directional over current relay

(i) have IDMT characteristic with definite minimum time of 3.0 sec at 10 timessetting
(ii) have a variable setting range of 50-200% of rated current.

(iii) Include hand reset flag indicators

b) Non Directional earth fault relay

(i) have IDMT characteristic with definite minimum time of 3.0 sec at 10 timessetting.

(ii) have a variable setting range of 20-80% of rated current.

(iii) Include hand reset flag indicators

c) Master Trip Relay

Non directional over current and earth fault relays will be wired to trip the master trip relay during faults Master Trip relay and also the ratings of the output contacts shall be suitable for 33 kV circuit breaker.

1.11 Instruments and Meters

1.11.1 Indicating instruments shall be flush mounted on panel front. The instruments shall be of atleast 96mm square size with 240 deg. scales, shall conform to IS:1248 and shall have an accuracy class of 1.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

1.11.2 Instruments shall have white dials with black numerals and lettering. Black knife edged pointer with parallax free details will be preferred.

1.11.3 Instruments and meters shall be factory calibrated to directly read the primary circuitquantities. Means shall be provided for zero adjustment without dismantling the instruments.

1.11.4 Watt-hour meters shall preferably be 3-phase two (2) element type suitable for measurement of unbalanced loads in three phase three wire system and shall be suitable for flush mounting.

Watt-hour meters shall preferably be provided in draw out cases with built-in testing facilities. Alternatively, they may have test blocks to facilitate testing of meters without disturbing CT and VT secondary connections.

1.12 Control and Selector Switches

1.12.1 Control and selector switches shall be of heavy duty, rotary type with escutcheon plates clearly marked to show the operating positions and circuit designation plates.The switches shall be of sturdy construction suitable for flush mounting. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.

1.12.2 On-Off control switches shall have three positions and shall be spring return to neutral from 'close' and 'trip' positions. They shall have two contacts closing in closeposition and two contacts closing in trip positions, and shall have Pistol Grip handles.Lost motion feature shall be provided wherever required.

1.12.3 Selector switches shall have two or three stay put positions. They shall have two contacts for each of the three positions and shall have black Spade handled.

1.12.4 Ammeter and Voltmeter selector switches shall have four stay put positions with adequate

number of contacts for three-phase system. These shall have OVAL handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondary.

1.12.5 Contacts of the switches shall be spring assisted and shall be of suitable material togive a long trouble free service. The contact rating shall be at least the following:

i)	Make and carry continuously	10A
ii)	Breaking current at 220V DC.	1A (Inductive)
iii)	Breaking current at 240V AC/220V DC	5A at 0.3 pf lag.

1.13 Indicating Lamps

1.13.1 Indicating lamps shall be of the panel mounting, LED type and low watt consumption.The lamps shall have escutcheon plates marked with its function, wherever necessary.

1.13.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application:

RED	CLOSED
GREEN	OPEN
WHITE	DC healthy
BLUE	For all healthy conditions (e.g. control supply, spring charged,and lock out relay coil healthy)
AMBER	For all alarm conditions (e.g. pressure low, over load) alsofor SERVICE and TEST positions indication.

1.13.3 It shall be easily replaceable from the front of the cubicles. The method of mounting indicating lamps fittings on panels shall prevent their rotation under the action of lamp removal or replacement, reliance upon the tightness of a ring-nut for the purpose is not sufficient.

1.13.4 Indicating lamps shall be located just above the associated push buttons/control switches. Red lamps shall invariably be located to the right of green lamps. In casea white lamp is also provided, it shall replace between the red and green lamps alongthe centre line of control switch/push button pair. Blue and amber lamps shall normally be located above the red and green lamps.

1.13.5 When associated with push buttons, red lamps shall be directly above the green push button, and green lamp shall be directly above the red push-button.

All indicating lamps shall be suitable for continuous operation at 90, to 100% of theirrated Voltage.

1.14 Switchgear Wiring

1.14.1 All Switchgear panels shall be supplied completely wired internally upto the terminalblock ready to receive external cabling. All inter cubicle wiring and connections between panels of same switchboard including all bus wiring for AC and DC suppliesshall be provided by the Contractor.

1.14.2 All internal wiring shall be carried out with 650 V grade, single core, 1.5 sq.mm, stranded copper wires having minimum of seven strands per conductor and colour coded, PVC insulation. CT circuits shall be wired with 2.5 sq.mm. wires which otherwise are similar to the above. Extra flexible wires shall be used for wiring between fixed and moving parts such as hinged doors.

1.14.3 All wiring shall be properly supported neatly arranged, readily accessible and securely connected to equipment, terminals and terminal blocks. Wiring troughs or gutters be used for this purpose.

1.14.4 Internal wire terminals shall be made with solder less crimping type tinned copper lugs which shall firmly grip the conductor. Insulation sleeves shall be provided over the exposed parts of lugs. The lugs related to CT secondary circuit wiring shall be ofhole type.

1.14.5 Engraved core identification plastic ferrules marked to correspond with panel wiring diagrams shall be fitted at both ends of each wire Number 6 and 9 shall not be usedfor wire identification. Ferrules shall fit tightly on wires and shall not fall off when wireis, disconnected from terminal. All wires directly connected to trip the circuit breaker shall be distinguished by the addition of a red colored unlettered ferrule.

1.14.6 Inter connection to adjacent panels shall be brought out to a separate set of terminalblocks located near the slots or holes, meant for the interconnecting wires. Arrangement shall permit neat layout and easy inter connections to adjacent panels at site and wires for this purpose shall be provided by Contractor looped and bunched properly inside the panels. The inter panel wires shall be cross-ferruled i.e.it shall have details of emanating terminal and also where it is terminated.

1.14.7 Contractor shall be fully responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

1.14.8 The Contractor shall provide the necessary clamps wiring troughs etc. for all wiring inside the switchgear enclosed including the power and control cables.

1.15 Power Cable Termination

1.15.1 The Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, armoured, PVC jacketed, single core/three core unearthed/earthed grade power cable(s).

1.15.2 A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Inter phase clearance in the cable termination compartment shall be adequate to meet electricaland mechanical requirement besides facilitating easy connections and disconnections of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and the electrical clearances available shall be submitted for Employer approval during detailed engineering.

1.15.2 Cable termination compartment shall be complete with power terminals, power lugs and associated hardware and removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material.

1.15.3 Supply of the cable termination kit and cable terminations shall be in scope of contractor.

1.16 Name Plates and Labels

1.16.1 Each switchboard shall have a name plate for its identification. All enclosure-mounted equipment shall be provided with individual engraved nameplates for clearequipment identification. Each unit panel shall be identified on front as well as backside by large engraved nameplates giving the distinct feeder description along with panel numbers. Backside nameplates shall be fixed in panel frame.

1.16.1 Nameplate shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering, on black background. Inscriptions and lettering shall be subjected to Employer's approval.

1.16.2 Suitable stenciled paint mark shall be provided for identification of all equipment, located inside

the enclosure, as well as for door mounted equipment, from the backside in addition to plastic sticker labels, if provided. These labels shall be located directly by the side of the respective equipment, shall be clearly visible and shall not be hidden by equipment wiring. Labels shall have device number as mentioned in wiring drawings. Type of labels and fixing of labels shall be such that they are not likely to peel or fall off during prolonged use.

1.17 33 kV Indoor Switchgear panels as per quantity and details given below shall be offered:

Sl. No.	Description	Quantity
1.	Panel for incomer feeder with Bus PT Type IP-1, fault level of 25KA for 3 secs. **[Incoming]**	2
2.	Panel for 1 MVA, 33/0.433KV LT transformer feederType IP-2, fault level of 25KA for 3 sec. **[Outgoing]**	2
3.	Panel for Bus Coupler feeder Type IP-3, fault level of 25KA for 3 secs. **[Bus Coupler]**	1

Detailed Description for each HT indoor VCB panels: -

Sl. No.	Equipment	IP1 I/C	IP2 O/G	IP3 B/C
1.	36 kV, 630A, 25KA for 3 secs, VCB	1	1	1
2.	36 kV, 40-20/1A CT	1	1	1
3	Potential Transformer, 36 kV/ 110V, drawout type, cast resin type, dual accuracy 1.0/3.0 and150VA burden.	1	-	-
4.	Multifunction Meter	1	1	1
5.	Control switch for breaker	1	1	1
6.	Green Indicating lamps	1	1	1
7.	Red indicating lamps	1	1	1
8.	DC healthy lamp (white)	1	1	1
9.	Mimic to represent SLD	1	1	1
10.	Non directional protection consisting of 2 over current & 1 earth fault protection (set)	-	1	1
11.	Trip relays	1	1	1
12.	Directional backup protection consisting of 3over current &1 earth fault protection (set)	1	-	-
13.	Flag relays, trip relays, Auxiliary relays timers etc (as per scheme requirement)	Lot	Lot	Lot
14.	Annunciation Facia (as per requirement)	Lot	Lot	Lot

1.18 Tests

The Bidder shall submit the type test reports of following type tests for approval of theEmployer for circuit breaker, circuit breaker panels, of each voltage class and currentrating:

1. Short circuit duty test on circuit breaker, mounted inside the panel offered.
2. Short time withstand test on circuit breaker, mounted inside panel offered.
3. Power frequency withstand test on breaker and panel.
4. Lightning impulse withstand test on breaker and panel.
5. Temperature rise test on breaker and panel together.
6. Test to verify pressure relief devices operation of the panel. This shall be doneon one panel of each voltage class.

7. Measurement of resistance of main circuit.
8. Mechanical endurance test on breaker.
9. Mechanical operation test.

For all important components like instrument transformers, relays, instruments, switches, bushings, wires, insulators, timers, annunciators, terminal blocks and fusesetc. the contractor shall furnish satisfactory type test reports for Employer's approval. Such reports shall cover all applicable type tests listed in relevant Indian Standards,for all components of type and rating being supplied.

1.19 Commissioning Checks/Tests

After installation of panels, power and Control wiring and connect Contractor shall perform commissioning checks as listed below to proper operation of switchgear/ panels and correctness of all respects.

In addition the Contractor shall carry out all other checks and tests recommended by the manufacturers.

A. General

1 Check nameplate details according to specification.
2 Check for physical damage
3 Check tightens of all bolts, clamps and connecting terminal
4 Check earth connections.
5 Check cleanliness of insulators and bushings.
6 Check heaters are provided.
7 HV test on complete switchboard with CT & breaker/ contractor lubricated in position.
8 Check all moving Parts are properly lubricated.
9 Check for alignment of bus bars with the insulators to ensure alignment andfitness of insulators.
10 Check for inter changeability of breakers.
11 Check continuity and IR value of space heater.
12 Check earth continuity of the complete switchgear board.

B. Circuit Breaker

1 Check alignment of trucks for free movement.
2 Check correct operation of shutters.
3 Check slow closing operation.
4 Check control wiring for correctness of connections, continuity and IR values.
5 Manual operation of breakers completely assembled.
6 Power closing/opening operation, manually and electrically at extremecondition of control supply voltage.
7 Closing and tripping time.
8 Trip free and anti-pumping operation.
9 IR values, resistance and minimum pick up voltage of coils.
10 Simultaneous closing of all the three phases.
11 Check electrical and mechanical inter locks provided.
12 Checks on spring charging motor, correct operation of limit switches and timeof charging.
13 All functional checks.

C. Current Transformers

1 Megger between windings and winding terminals to body.
2 Polarity tests.
3 Ratio identification checking of all ratios on all cores by primary injection ofcurrent.

4 Magnetization characteristics & secondary winding resistance.
5 Spare CT cores, if any to be shorted and earthed.

D. Voltage Transformers

1 Insulation resistance
2 Ratio test on all cores.
3 Polarity test
4 Line connections as per connection diagram.

E. Cubicle Wiring

1 Check all switch developments.
2 It should be ensured that the wiring is as per relevant drawings. All interconnections between panels shall similarly be checked.
3 All the wires shall be meggered to earth.
4 Functional checking of all control circuit e.g. closing, tripping, interlock, supervision and alarm circuit including proper functioning of component/ equipment .
5 Check terminations and connections. To check wiring related to CT and PT circuits, carryout primary injection and then check for secondary value at relayand metering instrument terminals.
6 Wire ducting.
7 Gap sealing and cable bunching.

F. Relays

1 Check internal wiring.
2 IR of all terminal body.
3 IR of AC to DC terminals
4 Check operating characteristics by secondary injection.
5 Check minimum pick up voltage of DC coils.
6 Check operation of electrical/ mechanical targets.
7 Check CT connections with particular reference to their polarities fordifferential type relays.
8 Relay settings.

G. Meters

1 IR of all insulated portions.
2 Check CT & VT connections with particular reference to their polarities forpower type meter.

1.20 Technical parameters for 33 kV Switchgear panel

1.20.1 Parameters common to all equipment:

a)	Nominal System Voltage	33 kV
b)	Highest system Voltage	36KV
c)	Rated Frequency	50Hz
d)	No of phases	Three
e)	System neutral earthing	Solidly Earthed
f)	One minute Power Freq. withstand voltage	70KV (rms)
g)	Lighting Impulse withstand Voltage	170KVp

h)	System fault level	25kA for 3 secs
i)	Auxiliary Supply Voltage	220V DC

1.20.2 Circuit Breaker

a)	Rated continuous current at design ambient temp.	630A
b)	Rated short circuit current capacity at rated minimum opening time under operating conditions specified	25kA with % of DC component as Breaking per IEC: 62271-100 corresponding to Voltage
c)	Symmetrical interrupting Capability	25kA (rms)
d)	Rated short circuit making	62.5 kApCurrent
e)	Out of phase breaking	As per IECCurrent capacity
f)	Rated line/cable charging Leading power factor angle	As per IECInterrupting current at 90°
g)	Rated small inductive current Switching capability with over Voltage less than 2.3 pu	0.5 to 10 A
h)	Maximum allowable switching Over voltage under any switching Condition	As per IEC
i)	First pole to clear factor	1.5
j)	Rated break time as per IEC	45ms
k)	Total closing time	Not more than 100ms
l)	Rated operating duty cycle	O-3min-CO-3minCO
m)	Reclosing	3 phase auto reclosing
n)	Max. difference in the instants Of closing/opening contacts Between poles at rated control Voltage and rated operating and Quenching media pressures	3.3ms
o)	Trip coil and closing coil voltage	220V DC with variation 0f 190V-240V
p)	Auxiliary contacts	5NO+ 5NC for Employer's use besides spec requirement
q)	Temperature rise over the Design ambient temp	As per IEC: 62271-100/IEC: 60694

1.20.3 Current Transformer (LT transformer)

a)	Rated primary current	40 A
b)	Max temp rise	As per IEC: 44-1
c)	Type of Insulation	Class E
d)	One minute power frequency Withstand voltage between Secondary terminal & earth	2KV

e) Detail of Secondary Cores	Metering	O/C & E/F Protn.
Current ratio	40-20/1	40-20/1
Accuracy class	0.5 class	5P10
Knee point Voltage	--	--
Rated Burden	15 VA	--

1.20.4 Potential Transformer

a)	Rated primary Voltage	36KV	
b)	Type	Single phase potential transformer	
c)	Voltage/ Ratio (KV)	(33/√3)/(0.11/√3)/(110/√3)/ /(110/√3)	
d)	Rated voltage factor	1.2 continuous, 1.5 – 30seconds	
e)	One minute power freq. Withstand voltage for Secondary winding	2KV(rms)	
f)	Rated output burden	150VA	
g)	Detail of secondary	Metering	Protection
h)	Accuracy	0.5	3P

Note:

1. The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

C. TECHNICAL SPECIFICATIONS FOR LT CAPACITORS

1.0 **Scope**

This specifications covers the design, manufacture, supplying and testing of Dry Type LT Capacitors required to be installed in LT Room of the sub-station forcorrection of the power factor.

2.0 **Standards**

All relevant Indian Standards shall be made applicable with latest amendments and in particularly IS 133340/41, IEC 831-1-1996, IEC 831-2-1995, EN 60831-2-1996, VDE 560-46:3/95, VDE 560-47:3/95 and any other specific application is required, then the same shall be complied to.

3.0 Specifications

3.1 The capacitors are to be provided with Duro Plastic Polyurethane Case, Easy disposal, Fire Retardant case with IP 20 enclosure, indoor mounting. The containers shall be heat-proof, dust-proof, indoor type and PCB environment.

3.2 The capacitors shall be fir retardant in nature.

3.3 Terminal provided should be Double, Three way SIGUT terminal strip with protection against electric shock hazard. 9According to IP 20 /IP 54 to VDE 0106 part 100)

3.4 The capacitor should be able to handle in rush current up to 200 times the rated current and should be corona free.

3.5 The raw materials should be Non PCB, Epoxy Resin and polypropylene film should be provided as dielectric.

3.6 The dielectric loss should be very low in the order of less than 0.25 Watts/ KVARor lower.

3.7 Each unit shall have over pressure tear off fuse, self healing technology, explosion proof construction, touch proof terminals Eco friendly, non flammable.

3.8 The Capacitors shall be of the 3 Phase, Delta connected natural or forced cooledtype with capacitance tolerance of +5% . the capacitor should be able to perform up to humidity of 95% and discharge module resistor should be included.

3.9 The basic unit shall be of 5 KVAR to give 50 KVAR as basic step or any other step as specified in the schedule of quantities.

3.10 The Capacitors banks shall be erected directly inside the panel on the mountingstands and with complete treatment done to the stand. The stand shall be effectively doubled earthed to the earthing grid.

4.0 Discharge Resistance

4.1 The Capacitors shall be provided with discharge resistors module so that residual voltage of the capacitor shall be reduced to 50 Volts or less within one minute after the capacitor is

disconnected from the source of supply.

5.0 Testing

5.1 The Capacitor bank shall be subject to all routine and acceptance tests as specified in relevant Indian Standards at the factory and the actual test results shall be furnished.

5.1.1 Residual voltage after switching of the capacitors shall be less than 50 Volts afterone minute.

5.1.2 Insulation resistance shall be tested with a 1000 Volts megger between phases and phase to earth.

5.1.3 Each discharge resistors shall be tested for its working.

5.1.4 Loss angle test will be conducted and power losses will not exceed 025 Watts KVAR.

5.1.5 The value of discharge resistance shall be furnished at the time of testing.

D. TECHNICAL SPECIFICATIONS FOR POWER & CONTROL CABLES

1.0 GENERAL

All cabling systems, including cables, wiring, terminations etc., shall be in accordancewith the applicable Standards and with the additional requirements listed below and elsewhere in this Specification. Cable sealing & termination for cable end to be terminated at Employer's side shall be included in the Contractor's scope.

2.0 CABLES

2.1 CABLE TYPE

a) The High Voltage (33 kV) power cables shall be XLPE insulated conforming toIS-7098 (II).

b) The Low Voltage power cables shall be 1.1 kV XLPE insulated conforming to IS-7098 (I) and/or PVC insulated conforming to IS-1554 (I).

c) The control cables shall be 1.1 kV PVC insulated conforming to IS-1554 (I).

2.2 GENERAL TECHNICAL REQUIREMENTS

a) The cables shall be suitable for laying in racks/trays, ducts, trenches, conduits and underground buried installation with uncontrolled backfill and with chancesof flooding by water.

b) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

c) The XLPE insulated power cables shall suitable for withstanding short circuit currents on the basis of area of cross section of cable as per manufacturer's standard ratings. The area of cross-section of cable shall be decided on the basis of connected load.

d) The conductor and armour for 1100V grade XLPE insulated power cables shallbe capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

e) Cable construction shall include sufficient electric magnetic shielding and adequate grounding, to ensure that any interference picked up by the signal pairs is sufficiently attenuated to prevent mal-operation, damage, or danger toany equipment and personnel under all operating conditions, including the effects of switching, faults, converter operation and the environment.

f) The Aluminium/copper wires used for manufacturing of the cables shall be truecircular in shape before stranding and shall be of uniform good quality, free from defects. All aluminium used in the cables shall be of H2 grade.

g) The fillers and inner sheath shall be of non-hygroscopic, fire retardant material,softer than insulation & outer sheath and suitable for the operating temperature of the cable.

h) Strip wire armoring following method (a) mentioned in the relevant IS shall not be accepted for any of the cables. For armored control cables only roundwire armoring shall be used.

i) Progressive sequential marking of the length in metres at every one metre shall be provided on the outer sheath of all cables.

j) The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

k) The normal current rating of all cables shall be as per IS-3961.

l) During a short circuit as specified in (b) above the PVC insulated cables shall be capable of withstanding a conductor temperature of at least 160°C. However, the XLPE insulated cables shall be capable of withstanding aconductor temperature of at least 250°C.

m) Repaired cables shall not be accepted.

n) Allowable tolerance on the overall diameter of the cables shall be as per the relevant IS/IEC standard.

o) All cables shall be armoured and of fire retardant low smoke type.

2.3 XLPE Power Cables

The XLPE (90°C) insulated cables shall be of FR typ e, C1 category conforming to IS:7098 (Part-I) and its amendments read alongwith this specification. The conductorshall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables.For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS:5831.When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS:5831 for all XLPE cables.

2.4 PVC Power Cables

The PVC (70°C) insulated power cables shall be of F R type, C1 category, conformingto IS: 1554 (Part-I) and its amendments read alongwith this specification and shall besuitable for a steady conductor temperature of 70°C . The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct innersheath shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.

2.5 PVC Control Cables

The PVC (70°C) insulated control cables shall be of FR type C1 category conformingto IS: 1554 (Part-1) and its amendments, read alongwith this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A ofIS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be greyin colour.

Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done byprinting legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 1554 (Part-1).

2.6 HV POWER CABLE FOR AUXILIARY POWER SUPPLY

The HV cable (Aluminium Conductor) of voltage class as specified for tertiary loadingshall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-II). Terminatingaccessories shall conform to IS 17573-1992 or IEC 61442- 1997/IEC60502-4 1998.

2.6.1 Constructional Requirements

Cable shall have compacted circular Aluminium conductor, Conductor screened with extruded semi conducting compound, XLPE insulated, insulation screened with extruded semi conducting compound, armoured with non-magnetic material, followedby extruded PVC outer sheath (Type ST-2), with FR properties.

2.6.2 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable. The cables shall have outer sheathof a material with an Oxygen Index of not less than 29 and a Temperature index of notless than 250°C.

2.6.3 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

2.7 TESTS

Cables & accessories of each type and size shall be of type tested design as per relevant IS/IEC (as applicable). Bidder shall submit test reports for approval during detailed engineering.

E. TECHNICAL SPECIFICATIONS FOR LT PANEL/BOARD

1.1 CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS

1.1.1. All boards shall- be of metal enclosed, indoor floor mounted, compartmentalized double front construction and freestanding type.

1.1.2. All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Framesshall be enclosed in cold-rolled sheet steel of thickness nut less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steer Of thickness not less than 1.6 mm.Stiffeners shall be provided wherever necessary. Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic materialof at least 4mm thickness.

1.1.3. All panel edges and cover/door edges shall be reinforced against distortion by rolling,bending or by the addition of welded reinforcement members.

1.1.4. The complete structures: shall be rigid, self-Supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.

1.1.5. All boards shall be of dust and vermin degree of protection of IP: 52, for category –I enclosure as per IS 13947 (Part-I) However, the bus bar chambers having -a degree of protection of IP-. 42, in accordance with IS 13947 (Part-1), are also acceptable where continuous bus bar rating exceeds 1000 Amp. Provision shall be made in all draw out Air Circuit Breaker compartments for providing IP: 52 degree of protection, when Circuit breaker trolley, has been removed. Panels with lighting transformers shall have 1P 31 degree of protection in accordance with IS 13947 (Part-1). Door frame of panels, meters, relays, Breaker cut-outs shall be provided with neoprene rubber gaskets generally conforming to Type- Class 2A as per IS: 11149.

1.1.6. Provision of louvers on boards would not be preferred. However, louvers backed withmetal screen are acceptable on the bus bar chambers where 'Continuous bus bar rating exceeds 1000 Amps. shall have louvers. Panels with lighting transformers in lighting distribution boards

1.1.7. All boards shall be of uniform height not exceeding 2450 mm.

1.1.8. Boards shall be easily extendible on both sides, by the addition of the vertical sectionsafter removing the end covers of bus bar chambers.

1.19 Boards shall be supplied with base frames made of structural steel sections, alongwithall necessary mounting hardware required for welding the base frames to the insert plates.

1.1.10.a) All boards shall be of double front construction and shall have

(i) A completely enclosed busbar compartment for running horizontal busbars and vertical busbars. Busbar chambers shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars for repair and maintenance, which shall be feasible Without disturbing feeder compartment. Vertical bus

bar chambers shall be accessible from front as well as back side 'of the panel and shall be of at least 350 mm width. One set of vertical busbars shall be used in between two adjacent sections for switchgear connections. In case of Incomer(s), Bus coupler and ACB feeders, the panel shall have single front without any vertical busbar chamber, however vertical busbars associated with ACBs shall be located in rear side and shall be additionally covered with metallic perforated/ transparentacrylic or polyvinyl bolted sheets to avoid direct access after opening rear doorof chamber.

(ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.

(iii) A distinct compartment or alley for power and control cables on each sic. Jf panel. Cable alley compartment shall have a through metallic partition for segregating cables on both sides. Cable alley door shall preferably be hinged.Cable alley shall have no exposed live parts. Any live terminals shall be fully Shrouded /insulated from safety aspects. However, it shall be of atleast35.0mm width.

(iv) A compartment for relays and other control devices associated with a circuit Breaker

1.1.11 Sheet steel barriers shall be provided between two adjacent vertical panel's runningto the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.

1.1. I2. All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheetsteel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities. In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to he usedin a common compartment shall not exceed 4 (four) and front of MCB compartment.shall have a viewing port of toughen glass sheet for viewing and sheet steel door ofmodule shall be lockable with star knob/panel key.

1.1.13. After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cableterminations located in cable alley.

1.1.14. The minimum clearance in air between phases and between phase and earth for theentire run of horizontal and vertical busbars, shall be 25 mm. For all other components, the clearance between "two live parts", " A live part and an earthed part" and isolating distance shall be atleast ten (10) mm throughout. Wherever it isnot possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25 mm should be maintained even if they are sleeved.

1.1.15 The temperature rise of horizontal & vertical bus bars when carrying rated current along its full run shall in no case exceed 55°C, wi th silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 50°C.

1.16. All busbar chambers shall be provided with removable bolted covers. The covers shall be provided with danger labels.

1.1.17 All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.

1.1.18 All Circuit breaker boards shall be of Single Front type, with fully draw out circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.

1.1.19 Wherever two breaker compartments are provided in the same vertical section; insulating barriers and shrouds shall be provided in the rear cable- compartment to avoid accidental touch with the live parts of one circuit when working on the, other circuit.

1.1.20 All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power draw out contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.

1.1.21 All AC & DC boards shall be of single Front type.

1.1.22 All module shall be fixed type except air circuit breaker module, which shall be drawout type.

1.1.23 The connections from bus bars to the main switch shall be fully insulated/shrouded,and securely bolted. The partition between the feeder compartment and cable alleymay be non-metallic, and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

1.1.24. All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to PURCHASER approval. Bidder shall submit dimensional drawings showing complete internal details of Bus bars and module components, for each type and rating for approval.

1.1.25. The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.

1.1.26 Adopter panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

1.2 DERATING OF EQUIPMENTS

The current ratings of all equipments as specified in the Single Line Diagram for AC& DC System are the minimum standards current ratings at a reference ambient temperature as per relevant Indian Standards.

1.3 POWER BUS BARS AND INSULATORS

1.3.1. All AC Distribution Boards shall be provided with three phase buses and a neutral bus bars and the DC Distribution Boards shall be provided with two busbars.

1.3.2. All busbars and jumper connections shall be of high conductivity aluminium of adequate size

1.3.3. The Cross-Section of the busbars shall be uniform throughout the length of Switchgear and shall be adequately supported and braced to withstand the stressesdue to the specified Short circuit currents.

1.3.4. All busbars shall be adequately supported by adequate numbers of high strength type Polyester fibre glass moulded Insulators to withstand short circuit withstand capability of panel. Separate supports shall be provided for each phase and neutralbusbar. If a common support is provided anti-tracking barriers, shall be provided between the supports.

1.3.5. All busbars joints shall be provided with high tensile steel bolts. Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars jr"-its shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint

1.3.6. All busbars shall be colour coded as per IS: 11353-1985: Guide for Uniform Systemof Marking and Identification of Conductors and Apparatus Terminals.

1.3.7. The Bidder shall furnish calculations along with the bid, establishing the adequacy ofbusbar sizes for specified current ratings, On the basis of short circuit current and temperature rise consideration at specified ambient temp.

1.4 EARTH BUS

1.4.1. A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

1.4.2. The earth bus shall have sufficient cross-section to carry the momentary short circuitand short time fault currents to earth as indicated in 'Bill of Materials' without exceeding the allowable temperature rise.

1.4.3. Suitable arrangements shall be provided at each end of the horizontal earth bus forbolting to Purchaser's earthing conductors. The horizontal earth bus shall project outthe switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.

1.4.4. All non-current metal work of the Switchboard shall be effectively bonded to the earth bus Electrical conductivity of the whole switchgear enclosures frame work andthe truck shall be maintained even after painting.

1.4.5. The truck and breaker frame shall get earthed while the truck is being inserted in thepanel and positive earthing of the truck and breaker frame shall be maintained in allpositions. SERVICES & ISOLATED, as well as throughout the intermediate travel.

1.4.6. Air Circuit Breaker (A CB) Each module frame shall get engaged to the vertical earthbus, before the disconnecting contacts on these modules are engaged to the vertical busbar.

1.4.7 All metallic cases of relays, instruments and other panel mounted equipments shallbe connected to earth by independent stranded copper wires of size not less than 2.5 mm2. Insulation colour code of earthing wires shall be green. Earthing wires shall be-connected to terminals with suitable clamp connectors and soldering is notacceptable. Looping of earth Connection which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.

1.4.8 VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

1.4.9 All hinged doors shall be earthed through flexible earthing braid.

1.4.10 Caution nameplate 'Caution -Live Terminals shall be provided at all points where theterminals are like to remain live and isolation is possible only at remote end.

1.5 AIR CIRCUIT BREAKERS

1.5.1 Circuit breakers shall be three-pole air break horizontal draw out type and shall haveinherent fault making and breaking capacities as specified in "TechnicalParameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable:

1.5.2 Circuit breakers shall be mounted along with it operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimize misalignment of the breaker.

1.5.3 There shall be 'Service', 'Test' and 'Fully withdrawn positions for the breakers. In 'Test' Position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the SERVICE', 'TEST" OR FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.

1.5.4 All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts, These contacts shall-be in addition- to those required for internal mechanism of the breaker. Separate limit switches each having required number of contacts shall be provided in both 'SERVICE' & TEST" position of the breaker. Contacts shall be rated for making continuously carrying and breaking 10 Amps at'240V AC and 1 Amp (Inductive) at 220V DC.

1.5.5 Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN'. 'CLOSE', 'SERVICE', 'TEST" and 'SPRING CHARGED' positions.

1.5.6 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during - closing shall not exceed half cycle of rated frequency.

1.5.7 All circuit breakers shall be provided with the interlocks as explained in further clauses

1.5.8 Movement of a circuit breaker between SERVICE AND TEST positions shall not be possible unless it is in OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.

1.5.9 Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.

1.5.10 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the Circuit: breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, 'be possible to open the shutters intentionally, against spring pressure for testing purpose.

1.5.11 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

1.5.12 Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical antipumping feature is provided.

1.5.13 Mechanical tripping shall be possible by means of front mounted RED 'Trip' push- button. In case of electrically operated breakers these push buttons shall be shrouded to present accidental operation.

1.5.14 Breaker controlled motors shall operate satisfactorily under the following conditions:

(i) Direct on-line starting of Induction Motors rated 110 kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.

(ii) Breaking on-load, full load and locked rotor currents of Induction Motors forrated 100 kW to 220 kW.

1.5.15 Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shall not be possible.

1.5.16 Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.

1.5.17 The motor shall be such that it requires not more than 30 seconds for fully chargingthe closing spring.

1.5.18 Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

1.5.19 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

1.5.20 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

1.5.21 All circuit breakers shall be provided with closing and trip coils. -The closing coils shall operate correctly al all values of Voltage between 85% to 110% at rated controlvoltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

1.5.22 Provision for mechanical closing of the breaker only in 'TEST' and 'WITHDRAWN' positions shall be-made.

1.5.23 PROTECTION CO-ORDINATION

1.5.23.1 It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit' tripping : of the circuit breakers with the upstream and downstream circuit breakers/fuses/Motor/starter's, to provide satisfactory discrimination.

1.6 MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB

1.6.1 MCCB shall in general conform to IS: 13947 Part-2. All MCCB offered shall have Ics =100% Icu rating. Type test reports for offered model of MCCB shall be submittedduring detailed engineering for owner's acceptance.

1.6.2 MCCB shall be flush mounted on the AC/DC distribution boards and shall have extended handle.

1.6.3 MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 80% to 100% of the rated current. The MCCB shall have breaking capacitynot less than 20kA.

1.6.4 MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.

1.6.5 Miniature circuit breaker (MCB) shall conform to IEC: 898-1987 and IS: 8828.

1.7 RELAYS

1.7.1 All relays and timers in protective circuits shall be flush mounted on panel front withconnections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction foreasy replacement from the front. They shall either have built-in test facilities, or shallbe provided with necessary test blocks and test

switches located immediately beloweach relay. The auxiliary relays and timers may be furnished in non-drawout cases.

1.7.2 All AC relays shall be suitable for operation, at 50 Hz with auxiliary AC supply available in the panel.

1.7.3 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on-the relay cases for applicable relaying schemes.

1.7.4 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (Flags) for analysing the cause of operation.

1.7.5 All relays shall withstand a test voltage of 2 KV (rms) for one minute.

1.7.6 Motor starters shall be provided with three elements, ambient temperature compensated; time lagged, hand reset type overload relays with adjustable settings. The setting ranges shall be properly selected to suit the motor ratings. These relaysshall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

1.7.7 All fuse-protected contactor-controlled motors shall have single phasing protection,either as a distinct feature in the overload relays.(by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

1.8 CONTACTORS

1.8.1 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty as per IS:13947 (Part 4).

1.8.2 Contactors shall be double break, non-gravity type and their main contacts shall besilver faced.

1.8.3 Direct on line starter contactors shall be of utilization category AC2. These contactors shall be as per 1S:13947 (Part 4).

1.8.4 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.

1.8.5 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of therated voltage. The Contactor shall drop out at 70% of the rated voltage.

1.9 INSTRUMENT TRANSFORMERS

1.9.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing insidethe switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.

1.9.2 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings ofthe associated switchgear.

1.9.3 All instrument transformer shall have clear indelible polarity markings. All secondaryterminals shall be wired to a separate terminal on an accessible terminal block where star .point formation

and earthing shall be done.

1.9.4 Current transformers may be multi or single core type. All voltage transformers shallbe single phase type. The Bus VTs shall be housed in a separate compartment.

1.9.5 All VTs shall have readily accessible MCBs on both primary and secondary sides.

1.10 INDICATING INSTRUMENTS

1.10.1 All indicating and integrating meters shall be flush mounted on panel. front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall
have an accuracy class of 2.5 or better. The covers and cases of instruments andmeters shall provide a dust and vermin proof construction.

1.10.2 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for Zero adjustmentwithout removing or dismantling the instruments.

1.10.3 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

1.10.4 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.

1.10.5 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators d need not be provided.

1.11 CONTROL & SELECTOR SWITCHES

1.11.1 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel-front. Switches with Shrouding of-live parts and sealing of contacts against dust ingress shall be preferred.

1.11.2 Circuit breaker selector switches for breaker Controlled motor shall have three stayput positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall havetwo contacts of each of the three positions and shall have black shade handles.

1.11.3 Ammeter and voltmeter selector switches shall have four stay put position with adequate number of contacts for three phase 4 wire system. These shall have ovalhandles Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

1.11.4 Contacts of- the switches shall be spring assisted and shall be .of suitable material to give a long trouble free service.

1.11.5 The contact ratings shall be at least the following

(i)	Make and carry continuously	10 Amp.
(ii)	Breaking current at 220V DC	1 Amp (Inductive)
(iii)	Breaking current at 240V AC	5 Amp (at 0.3 pf lagging)

1.12 AIR BREAK SWITCHES

1.12.1 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make

type complying with IS:4064,13947,Part-3.

1.12.2 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such asoverload, locked motor, short circuit etc.

1.12.3 Switch operating handles shall be provided with padlocking facilities to lock them in'OFF' position.

1.12.4 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only - when the door is closed. However suitable means shall be provided to intentionally defeat theinterlocks explained above.

1.12.5 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

1.13 PUSH BUTTONS

1.13.1 Push-buttons shall be of spring return, push to actuate type. Their contacts shall berated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

1.13.2 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver. alloy.

1.13.3 All push-buttons shall be provided with integral escutcheon plates marked with its function.

1.13.4 The colour of the button shall be as follows

(i)	GREEN	For motor START, Breaker CLOSE
(ii)	RED	For motor TRIP, Breaker OPEN
(iii)	BLACK	For overload reset.

1.13.5 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.

1.14 INDICATING LAMPS

1.14.1 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary. Lamps shallhave translucent lamp-covers of the following colours, as warranted by the application :

(i)	RED	For motor ON, Breaker CLOSED
(ii)	GREEN	For motor OFF, Breaker OPEN
(iii)	WHITE	For motor Auto-Trip
(iv)	BLUE	For all healthy conditions (e.g. control supply, and alsofor 'SPRING CHARGED"
(v)	AMBER	For all alarm conditions (e.g. overload) Also for SERVICE' and 'TEST" positions indicators.

1.14.2 Lamps shall be easily replaceable from the front of the cubicle.

1.14.3 Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In casea white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lampsshould normally be located above the Red and

Green lamps.

1.14.4 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

1.15 FUSES

1.15.1 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for A.C. Circuits shall be of Class 2 type, 20 kA (RMS) breaking current at 415 AC, and for DC circuits Class 1 type 4 kA breaking current.

1.15.2 Fuses shall have visible operation indicators.

1.15.3 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mountedon plug in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

1.15.4 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of PURCHASER.

1.16 TERMINAL BLOCKS

1.16.1 Terminal blocks shall be of 750 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, Clip-on-type/stud type terminals for Control. Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent.

1.16.2 Terminal blocks for CT and VT secondary leads shall be provided with test links andisolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to 'Elem.' 'CATD' - Type.

1.16.3 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also beavailable.

1.16.4 All terminal blocks shall be suitable for terminating on each side, two (2) Nos. of 2.5mm square size standard copper conductors.

1.16.5 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

1.16.6 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

1.16.7 Terminal blocks shall be arranged with at least 100 mm clearance between two setsof terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

1.17 NAME PLATES AND LABELS

1.17.1 All switchgears, AC/DC, distribution boards, shall be provided- with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

1.17.2 All name plates shall be of non-rusting metal or 3-ply lamicoid with white, engraved lettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.

1.17.3 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so asto be clearly visible and shall give the device number as mentioned in the module wiring drawings:

1.18 SPACE HEATER

1.18.1 Space heater shall be provided in all the boards for preventing harmful moisture condensation.

1.18.2 The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided

1.19 CONTROL AND SECONDARY WIRING

1.19.1 All switchboards shall be supplied completely wired internally up to the terminal blocks ready to receive Purchaser's control cables.

1.19.2 All inter cubicle and inter panel wiring and connections between panels of same .switchboard including all bus wiring for AC and DC supplies shall be provided bythe Bidder.

1.19.3 All internal wiring shall be carried out with 1100 V grade, single core, 1.5-square mmor larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 Sq mm copper wires. Voltage grade and insulation shall be same as above.

1.19.4 Extra-flexible wires shall be used for wiring to device mounted on moving parts suchas hinged doors.

1.19.5 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

1.20 POWER CABLES TERMINATION

1.20.1 Cable termination compartment and arrangement for power cables shall be suitablefor stranded aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100 V grade cables.

1.20.2 All necessary cable terminating accessories such as Gland plates, supportingclamps and brackets, power cable lugs, hardware etc. shall be provided by the successful bidder, to suit the cable sizes which would be advised later.

1.20.3 The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. For allsingle core cables, glands plats shall be of non magnetic material.

1.21 TYPE TESTS

1.21.1 Type tests reports an Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall be submitted for the following tests in line with relevant standards.

i) Verification of temperature rise limits
ii) Verification of the dielectric properties
iii) Verification of circuit strength

iv) Verification of the continuity of the protective circuit
v) Verification of clearances and creepage distances
vi) Verification of mechanical operation
vii) Verification of degree of protection

1.21.2 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started:

1. Circuit breakers/MCCB as per IS 13947 Part-II
2. Protective' Relays as per IEC: 60255.

1.22 EQUIPMENT TO BE FURNISHED

1.22.1 The Bidder shall quote for distribution boards in accordance with this specification.

1.22.2 Scheme of interconnection of switchboards and distribution boards along withtentative feeder disposition for each board is indicated in Standard SLD of system enclosed along with bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders. Any other feeder required asper system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.22.3 The Bill of Materials for each type of module shall be as per indicative requirement of the systems. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item/component required with in a module 'for efficient and reliable operation shall be deemed to be includedin bidder's scope.

1.23 AUTOMATIC SUPPLY CHANGEOVER

Automatic changeover between LT supply and DG set is to be carried out during the failure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions shall be finalized during detailed engineering.

F. TECHNICAL SPECIFICATIONS - EARTHING

1.0 Scope

a) Earthing system to be provided shall comprise of earth electrode of copper plate or hot dipped Galvanised plates in earth pits, earth bus/grid of copper flats or GI Flats or Aluminium flats as called for and bare copper earth wires or Galvanised earth wires or aluminium earth wires as called for, for acting as earth continuity conductor.

b) Lightning Protection system shall comprise of earth electrode of Cu or GI plate in earth pits, earth bus of down conductors of Cu or GI flats.

c) Earthing of Compound, Flood Lighting and Road Lighting poles shall be done by using Cu or GI plates in earth pits near pole and 7/16 size galvanised strained wire for connecting to the pole or as specified in the Schedule or in drawings.

d) Entire earth system shall conform to the Code of Practice as per IS. 3043 of 1987.

2.0 General Requirement

a) Enclosures and frame work of all current carrying equipment and accessories, structural steel/columns shall be adequately earthed to a single earthingsystem, unless separate earthing systems are specifically stipulated. All electrical equipment

shall be earthed at two distinct points.

b) Earth loads and risers shall follow as direct and short a path as possible. Suitable risers shall be provided as directed if equipment is not available when earthing is installed.

3.0 Earth Electrodes in Earth Pits :

Plate electrodes of Copper shall be 600x600x6 mm thick and 600x600x12 mmthick for GI unless otherwise specified.

4.0 Earth Bus and Earth Continuity Conductor :

a) Earth bus is a copper strip or flat of specified size interconnecting all earth electrodes.

b) Switchgears and Power Distribution Boards shall be earthed by a copper flat strip.

c) Panels, fused DBs and motors up to 30 KW rating shall be earthed by a continuity conductor, as specified. Minimum size of continuity conductor shall be 25x3 mm bare copper strip, soft drawn.

d) Road Lighting Poles shall be earthed with Cu stranded wire conductor whilefor lighting and power wiring bare copper conductor shall be provided unless otherwise specified to use insulated conductor.

5.0 Earth Bus Station :

Earth Bus Station shall be provided to facilitate tapping of earth continuity conductor from earth bus/grid very conveniently. It will comprise of a 400 mm long 50x6 mm bare copper strips/flat fixed with rawl plugs/bolts securely on wall/column above floor level. Spacers of 20 mm to 25 mm shall be provided to keep the flat away from wall and facilitate connections of earth conductor for which 6 mm dia holes 8 to 10 numbers are provided with proper size brass nuts, bolts, and washers. Earth bus shall be connected to it.

6.0 Lightning Protection System :

a) Air termination shall be five prong type copper Rod with round head and the same shall be securely clamped/installed to withstand severe weather conditions and provide protection against lightning. Horizontal air termination conductors shall be Cu or GI flat/strip and shall be provided where specified.

b) Earth Electrodes for lightning protection system shall be Copper plate installed in earth pits as per IS.

c) The down conductors from air terminals shall be done in tinned Cu or GI Flat/strip, of size as specified in the schedule of quantities or drawings, but shall not be less than 12.5x3mm as required. The down conductors shall followa direct path to the earth electrode without any sharp bend, turn or kinks. Thesedown conductors shall not be connected to other earthing conductors above ground level but the metallic parts in the vicinity of lighting protection conductorsuch as ladders, pipes, etc. shall be effectively connected and bonded.

d) A test joint as per IS shall be provided for every down conductor within 1500 mm above ground level.

e) Hardware and clamps shall be similar as used for the earthing systems.

7.0 Artificial Treatment of Soil

If the earth resistance is too high and the multiple electrode earthing does not giveadequate low resistance to earth, 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.

8.0 Resistance to Earth

The Contractor shall measure the resistance of the individual earthing pit and report to the Architect/ Consultants. The Contractor will make after due consultation with Architect/Consultants, No. of Earth pits, such that, the overall resistance in the earth mat does not exceed 1.0 ohm.

9.0 Earthing Station

9.1 Plate Electrode Earthing

Earthing electrode shall consist of a tinned copper plate not less than 600 x 600 x6 mm thick, or, 600 x 600 x 6 mm G.I. as called for in the drawings. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 mts. below ground level. Wherever possible earth electrodeshall be located as near the water tap, water drain or a down take pipe as possible. Earth electrodes shall not be installed in proximity to a metal fence.

It shall be kept clear of the buildings foundations and in no case shall it be nearer than1 meter from the outdoor face of the wall. The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. 20 mm G.I. 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 earth.The main earth conductors shall be connected to the electrode just below the funnel, with proper terminal lugs and checks nuts. The funnel over the G.I. pipe and earth connections houses 300 mm wide and 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting cover a C.I. frame embedded in masonry.

9.2 Pipe Electrode Earthing

Earthing electrode shall consist of a G.I. Pipe (Class 'B') Indian Tube Company make/ zenith or approved equal, not less than 40 mm dia and 5 meters long.
F.I. Pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia. drilled at 75 mm interval upto 2.5 meters length from bottom. The electrode shall buried vertically in the ground as far as practicable below permanentmoisture level with its top not less than 200 mm below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible earth electrodes shall be located as near water tap, water drainor a down take pipe. Earth electrode shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall be nearer than 2 meters from the outer face of the wall.

The pipe earth electrode shall be kept vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture upto a height of 2.5 meters from the bottom. At the top of the electrode a funnel with a mesh shall be provided for watering.

G. TECHNICAL SPECIFICATIONS FOR LIGHTING FIXTURES

1.0 Scope

Manufacture, Test, Supply and Delivery at site, Erection in proper position testing and commission the specified Light Fittings. All the fittings shall have Electronic Ballets of Approved make.

2.0 **Standards :**

Lighting Fittings covered against this specifications shall comply with the relevant latest Indian Standards and Codes and more specifically to IS 2418 for tubular fluorescent lamps, and IS 1771 for Industrial Fittings with metallic reflector.

3.0 Construction :

a) The atmosphere where these fittings are to be installed will be humid and conducive to chemical corrosion. Suitable protection against the same shall be offered. The fittings shall be suitable for 240 Volts. Single phase A.C. supply (+)/(-) 5% and frequency 50 Hz. (+)/(-)3%.

b) The complete fittings and its accessories such as Ballets, Side holders shall be fixed and pre wired. All fittings shall be provided with one internal and one external earthing terminal of appropriate diameter GI/Passivated Brass complete with one spring and two flat washers. The fluorescent fittings shall be complete with high frequency ballast, lamp holders, terminal block (4 way), etc. and fully wired upto terminal block.

Lighting Fittings Components/Accessories :-

a) Electronic Ballast :-

All the Electronic ballast shall be compact in design, electronic type and high frequency type having low power loss, good heat dissipation, with no humming. The HF ballast should not interfere with the Computers. The H.F Ballasts shouldnot have any "H" mark on it. The Electronic Ballast should have total harmonic distortion less than 10%. The Electronic Ballast should have constant light out put
i.e in case of variation in supply voltage the light out put of the lamp should remain constant. The Ballast should have following compliances and approvals.

RFI Less than 30 MHz	EN 55015
RFI more than 30 MHz	EN 55022 A
Harmonics	EN 61000-3-2
Immunity	EN 61547
Safety	IEC 928
Performance	IEC 929
Vibration & Bump Tests	IEC 68-2-6FC & IEC 68-2-29Eb
Quality Standard	ISO 9001
Environmental Standard	ISO 14001

All the Ballast's should be flicker free warm start. The ballast should have constant light output irrespective of mains voltage fluctuations within 202-254 Volts. In case of the Mains fluctuations within 202-254 Volts the luminous flux should not change more than +/- 4%. The ballast should have Low harmonics
distortion The total harmonic distortion should be less than 10%. The Earth leakage Current should be less than 0.5 mA per ballast and ignition time should be less than 2 sec. Further the ballast should have over voltage protection i.e. itshould able to sustain for 48 hrs at 320 Volts AC and 2 hours at 350 Volts AC. The Ballast should either of Philips make having Cat No. EB-PERFORMER (EB-P 220-240 1/36 RS) for Single Tubes or EB-PERFORMER (EB-P 220-240 2/36 RS) for double tubes or approved equivalent make .

b) Lamp Holders :

These shall be rotary, spring loaded resilient type, either moulded from Urea-Formaldehyde.

c) Fluorescent Lamps :

These shall be of High Lumen out put and of approved colors and of Philips or any other approved make similar to Philips True Light and of stated wattage.

I. TECHNICAL SPECIFICATION FOR CABLE TRAYS

1.0 Perforated Cable Trays of ladder type and associated accessories tees, bends, elbows and reducers shall be fabricated from 12 gauge (2.5mm) mild steel. Prefabricated Cable trays of perforated type and associated accessories tees, elbowsand reducers shall be fabricated from 14 gauge (2mm) White CRCA Sheets. Cable trays shall be made of corrosion resistant material or if made of material shall be adequately protected against the corrosion.

2.0 Cable trays accessories shall be painted with One Shop coat of Red oxide zinc chromate primer and two side coats of Aluminium alkyd paint.

3.0 Cable trays shall not have sharp edges, burrs or projections that may damage the insulation jackets of the wiring.

4.0 Cable trays shall not have side rails or equivalent structural members cable trays shallinclude fittings or other suitable means for change in direction and elevation of runs.

Cable Tray Mounting

Unless otherwise specifically noted on the relevant layout drawing, all cable tray mounting works to be carried out the following:

a) Cable tray mounting arrangement type to be as marked on layout drawing.

b) Assembly of tray mounting structures shall be supplied fabricated, erected & painted by the electrical contractor.

c) Tray Mounting structures shall be welded to plate inserts or to structural beams as approved by the Project Manager.

d) Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plate & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg, at no extra cost.

e) Maximum loading on a horizontal support arm to be 120 Kg/metre of cable run.

f) Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports.

g) The length of vertical supporting members for horizontal tray runs will be to suit the number of tray tiers shown in tray layout drawings.

h) Spacing between horizontal support arms of vertical tray runs to be 300 mm.

i) Cable trays will be welded to their mounting supports.

j) Minimum clearance between the top most tray tier and structural member to be

300 mm.

k) Cable in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angles. Clamps to be fabricated from 3mm. thick aluminiumstrip at site by the electrical contractor to suit cable groups.

l) The structural steel (standard quality) shall be according to latest revision of IS:2062 & IS 808 Rev III of 1989. Welding shall be as per latest revision of IS :816 Rev I of 1969. All structural steel to be painted with one shop coat of redoxide and oil primer followed by a finishing coat of aluminium alkyd paint where any cuts or holes are made on finished steelwork these shall be sealedagainst oxidation by red oxide followed by the same finishing paint. Steel sheetcovers wherever indicated to be similarly painted.

J. TECHNICAL SPECIFICATIONS FOR POINT WIRING USING PVC CONDUITS

1.0 Scope of Work

The scope of this section comprises of supply, delivery, store at site, prepare the conduit assembly, fix and erect in proper position, rigid PVC conduits of minimum 2.0 mm wall thickness and as per IS 9537 Part III. Concealed work check before casting of slab, measure and tie the assembly to reinforcements, complete with providing GI pull wires.

1.1 Applicable Standards

The relevant sections of Indian Standard Specifications as more particularly stated herein and broadly to all the codes, statues and regulations as applicable shall be strictly enforced and adhered to. More particularly following codes should be strictlyfollowed.

IS 9537 Part III : Rigid non metallic conduits for Electrical work.IS 2274 : Wiring Practice.
IS 3043 : Code of Practice of Earthing.

2.0 Rigid PVC Conduit Work

2.1 Material

2.1.1 The minimum wall thickness of Rigid PVC Conduits permitted for concealed conduiting shall be 2.0 mm thick and shall be suitable for heavy duty.

2.1.2 The tubing must be perfectly circular, without any burrs or kinks.

2.1.3 The Conduits shall be of such type, so as to be capable of making tight fitting joints.

2.1.4 The minimum size of Rigid PVC Conduits allowed in concealed work shall be of 20 mm and above.

2.2 Conduit Accessories

2.2.1 All conduit accessories that are to be used in concealed work shall be of Rigid PVCtype conforming to latest and relevant IS codes.

2.2.2 Conduit Accessories shall be capable of clean and tight fittings.

2.2.3 All junction boxes of one way or above shall be of high dome type with a depth of minimum 65 mm and minimum 2 mm wall thickness.

2.2.4 In concealed work, inspection types of bends are not allowed, normal bends/ elbows may be permitted after specific approval.

2.3 Conduit Assembly Work

2.3.1 The Contractor shall submit to the Architect/Consultant detail layout plan of conduit network containing particulars regarding size and routes of conduits, number of wires carrying in each conduit, inspection and junction boxes provided along with the routes of the conduits. The number of wires in each conduit shall not exceed as specified in the table of conduit capacity. All the conduits are supported using minimum 16 gauge M.S. Spacers and G.I Saddles fabricated using 16 gauge sheetsand fixed using GI Screws.

2.3.2 Initially all drawings for concealed conduit work shall be inspected. Any discrepancies or otherwise occurring due to site conditions or change in internal layouts or in walls shall be reported. After rectification of the same, then the measurements and marking shall be done for the conduit assembly, on the shuttering of the slab.

2.3.3 All conduits shall be assembled. Wherever straight runs exceeds 3 mts., additionalpull boxes or junction boxes shall be provided. However, the entire assembly shallbe so assembled in order to facilitate renewal of wires etc. in the future.

2.3.4 Wherever fluorescent light fixtures are shown in the layout, the conduit shall be terminated in a high dome junction box at the centre of the fixture, unless otherwise specified or indicated in drawings.

2.3.5 In the concealed conduit work, all junction boxes, bends, elbows shall have PVC tapes on either side to ensure security of the accessories in its place. They shall also be PVC taped at all joints in order to prevent cement, water or slurry entering the Rigid PVC conduit assembly.

2.3.6 All precautions should be taken in concealed work, to ensure no entry of cement slurry or blocking of conduits due to concreting.

2.3.7 For all circuit wiring, i.e. from Lighting Distribution Boards to Individual Switchboards, minimum 25 mm Rigid PVC conduits and minimum 2.0 mm wall thickness conduits shall be used.

2.3.8 All PVC conduits drops that are to be taken for the purpose of joining the Distribution Board or Switch Boards shall be taken out of the shuttering with a clean hole. Sand then shall be provided at the bottom most part of the entry in the shuttering. The projected part of the PVC conduit shall have a coupling over the same.

2.3.9 The entire PVC conduit assembly shall be properly secured and bonded by means of steel wires, twisted and fixed to the reinforcements. Additional fixing shall be done near joints, junction boxes, pull boxes etc.

2.3.10 The entire Rigid PVC conduit assembly then shall be checked for rigidity and no movement shall be allowed in the assembly.

2.3.11 The entire Rigid PVC conduit assembly shall be provided with proper GI pull wiresof minimum 14 gauge.

2.3.12 Adequate number of PVC, pull boxes of suitable sizes shall be provided in the PVC conduit assembly.

2.3.13 It shall be the entire responsibility of the Contractor to supervise the concealed conduit

assembly work during the casting of the slabs. Adequate precautions should be taken to spread fine sand covering the opening of the PVC conduit boxesor junction boxes at the bottom of the slab.

2.3.14 Where the conduit passes through the flooring the same shall be passed through galvanised pipe of suitable size fixed in the flooring, so that conduits, cables or wirescan be renewed at any time without breaking the floor.

2.3.15 Where the conduit runs in brick walls same should be necessarily fixed by using MSclamps. In the straight run the distance between the two clamps shall not exceed 500mm and additional clamps should be provided near bend and junction box.

2.3.16 The entire jointing in PVC conduit assembly shall be done using PVC solvent cement only. Wherever the conduits are terminated in PVC switchboard boxes or PVC, socket outlets boxes, the use of collars, male female type of adaptors shall be only used.

2.4 Conduit Capacity

The maximum capacity of a conduit for drawing in Flame Retardant Low Smoke (FRLS) wires shall be in accordance with IS 2274. The minimum size of conduit to be used shall not be less than 20 mm (approx.) and not more than two circuits connected to same phase be bunched in one conduit. Two different phases are notallowed in one conduit.

Commonly used sizes of 650/1100 Volts Flame Retardant Low Smoke (FRLS) wires and conduit capacities are as tabulated below:-

Size of Wire	Voltage Grade	Capacity of the Conduit 20 mm	25 mm
1.5 sq.mm.	650/1100	5 Nos.	8 Nos.
2.5 sq.mm.	650/1100	5 Nos.	6 Nos.
4.0 sq.mm.	650/1100	3 Nos.	5 Nos.
6.0 sq.mm.	650/1100	2 Nos.	3 Nos.
10.0 sq.mm.	650/1100	.....	3 Nos.

2.5 Point Wiring

The wiring shall be of the looping in system as different from the tree system. Connectors should not be used without specific prior approval. Looping in on the phase side shall be at the switches and that on the neutral side at the ceiling roses.Every light point, fan point and plug point shall have individual control switch unlessstated otherwise. Earthing shall be provided for all the points according to the statutory requirement wherever necessary. The number of points per circuit shall notexceed 8 in any case.

a) The point wiring in conduit consists of wiring from the branch distribution boardin conduit with its ancillary work, such as inspection bends, junction boxes andFRLS wires upto the fixed terminals of ceiling roses, connectors, batten holders, etc. depending upon the type of point.

b) For easy identification, wires with different colours shall be used for phase andneutral as far as practicable.

c) The control switches for lights, fans, wall sockets and fan regulators shall suitably be grouped on sheet steel cases of all welded design fabricated out of 1.2 mm (approx.). Generally, the bakelite sheet shall be 3 mm thick where SP Piano type flush mounting switches are to be accommodated and in all other cases it shall be 5 mm thick. The bakelite sheet cover shall be fitted above the sheet steel case and shall be leveled on the outer edges. Control accessories for

one circuit only shall be grouped on a sheet steel case. Not more than 2 ceiling fan regulators shall be mounted on a sheet steel case. Suitable earthing terminal shall be provided on the sheet steel case. All the conduits entering and leaving D.B. shall be bonded together with 4 sq.mm bare aluminium/copper wire and earth clips (as mentioned in the schedule.).

d) Point Wiring by using Flame Retardant Low Smoke (FRLS) Wires:- This shall be similar to point wiring in conduit system. The fixing of cables shall, however, be according to the specifications.

e) All the Flame Retardant Low Smoke (FRLS) wires shall have a grade 650/1100 Volts for lighting and power wiring.

2.6 Mains and Sub-Mains Wiring

This shall include the cost of all Flame Retardant Low Smoke (FRLS) wires conduit, conduit accessories, clamps spacers, Flame Retardant Low Smoke (FRLS) wires on battens depending upon the type of wiring, all masonry work, such as cutting, neat finishing of walls, floor openings etc. Only approximate lengths are included in the Schedule of Quantities and Rates, but the actual lengths of the mains and sub- mains executed will be measured between terminating points and will be paid for. Where the mains and sub-mains pass through the flooring, or through the wall, the same shall pass as specified in 3(b) above. Mains and Sub-Mains risers in conduit shall be bonded together with 4.0 sq.mm. bare aluminium/copper as specifically mentioned in Schedule and earth clips on each floor landing/mid-landing. The FlameRetardant Low Smoke (FRLS) wires are provided as mains and sub-mains, the same shall be fixed as per specifications.

3.0 Switches, Sockets & Ceiling Roses :

3.1 Ceiling Roses

These shall be of bakelite and of approved make and colour and shall not contain fuse terminals. These shall be provided with brass ceiling plate and M. T. Brass screws and washers with cord grip for termination of wires.

4.0 Plate type, moulded design-switches on white Urea Power pressed coverplates

These shall be of single pole, double pole, two ways, one ways or otherwise as called for in the Schedule. These shall be manufactured as per relevant IS Codes and shall amply to Indian Electricity Rules. The minimum rating shall be 5 Amp at 250 V AC.

5.0 Socket Outlets With Plugs

These shall be with porcelain base, in 2 Pin and earth design of best quality, suitable for single phase, 250 volts supply. The earth pin shall be effectivelyconnected to the nearest conduit or earth connections in distribution board with notless than 3 sq.mm (No. 14 SWG) copper wire. The socket outlet shall be complete unit shall be with ratings of 5 Amps. 250 Volts or 15 Amps 250 Volts to suit individual requirement as stated in Schedule of Quantities and Rates. The socketoutlets shall be in flush mounting or on plate designs as called for in the Schedule.

6.0 Interlocked Metal Clad Switch Fuse Units :

a) The Metal Clad switch fuse unit shall be of the heavy duty type, quick makeand quick break action, of approved pattern and capable of carrying continuously the current specified. All the switch fuse units shall have 'U' type contacts on fuse carriers and the switch fuse units of capacities 30 Amps. and above shall be provided with spring type contacts on the fuse bases. Unless otherwise specifically brought out in the Schedule the metal cases shall be of cast iron and shall be

provided with knock-outs for incomingand outgoing pipes or cables and earthing terminals. The cover of the switch shall be interlocked with the switch handle so that the cover cannot be opened unless the switch is 'OFF' and the switch cannot be made on unless the cover is fixed.

b) The fuse shall be either rewire-able type or HRC type as detailed in Schedule of Quantities and Rates. The Switches with HRC fuse links shallbe supplied with insulated fuse removers.

K. SPECIFICATIONS FOR INSTALLATION OF ELECTRICAL EQUIPMENTS

1.0 Specification for Marking of Panels and Nomenclature:

All Panels shall borne the Nomenclature as suggested in the tender. The same shallbe embossed on steel plates and not painted. All Panels shall also bear the name ofthe Consultants of the project. All panels shall also indicate the line diagram and themethod of receiving Power from upstream Panel /Switch.

2.0 Specification for Installation of Main LT Panel

2.1 The Main LT Panel shall be installed in the electrical room allotted at site. The panels shall be properly assembled if dispatched in sections. All bus bars fish plates will be thoroughly cleaned, greased and bolted to instructions. The Main Panel will be mounted on base frame of adequate size using 100x50x6 mm ISMC channels fabricated to meet the design of the base frame of the Main LT Panel. Thefabricated frame shall be welded in design and will undergo metal treatment process as stated in the specifications elsewhere. The base-frame shall have adequate size Anchor Fasteners which shall be grouted in the flooring. The base- frame of the panels will then be aligned with the fabricated base-frame already grouted. The whole structure will be rigid and will not in any way move while operating any of the switchgears. If found necessary, then, additional supports by way of angles horizontally bolted to the panel and grouted in the nearby wall shall be done. The entire erection of the panel shall have a neat and aesthetic appearance.

3.0 Specification for Installation of Power Control Centers and A.P.F.C. Panel.

3.1 The PCCs and APFC shall be installed in the electrical room allotted at site. The panels shall be properly assembled if dispatched in sections. All busbars fish plates will be thoroughly cleaned, greased and bolted to instructions. The Main Panel will be mounted on base frame of adequate size using 100x50x6 mm ISMC channels fabricated to meet the design of the base frame of the PCCs or APFC Panel. The fabricated frame shall be welded in design and will undergo metal treatment process as stated in the specifications elsewhere. The base-frame shall have adequate size Anchor Fasteners which shall be grouted in the flooring. The base-frame of the panels will then be aligned with the fabricated base-frame alreadygrouted.

The whole structure will be rigid and will not in any way move while operating any ofthe switchgears. If found necessary, then, additional supports by way of angles horizontally bolted to the panel and grouted in the nearby wall shall be done. The entire erection of the panel shall have a neat and aesthetic appearance.

4.0 Specifications for Installation of Sub-Power and Sub-Lighting Distribution Boards and Power & Lighting Distribution Boards

4.1 Before erecting the SLDB and SPDB and LDBs and PDBs at site, a thorough inspection shall be done by the Contractor and reported to the Architect / Consultants if any difficulties are envisaged for erection. Thereafter, an erection sketch shall be prepared, indicating the dimensions and the clearances between theBoards. A similar marking will also be made at site.

4.2 All Power and Distribution Boards shall be tested for mechanical endurance. After checking wiring and cable connections the entire boards, shall be erected in places indicated and marked on the plan. All touching up work of points shall then be doneand foundation bolts granted. All necessary holes and civil works shall be done as per directions. The Panel after duly testing shall be put to commission for trial. All the lighting and power distribution boards shall be mounted directly on wall.

5.0 Specification for installation of LT Capacitors

5.1 LT Capacitor shall be neatly arranged and installed in tier formation. Proper checks should be done to ensure proper banking and number of LT Capacitors banked together. The Capacitors after installation and cable joints, shall be finally checked for any leakage etc. The LT Capacitors banks shall be fixed on angle iron frame work firmly granted in the floor and fixed as MS Channels frames. All Joints shall bechecked for proper connections and after conducting all tests, the Capacitor Banks shall be commissioned. The Capacitor Banks shall be commissioned. The operationof banks shall also be tested and terminal voltages discharge should be tested andnoted prior to commissioning.

6.0 Specifications for installation of MV/LV cables

6.1 General

6.1.1 MV Cables shall be inspected prior to laying, 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 inoriginal drums with manufacturer's name clearly written in the drum.

6.1.2 The recommendations of the cable manufacturer with regard to jointing and sealingshall be strictly followed.

6.2 Inspection

6.2.1 All cables shall be inspected upon receipt at site and checked for any damage during transit.

6.2.2 While selecting cable route for external lighting, sewage effluent pipes, Fire HydrantPipes etc. shall be avoided; where this is not feasible, special precautions as decided by the Architect/Consultants, shall be taken.

6.2.3 Proximity to communication cables

a) Power and communication cables shall as far as possible cross at right angles.Where power cables are laid in proximity to communication cables the horizontal and vertical clearances shall not normally be less than 60 cms.

6.2.4 Laying methods

a) Cables shall be laid direct in ground, in pipes/closed ducts, in open ducts or on surface depending on environmental and site conditions.

b) During the preliminary stages of laying the cables, consideration should be given to proper location of he joint position so that when the cables are actually laid the joints are made in the most suitable places. As far as possible
water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts pipes racks etc. shall be avoided for joint position.

6.3 Laying direct in ground

6.3.1 **General :** This method shall be adopted where the cable route is along roads etc. and where no frequent excavations are encountered and where re-excavations is easily possible without affecting other services.

6.4 Trenching

6.4.1 **Width of trench**: The width of the trench shall first be determined on the following basis:

a) The minimum width of trench for laying single cable shall be 35 cm.

b) Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that he inter-axial spacing between the cables, except where otherwise specified shall be at least20 cm.

c) There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

6.4.2 Depth of Trench :-

The depth of the trench shall be determined on the following basis :

a) Where cables are laid in single tier formation, the total depth of trench shall notbe less than 75 cm. for cables up to 1.1 KV and 1.20 m for cables above 1.1 KV.

b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in above shall be increased by 30 cm for each additional tier to be formed.

6.4.3 Excavation of Trenches :-

a) The trenches shall be excavated in reasonably straight lines. Wherever thereis a change in direction, suitable curvature shall be provided complying with the requirements of the manufacturer.

b) Adequate precautions should be taken not to damage any existing cable(s), pipes or other such installation in the proposed route during excavation.Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Architect / Consultants.

c) If there is any danger of a trench collapsing or endangering adjacent structures, the sides should be well shored up with timbering and/or sheeting as the excavation proceeds. Where necessary, these may even be left in places when back filling the trench.

d) Excavation through lawns shall be done in consultation with the staff of the department/owner concerned.

e) The bottom of the trench shall be level and free from stone, brick bats etc. The trench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth.

6.5 Laying of Cable in trench

6.5.1 At the time of issue of cable for laying the cores shall be tested for continuity and insulation resistance.

6.5.2 When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable is then measured. In case of PVC cables suitable moisture seal tape shall be used for this purpose. All wastage to be contractors account.

6.5.3 a) Cable laid in trenches in a single timer formation shall have a covering of clean, dry sand of not less than 17 cms. above the base cushion of sand before the protective cover is laid.

b) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cms. shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms. as stated above. The top most cable shall have a final sand covering not less than 17 cms. before the protective cover is laid.

6.5.4 At the time of original installation, approximately 3m of surplus cable shall be left oneach end of the cable and on each side of underground joints (straight through /Tee/Termination) and at entries and places as may be decided by the Architect / Consultants. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length, loose cable may be left at suitable intervals as specified by the Architect / Consultants.

6.5.5 Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20cmx10cmx10cm (nominal size) protection covers placed on top of the sand, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Architect / Consultants. Where more than one cable is to be laid inthe same trench, this protective covering shall cover all the cables and projects at least 5cm. over the sides of the end cables.

6.6 Back filling

6.6.1 The trenches shall be then back filled with excavated earth free from stones or othersharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm. in the center and tapering towards the sides of the trench shall be leftto allow for subsidence. The crown of earth however should not exceed 10 cm. so as not to be a hazard to vehicular traffic.

The temporary reinstatements of roadways should be inspected at regular intervals, particularly during the wet weather, and any settlement should be made good by further filling as may be required. After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved to the satisfaction of the Architect / Consultants.

6.6.2 Where road turns or lawns, have been cut to kerb stones displaced, the same shallbe repaired and made good except turning / asphalting to the satisfaction of the Architect/Consultants and all surplus earth or rock removed to places as specified.

6.7 Route Marker:-

6.7.1 Route marker shall be provided along straight runs of the cables at locations approved by the Architect/Consultants and generally at intervals not exceeding 100 m. Markers shall also be provided to identify change in the direction of the cableroute and also for location of every underground joint.

6.7.2 Route markers shall be made out of 100mmx100mmx5mm GI/Aluminum plate, welded or bolted on to 35mmx35mmx6mm angle iron 60cm. long. Such plates marker shall be mounted parallel to and 0.5m or so away from the edge of the trench.

6.7.3 The word `cable` and other details such as voltage grading size etc. as furnished bythe Architect /Consultants shall be inscribed on the marker.

6.8 Single Core Cables :-

Three single core cables forming one three phase circuit shall normally be laid in close trefoil formation and shall be bound together at intervals of approximately 1m.The relative position of the three cables shall be changed at each point, complete transposition being effected in every three consecutive cable lengths. The joints shall be clearly marked in an approved manner to indicate the circuit and phases. The arrangement for laying a number of parallel cables shall be as detailed of IS:1255/1967.

6.9 Laying in Pipes/Closed Ducts :-

6.9.1 In locations such as road crossing, entry to buildings, on poles, in paved areas etc.cables shall be laid in pipes or closed ducts.

6.9.2 Stone ware pipes, GI, CI or Spun reinforced concrete pipes shall be used for such purposes. In the case of new construction, pipes as required shall be laid along withthe Civil Works, and jointed as per the instructions of the Architect / Consultants. The size of the pipe shall be decided by the Architect / Consultants and shall not beless than 10cm in diameter for a single cable and not less than 15cm for more thanone cable. These pipes shall be laid directly in ground without any special bed except for SW pipe which shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40 mm nominal size) bed.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 1m. from the ground level when laid under roads, pavements etc.

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 poly-phase system.

6.9.3 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 suitable sealed to avoid entry of water.

6.9.4 All chases and passage necessary for the laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Architect / Consultants.

6.9.5 Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

6.10 Laying of Cables in open ducts/Trenches

6.10.1 Trenches with suitable removable covers shall be preferred in sub-stations, switch rooms, plant rooms, etc.

6.10.2 The cable ducts should be of suitable dimensions so that the cables can be conveniently laid. If necessary, cables may be fixed with clamps on the walls of theduct or taken in troughs in duct. The duct should be covered with removable slabs orchequered plates.

6.10.3 Ducts may be filled with dry sand after the cable is laid and covered as above or finished with cement plaster specially in high voltage applications.

6.10.4 Splices or joints of any type shall not be permitted.

6.10.5 As far as possible laying of cables with different voltage ratings in the same duct shall be

avoided.

6.10.6 Where considered necessary, hooks or racks shall be provided for supporting the cables in masonry/concrete cable ducts, cable troughs. Otherwise cables shall be laid direct in the trench or trough etc. While deciding the layout of cables in such ducts, care should be exercised to ensure, that, unnecessary crossing of cables is avoided.

6.11 Laying on Surface

6.11.1 The cables may be laid in troughs or brackets at regular intervals or directly cleatedto wall/ceiling. When laid over bracket supports, the cables shall be clamped to prevent undue sag.

6.11.2 Cable clamps shall be made from materials such as mild steel or Aluminum only. Incase of single core cables the clamps shall be non-magnetic materials. A suitable non-corrosive packing shall be used for clamping unarmoured cables, to prevent damage to the cable sheath.

6.12 Cable Identification Tags :-

6.12.1 Wherever more than one cable is laid/run side by side, marker tags as approved, inscribed with cable identification details shall be permanently attached to all the cables in the manholes/open ducts etc. These shall also be attached to various cables laid direct in ground at suitable intervals as decided by the Architect / Consultants before trenches are filled up.

6.13 Testing

6.13.1 All cables before laying shall be tested with a 500 Volts megger for 1.1KV grade or with a 2500/5000 Volts megger for cables of higher voltages. The cable cores shallbe tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armor and insulation resistance between conductors.

6.13.2 All cables shall be subjected to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

6.13.3 In the absence of facilities for pressure testing, it is sufficient to test for one minute with 1000 Volts megger for cables for 1.1KV grade and with 2500/5000 Volts megger for cables of higher voltages.

6.14 Completion Plan and Completion Certificate-

6.14.1 The work shall be carried out in accordance with the drawings enclosed with the tender and also in accordance with the modifications thereto from time to time approved by the Architect / Consultants.

6.14.2 At Completion, all layout drawings should be on Auto-cad and on 1:100 scale. The contractor is required to submit 5 sets of as built drawings on A-1 Size white paper along with 5 sets of Rewritable CDs. The Virtual Completion certificate can be issued to the contractor only when he submit all the shop drawings, As built drawings, Operation and Maintenance Manual to owner, Architect/ Consultant and PMC.

6.14.3 Layout of Cable Work.

6.14.4 Length, size, type and grade of cables.

6.14.5 Method of laying i.e. direct in ground, in pipes etc.

6.14.6 Location of each joint with jointing method followed.

6.14.7 Route marker and joint marker with respect to permanent land marks available at site.

6.14.8 Name of work, Job Number, accepted tender reference, date of completion, names of Division and Sub-Division, names of Contractor with their signature and scale of drawing.

6.15 Specifications for Earthing Grid and Earth Stations

The earthing system shall comply with the relevant standard as laid down in the Fire Insurance and Indian Standard Specifications.

The Earthing stations for Pipe and Plate Earthing shall be as per drawings. Entire Civil works, Salt, Charcoal in proper proportions, Watering chamber with wire mixingetc. shall be done. The Earth tapes wherever indicated shall be obtained by using Earth Megger. The results should comply with the Standards bid down by the Indian Standard Specifications.

The Lightning Arrestors shall be fixed on angle from frame work secured to the building walls at the top most painted and at all other points wherever indicated on the plan. They shall be connected to earth by using G.I. tapes of appropriate size. The entire unit shall have completed earth grid running around the unit and the same shall be inter-connected. The entire works of earthing should be complete in all respects such as welding the GI tape joints, tapping etc. There shall be no placewhere earthing strips are not connected to earth stations. G.I. tape shall be fixed onwalls or laid in prepared trenches or chiseled in ground and redone etc. as per directions.

7.0 Document, Certificates, Drawings and Spare Requirements :

7.1 The intent of this specification is to give a guideline of the Contractor to furnish in reproducible all sets of relevant papers and lists of spares for the continuous performance of the Owner`s Building. Nothing shall absolve the Contractor from notfurnishing any information documents and/or papers that have not been specificallystated herein.

a) **Document**:-All relevant documents for maintenance, manuals procedures anddata of all Electrical Equipment's supplied and erected by the Contractor on the site. The documents shall be bound and furnished to the Owner.

b) **Certificates**: All relevant tests certificates etc. and as more specifically statedin clause, shall be furnished. Contract shall also furnish all such certificates issued by the original manufacturer towards guarantee of performance of all equipment's supplied by the Contractor.

c) **Drawings**: All working / shop drawings and erection / as built drawings of the final erected plan of all electrical & all other services installation work as required in reproducible of equipment's such as MV Panel Distribution Boards, Cable routing, sizing, connection diagrams, circuits, wiring diagram and conductor sizes, lengths, terminations details, operational charts, recorded readings, load details, etc. shall be furnished to the Owner. The Ownerreserves the right to the mode of submission of such details being furnished by the Contractor.

d) The **Contractor** shall, notwithstanding anything stated otherwise, shall furnishlist of recommended maintenance tools, spares, fuses, sets, codes, catalogues, appropriate pricing, original equipment manufacturer's addressesetc. to the Owner. Prior to such furnishings contractor shall make a proper assessment of all such requirements and then proceed to make the lists. The Contractor shall also be deemed to have understood the requirements, in such a way that it ensures a

continuous operation and functioning of the Electrical Equipment under the stated ratings, conditions and specifications.

L. TESTING, MANUFACTURER`S TESTS PRECOMMISSIONING TESTS ANDCOMPLETE COMMISSIONING

TESTING

1.0 General

At the completion of the work, the entire installation shall be subjected to the following tests :-

a) Insulation Continuity Test.
b) Insulation Resistance Test.
c) Earth Continuity Test.
d) Earth Resistivity Test.

Besides the above tests, any other test specified by the Local Authority shall also becarried out.

2.0 Testing of Wiring

All the wiring system shall be tested for continuity of circuits, short circuits and earthing after the wiring as completed and before energizing.

3.0 Insulation Resistance Test

The insulation resistance shall be measured by applying between earth and the whole system of conductors, or any section thereof, with all fuses in place and all switches closed and except in concentric wiring all lamps in position of both polesof the installation otherwise electrically connected together, a direct currentpressure provided that it does not exceed 60volts for medium voltage circuit. Wherethe supply is derived from AC three phase system the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained 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 greater than one mega ohm.

The insulation resistance shall also be measured between all conductors connectedto one phase conductor of the supply and all the conductors connected to the middle wire of the neutral or to the other phase conductors of the supply. Such a test shall be carried out after removing all metallic connections between the two poles of the installation and in those circumstances the installation shall not be lessthan that specified above. The insulation resistance between the case of frame workof housing and power appliances, and all live parts of each appliance shall not be less than that specified in the relevant Indian Standard Specifications or where thereis no such specification shall not be less than half a mega ohm.

4.0 Testing of Earth Continuity Test

The earth continuity conductor metallic envelopes of cable shall be tested for electric continuity and the electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrode to any point inthe earth continuity conductor in the completed installation shall not exceed one ohm.

5.0 Testing of Polarity of Non linked single pole switches

In a two wire installation a 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 labeled or marked for connections, to an outer or phase conductor or to thenon-earthed conductor of the supply. In the three of four wire installation a test shallbe made to verify that every non-linked single pole switch fitted in a conductor to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of Architect / Consultants as well as the localauthorities.

6.0 Earth Resistivity Test

Earth Resistivity Test shall be carried out in accordance with Indian Standard Codeof Practice for earthing IS 3043 - 1966. All tests shall be carried out in the presenceof the Architect / Consultants/PMC.

7.0 Testing, Manufacturer's Tests Pre-commissioning Tests and Complete Commissioning

7.1 The general intent of this specification is to mention all the relevant tests to be doneand results to be furnished to Owner/Consultant/PMC by the contractor, prior to commissioning of the electrical work. These are guidelines, however, the Contractorshall carryout all such tests and complete all formalities as per relevant Indian Standard Specifications, Fire Insurance Requirements and/or Electricity Rules and Regulations as per Government as per Government Gazette and Publications.

7.2 Testing of Equipments

All equipments before installing on the site work shall be tested and all such results produced to the Owner. Nothing shall absolve the Contractor from re-performing any tests that the Contractor may be called upon specifically by the Architect / Consultants.

7.3 Manufacturer's Tests

The Contractor shall specifically perform all tests such as type, routine tests on all equipments such as Medium Voltage Panels, Light Fixtures etc. The details of suchtests shall be furnished by the Contractor to the Owner/ Architect / Consultants andobtain their approval in the matter. All costs incidental to such tests shall be deemedto have been included in the specific them for that equipment and no extra charge shall be payable by the Owner.

7.4 Pre-commissioning Tests

All tests underlined herein and/or called by the local Electrical Authorities, Government Officials and as laid down in relevant Indian Standard Specifications and/or Rules and Regulations stated in Indian Electricity Act shall be strictly complied megger, on M.V. side the reading shall not exceed 1 ohm and for H.V. sidenot exceeding 0.5 ohm.

7.5 Commissioning

a) The Contractor shall obtain the written permission and sanction of commissioning the equipment from Electrical Inspector of I.E.& L. Department of Government of Haryana State, if required under the specific rules of the Government.

b) All costs, visit fees etc. incidental to such obtaining sanctions shall be to the Contractors` Account, except statutory fees payable under relevant Indian ElectricityAct or Rules.

c) Contractor shall furnish all the necessary test and tests-reports to the Electrical Supply

Authorities and furnish all formalities required to comply as per the Rules and Regulations on laid down for release of Electrical Supply to the Building. If called on, the Contractor shall carry out all such tests and prove the results to the entire satisfaction of the local and electric supply authorities. All costs and expensesincidental to the release of electric supply shall be to the Contractors account and no demand whatsoever shall be made to the Owner, except for any securitydeposits that the supply authorities would deem it necessary for charging of the lineetc.

7.5.1 All such documents forwarded and/or letters and/or correspondence exchanged to this regard shall be made available for inspection and the Contractor shall furnish 3sets of such documents and drawings for the Owner`s records.

7.5.2 After release of electric supply to Owner, the Contractor shall furnish six sets of all tests and test reports declared to the Supply authorities and shall record the initial reading of the LT Meter and shall furnish all such documents, officially exchanged between the Contractor and the Supply authorities for the record of Owners.

7.5.3 Contractor shall also attend and furnish the relevant completion certificate from the Electrical Inspector, I.E & L. Department, Government of Haryana and/or any other authority thereof, such as Pollution Control Board, various Government Bodies, Electrical Inspector, and supply Authorities whichever may be applicable.

7.5.4 The Contractor shall maintain a close liaison with the Supply Authorities and keep informed to the Architect / Consultants/Owners of the entire developments and planning i.e. being done by the Supply Authorities. It is the primary responsibility of the Contractor to approach Supply Authorities for obtaining Electrical Loads Sanctions. All formalities connected with this work shall be to the account of the Contractor except for official fees or deposits or any other statutory obligations.

Technical Specification on Electrical Works

C. GENERAL

1.2 The following Technical Specifications are made applicable for the Stated Job and shall be rigidly adhered to while supplying and installing the materials at site.

1.3 **Codes and Standards**:

1.3.1 The following Codes and Standards shall be applicable for continuous performance of all electrical equipment's to be supplied, delivered at site, erected, tested and commissioned. The Electrical equipment's offered shall comply with the relevant IndianStandard Specifications, Fire Insurance Regulations, Tariff Advisory Committee's Regulations, and in particular to Indian Electricity Rules in all respects with all its latest amendments up-to-date.

1.3.2 For guidelines to the tenderers, few of the Indian Standards are indicated below:

IS 8084 / 1976	Interconnecting bus-bars for A.C voltage above1KV up to & including 36KV.
IS 13032 / 1991	A.C miniature circuit breaker board for voltagenot exceeding 1000V specification.
IS 3043 / 1987	Code of practice for earthing.
IS 3427 / 1997	A.C metal enclosed switchgear & control gearsfor rated voltage above 1KV up to & including 52KV.
IS 3837 / 1976	Accessories for rigid steel conduits forelectrical wiring.
IS 13947 / Part3 / 1993	Specification for low voltage switchgear & control gear.
IS 13947 / Part1 / 1993	Specification for low voltage switchgear & control gear.
IS 4615 / 1968	Switch socket outlets (Non-Interlocked type).
IS 5216 / Part1, 2 /1982	Guide for safety procedures & practices in electric work.
IS 5578 / 1984	Guide for marking of insulated conductors.
IS 5820 / 1970	Specification for precast concrete cable covers.
IS 6381 / 1972	Specifications for construction & testing of electrical apparatus with type of protection 'e'.
IS 10322/ Part1, 2/1982	Specification of luminaries.
IS 10322 /Part3, 4/1984	Specification of Laminaries.
IS 10322/Part5 (Sec1,2)/1985	Specification of Luminaries.
IS 10322/Part5 (Sec3 to 5)/1987	Specification of Luminaries
IS 13947 / Part1 / 1993	Specification for low-voltage switchgear & control gear.
IS 13703 / Part4 / 1993	Specification for low voltage fuse for voltages not exceeding 1000V AC or 1500V DC.
IS 2551 / 1982	Danger notice plates.
IS 2268 / 1994	Call bells / Buzzers.
IS 732 / 1989	Code of practice for electrical wiringinstallation.
IS 3854 / 1997	Switches for domestic & similar purpose.
IS 2312 / 1967	Exhaust fans.
IS 2309 / 1989	Code of practice for lighting production.
IS 2418 / Part1 to 3/1977	Tubular fluorescent lamps for general lightingservice.
IS 1937 / Part3 / 1983	Conduits for electrical installations.
IS 13032 / 1991	AC miniature circuit breaker board for voltagenot exceeding 1000V.
IS 2667 / 1988	Fittings for rigid steel conduits for electricalwiring.
IS 2675 / 1983	Enclosed distribution fuse boards cutouts forvoltage up to 1000V.
IS 2706 / Part1 to 5/1992	Current transformers.
IS 15086 / Part1 / 2001	Surge arresters.
IS 13925 / Part1 / 1998	Shunt capacitors for AC power systems having

	a rated voltage above 1000V.
IS 13118 / 1991	Specification for HVAC circuit breakers.
IS 374 / 1979	Ceiling fans.
IS 5578 / 1984	Guide for marking of insulated conductors.
IS 418 / 1978	Tungsten filament general service electricallamp.
IS 694 / 1990	PVC insulated cable & cords for power /lighting.
IS 13010 / 2002	A.C watt-hour meters.
IS 732 / 1989	Electrical wiring installation (up to 650V).
IS 10870 / 1984	Code of safety for hexane.
IS 1248 / Part1 / 1993	Direct acting indicating instruments & their accessories.
IS 1248 / Part2, 6 /1983	Direct acting indicating instruments & their accessories.
IS 1248 / Part7, 8/1984	Direct acting indicating instruments & their accessories.
IS 1248 / Part9/1983	Direct acting indicating instruments & their accessories.
IS 1293 / 1988	3 pin plugs & socket outlets.
IS 1554/Part1 to 3/1988	PVC insulated cables – heavy duty.
IS 13947/Part 1 to 5/1993	Low voltage switchgear & control gear.IS 1651 / 1991 Lead acid cell batteries.
IS 9537 / Part 5 / 2000	Conduits for electrical installation.

The entire electrical installation work shall be strictly complied with the Codes Standards, Rules and Regulations framed under the Indian Electricity Act. Further, itshall be carried out as per the Regulations and Rules set out by "Tariff Advisory Committee and/or Fire Insurance Regulations".

Any other IS Codes As applicable at the time of execution over and above whateverstated above. Some of the Rules framed under Indian Electricity Rules of 1956 andall amendments thereof more particularly complied to :-

35, 43, 44, 44-A, 45 (Part-I), 50, 51, 59, 61 (a), 61 (c), 62, 63 (2), 65, 66, 67, 68, 69 and 92 (2).

D. TECHNICAL SPECIFICATION FOR 33kV INDOOR VCB SWITCHGEAR

1.4 General requirements:

The manufacturer, whose 33 kV Indoor switch gear panels are offered should have designed, manufactured, type tested as per relevant IEC/IS, supplied and commissioned the Panels of similar rating. These Panels should have been in operation for at least two years as on the originally scheduled date of bid opening.

In addition to the requirements above, the Vacuum circuit breaker, CT, PT and relaysshould have been designed, manufactured and type tested as per relevant IEC/IS and should have been in satisfactory operation for at least two years as on the date of bid opening.

1.5 The equipment offered by the Bidder shall be complete in all respects. Any material and component not specifically stated in this specification but which are necessary for trouble free operation of the equipment and accessories specified in this specification shall be deemed to be included unless specifically excluded. All such equipment/accessories shall be supplied without any extra cost. Also all similar components shall be interchangeable and shall be of same type and rating for easy maintenance and low spare inventory.

Specific reference in this specification and documents to any Material by trade name,make, or catalogue number shall be constructed as establishing quality and performance requirements.

Equipment shall be installed in neat workman-like-manner so that it is levelled, plumbed, squared and properly aligned and oriented. Tolerances shall be as established on Contractor's drawings or as stipulated by Employer. No equipment shall be permanently bolted down/ tag welded to foundation until the alignment has been checked and found acceptable by the Engineer. Contractor shall furnish all supervision labors, tools, equipment rigging materials, bolts, wedges, anchors, concrete inserts etc. in proper time, required to completely install, test and commission the equipment.

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Manufacturer's and Employer's instructions and recommendations shall be correctlyfollowed in handling, erection, testing and commissioning of all equipment.

Contractor shall move all equipment into the respective rooms through the regular door or openings specifically provided for this purpose. No parts of structure shall beutilized to lift or erect any equipment without prior permission of Engineer.

Switchgear shall be installed on finished surfaces, concrete or steel sills. Contractor shall be required to install and align any channels sills, which form part of foundations. Circuit breaker trolley wheels shall move on channels, which shall formpart of floor. The channel length shall be minimum of 1 meter from the door of switchgear panel. Power bus enclosure, ground and control splices of conventional nature shall be cleaned and bolted together with torque wrench of proper size or by other approved means. Tape or compound shall be spilled where called for in drawings. Contractor shall take utmost care in handling instruments, relays and otherdelicate mechanisms. Wherever the instruments and relays are supplied loose alongwith switchgear, they shall be mounted only after the associated switchgear panels have been erected and aligned. The blocking materials, employed for safe transit of instrument and relays shall be removed after ensuring that panels have been completely installed and no further movement of the same would be necessary. Anydamage shall be immediately reported to Engineer.

Foundation work for all switchgear panels will be carried out by contractor.

1.6 Switchgear panel

1.6.1 The switchgear boards shall have a single front, single tier, fully compartmentalized,metal enclosed construction complying with IS: 3427:1997, comprising of a row of free standing floor mounted panels. Each circuit shall have a separate vertical panelwith distinct compartments for circuit breaker truck, cable termination, Main bus barsand auxiliary control devices. The adjacent panels shall be completely separated bysteel sheets except in busbar compartments where insulated barriers shall be provided to segregate adjacent panels. However, manufacturer's standard switchgear designs without internal barriers in busbar compartment may also be considered.

1.6.2 The circuit breakers and Bus VTs shall be mounted on withdrawable trucks which shall roll out horizontally from service position to isolated position.

1.6.3 For complete withdrawal from the panel, the truck shall rollout on the floor or shall rollout on telescopic rails. In case the later arrangement is offered, suitable trolley shall be provided by the Bidder for withdrawal and insertion of the truck from and into the panel.

1.6.4 Testing of the breaker shall be possible in isolated position by keeping the control plug connected.

1.6.5 The trucks shall have distinct SERVICE and ISOLATED positions. It shall be possibleto close the breaker compartment door in isolated position also, so that the switchgear retains its specified degree of protection. While switchboard designs withdoors for breaker compartment would be preferred, standard designs of reputed switchgear manufacturer's where the truck front serves as the compartment cover may also be considered, provided the breaker compartment is completely sealed from all other compartments and retains the IP-4X degree of protection in the Isolated position. In case the later arrangement is offered, the Bidder shall explain how this sealing is achieved and shall include blanking covers one for each size of panel per switchboard in his total bid price.

1.6.6 The truck in any position SERVICE, ISOLATED or removed, and all doors and covers closed. All doors, removable covers and glass windows shall be gasketted allround with synthetic rubber or neoprene gaskets.

1.6.7 The bus VT/ relay compartments shall have degree of protection not less than IP:4X in accordance with IS:13947. However, remaining compartments shall be dust, moisture, rodent and vermin proof, with degree of protection of IP:4X. All louvers if provided, shall have very fine brass or GI mesh screen. IPH-2 degree of protection as per IS: 3427:1997 to all live parts shall (whether isolated or removed from panel) even when the breaker compartment door is open. Tight

fitting garments/gaskets areto be provided at all openings in relay compartment.

1.6.8 The switchgear construction shall be such that the operating personnel are not endangered by breaker operation and internal explosions, and the front of the panelsshall be specially designed to withstand these. Pressure relief device shall be provided in each high voltage compartment of a panel, so that in case of a fault in a compartment, the gases produced are safely vented out, thereby minimizing the possibility of its spreading to other compartments and panels. The pressure relief device shall not however reduce the degree of' protection of panels under normal working conditions. The bidder shall ensure satisfactory operation of pressure relief device in accordance with relevant IEC. The test reports for internal arc fault test forall HT chambers shall be submitted.

1.6.9 Enclosure shall be constructed with rolled steel sections and cold rolled steel sheetsof at least 2.0 mm thickness, Gland plates shall be 2.5mm thick made out of hot rolled or cold rolled steel sheets and for non-magnetic material it shall be 3.0 mm.

1.6.10 The switchgear shall be cooled by natural air flow and cooling by any other method shall not be accepted.

1.6.11 Total height of the switchgear panels shall not exceed 2450 mm. The height of switches, pushbuttons and other hand operated devices shall not exceed 1800 mm and shall not be less than 700 mm.

1.6.12 Necessary guide channels shall be provided in the breaker compartments for properalignment of plug and socket contacts when truck is being moved to SERVICE position. A crank or level arrangement shall preferably be provided for smooth and positive movement of, truck between Service and Isolated positions.

1.6.13 Safety shutters complying with IEC-298 shall be provided to cover up the fixed high voltage contacts on busbar and cable sides when the truck is moved to ISOLATED position. The shutters shall move automatically, through a linkage with the movementof the truck. Preferably it shall however, be possible to open the shutters of busbar side and cable side individually against spring pressure for testing purpose after defeating the interlock with truck movement deliberately. It shall also be possible to padlock shutters individually. In case, insulating shutters are provided, these shall meet the requirements of Clause 3.102.1 Note-2 of IEC-298 and necessary tests asper IEC-298 Clause 5.103.1 shall be carried out. A clearly visible warning label "Isolate elsewhere before earthing" shall be provided on the shutters of incoming andthe connections which could be energized from other end.

1.6.14 Switchgear construction shall have a bushing or other sealing arrangement betweenthe circuit breaker compartment and the busbar/cable compartments, so that there isno air communication around the isolating contacts in the shutter area with the truckin service position.

1.6.15 The breaker and the auxiliary compartments provided on the front side shall have strong hinged doors, busbar and cabling compartments provided on the rear side shall have bolted compartment covers with self retaining bolts. Breaker compartmentdoors shall have locking facility.

1.6.16 In the Service position, the truck shall be so secured that it is not displaced by short circuit forces. Busbars, jumpers and other components of the switchgear shall also. be properly supported to withstand all possible short circuit forces corresponding to the short circuit rating specified.

1.6.17 Suitable base frames made out of steel channels shall be supplied alongwith necessary anchor bolts and other hardware, for mounting of the switchgear panels. These shall be dispatched in advance so that they may be installed and leveled whenthe flooring is being done, welding of base frame to the insert plates as per approved installation drawings. The bidder may offer panels with built in base frame ready for dispatch and suitable for installation on indoor cable trenches.

1.6.18 The switchboard shall have the facility of extension on both sides. Adopter panels and dummy panels required to meet the various bus bar arrangement, cable/bus ducttermination and layouts shall be included in Bidder's scope of work.

1.3 Circuit Breakers

1.4.14 The circuit breakers shall be of vacuum type and shall comprise of three separate, identical single pole interrupting units, operated through a common shaft by a sturdyoperating mechanism.

1.4.15 Circuit breakers shall be suitable for switching lines at any load.

1.4.16 Circuit breaker shall be restrike free, stored energy operated and trip free type. Motor wound closing spring charging shall only be acceptable. An antipumping device shall be provided for each breaker; even it has built-in mechanical anti- pumping features. An arrangement of two breakers in parallel to meet a specified current rating shall not be acceptable.

1.4.17 During closing, main poles shall not rebound objectionably and mechanism shall notrequire adjustments. Necessary dampers shall be provided to withstand the impact at the end of opening stroke.

1.4.18 Plug and socket isolating Contacts for main power circuit shall be silver plated, of self-aligning type, of robust design and capable of withstanding the specified short circuit currents. They shall preferably be shrouded with an insulating material. Plug and socket contacts for auxiliary circuits shall also be silver plated, sturdy and of self
-aligning type having a high degree of reliability. Thickness of silver plating shall notbe less than 10 microns.

1.4.19 All working part of the mechanism shall be of corrosion resisting material. Bearings which require greasing shall be equipped with pressure type grease fittings. Bearingpins, bolts, nuts and other parts shall be adequately secured and locked to prevent loosening or change in adjustment due to repeated operation or change in adjustment due to repeated operation of the breaker and the mechanism.

1.4.20 The operating mechanism shall be such that failure of any auxiliary spring shall not prevent tripping and shall not lead to closing or tripping of circuit breaker. Failure of any auxiliary spring shall also not cause damage to the circuit breaker or endanger the operator.

1.4.21 Mechanical indicators shall be provided on the breaker trucks to indicate OPEN/ CLOSED conditions of the circuit breaker, and CHARGED/DISCHARGED conditionsof the closing spring. An operation counter shall also be provided. These may be visible without opening the breaker compartment door.

1.4.22 The rated control supply voltage shall be as mentioned in Section-GTR. The closingcoil and spring charging motor shall operate satisfactorily at all values of control supply voltage with specified variation mentioned in Section-GTR. The shunt trip coilshall operate satisfactorily under all operating conditions of the circuit breaker up to its rated short circuit breaking current at all values of control supply voltage between70 and 110 percent of the rated voltage. The trip Coil shall be so designed that it does not get energised when its healthiness is monitored by indicating lamps (Red)and trip coil supervision relay.

1.4.23 The time taken for charging of closing spring shall not exceed 30 second. The springcharging shall take place automatically preferably after a closing operation. Breaker operation shall be independent of the spring charging motor, which shall only chargethe closing spring. Operating spring shall get charged automatically during closing operation. As long as power supply is available to the charging motor a continuous sequence of closing and opening operations shall be possible. One open-close-openoperation of the circuit breaker shall be possible after failure of power supply to the motor.

1.4.24 Spring charging motors shall be capable of starting and charging the closing spring twice in quick succession without exceeding acceptable Winding temperature when the control supply voltage is anywhere between 85% and 110% of the rated voltage.The initial temperature shall be as prevalent in the switchgear panel during full load operation with 50 deg. C ambient air temperature. The motor shall be provided with short circuit protection.

1.4.25 Motor windings shall be provided with class E insulation or better. The insulation shallbe given

tropical and fungicidal treatment for successful operation of the motor in a hot, humid and tropical climate.

1.4.26 Circuit breaker may be provided with inter pole barriers of insulating materials, if thesame is standard design of the manufacturer. But use of inflammable materials like Hylam shall not be acceptable.

1.21 Control and interlocks

1.21.1 The control switch located on the switchgear would normally be used for operation ofcircuit breaker in service/isolated position, and for tripping it in an emergency.

1.21.2 The Bidder shall study the basic control scheme as proposed to be adopted and clearly state in his bid the extent to which it can be complied with.

1.21.3 Facilities shall be provided for mechanical tripping of the breaker and for manual charging of the stored energy mechanism for a complete duty cycle, in an emergency. These facilities shall be accessible only after opening the compartment door.

1.21.4 Each panel shall have two separate limit switches, one for the Service position and the other for isolated position. Each of these limit switches shall have at least four (4)contacts which shall close in the respective positions

1.21.5 Auxiliary Contacts of breaker may be mounted in the fixed portion or in the with drawable truck as per the standard practice of the manufacturer, and shall be directlyoperated by the breaker operating mechanism.

1.21.6 For Employer's use six (6) normally open (NO) and six (6) normally closed (NC) auxiliary contacts shall be provided for all feeder and shall be wired out to the terminal blocks.

1.21.7 Contact multiplication, if necessary to meet the above contact requirement, shall be done through suitable latch relay.

1.21.8 The contacts of all limit switches and all breaker/auxiliary contacts located on truck portion and fixed portion shall be silver plated, rated to make, carry and break 1.0 Amp 220 V DC (Inductive) 10 Amps. 240V AC. Contacts of control plug and socket,shall be capable of carrying the above current continuously.

1.21.9 Movement of truck between SERVICE and ISOLATED positions shall be mechanically prevented when the breaker is closed. An attempt to withdraw a closedbreaker shall not trip it.

1.21.10 Closing of the breaker shall be possible only when truck is either in ISOLATED or inSERVICE position and shall not be possible when truck is in between. Further, closing shall be possible only when the auxiliary circuits to breaker truck have been connected up, and closing spring is fully charged.

1.21.11 Mechanical (Castle key) or a full proof electrical interlock shall be provided between the isolator and associated circuit breaker such that the former cannot be operated unless the later is open.

1.21.12 It shall be possible to easily insert breaker contactor of one feeder into any one of thepanel meant for same rating but at the same time shall be prevented from inserting itinto panels meant for a different type of rating.

1.21.13 Indicating lamps shall be provided in the panel front as brought out in Clause 16.13.It shall be possible to easily make out whether the truck is in SERVICE or ISOLATEDposition even when the compartment door is closed.

1.22 Bus bars and interlocks:

1.22.1 All busbar and jumper connections shall be of high conductivity aluminium/ copper ofadequate size and the bus bar size calculation shall be submitted for approval. Theyshall be adequately

supported on insulators to withstand electrical and mechanical stresses due to specified short circuit currents.

1.22.2 Busbar cross-section shall be uniform throughout the length of switchgear. Busbarsand other high voltage connection shall be sufficiently corona free at maximum working voltage.

1.22.3 Contact surfaces at all joints shall be silver plated or properly cleaned and no oxide grease applied to ensure an efficient and trouble free connection. All bolted joints shall have necessary plain and spring washers. All connection hardware shall havehigh corrosion resistance. Suitable bimetallic connectors shall be used for aluminiumto copper connections.

1.22.4 Busbar insulators shall be of arc and track resistant high strength, non-hygroscopic, non-combustible type and shall be suitable to withstand stresses due to over- voltages, and short circuit current. Busbar shall be supported on the insulators such that the conductor expansion and contraction are allowed without straining the insulators. In case of organic insulator partial discharge shall be limited to 100 Pico coulomb at rated voltage xl.1/□ 3. Use of insulators and barriers of inflammable material such as Hylam shall not be accepted.

1.22.5 Successful Bidder shall furnish calculation-establishing adequacy of busbar sizes forthe specified continuous and short time current ratings.

1.22.6 All busbars shall be colour coded for phase identification.

1.22.7 The temperature of the busbars and all other equipment, when carrying the rated current continuously shall be limited as per the stipulations of relevant Indian Standards, duly considering the specified ambient temperature (50 deg. C). The temperature rise of the horizontal and vertical busbars when carrying the rated current shall in no case exceed 55 deg.C for silver plated joints and 35 deg.C for allother type of joints. The temperature rise at the switchgear terminals intended for external cable termination shall not exceed 35 deg. C. Further the switchgear parts handled by the operator shall not exceed a rise of 5 deg.

1.23 Earthing and earthing device

1.23.1 A galvanized steel earthing bus shall be provided at the bottom and shall extend throughout the length of each switch board. It shall be bolted/ welded to the framework of each panel and each breaker earthing contact bar.

1.23.2 The earth bus shall have sufficient cross section to carry the momentary short circuitand short time fault currents to earth as indicated under switchgear parameters without exceeding the allowable temperature rise.

1.23.3 Suitable arrangement shall be provided at each end of the earth bus for bolting to earthing conductors. All joint splices to the earth bus shall be made through atleast two bolts and taps by proper lug and bolt connection.

1.23.4 All non- current carrying metal work switchboard shall be effectively bonded to the earth bus. Electrical continuity of the whole switchgear enclosure frame work and the truck shall be maintained even after painting.

1.23.5 The truck and breaker frame shall get earthed while the truck is being inserted in thepanel and positive earthing of the truck and breaker contactor frame shall bemaintained in all positions i.e. SERVICE and ISOLATED as well as throughout the intermediate travel. The truck shall also get and remain earthed when the control plug is connected irrespective of its position.

1.23.6 All metallic cases of relays, instruments and other panel mounted equipment shall beconnected to earth by independent stranded copper wires of size not less than 2.5 sq.mm. Insulation colour code of earthing wires shall be green. Earthing wires shallbe connected to terminals with suitable clamp connectors and soldering shall not beacceptable. Looping of earth connections, which would result in loss of earth connection to other devices, when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths of earthbus is acceptable.

1.23.7 VT and CT secondary neutral point earthing shall be at one plate only on the terminalblock. Such earthing shall be made through links so that earthing of one secondary circuit may be removed without disturbing the earthing of other circuits.

1.23.8 Built-in /Trolley mounted earthing facilities for the busbars and outgoing incoming connections shall be provided. However, there should be facility for alarm before engagement of earthing contacts, in case of feeder/incomer being in energized condition.

1.23.9 Interlocks shall be provided to prevent:
Closing of the earthing switch if the associated circuit breaker truck is in Service position.

Insertion of the breaker truck to Service position if earthing switch is in closed position.

Closing of the earth switch on a live connection. Three nos. voltage capacitive dividers shall be provided on each phase of the section intended for earthing and three nos. "RED' Neon lamps connected to these on the panel front for visual indication.

1.23.10 Energising and Earthed Section: Complete details of arrangement offered shall be included in the bid describing the safety features and interlocks.

1.23.11 The earthing device shall have the short circuit withstand capability equal to that of associated switchgear panel suitable number of auxiliary contacts of the earthing device shall be provided for interlocking purpose.

1.23.12 All hinged doors shall be earthed through flexible earthing braid.

1.24 Painting

All sheet steel work shall be pretreated in tanks, in accordance with IS: 6005. Degreasing shall be done by alkaline cleaning. Rust and scale shall be removed bypickling with acid. After pickling, the parts shall be washed in running water. Then these shall be rinsed in slightly alkaline hot water and dried. The phosphated coatingshall be Class 'C' as specified in IS: 6008. The phosphated surface shall be rinsed and passivated prior to application of stoved lead oxide primer coating. After primer application, two coats of finishing synthetic enamel paint on panels shall be applied.. The inside of the panels shall preferably be glossy white. Each coat finishing shall beproperly stoved. The paint thickness shall not be less than 50 microns. Finished partsshall be coated by peel able compound by spraying method to protect, finished surfaces from scratches, grease dirts and oily spots during testing, transportation, handling and erection. Electrostatic painting shall also be acceptable.

1.25 Instrument transformers

1.25.1 All current and voltage transformers shall be completely encapsulated cast resin insulated type, suitable for continuous operation at the ambient temperature prevailing inside the switchgear enclosure, when the switchboard is operating at its rated load and the outside ambient temperature is 50 deg. C. The class of insulationshall be E or better.

1.25.2 All instrument transformers shall withstand the power frequency and impulse test voltage specified for the switchgear assembly. The current transformer shall further have the dynamic and short time rating at least equal to those specified for the associated switchgear and shall safely withstand the thermal and mechanical stressproduced by maximum fault currents specified when mounted inside the switchgear for circuit breaker modules.

1.25.3 The parameters of instrument transformer specified in this specification are tentativeand shall be finalised by the Employer in due course duly considering the actual burden of various relays and other devices finally selected. In case the Bidder finds that the specified ratings are not adequate for the relays and other devices offered by him he shall offer instrument transformer of adequate ratings and shall bring outthis fact clearly in his bid.

1.25.4 All instrument transformers shall have clear indelible polarity markings. All secondaryterminals shall be wired to separate terminals on an accessible terminal block.

1.25.5 Current transformers may be multi or single core and shall be located in the cable termination compartment. All voltage transformers shall be drawout type. The bus VTs shall be housed in a separate panel on a truck so as to be fully withdrawable.

1.25.6 All voltage transformers shall have suitable HRC current limiting fuses on both primary and secondary sides. Primary fuses shall be mounted on the withdrawable portion. Replacement of the primary fuses shall be possible with VT truck in ISOLATED position. The secondary fuses shall be mounted on the fixed portion andthe fuses replacement shall be possible without drawing out the VT, truck from Service position.

1.26 Relays and protections

1.26.1 In addition to the requirements specified hereunder the relays, indicating instruments,recorders, transducers, terminal blocks, Mimic diagram, Name Plates, switches, indicating lamps, position indicators shall also meet the requirements of corresponding clauses in Section Control and Relay Panels.

1.26.2 General Features

a) All relays and timers in protective circuits shall be flush mounted on panel frontwith connections from the inside. They shall have transparent, dust tight cover, removable from the front. They shall either have built-in test facilities, orshall be provided with necessary test blocks and test switches located immediately below each relay. The auxiliary relays and timers may be furnished in non-drawout cases. The contact multiplying auxiliary relays if anymay be located inside.

b) All relays and timers shall be rated for control supply voltage as mentioned in Section – GTR with specified variation. Making, carrying and breaking current ratings of their contacts shall be adequate for the circuits in which they are used. Auxiliary seal in units if provided shall be of shunt reinforcing type.

c) The protective relays and timers shall have atleast two potential free output contacts in addition to scheme requirement for owner's use. Auxiliary relays, shall have contacts as required. Adequate number of terminals shall beavailable on the relay cases for applicable relaying schemes.

d) All protective relays, auxiliary relays and timers. shall be provided with hand reset operation indicators (flags) for analysing the cause of tripping.

e) Timers shall be of electromagnetic or static type.

f) Failure of a control or auxiliary supply and de-energisation of a relay shall not initiate any circuit breaker contactor operation.

h) The relay and timers used in protective circuits shall be of reputed makes and proven types which have been in successful operation for atleast three (3) years and shall be subject to Employer's approval before procurement by the Contractor.

1.26.3 Special Protection Features

33 kV feeders shall have three over current and one earth fault element which shall be either independent or composite units. And shall meet the following requirements.

a) Non directional over current relay

(iv) have IDMT characteristic with definite minimum time of 3.0 sec at 10 timessetting
(v) have a variable setting range of 50-200% of rated current.

(vi) Include hand reset flag indicators

b) Non Directional earth fault relay

(iv) have IDMT characteristic with definite minimum time of 3.0 sec at 10 timessetting.

(v) have a variable setting range of 20-80% of rated current.

(vi) Include hand reset flag indicators

c) Master Trip Relay

Non directional over current and earth fault relays will be wired to trip the master trip relay during faults Master Trip relay and also the ratings of the output contacts shall be suitable for 33 kV circuit breaker.

1.27 Instruments and Meters

1.27.1 Indicating instruments shall be flush mounted on panel front. The instruments shall be of atleast 96mm square size with 240 deg. scales, shall conform to IS:1248 and shall have an accuracy class of 1.5 or better. The covers and cases of instruments and meters shall provide a dust and vermin proof construction.

1.27.2 Instruments shall have white dials with black numerals and lettering. Black knife edged pointer with parallax free details will be preferred.

1.27.3 Instruments and meters shall be factory calibrated to directly read the primary circuitquantities. Means shall be provided for zero adjustment without dismantling the instruments.

1.27.4 Watt-hour meters shall preferably be 3-phase two (2) element type suitable for measurement of unbalanced loads in three phase three wire system and shall be suitable for flush mounting.

Watt-hour meters shall preferably be provided in draw out cases with built-in testing facilities. Alternatively, they may have test blocks to facilitate testing of meters without disturbing CT and VT secondary connections.

1.28 Control and Selector Switches

1.28.1 Control and selector switches shall be of heavy duty, rotary type with escutcheon plates clearly marked to show the operating positions and circuit designation plates.The switches shall be of sturdy construction suitable for flush mounting. Switches with shrouding of live parts and sealing of contacts against dust ingress shall be preferred.

1.28.2 On-Off control switches shall have three positions and shall be spring return to neutral from 'close' and 'trip' positions. They shall have two contacts closing in closeposition and two contacts closing in trip positions, and shall have Pistol Grip handles.Lost motion feature shall be provided wherever required.

1.28.3 Selector switches shall have two or three stay put positions. They shall have two contacts for each of the three positions and shall have black Spade handled.

1.28.4 Ammeter and Voltmeter selector switches shall have four stay put positions with adequate number of contacts for three-phase system. These shall have OVAL handles. Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondary.

1.28.5 Contacts of the switches shall be spring assisted and shall be of suitable material togive a long trouble free service. The contact rating shall be at least the following:

iv)	Make and carry continuously	10A
v)	Breaking current at 220V DC.	1A (Inductive)

vi) Breaking current at 240V AC/220V DC 5A at 0.3 pf lag.

1.29 Indicating Lamps

1.29.1 Indicating lamps shall be of the panel mounting, LED type and low watt consumption.The lamps shall have escutcheon plates marked with its function, wherever necessary.

1.29.2 Lamps shall have translucent lamp-covers of the following colours, as warranted by the application:

RED	CLOSED
GREEN	OPEN
WHITE	DC healthy
BLUE	For all healthy conditions (e.g. control supply, spring charged,and lock out relay coil healthy)
AMBER	For all alarm conditions (e.g.pressure low, over load) alsofor SERVICE and TEST positions indication.

1.29.3 It shall be easily replaceable from the front of the cubicles. The method of mounting indicating lamps fittings on panels shall prevent their rotation under the action of lamp removal or replacement, reliance upon the tightness of a ring-nut for the purpose is not sufficient.

1.29.4 Indicating lamps shall be located just above the associated push buttons/control switches. Red lamps shall invariably be located to the right of green lamps. In casea white lamp is also provided, it shall replace between the red and green lamps alongthe centre line of control switch/push button pair. Blue and amber lamps shall normally be located above the red and green lamps.

1.29.5 When associated with push buttons, red lamps shall be directly above the green push button, and green lamp shall be directly above the red push-button.

All indicating lamps shall be suitable for continuous operation at 90, to 100% of theirrated Voltage.

1.30 Switchgear Wiring

1.30.1 All Switchgear panels shall be supplied completely wired internally upto the terminalblock ready to receive external cabling. All inter cubicle wiring and connections between panels of same switchboard including all bus wiring for AC and DC suppliesshall be provided by the Contractor.

1.30.2 All internal wiring shall be carried out with 650 V grade, single core, 1.5 sq.mm, stranded copper wires having minimum of seven strands per conductor and colour coded, PVC insulation. CT circuits shall be wired with 2.5 sq.mm. wires which otherwise are similar to the above. Extra flexible wires shall be used for wiring between fixed and moving parts such as hinged doors.

1.30.3 All wiring shall be properly supported neatly arranged, readily accessible and securely connected to equipment, terminals and terminal blocks. Wiring troughs or gutters be used for this purpose.

1.30.4 Internal wire terminals shall be made with solder less crimping type tinned copper lugs which shall firmly grip the conductor. Insulation sleeves shall be provided over the exposed parts of lugs. The lugs related to CT secondary circuit wiring shall be ofhole type.

1.30.5 Engraved core identification plastic ferrules marked to correspond with panel wiring diagrams shall be fitted at both ends of each wire Number 6 and 9 shall not be usedfor wire identification. Ferrules shall fit tightly on wires and shall not fall off when wireis, disconnected from terminal. All wires directly connected to trip the circuit breaker shall be distinguished by the addition of a red colored unlettered ferrule.

1.30.6 Inter connection to adjacent panels shall be brought out to a separate set of terminalblocks located near the slots or holes, meant for the interconnecting wires. Arrangement shall permit neat layout and easy inter connections to adjacent panels at site and wires for this purpose shall be provided by Contractor looped and bunched properly inside the panels. The inter panel wires shall be cross-ferruled i.e.it shall have details of emanating terminal and also where it is terminated.

1.30.7 Contractor shall be fully responsible for the completeness and correctness of the internal wiring and for the proper functioning of the connected equipment.

1.30.8 The Contractor shall provide the necessary clamps wiring troughs etc. for all wiring inside the switchgear enclosed including the power and control cables.

1.31 Power Cable Termination

1.31.1 The Cable termination compartment shall receive the stranded Aluminium conductor, XLPE insulated, armoured, PVC jacketed, single core/three core unearthed/earthed grade power cable(s).

1.31.2 A minimum clearance of about 600 mm shall be kept between the cable lug bottom ends and gland plates for stress cone formation for XLPE cables. Inter phase clearance in the cable termination compartment shall be adequate to meet electricaland mechanical requirement besides facilitating easy connections and disconnections of cables. Dimensional drawing of cable connection compartment showing the location of lug, glands, CTs, gland plates etc. and the electrical clearances available shall be submitted for Employer approval during detailed engineering.

1.15.4 Cable termination compartment shall be complete with power terminals, power lugs and associated hardware and removable undrilled gland plates. For all single core cables gland plates shall be of nonmagnetic material.

1.15.5 Supply of the cable termination kit and cable terminations shall be in scope of contractor.

1.32 Name Plates and Labels

1.32.1 Each switchboard shall have a name plate for its identification. All enclosure-mounted equipment shall be provided with individual engraved nameplates for clearequipment identification. Each unit panel shall be identified on front as well as backside by large engraved nameplates giving the distinct feeder description along with panel numbers. Backside nameplates shall be fixed in panel frame.

1.16.3 Nameplate shall be of non-rusting metal or 3-ply lamicoid with white engraved lettering, on black background. Inscriptions and lettering shall be subjected to Employer's approval.

1.16.4 Suitable stenciled paint mark shall be provided for identification of all equipment, located inside the enclosure, as well as for door mounted equipment, from the backside in addition to plastic sticker labels, if provided. These labels shall be located directly by the side of the respective equipment, shall be clearly visible and shall not be hidden by equipment wiring. Labels shall have device number as mentioned in wiring drawings. Type of labels and fixing of labels shall be such that they are not likely to peel or fall off during prolonged use.

1.33 33 kV Indoor Switchgear panels as per quantity and details given below shall be offered:

Sl. No.	Description	Quantity
1.	Panel for incomer feeder with Bus PT Type IP-1, fault level of 25KA for 3 secs. **[Incoming]**	2
2.	Panel for 1 MVA, 33/0.433KV LT transformer feederType IP-2, fault level of 25KA for 3 sec. **[Outgoing]**	2
3.	Panel for Bus Coupler feeder Type IP-3, fault level of 25KA for 3 secs. **[Bus Coupler]**	1

Detailed Description for each HT indoor VCB panels: -

Sl. No.	Equipment	IP1 I/C	IP2 O/G	IP3 B/C
1.	36 kV, 630A, 25KA for 3 secs, VCB	1	1	1
2.	36 kV, 40-20/1A CT	1	1	1
3	Potential Transformer, 36 kV/ 110V, drawout type, cast resin type, dual accuracy 1.0/3.0 and150VA burden.	1	-	-
4.	Multifunction Meter	1	1	1
5.	Control switch for breaker	1	1	1
6.	Green Indicating lamps	1	1	1
7.	Red indicating lamps	1	1	1
8.	DC healthy lamp (white)	1	1	1
9.	Mimic to represent SLD	1	1	1
10.	Non directional protection consisting of 2 overcurrent & 1 earth fault protection (set)	-	1	1
11.	Trip relays	1	1	1
12.	Directional backup protection consisting of 3over current &1 earth fault protection (set)	1	-	-
13.	Flag relays, trip relays, Auxiliary relays timers etc (as per scheme requirement)	Lot	Lot	Lot
14.	Annunciation Facia (as per requirement)	Lot	Lot	Lot

1.34 Tests

The Bidder shall submit the type test reports of following type tests for approval of theEmployer for circuit breaker, circuit breaker panels, of each voltage class and currentrating:

10. Short circuit duty test on circuit breaker, mounted inside the panel offered.
11. Short time withstand test on circuit breaker, mounted inside panel offered.
12. Power frequency withstand test on breaker and panel.
13. Lightning impulse withstand test on breaker and panel.
14. Temperature rise test on breaker and panel together.
15. Test to verify pressure relief devices operation of the panel. This shall be doneon one panel of each voltage class.
16. Measurement of resistance of main circuit.
17. Mechanical endurance test on breaker.
18. Mechanical operation test.

For all important components like instrument transformers, relays, instruments, switches, bushings, wires, insulators, timers, annunciators, terminal blocks and fusesetc. the contractor shall furnish satisfactory type test reports for Employer's approval.Such reports shall cover all applicable type tests listed in relevant Indian Standards,for all components of type and rating being supplied.

1.35 Commissioning Checks/Tests

After installation of panels, power and Control wiring and connect Contractor shall perform commissioning checks as listed below to proper operation of switchgear/ panels and correctness of all respects.

In addition the Contractor shall carry out all other checks and tests recommended by the manufacturers.

H. General

13 Check nameplate details according to specification.
14 Check for physical damage
15 Check tightens of all bolts, clamps and connecting terminal
16 Check earth connections.
17 Check cleanliness of insulators and bushings.
18 Check heaters are provided.
19 HV test on complete switchboard with CT & breaker/ contractor lubricated inposition.

20 Check all moving Parts are properly lubricated.
21 Check for alignment of bus bars with the insulators to ensure alignment andfitness of insulators.
22 Check for inter changeability of breakers.
23 Check continuity and IR value of space heater.
24 Check earth continuity of the complete switchgear board.

I. Circuit Breaker

14 Check alignment of trucks for free movement.
15 Check correct operation of shutters.
16 Check slow closing operation.
17 Check control wiring for correctness of connections, continuity and IR values.
18 Manual operation of breakers completely assembled.
19 Power closing/opening operation, manually and electrically at extremecondition of control supply voltage.
20 Closing and tripping time.
21 Trip free and anti-pumping operation.
22 IR values, resistance and minimum pick up voltage of coils.
23 Simultaneous closing of all the three phases.
24 Check electrical and mechanical inter locks provided.
25 Checks on spring charging motor, correct operation of limit switches and timeof charging.
26 All functional checks.

J. Current Transformers

6 Megger between windings and winding terminals to body.
7 Polarity tests.
8 Ratio identification checking of all ratios on all cores by primary injection ofcurrent.
9 Magnetization characteristics & secondary winding resistance.
10 Spare CT cores, if any to be shorted and earthed.

K. Voltage Transformers

5 Insulation resistance
6 Ratio test on all cores.
7 Polarity test
8 Line connections as per connection diagram.

L. Cubicle Wiring

8 Check all switch developments.
9 It should be ensured that the wiring is as per relevant drawings. Allinterconnections between panels shall similarly be checked.
10 All the wires shall be meggered to earth.
11 Functional checking of all control circuit e.g. closing, tripping, interlock,supervision and alarm circuit including proper functioning of component/equipment .
12 Check terminations and connections. To check wiring related to CT and PT circuits, carryout primary injection and then check for secondary value at relayand metering instrument terminals.
13 Wire ducting.
14 Gap sealing and cable bunching.

M. Relays

9 Check internal wiring.
10 IR of all terminal body.
11 IR of AC to DC terminals
12 Check operating characteristics by secondary injection.
13 Check minimum pick up voltage of DC coils.
14 Check operation of electrical/ mechanical targets.

15 Check CT connections with particular reference to their polarities fordifferential type relays.
16 Relay settings.

N. Meters

3 IR of all insulated portions.
4 Check CT & VT connections with particular reference to their polarities forpower type meter.

1.36 Technical parameters for 33 kV Switchgear panel

1.36.1 Parameters common to all equipment:

a)	Nominal System Voltage	33 kV
b)	Highest system Voltage	36KV
c)	Rated Frequency	50Hz
d)	No of phases	Three
e)	System neutral earthing	Solidly Earthed
f)	One minute Power Freq.	70KV (rms)withstand voltage
g)	Lighting Impulse withstand Voltage	170KVp
h)	System fault level	25kA for 3 secs
i)	Auxiliary Supply Voltage	220V DC

1.36.2 Circuit Breaker

a)	Rated continuous current	630Aat design ambient temp.
b)	Rated short circuit current capacity at rated minimum opening time under operating conditions specified	25kA with % of DC component as Breaking per IEC: 62271-100 corresponding to Voltage
c)	Symmetrical interrupting Capability	25kA (rms)
d)	Rated short circuit making	62.5 kApCurrent
e)	Out of phase breaking	As per IECCurrent capacity
f)	Rated line/cable charging Leading power factor angle	As per IECInterrupting current at 90^{o}
g)	Rated small inductive current Voltage less than 2.3 pu	0.5 to 10 ASwitching capability with over
h)	Maximum allowable switching switching Condition	As per IECOver voltage under any
i)	First pole to clear factor	1.5
j)	Rated break time as per IEC	45ms
k)	Total closing time	Not more than 100ms
l)	Rated operating duty cycle	O-3min-CO-3minCO
m)	Reclosing	3 phase auto reclosing
n)	Max. difference in the instants Between poles at rated control Voltage and rated operating pressures	3.3msOf closing/opening contacts andQuenching media
o)	Trip coil and closing coil voltage	220V DC with variation 0f 190V-240V
p)	Auxiliary contacts	5NO+ 5NC for Employer's usebesides spec requirement
q)	Temperature rise over the ambient temp	As per IEC: 62271-100/IEC: 60694Design

1.36.3 Current Transformer (LT transformer)

a)	Rated primary current	40 A	
b)	Max temp rise	As per IEC: 44-1	
c)	Type of Insulation	Class E	
d)	One minute power frequency Secondary terminal & earth	2KVWithstand voltage between	
e)	Detail of Secondary Cores	Metering	O/C & E/F Protn.
	Current ratio	40-20/1	40-20/1
	Accuracy class	0.5 class	5P10
	Knee point Voltage	--	--
	Rated Burden	15 VA	--

1.36.4 Potential Transformer

a)	Rated primary Voltage	36KV	
b)	Type	Single phase potential transformer	
c)	Voltage/ Ratio (KV)	(33/□ 3)/(0.11/□ 3)/(110/□ 3)/ /(110/□ 3)	
i)	Rated voltage factor	1.2 continuous, 1.5 – 30seconds	
j)	One minute power freq. Secondary winding	2KV(rms)Withstand voltage for	
k)	Rated output burden	150VA	
l)	Detail of secondary	Metering	Protection
m)	Accuracy	0.5	3P

Note:

2. The ratings indicated for instrument transformer are tentative only and may be changed to meet the requirements.

H. TECHNICAL SPECIFICATIONS FOR LT CAPACITORS

1.0 **Scope**

This specifications covers the design, manufacture, supplying and testing of Dry Type LT Capacitors required to be installed in LT Room of the sub-station forcorrection of the power factor.

2.0 **Standards**

All relevant Indian Standards shall be made applicable with latest amendments and in particularly IS 133340/41, IEC 831-1-1996, IEC 831-2-1995, EN 60831-2-1996, VDE 560-46:3/95, VDE 560-47:3/95 and any other specific application is required, then the same shall be complied to.

3.11 Specifications

3.12 The capacitors are to be provided with Duro Plastic Polyurethane Case, Easy disposal, Fire Retardant case with IP 20 enclosure, indoor mounting. The containers shall be heat-proof, dust-proof, indoor type and PCB environment.

3.13 The capacitors shall be fir retardant in nature.

3.14 Terminal provided should be Double, Three way SIGUT terminal strip with protection against electric shock hazard. 9According to IP 20 /IP 54 to VDE 0106 part 100)

3.15 The capacitor should be able to handle in rush current up to 200 times the rated current and should be corona free.

3.16 The raw materials should be Non PCB, Epoxy Resin and polypropylene film should be provided as dielectric.

3.17 The dielectric loss should be very low in the order of less than 0.25 Watts/ KVARor lower.

3.18 Each unit shall have over pressure tear off fuse, self healing technology, explosion proof construction, touch proof terminals Eco friendly, non flammable.

3.19 The Capacitors shall be of the 3 Phase, Delta connected natural or forced cooledtype with capacitance tolerance of +5% . the capacitor should be able to perform up to humidity of 95% and discharge module resistor should be included.

3.20 The basic unit shall be of 5 KVAR to give 50 KVAR as basic step or any other step as specified in the schedule of quantities.

3.21 The Capacitors banks shall be erected directly inside the panel on the mountingstands and

with complete treatment done to the stand. The stand shall be effectively doubled earthed to the earthing grid.

4.2 Discharge Resistance

4.3 The Capacitors shall be provided with discharge resistors module so that residual voltage of the capacitor shall be reduced to 50 Volts or less within one minute after the capacitor is disconnected from the source of supply.

5.2 Testing

5.3 The Capacitor bank shall be subject to all routine and acceptance tests as specified in relevant Indian Standards at the factory and the actual test results shall be furnished.

5.3.1 Residual voltage after switching of the capacitors shall be less than 50 Volts afterone minute.

5.3.2 Insulation resistance shall be tested with a 1000 Volts megger between phases and phase to earth.

5.3.3 Each discharge resistors shall be tested for its working.

5.3.4 Loss angle test will be conducted and power losses will not exceed 025 Watts KVAR.

5.3.5 The value of discharge resistance shall be furnished at the time of testing.

I. TECHNICAL SPECIFICATIONS FOR POWER & CONTROL CABLES

1.0 GENERAL

All cabling systems, including cables, wiring, terminations etc., shall be in accordancewith the applicable Standards and with the additional requirements listed below and elsewhere in this Specification. Cable sealing & termination for cable end to be terminated at Employer's side shall be included in the Contractor's scope.

2.8 CABLES

2.9 CABLE TYPE

a) The High Voltage (33 kV) power cables shall be XLPE insulated conforming toIS-7098 (II).

b) The Low Voltage power cables shall be 1.1 kV XLPE insulated conforming to IS-7098 (I) and/or PVC insulated conforming to IS-1554 (I).

c) The control cables shall be 1.1 kV PVC insulated conforming to IS-1554 (I).

2.10 GENERAL TECHNICAL REQUIREMENTS

a) The cables shall be suitable for laying in racks/trays, ducts, trenches, conduits and underground buried installation with uncontrolled backfill and with chancesof flooding by water.

b) They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating conditions.

c) The XLPE insulated power cables shall suitable for withstanding short circuit currents on the basis of area of cross section of cable as per manufacturer's standard ratings. The area of cross-section of cable shall be decided on the basis of connected load.

d) The conductor and armour for 1100V grade XLPE insulated power cables shallbe capable of carrying 45 kA for at least 0.12 seconds without exceeding the maximum allowable temperature of PVC outer sheath.

e) Cable construction shall include sufficient electric magnetic shielding and adequate grounding, to ensure that any interference picked up by the signal pairs is sufficiently attenuated to prevent mal-operation, damage, or danger toany equipment and personnel under all operating conditions, including the effects of switching, faults, converter operation and the environment.

f) The Aluminium/copper wires used for manufacturing of the cables shall be truecircular in shape before stranding and shall be of uniform good quality, free from defects. All aluminium used in the cables shall be of H2 grade.

g) The fillers and inner sheath shall be of non-hygroscopic, fire retardant material,softer than insulation & outer sheath and suitable for the operating temperature of the cable.

h) Strip wire armoring following method (a) mentioned in the relevant IS shall not be accepted for any of the cables. For armored control cables only roundwire armoring shall be used.

i) Progressive sequential marking of the length in metres at every one metre shall be provided

on the outer sheath of all cables.

j) The cables shall have outer sheath of a material with an oxygen index of not less than 29 and a temperature index of not less than 250°C.

k) The normal current rating of all cables shall be as per IS-3961.

l) During a short circuit as specified in (b) above the PVC insulated cables shall be capable of withstanding a conductor temperature of at least 160°C. However, the XLPE insulated cables shall be capable of withstanding aconductor temperature of at least 250°C.

m) Repaired cables shall not be accepted.

n) Allowable tolerance on the overall diameter of the cables shall be as per the relevant IS/IEC standard.

o) All cables shall be armoured and of fire retardant low smoke type.

2.11 XLPE Power Cables

The XLPE (90°C) insulated cables shall be of FR typ e, C1 category conforming to IS:7098 (Part-I) and its amendments read alongwith this specification. The conductorshall be stranded aluminium circular/sector shaped and compacted. In multicore cables, the core shall be identified by red, yellow, blue and black coloured strips or colouring of insulation. A distinct inner sheath shall be provided in all multicore cables.For XLPE cables, the inner sheath shall be of extruded PVC of type ST-2 of IS:5831.When armouring is specified for single core cables, the same shall consist of aluminium wires/strips. The outer sheath shall be extruded PVC of Type ST-2 of IS:5831 for all XLPE cables.

2.12 PVC Power Cables

The PVC (70°C) insulated power cables shall be of F R type, C1 category, conformingto IS: 1554 (Part-I) and its amendments read alongwith this specification and shall besuitable for a steady conductor temperature of 70°C . The conductor shall be stranded aluminium. The Insulation shall be extruded PVC to type-A of IS: 5831. A distinct innersheath shall be provided in all multicore cables. For multicore armoured cables, the inner sheath shall be of extruded PVC. The outer sheath shall be extruded PVC to Type ST-1 of IS: 5831 for all cables.

2.13 PVC Control Cables

The PVC (70°C) insulated control cables shall be of FR type C1 category conformingto IS: 1554 (Part-1) and its amendments, read alongwith this specification. The conductor shall be stranded copper. The insulation shall be extruded PVC to type A ofIS: 5831. A distinct inner sheath shall be provided in all cables whether armoured or not. The over sheath shall be extruded PVC to type ST-1 of IS: 5831 and shall be greyin colour.

Cores shall be identified as per IS: 1554 (Part-1) for the cables up to five (5) cores and for cables with more than five (5) cores the identification of cores shall be done byprinting legible Hindu Arabic Numerals on all cores as per clause 10.3 of IS 1554 (Part-1).

2.14 HV POWER CABLE FOR AUXILIARY POWER SUPPLY

The HV cable (Aluminium Conductor) of voltage class as specified for tertiary loadingshall be, XLPE insulated, armoured cable conforming to IS 7098 (Part-II). Terminatingaccessories shall conform to IS 17573-1992 or IEC 61442- 1997/IEC60502-4 1998.

2.6.4 Constructional Requirements

Cable shall have compacted circular Aluminium conductor, Conductor screened with extruded semi conducting compound, XLPE insulated, insulation screened with extruded semi conducting compound, armoured with non-magnetic material, followedby extruded PVC outer sheath (Type ST-2), with FR properties.

2.6.5 Progressive sequential marking of the length of cable in metres at every one metre shall be provided on the outer sheath of the cable. The cables shall have outer sheathof a material with an Oxygen Index of not less than 29 and a Temperature index of notless than 250°C.

2.6.6 Allowable tolerance on the overall diameter of the cables shall be plus or minus 2 mm.

2.15 TESTS

Cables & accessories of each type and size shall be of type tested design as per relevant IS/IEC (as applicable). Bidder shall submit test reports for approval during detailed engineering.

J. TECHNICAL SPECIFICATIONS FOR LT PANEL/BOARD

1.2 CONSTRUCTIONAL DETAILS OF SWITCHBOARDS AND DISTRIBUTION BOARDS

1.2.1. All boards shall- be of metal enclosed, indoor floor mounted, compartmentalized double front construction and freestanding type.

1.2.2. All board frames, shall be fabricated using suitable mild steel structural sections or pressed and shaped cold-rolled sheet steel of thickness not less than 2.0 mm. Framesshall be enclosed in cold-rolled sheet steel of thickness nut less than 1.6 mm. Doors and covers shall also be of cold rolled sheet steer Of thickness not less than 1.6 mm.Stiffeners shall be provided wherever necessary. Gland plate shall be cold rolled sheet steel having thickness not less than 3 mm in all cases. However, in case of termination of single core power cables, gland plate shall be of non-magnetic materialof at least 4mm thickness.

1.2.3. All panel edges and cover/door edges shall be reinforced against distortion by rolling,bending or by the addition of welded reinforcement members.

1.2.4. The complete structures: shall be rigid, self-Supporting, and free from flaws, twists and bends. All cut-outs shall be true in shape and devoid of sharp edges.

1.2.5. All boards shall be of dust and vermin degree of protection of IP: 52, for category –I enclosure as per IS 13947 (Part-I) However, the bus bar chambers having -a degree of protection of IP-. 42, in accordance with IS 13947 (Part-1), are also acceptable where continuous bus bar rating exceeds 1000 Amp. Provision shall be made in all draw out Air Circuit Breaker compartments for providing IP: 52 degree of protection, when Circuit breaker trolley, has been removed. Panels with lighting transformers shall have 1P 31 degree of protection in accordance with IS 13947 (Part-1). Door frame of panels, meters, relays, Breaker cut-outs shall be provided with neoprene rubber gaskets generally conforming to Type- Class 2A as per IS: 11149.

1.2.6. Provision of louvers on boards would not be preferred. However, louvers backed withmetal screen are acceptable on the bus bar chambers where 'Continuous bus bar rating exceeds 1000 Amps. shall have louvers. Panels with lighting transformers in lighting distribution boards

1.2.7. All boards shall be of uniform height not exceeding 2450 mm.

1.2.8. Boards shall be easily extendible on both sides, by the addition of the vertical sectionsafter removing the end covers of bus bar chambers.

1.19 Boards shall be supplied with base frames made of structural steel sections, alongwithall necessary mounting hardware required for welding the base frames to the insert plates.

1.1.10.b) All boards shall be of double front construction and shall have

(i) A completely enclosed busbar compartment for running horizontal busbars and vertical busbars. Busbar chambers shall be completely enclosed with metallic portions. Bolted covers shall be provided for access to horizontal and Vertical busbars for repair and maintenance, which shall be feasible Without disturbing feeder compartment. Vertical bus bar chambers shall be accessible from front as well as back side 'of the panel and shall be of at least 350 mm width. One set of vertical busbars shall be used in between two adjacent sections for switchgear connections. In case of Incomer(s), Bus coupler and ACB feeders, the panel shall have single front without any vertical busbar chamber, however vertical busbars associated with ACBs shall be located in rear side and shall be additionally covered with metallic perforated/ transparentacrylic or polyvinyl bolted sheets to avoid direct access

after opening rear doorof chamber.

(ii) Completely enclosed switchgear compartment(s) one for each circuit for housing circuit breaker or MCCB or motor starter.

(iii) A distinct compartment or alley for power and control cables on each sic. Jf panel. Cable alley compartment shall have a through metallic partition for segregating cables on both sides. Cable alley door shall preferably be hinged.Cable alley shall have no exposed live parts. Any live terminals shall be fully Shrouded /insulated from safety aspects. However, it shall be of atleast35.0mm width.

(iv) A compartment for relays and other control devices associated with a circuit Breaker

1.1.11 Sheet steel barriers shall be provided between two adjacent vertical panel's runningto the full height of the switchboard, except for the horizontal busbar compartment. Each shipping section shall have full metal sheets at both ends for transport and storage.

2.1. I2. All equipments associated with a single circuit except MCB circuits shall be housed in a separate compartment of the vertical section. The Compartment shall be sheetsteel enclosed on all sides with the withdrawal units in position or removed. The front of the compartment shall be provided with the hinged single leaf door, with locking facilities. In case of circuits controlled by MCBs, group of MCB feeders can be offered in common compartment. In such case number of MCB feeder to he usedin a common compartment shall not exceed 4 (four) and front of MCB compartment.shall have a viewing port of toughen glass sheet for viewing and sheet steel door ofmodule shall be lockable with star knob/panel key.

1.1.15. After isolation of power and control circuit connections it shall be possible to safely carryout maintenance in a compartment with the busbar and adjacent circuit live. Necessary shrouding arrangement shall be provided for this purpose over the cableterminations located in cable alley.

1.1.16. The minimum clearance in air between phases and between phase and earth for theentire run of horizontal and vertical busbars, shall be 25 mm. For all other components, the clearance between "two live parts", " A live part and an earthed part" and isolating distance shall be atleast ten (10) mm throughout. Wherever it isnot possible to maintain these clearances, insulation shall be provided by sleeving or barriers. However, for horizontal run of busbar minimum clearance of 25 mm should be maintained even if they are sleeved.

1.1.15 The temperature rise of horizontal & vertical bus bars when carrying rated current along its full run shall in no case exceed 55°C, wi th silver plated joints and 40°C with all other type of joints over an outside ambient temperature of 50°C.

1.16. All busbar chambers shall be provided with removable bolted covers. The covers shall be provided with danger labels.

1.1.24 All identical circuit breakers and module chassis of same test size shall be fully interchangeable without having to carryout modifications.

1.1.25 All Circuit breaker boards shall be of Single Front type, with fully draw out circuit breakers, which can be drawn out without having to unscrew any connections. The circuit breakers shall be mounted on rollers and guides for smooth movement between SERVICE, TEST and ISOLATED positions and for withdrawal from the Switchboard. Testing of the breaker shall be possible in the TEST position.

1.1.26 Wherever two breaker compartments are provided in the same vertical section; insulating barriers and shrouds shall be provided in the rear cable- compartment to avoid accidental touch with the live parts of one circuit when working on the, other circuit.

1.1.27 All disconnecting contacts for power circuits shall be of robust design and fully self aligning. Fixed and moving contacts of the power draw out contact system shall be silver plated. Both fixed and moving contacts shall be replaceable.

1.1.28 All AC & DC boards shall be of single Front type.

1.1.29 All module shall be fixed type except air circuit breaker module, which shall be drawout type.

1.1.30 The connections from bus bars to the main switch shall be fully insulated/shrouded,and securely bolted. The partition between the feeder compartment and cable alleymay be non-metallic, and shall be of such construction as to allow cable cores with lugs to be easily inserted in the feeder compartment for termination.

1.1.26. All equipment and components shall be neatly arranged and shall be easily accessible for operation and maintenance. The internal layout of all modules shall be subject to PURCHASER approval. Bidder shall submit dimensional drawings showing complete internal details of Bus bars and module components, for each type and rating for approval.

1.1.27. The tentative power and control cable entries shall be from bottom. However, Purchaser reserves the right to alter the cable entries, if required, during detailed engineering, without any additional commercial implication.

1.1.26 Adopter panels and dummy panels required to meet the various busbar arrangements and layouts required shall be included in Bidder's scope of work.

1.24 DERATING OF EQUIPMENTS

The current ratings of all equipments as specified in the Single Line Diagram for AC& DC System are the minimum standards current ratings at a reference ambient temperature as per relevant Indian Standards.

1.25 POWER BUS BARS AND INSULATORS

1.25.1. All AC Distribution Boards shall be provided with three phase buses and a neutral bus bars and the DC Distribution Boards shall be provided with two busbars.

1.25.2. All busbars and jumper connections shall be of high conductivity aluminium of adequate size

1.25.3. The Cross-Section of the busbars shall be uniform throughout the length of Switchgear and shall be adequately supported and braced to withstand the stressesdue to the specified Short circuit currents.

1.25.4. All busbars shall be adequately supported by adequate numbers of high strength type Polyester fibre glass moulded Insulators to withstand short circuit withstand capability of panel. Separate supports shall be provided for each phase and neutralbusbar. If a common support is provided anti-tracking barriers, shall be provided between the supports.

1.25.5. All busbars joints shall be provided with high tensile steel bolts. Belleville/spring washers and nuts, so as to ensure good contacts at the joints. Non-silver plated Busbars jr"-its shall be thoroughly cleaned at the joint locations and a suitable contact grease shall be applied just before making a joint

1.25.6. All busbars shall be colour coded as per IS: 11353-1985: Guide for Uniform Systemof Marking and Identification of Conductors and Apparatus Terminals.

1.25.7. The Bidder shall furnish calculations along with the bid, establishing the adequacy ofbusbar sizes for specified current ratings, On the basis of short circuit current and temperature rise consideration at specified ambient temp.

1.26 EARTH BUS

1.26.1. A galvanised steel earthing shall be provided at the bottom of each panel and shall extend throughout the length of each switchboard. It shall be welded/bolted to the frame work of each panel and breaker earthing contact bar vertical bus shall be provided in each vertical section which shall in turn be bolted/welded to main horizontal ground bus.

1.26.2. The earth bus shall have sufficient cross-section to carry the momentary short circuitand short time fault currents to earth as indicated in 'Bill of Materials' without exceeding the allowable temperature rise.

1.26.3. Suitable arrangements shall be provided at each end of the horizontal earth bus forbolting to Purchaser's earthing conductors. The horizontal earth bus shall project outthe switchboard ends and shall have predrilled holes for this connection. A joint spaced and taps to earth bus shall be made through at least two bolts.

1.26.4. All non-current metal work of the Switchboard shall be effectively bonded to the earth bus Electrical conductivity of the whole switchgear enclosures frame work andthe truck shall be maintained even after painting.

1.26.5. The truck and breaker frame shall get earthed while the truck is being inserted in thepanel and positive earthing of the truck and breaker frame shall be maintained in allpositions. SERVICES & ISOLATED, as well as throughout the intermediate travel.

1.26.6. Air Circuit Breaker (A CB) Each module frame shall get engaged to the vertical earthbus, before the disconnecting contacts on these modules are engaged to the vertical busbar.

1.4.11 All metallic cases of relays, instruments and other panel mounted equipments shallbe connected to earth by independent stranded copper wires of size not less than 2.5 mm2. Insulation colour code of earthing wires shall be green. Earthing wires shall be-connected to terminals with suitable clamp connectors and soldering is notacceptable. Looping of earth Connection which would result in loss of earth connection to the devices when a device is removed is not acceptable. However, looping of earth connections between equipment to provide alternative paths or earth bus is acceptable.

1.4.12 VT and CT secondary neutral point earthing shall be at one place only, on the terminal block. Such earthing shall be made through links so that earthing of one secondary circuit shall be removed without disturbing the earthing of other circuit.

1.4.13 All hinged doors shall be earthed through flexible earthing braid.

1.4.14 Caution nameplate 'Caution -Live Terminals shall be provided at all points where theterminals are like to remain live and isolation is possible only at remote end.

1.27 AIR CIRCUIT BREAKERS

1.5.24 Circuit breakers shall be three-pole air break horizontal draw out type and shall haveinherent fault making and breaking capacities as specified in "TechnicalParameters". The circuit breakers which meet specified parameter only after provision of releases or any other devices shall not be acceptable:

1.5.25 Circuit breakers shall be mounted along with it operating mechanism on a wheeled carriage. Suitable guides shall be provided to minimize misalignment of the breaker.

1.5.26 There shall be 'Service', 'Test' and 'Fully withdrawn positions for the breakers. In 'Test' Position the circuit breaker shall be capable of being tested for operation without energizing the power circuits i.e. the power Contacts shall be disconnected while the Control circuits shall remain undisturbed. Locking facilities shall be provided so as to prevent movement of the circuit breaker from the SERVICE', 'TEST' OR FULLY WITHDRAWN' position. It shall be possible to close the door in TEST position.

1.5.27 All circuit breakers shall be provided with 4 NO and 4 NC potentially free auxiliary contacts, These contacts shall-be in addition- to those required for internal mechanism of the breaker. Separate limit switches each having required number ofcontacts shall be provided in both 'SERVICE' & TEST' position of the breaker. Contacts shall be rated for making continuously carrying and breaking 10 Amps at'240V AC and 1 Amp (Inductive) at 220V DC.

1.5.28 Suitable mechanical indications shall be provided on all circuit breakers to show 'OPEN'. 'CLOSE', 'SERVICE', 'TEST' and 'SPRING CHARGED' positions.

1.5.29 Main poles of the circuit breakers shall operate simultaneously in such a way that the maximum difference between the instants of contacts touching during - closing shall not exceed half cycle of rated frequency.

1.5.30 All circuit breakers shall be provided with the interlocks as explained in further clauses

1.5.31 Movement of a circuit breaker between SERVICE AND TEST positions shall not bepossible unless it is in OPEN position. Attempted with drawl of a closed circuit breaker shall trip the circuit breaker.

1.5.32 Closing of a circuit breaker shall not be possible unless it is in SERVICE, TEST POSITION or in FULLY WITHDRAWN POSITION.

1.5.33 Circuit breaker cubicles shall be provided with safety shutters operated automatically by the movement of the Circuit: breaker carriage to cover the stationary isolated contacts when the breaker is withdrawn. It shall however, 'be possible to open the shutters intentionally, against spring pressure for testingpurpose.

1.5.34 A breaker of particular rating shall be prevented from insertion in a cubicle of a different rating.

1.5.35 Circuit breakers shall be provided with electrical anti-pumping and trip free feature, even if mechanical antipumping feature is provided.

1.5.36 Mechanical tripping shall be possible by means of front mounted RED 'Trip' push- button. In case of electrically operated breakers these push buttons shall be shrouded to present accidental operation.

1.5.37 Breaker controlled motors shall operate satisfactorily under the following conditions:

(i) Direct on-line starting of Induction Motors rated 110 kW to 220 kW with a locked rotor current of seven times the rated current, and starting time of up to 30 seconds.

(ii) Breaking on-load, full load and locked rotor currents of Induction Motors forrated 100 kW to 220 kW.

1.5.38 Means shall be provided to slowly close the circuit breaker in withdrawn position. If required for inspection and setting of Contacts, in service position slow closing shallnot be possible.

1.5.39 Power operated mechanism shall be provided with a universal motor suitable for operation 220V DC Control supply with voltage variation from 90% to 110% rated voltage. Motor insulation shall be class 'E' or better.

1.5.40 The motor shall be such that it requires not more than 30 seconds for fully chargingthe closing spring.

1.5.41 Once the closing springs are discharged, after the one closing operation of circuit breaker, it shall automatically initiate, recharging of the spring.

1.5.42 The mechanism shall be such that as long as power is available to the motor, a continuous sequence of closing and opening operations shall be possible. After failure of power supply at least one open-close-open operation shall be possible.

1.5.43 Provision shall be made for emergency manual charging and as soon as this manual charging handle is coupled, the motor shall automatically get mechanically decoupled.

1.5.44 All circuit breakers shall be provided with closing and trip coils. -The closing coils shall operate correctly al all values of Voltage between 85% to 110% at rated controlvoltage. The trip coil shall operate satisfactorily under all values of supply voltage between 70% to 110% of rated control voltage.

1.5.45 Provision for mechanical closing of the breaker only in 'TEST" and 'WITHDRAWN' positions shall be-made.

1.5.46 PROTECTION CO-ORDINATION

1.5.23.1 It shall be the responsibility of the Contractor to fully co-ordinate the overload and short circuit' tripping : of the circuit breakers with the upstream and downstream circuit breakers/fuses/Motor/starter's, to provide satisfactory discrimination.

1.28 MOULDED CASE CIRCUIT BREAKER (MCCB) and MCB

1.6.6 MCCB shall in general conform to IS: 13947 Part-2. All MCCB offered shall have Ics =100% Icu rating. Type test reports for offered model of MCCB shall be submittedduring detailed engineering for owner's acceptance.

1.6.7 MCCB shall be flush mounted on the AC/DC distribution boards and shall have extended handle.

1.6.8 MCCBs shall be provided with thermo-magnetic type release for over current and short circuit protection. The setting of the thermal release shall be adjustable between 80% to 100% of the rated current. The MCCB shall have breaking capacitynot less than 20kA.

1.6.9 MCCBs used for ACDB incomers and Bus coupler shall be equipped with stored energy mechanism for electrical closing and tripping. All other MCCBs shall be manually operated. The operating handle should give a clear trip indication.

1.6.10 Miniature circuit breaker (MCB) shall conform to IEC: 898-1987 and IS: 8828.

1.29 RELAYS

1.7.8 All relays and timers in protective circuits shall be flush mounted on panel front withconnections from the inside. They shall have transparent dust tight covers removable from the front. All protective relays shall have a drawout construction foreasy replacement from the front. They shall either have built-in test facilities, or shallbe provided with necessary test blocks and test switches located immediately beloweach relay. The auxiliary relays and timers may be furnished in non-drawout cases.

1.7.9 All AC relays shall be suitable for operation, at 50 Hz with auxiliary AC supply available in the panel.

1.7.10 All protective relays and timers shall have at least two potentially free output contacts. Relays shall have contacts as required for protection schemes. Contacts of relays and timers shall be silver faced and shall have a spring action. Adequate number of terminals shall be available on-the relay cases for applicable relaying schemes.

1.7.11 All protective relays auxiliary relays and timers shall be provided with hand reset operation indicators (Flags) for analysing the cause of operation.

1.7.12 All relays shall withstand a test voltage of 2 KV (rms) for one minute.

1.7.13 Motor starters shall be provided with three elements, ambient temperature compensated; time lagged, hand reset type overload relays with adjustable settings.The setting ranges shall be properly selected to suit the motor ratings. These relaysshall have a separate black coloured hand reset push button mounted on compartment door and shall have at least one changeover contact.

1.7.14 All fuse-protected contactor-controlled motors shall have single phasing protection,either as a distinct feature in the overload relays.(by differential movement of bimetallic strips), or as a separate device. The single phasing protection shall operate even with 80% of the set current flowing in two of the phases.

1.30 CONTACTORS

1.8.6 Motor starter contactors shall be of air break, electromagnetic type rated for uninterrupted duty

as per IS:13947 (Part 4).

1.8.7 Contactors shall be double break, non-gravity type and their main contacts shall besilver faced.

1.8.8 Direct on line starter contactors shall be of utilization category AC2. These contactors shall be as per 1S:13947 (Part 4).

1.8.9 Each contactor shall be provided with two (2) normally open (NO) and two (2) normally close (NC) auxiliary contacts.

1.8.10 Operating coils of contactors shall be of 240V AC Unless otherwise specified elsewhere. The Contactors shall operate satisfactorily between 85% to 110% of therated voltage. The Contactor shall drop out at 70% of the rated voltage.

1.31 INSTRUMENT TRANSFORMERS

1.9.6 All current and voltage transformers shall be completely encapsulated cast resin insulated type suitable for continuous operation at the temperature prevailing insidethe switchgear enclosure, when the switchboard is operating at its rated condition and the outside ambient temperature is 50°C.

1.9.7 All instrument transformers shall be able to withstand the thermal and mechanical stresses resulting from the maximum short circuit and momentary current ratings ofthe associated switchgear.

1.9.8 All instrument transformer shall have clear indelible polarity markings. All secondaryterminals shall be wired to a separate terminal on an accessible terminal block where star .point formation and earthing shall be done.

1.9.9 Current transformers may be multi or single core type. All voltage transformers shallbe single phase type. The Bus VTs shall be housed in a separate compartment.

1.9.10 All VTs shall have readily accessible MCBs on both primary and secondary sides.

1.32 INDICATING INSTRUMENTS

1.10.6 All indicating and integrating meters shall be flush mounted on panel. front. The instruments shall be of at least 96 mm square size with 90 degree scales, and shall
have an accuracy class of 2.5 or better. The covers and cases of instruments andmeters shall provide a dust and vermin proof construction.

1.10.7 All instruments shall be compensated for temperature errors and factory calibrated to directly read the primary quantities. Means shall be provided for Zero adjustmentwithout removing or dismantling the instruments.

1.10.8 All instruments shall have white dials with black numerals and lettering. Black knife edge pointer with parallax free dials will be preferred.

1.10.9 Ammeters provided on Motor feeders shall have a compressed scale at the upper current region to cover the starting current.

1.10.10 Watt-hour meters shall be of 3 phase three element type, Maximum demand indicators d need not be provided.

1.33 CONTROL & SELECTOR SWITCHES

1.11.6 Control & Selector switches shall be of rotary type with escutcheon plates clearly marked to show the function and positions. The switches shall be of sturdy construction suitable for mounting on panel-front. Switches with Shrouding of-live parts and sealing of contacts against dust ingress shall be preferred.

1.11.7 Circuit breaker selector switches for breaker Controlled motor shall have three stayput positions marked 'Switchgear', 'Normal' and 'Trial' respectively. They shall havetwo contacts of each of the three positions and shall have black shade handles.

1.11.8 Ammeter and voltmeter selector switches shall have four stay put position with adequate number of contacts for three phase 4 wire system. These shall have ovalhandles Ammeter selector switches shall have make before break type contacts to prevent open circuiting of CT secondaries.

1.11.9 Contacts of- the switches shall be spring assisted and shall be .of suitable material to give a long trouble free service.

1.11.10 The contact ratings shall be at least the following

(i)	Make and carry continuously	10 Amp.
(ii)	Breaking current at 220V DC	1 Amp (Inductive)
(iii)	Breaking current at 240V AC	5 Amp (at 0.3 pf lagging)

1.34 AIR BREAK SWITCHES

1.12.6 Air breaker switch shall be of the heavy duty, single throw group operated, load break, fault make type complying with IS:4064,13947,Part-3.

1.12.7 The Bidder shall ensure that all switches are adequately rated so as to be fully protected by the associated fuses during all abnormal operating conditions such asoverload, locked motor, short circuit etc.

1.12.8 Switch operating handles shall be provided with padlocking facilities to lock them in'OFF' position.

1.12.9 Interlocks shall be provided such that it is possible to open the cubicle door only when the switch is in 'OFF' position and to close the switch only - when the door is closed. However suitable means shall be provided to intentionally defeat theinterlocks explained above.

1.12.10 Switches and fuses for AC/DC control supply and heater supply wherever required shall be mounted inside and cubicles.

1.35 PUSH BUTTONS

1.13.6 Push-buttons shall be of spring return, push to actuate type. Their contacts shall berated to make, continuously carry and break 10A at 240V and 0.5A (inductive) at 220V DC.

1.13.7 All push-buttons shall have one normally open and one normally closed contact, unless specified otherwise. The contact faces shall be of silver or silver. alloy.

1.13.8 All push-buttons shall be provided with integral escutcheon plates marked with its function.

1.13.9 The colour of the button shall be as follows

(i)	GREEN	For motor START, Breaker CLOSE
(ii)	RED	For motor TRIP, Breaker OPEN
(iii)	BLACK	For overload reset.

1.13.10 All push-buttons on panels shall be located in such a way that Red-push-buttons shall always be to the left of green push-buttons.

1.36 INDICATING LAMPS

1.14.5 Indicating lamps shall be of the panel mounting cluster LED type. The lamps shall have escutcheon plates marked with its function, wherever necessary. Lamps shallhave translucent

lamp-covers of the following colours, as warranted by the application :

(i)	RED	For motor ON, Breaker CLOSED	
(ii)	GREEN	For motor OFF, Breaker OPEN	
(iii)	WHITE	For motor Auto-Trip	
(iv)	BLUE	For all healthy conditions (e.g. control supply, and alsofor 'SPRING CHARGED"	
(v)	AMBER	For all alarm conditions (e.g. overload) Also for SERVICE' and 'TEST" positions indicators.	

1.14.6 Lamps shall be easily replaceable from the front of the cubicle.

1.14.7 Indication lamps should be located just above the associated push buttons/control switches. Red lamps shall invariable be located to the right of green lamps. In casea white lamp is also provided, it shall be placed between the red and green lamps along with the centre line of control switch/push button pair. Blue and Amber lampsshould normally be located above the Red and Green lamps.

1.14.8 When associated with push-buttons, red lamps shall be directly above the green push button, and green lamps shall be directly above the red push-button. All indicating lamps shall be suitable for continuous operation at 90 to 110% of their rated voltage.

1.37 FUSES

1.15.5 All fuses shall be of HRC cartridge fuse link type. Screw type fuses shall not be accepted. Fuses for A.C. Circuits shall be of Class 2 type, 20 kA (RMS) breaking current at 415 AC, and for DC circuits Class 1 type 4 kA breaking current.

1.15.6 Fuses shall have visible operation indicators.

1.15.7 Fuses shall be mounted on fuses carriers, which are mounted on fuse bases, wherever it is not possible to mount fuses on carriers fuses shall be directly mountedon plug in type of bases. In such cases one set of insulated fuse pulling handles shall be supplied with each switchgear.

1.15.8 Fuse rating shall be chosen by the Bidder depending upon the circuit requirements and these shall be subject to approval of PURCHASER.

1.38 TERMINAL BLOCKS

1.16.8 Terminal blocks shall be of 750 volts grade and have continuous rating to carry the maximum expected current on the terminals. It shall be complete with insulating barriers, Clip-on-type/stud type terminals for Control. Cables and identification strips. Marking on terminal strip shall correspond to the terminal numbering on wiring on diagrams. It shall be similar to 'ELEMEX' standard type terminals, cage clamp type of Phoenix or WAGO or equivalent.

1.16.9 Terminal blocks for CT and VT secondary leads shall be provided with test links andisolating facilities. CT secondary leads shall be provided with short circuiting and earthing facilities. It shall be similar to 'Elem.' 'CATD' - Type.

1.16.10 In all circuit breaker panels at least 10% spare terminals for external connections shall be provided and these spare terminals shall be uniformly distributed on all terminal blocks. Space for adding another 10% spare terminals shall also beavailable.

1.16.11 All terminal blocks shall be suitable for terminating on each side, two (2) Nos. of 2.5mm square size standard copper conductors.

1.16.12 All terminals shall be numbered for identification and grouped according to the function. Engraved white-on-black labels shall be provided on the terminal blocks.

1.16.13 Wherever duplication of a terminal block is necessary it shall be achieved by solid bonding links.

1.16.14 Terminal blocks shall be arranged with at least 100 mm clearance between two setsof terminal block. The minimum clearance between the first row of terminal block and the associated cable gland plate shall be 250 mm.

1.39 NAME PLATES AND LABELS

1.17.4 All switchgears, AC/DC, distribution boards, shall be provided- with prominent, engraved identification plates. The module identification plate shall clearly give the feeder number and feeder designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

1.17.5 All name plates shall be of non-rusting metal or 3-ply lamicoid with white, engravedlettering on black back ground. Inscriptions and lettering sizes shall be subject to PURCHASER approval.

1.17.6 Suitable plastic sticker labels shall be provided for easy identification of all equipments, located inside the panel/module. These labels shall be positioned so asto be clearly visible and shall give the device number as mentioned in the module wiring drawings:

1.40 SPACE HEATER

1.18.3 Space heater shall be provided in all the boards for preventing harmful moisture condensation.

1.18.4 The space heaters shall be suitable for continuous operation on 240V AC, 50 Hz, single phase supply, and shall be automatically controlled by thermostats. Necessary isolating switches and fuses shall also be provided

1.41 CONTROL AND SECONDARY WIRING

1.19.6 All switchboards shall be supplied completely wired internally up to the terminal blocks ready to receive Purchaser's control cables.

1.19.7 All inter cubicle and inter panel wiring and connections between panels of same .switchboard including all bus wiring for AC and DC supplies shall be provided bythe Bidder.

1.19.8 All internal wiring shall be carried out with 1100 V grade, single core, 1.5-square mmor larger stranded copper wires having colour coded, PVC insulation. CT circuits shall be wired with 2.5 Sq mm copper wires. Voltage grade and insulation shall be same as above.

1.19.9 Extra-flexible wires shall be used for wiring to device mounted on moving parts suchas hinged doors.

1.19.10 All wiring shall be properly supported, neatly arranged, readily accessible and securely connected to equipment terminals and terminals blocks.

1.42 POWER CABLES TERMINATION

1.20.4 Cable termination compartment and arrangement for power cables shall be suitablefor stranded aluminium conductor, armoured XLPE/PVC insulated and sheathed, single core/three core, 1100 V grade cables.

1.20.5 All necessary cable terminating accessories such as Gland plates, supportingclamps and brackets, power cable lugs, hardware etc. shall be provided by the successful bidder, to suit the cable sizes which would be advised later.

1.20.6 The gland plate shall be of removable type and shall cover the entire cable alley. Bidder shall also ensure that sufficient space is provided for all cable glands. For allsingle core cables, glands plats shall be of non magnetic material.

1.43 TYPE TESTS

1.21.3 Type tests reports an Panels (Switchgear and Control gear assemblies) as per IS 8623 Part-I shall

be submitted for the following tests in line with relevant standards.

i) Verification of temperature rise limits
ii) Verification of the dielectric properties
iii) Verification of circuit strength
iv) Verification of the continuity of the protective circuit
v) Verification of clearances and creepage distances
vi) Verification of mechanical operation
vii) Verification of degree of protection

1.21.4 Contractor shall submit type test reports for the following Switchgear and Control gears before the fabrication of switchgear is started:

3. Circuit breakers/MCCB as per IS 13947 Part-II
4. Protective' Relays as per IEC: 60255.

1.44 EQUIPMENT TO BE FURNISHED

1.22.4 The Bidder shall quote for distribution boards in accordance with this specification.

1.22.5 Scheme of interconnection of switchboards and distribution boards along withtentative feeder disposition for each board is indicated in Standard SLD of system enclosed along with bid documents. The bidder shall quote board prices on the basis of standard SLD and their estimation of feeders. Any other feeder required asper system requirement for efficient and reliable operation shall be deemed to be included in bidder's scope.

1.22.6 The Bill of Materials for each type of module shall be as per indicative requirement of the systems. The necessary auxiliary relays, push buttons and indicating lamps shall be provided as per scheme requirement. Any other item/component required with in a module 'for efficient and reliable operation shall be deemed to be includedin bidder's scope.

1.45 AUTOMATIC SUPPLY CHANGEOVER

Automatic changeover between LT supply and DG set is to be carried out during thefailure of supply in one/or both the incomers. After the restoration of the supply, system shall be restored to normal condition automatically. The requirement of changeover under various conditions shall be finalized during detailed engineering.

K. TECHNICAL SPECIFICATIONS - EARTHING

1.1 Scope

a) Earthing system to be provided shall comprise of earth electrode of copper plate or hot dipped Galvanised plates in earth pits, earth bus/grid of copper flats or GI Flats or Aluminium flats as called for and bare copper earth wires or Galvanised earth wires or aluminium earth wires as called for, for acting as earth continuity conductor.

b) Lightning Protection system shall comprise of earth electrode of Cu or GI plate in earth pits, earth bus of down conductors of Cu or GI flats.

c) Earthing of Compound, Flood Lighting and Road Lighting poles shall be done by using Cu or GI plates in earth pits near pole and 7/16 size galvanised strained wire for connecting to the pole or as specified in the Schedule or in drawings.

d) Entire earth system shall conform to the Code of Practice as per IS. 3043 of 1987.

2.1 General Requirement

a) Enclosures and frame work of all current carrying equipment and accessories,structural steel/columns shall be adequately earthed to a single earthing system, unless separate

earthing systems are specifically stipulated. All electrical equipment shall be earthed at two distinct points.

b) Earth loads and risers shall follow as direct and short a path as possible. Suitable risers shall be provided as directed if equipment is not available when earthing is installed.

3.0 Earth Electrodes in Earth Pits :

Plate electrodes of Copper shall be 600x600x6 mm thick and 600x600x12 mmthick for GI unless otherwise specified.

4.1 Earth Bus and Earth Continuity Conductor :

a) Earth bus is a copper strip or flat of specified size interconnecting all earth electrodes.

b) Switchgears and Power Distribution Boards shall be earthed by a copper flat strip.

c) Panels, fused DBs and motors up to 30 KW rating shall be earthed by a continuity conductor, as specified. Minimum size of continuity conductor shall be 25x3 mm bare copper strip, soft drawn.

d) Road Lighting Poles shall be earthed with Cu stranded wire conductor whilefor lighting and power wiring bare copper conductor shall be provided unless otherwise specified to use insulated conductor.

5.0 **Earth Bus Station :**

Earth Bus Station shall be provided to facilitate tapping of earth continuity conductor from earth bus/grid very conveniently. It will comprise of a 400 mm long 50x6 mm bare copper strips/flat fixed with rawl plugs/bolts securely on wall/column above floor level. Spacers of 20 mm to 25 mm shall be provided to keep the flat away from wall and facilitate connections of earth conductor for which 6 mm dia holes 8 to 10 numbers are provided with proper size brass nuts, bolts, and washers. Earth bus shall be connected to it.

6.1 Lightning Protection System :

a) Air termination shall be five prong type copper Rod with round head and the same shall be securely clamped/installed to withstand severe weather conditions and provide protection against lightning. Horizontal air termination conductors shall be Cu or GI flat/strip and shall be provided where specified.

b) Earth Electrodes for lightning protection system shall be Copper plate installed in earth pits as per IS.

c) The down conductors from air terminals shall be done in tinned Cu or GI Flat/strip, of size as specified in the schedule of quantities or drawings, but shall not be less than 12.5x3mm as required. The down conductors shall followa direct path to the earth electrode without any sharp bend, turn or kinks. Thesedown conductors shall not be connected to other earthing conductors above ground level but the metallic parts in the vicinity of lighting protection conductorsuch as ladders, pipes, etc. shall be effectively connected and bonded.

d) A test joint as per IS shall be provided for every down conductor within 1500 mm above ground level.

e) Hardware and clamps shall be similar as used for the earthing systems.

7.0 **Artificial Treatment of Soil**

If the earth resistance is too high and the multiple electrode earthing does not giveadequate low resistance to earth, 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.

8.0 **Resistance to Earth**

The Contractor shall measure the resistance of the individual earthing pit and report to the Architect/ Consultants. The Contractor will make after due consultation with Architect/Consultants, No. of Earth pits, such that, the overall resistance in the earth mat does not exceed 1.0 ohm.

9.3 Earthing Station

9.4 Plate Electrode Earthing

Earthing electrode shall consist of a tinned copper plate not less than 600 x 600 x6 mm thick, or, 600 x 600 x 6 mm G.I. as called for in the drawings. The plate electrode shall be buried as far as practicable below permanent moisture level but in any case not less than 3 mts. below ground level. Wherever possible earth electrodeshall be located as near the water tap, water drain or a down take pipe as possible. Earth electrodes shall not be installed in proximity to a metal fence.

It shall be kept clear of the buildings foundations and in no case shall it be nearer than1 meter from the outdoor face of the wall. The earth plate shall be set vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture. 20 mm G.I. 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 earth.The main earth conductors shall be connected to the electrode just below the funnel, with proper terminal lugs and checks nuts. The funnel over the G.I. pipe and earth connections houses 300 mm wide and 300 mm deep. The masonry chamber shall be provided with a cast iron cover resting cover a C.I. frame embedded in masonry.

9.5 Pipe Electrode Earthing

Earthing electrode shall consist of a G.I. Pipe (Class 'B') Indian Tube Company make/ zenith or approved equal, not less than 40 mm dia and 5 meters long.
K.I. Pipe electrode shall be cut tapered at the bottom and provided with holes of 12mm dia. drilled at 75 mm interval upto 2.5 meters length from bottom. The electrode shall buried vertically in the ground as far as practicable below permanentmoisture level with its top not less than 200 mm below ground level. The electrode shall be in one piece and no joints shall be allowed in the electrode. Wherever possible earth electrodes shall be located as near water tap, water drainor a down take pipe. Earth electrode shall not be located in proximity to a metal fence. It shall be kept clear of the building foundations and in no case shall be nearer than 2 meters from the outer face of the wall.

The pipe earth electrode shall be kept vertically and surrounded with 150 mm thick layer of charcoal dust and salt mixture upto a height of 2.5 meters from the bottom. At the top of the electrode a funnel with a mesh shall be provided for watering.

L. TECHNICAL SPECIFICATIONS FOR LIGHTING FIXTURES

1.0 **Scope**

Manufacture, Test, Supply and Delivery at site, Erection in proper position testing andcommission the specified Light Fittings. All the fittings shall have Electronic Ballets ofApproved make.

2.0 **Standards :**

Lighting Fittings covered against this specifications shall comply with the relevant latest Indian Standards and Codes and more specifically to IS 2418 for tubular fluorescent lamps, and IS 1771 for Industrial Fittings with metallic reflector.

3.1 Construction :

a) The atmosphere where these fittings are to be installed will be humid and conducive to chemical corrosion. Suitable protection against the same shall be offered. The fittings shall be suitable for 240 Volts. Single phase A.C. supply (+)/(-) 5% and frequency 50 Hz. (+)/(-)3%.

b) The complete fittings and its accessories such as Ballets, Side holders shall be fixed and pre wired. All fittings shall be provided with one internal and one external earthing terminal of appropriate diameter GI/Passivated Brass complete with one spring and two flat washers. The fluorescent fittings shall be complete with high frequency ballast, lamp holders, terminal block (4 way), etc. and fully wired upto terminal block.

Lighting Fittings Components/Accessories :-

d) Electronic Ballast :-

All the Electronic ballast shall be compact in design, electronic type and high frequency type having low power loss, good heat dissipation, with no humming. The HF ballast should not interfere with the Computers. The H.F Ballasts shouldnot have any "H" mark on it. The Electronic Ballast should have total harmonic distortion less than 10%. The Electronic Ballast should have constant light out put
i.e in case of variation in supply voltage the light out put of the lamp should remain constant. The Ballast should have following compliances and approvals.

RFI Less than 30 MHz	EN 55015
RFI more than 30 MHz	EN 55022 A
Harmonics	EN 61000-3-2
Immunity	EN 61547
Safety	IEC 928
Performance	IEC 929
Vibration & Bump Tests	IEC 68-2-6FC & IEC 68-2-29Eb
Quality Standard	ISO 9001
Environmental Standard	ISO 14001

All the Ballast's should be flicker free warm start. The ballast should have constant light output irrespective of mains voltage fluctuations within 202-254 Volts. In case of the Mains fluctuations within 202-254 Volts the luminous flux should not change more than +/- 4%. The ballast should have Low harmonics
distortion The total harmonic distortion should be less than 10%. The Earth leakage Current should be less than 0.5 mA per ballast and ignition time should be less than 2 sec. Further the ballast should have over voltage protection i.e. itshould able to sustain for 48 hrs at 320 Volts AC and 2 hours at 350 Volts AC. The Ballast should either of Philips make having Cat No. EB-PERFORMER (EB-P 220-240 1/36 RS) for Single Tubes or EB-PERFORMER (EB-P 220-240 2/36 RS) for double tubes or approved equivalent make .

e) Lamp Holders :

These shall be rotary, spring loaded resilient type, either moulded from Urea-Formaldehyde.

f) Fluorescent Lamps :

These shall be of High Lumen out put and of approved colors and of Philips orany other approved make similar to Philips True Light and of stated wattage.

I. TECHNICAL SPECIFICATION FOR CABLE TRAYS

1.0 Perforated Cable Trays of ladder type and associated accessories tees, bends, elbows and reducers shall be fabricated from 12 gauge (2.5mm) mild steel. Prefabricated Cable trays of perforated type and associated accessories tees, elbowsand reducers shall be fabricated from 14 gauge (2mm) White CRCA Sheets. Cable trays shall be made of corrosion resistant material or if made of material shall be adequately protected against the corrosion.

2.0 Cable trays accessories shall be painted with One Shop coat of Red oxide zinc chromate primer and two side coats of Aluminium alkyd paint.

3.0 Cable trays shall not have sharp edges, burrs or projections that may damage the insulation jackets of the wiring.

4.1 Cable trays shall not have side rails or equivalent structural members cable trays shallinclude fittings or other suitable means for change in direction and elevation of runs.

Cable Tray Mounting

Unless otherwise specifically noted on the relevant layout drawing, all cable traymounting works to be carried out the following:

a) Cable tray mounting arrangement type to be as marked on layout drawing.

b) Assembly of tray mounting structures shall be supplied fabricated, erected & painted by the electrical contractor.

c) Tray Mounting structures shall be welded to plate inserts or to structural beams as approved by the Project Manager.

d) Wherever embedded plates & structural beams are not available for welding the tray mounting structure electrical contractor to supply the MS plate & fix them to floor slab by four anchor fasteners of minimum 16 mm dia having minimum holding power of 5000 Kg, at no extra cost.

e) Maximum loading on a horizontal support arm to be 120 Kg/metre of cable run.

f) Width of the horizontal arms of the tray supporting structures to be same as the tray widths specified in tray layout drawings, plus length required, for welding to the vertical supports.

g) The length of vertical supporting members for horizontal tray runs will be to suit the number of tray tiers shown in tray layout drawings.

h) Spacing between horizontal support arms of vertical tray runs to be 300 mm.

i) Cable trays will be welded to their mounting supports.

j) Minimum clearance between the top most tray tier and structural member to be 300 mm.

k) Cable in vertical race ways to be clamped by saddle type clamps to the horizontal slotted angles. Clamps to be fabricated from 3mm. thick aluminiumstrip at site by the electrical contractor to suit cable groups.

l) The structural steel (standard quality) shall be according to latest revision of IS:2062 & IS 808 Rev III of 1989. Welding shall be as per latest revision of IS :816 Rev I of 1969. All structural steel to be painted with one shop coat of redoxide and oil primer followed by a finishing coat of aluminium alkyd paint where any cuts or holes are made on finished steelwork these shall be sealedagainst oxidation by red oxide followed by the same finishing paint. Steel sheetcovers wherever indicated to be similarly painted.

M. TECHNICAL SPECIFICATIONS FOR POINT WIRING USING PVC CONDUITS

1.0 **Scope of Work**

The scope of this section comprises of supply, delivery, store at site, prepare the conduit assembly, fix and erect in proper position, rigid PVC conduits of minimum
2.0 mm wall thickness and as per IS 9537 Part III. Concealed work check before casting of slab, measure and tie the assembly to reinforcements, complete with providing GI pull wires.

1.1 **Applicable Standards**

The relevant sections of Indian Standard Specifications as more particularly stated herein and broadly to all the codes, statues and regulations as applicable shall be strictly enforced and adhered to. More particularly following codes should be strictlyfollowed.

IS 9537 Part III : Rigid non metallic conduits for Electrical work.IS 2274 : Wiring Practice.
IS 3043 : Code of Practice of Earthing.

2.7 Rigid PVC Conduit Work

2.8 Material

2.8.1 The minimum wall thickness of Rigid PVC Conduits permitted for concealed conduiting shall be 2.0 mm thick and shall be suitable for heavy duty.

2.8.2 The tubing must be perfectly circular, without any burrs or kinks.

2.8.3 The Conduits shall be of such type, so as to be capable of making tight fitting joints.

2.8.4 The minimum size of Rigid PVC Conduits allowed in concealed work shall be of 20 mm and above.

2.9 Conduit Accessories

2.9.1 All conduit accessories that are to be used in concealed work shall be of Rigid PVCtype conforming to latest and relevant IS codes.

2.9.2 Conduit Accessories shall be capable of clean and tight fittings.

2.9.3 All junction boxes of one way or above shall be of high dome type with a depth of minimum 65 mm and minimum 2 mm wall thickness.

2.9.4 In concealed work, inspection types of bends are not allowed, normal bends/ elbows may be permitted after specific approval.

2.10 Conduit Assembly Work

2.10.1 The Contractor shall submit to the Architect/Consultant detail layout plan of conduitnetwork containing particulars regarding size and routes of conduits, number of wires carrying in each conduit, inspection and junction boxes provided along with the routes of the conduits. The number of wires in each conduit shall not exceed as
specified in the table of conduit capacity. All the conduits are supported using minimum 16 gauge M.S. Spacers and G.I Saddles fabricated using 16 gauge sheetsand fixed using GI Screws.

2.10.2 Initially all drawings for concealed conduit work shall be inspected. Any discrepancies or otherwise occurring due to site conditions or change in internal layouts or in walls shall be reported. After rectification of the same, then the measurements and marking shall be done for the conduit assembly, on the shuttering of the slab.

2.10.3 All conduits shall be assembled. Wherever straight runs exceeds 3 mts., additionalpull boxes or junction boxes shall be provided. However, the entire assembly shallbe so assembled in order to facilitate renewal of wires etc. in the future.

2.10.4 Wherever fluorescent light fixtures are shown in the layout, the conduit shall be terminated in a high dome junction box at the centre of the fixture, unless otherwisespecified or indicated in drawings.

2.10.5 In the concealed conduit work, all junction boxes, bends, elbows shall have PVC tapes on either side to ensure security of the accessories in its place. They shall also be PVC taped at all joints in order to prevent cement, water or slurry entering the Rigid PVC conduit assembly.

2.10.6 All precautions should be taken in concealed work, to ensure no entry of cement slurry or blocking of conduits due to concreting.

2.10.7 For all circuit wiring, i.e. from Lighting Distribution Boards to Individual Switchboards, minimum 25 mm Rigid PVC conduits and minimum 2.0 mm wall thickness conduits shall be used.

2.10.8 All PVC conduits drops that are to be taken for the purpose of joining the Distribution Board or Switch Boards shall be taken out of the shuttering with a clean hole. Sand then shall be provided at the bottom most part of the entry in the shuttering. The projected part of the PVC conduit shall have a coupling over the same.

2.10.9 The entire PVC conduit assembly shall be properly secured and bonded by means of steel wires, twisted and fixed to the reinforcements. Additional fixing shall be done near joints, junction boxes, pull boxes etc.

2.10.10 The entire Rigid PVC conduit assembly then shall be checked for rigidity and nomovement shall be allowed in the assembly.

2.10.11 The entire Rigid PVC conduit assembly shall be provided with proper GI pull wiresof minimum 14 gauge.

2.10.12 Adequate number of PVC, pull boxes of suitable sizes shall be provided in the PVC conduit assembly.

2.10.13 It shall be the entire responsibility of the Contractor to supervise the concealed conduit assembly work during the casting of the slabs. Adequate precautions should be taken to spread fine sand covering the opening of the PVC conduit boxesor junction boxes at the bottom of the slab.

2.10.14 Where the conduit passes through the flooring the same shall be passed through galvanised pipe of suitable size fixed in the flooring, so that conduits, cables or wirescan be renewed at any time without breaking the floor.

2.10.15 Where the conduit runs in brick walls same should be necessarily fixed by using MSclamps. In the straight run the distance between the two clamps shall not exceed 500mm and additional clamps should be provided near bend and junction box.

2.10.16 The entire jointing in PVC conduit assembly shall be done using PVC solvent cement only. Wherever the conduits are terminated in PVC switchboard boxes or PVC, socket outlets boxes, the use of collars, male female type of adaptors shall be only used.

2.11 Conduit Capacity

The maximum capacity of a conduit for drawing in Flame Retardant Low Smoke (FRLS) wires shall be in accordance with IS 2274. The minimum size of conduit to be used shall not be less than 20 mm (approx.) and not more than two circuits connected to same phase be bunched in one conduit. Two different phases are notallowed in one conduit.

Commonly used sizes of 650/1100 Volts Flame Retardant Low Smoke (FRLS) wires and conduit capacities are as tabulated below:-

Size of Wire	Voltage Grade	Capacity of the Conduit 20 mm	25 mm
1.5 sq.mm.	650/1100	5 Nos.	8 Nos.
2.5 sq.mm.	650/1100	5 Nos.	6 Nos.
4.0 sq.mm.	650/1100	3 Nos.	5 Nos.
6.0 sq.mm.	650/1100	2 Nos.	3 Nos.
10.0 sq.mm.	650/1100	.....	3 Nos.

2.12 Point Wiring

The wiring shall be of the looping in system as different from the tree system. Connectors should not be used without specific prior approval. Looping in on the phase side shall be at the switches and that on the neutral side at the ceiling roses.Every light point, fan point and plug point shall have individual control switch unless stated otherwise. Earthing shall be provided for all the points according to the statutory requirement wherever necessary. The number of points per circuit shall notexceed 8 in any case.

a) The point wiring in conduit consists of wiring from the branch distribution boardin conduit with its ancillary work, such as inspection bends, junction boxes andFRLS wires upto the fixed terminals of ceiling roses, connectors, batten holders, etc. depending upon the type of point.
b) For easy identification, wires with different colours shall be used for phase and neutral as far as practicable.
c) The control switches for lights, fans, wall sockets and fan regulators shall suitably be grouped on sheet steel cases of all welded design fabricated out of 1.2 mm (approx.). Generally, the bakelite sheet shall be 3 mm thick where SP Piano type flush mounting switches are to be accommodated and in all other cases it shall be 5 mm thick. The bakelite sheet cover shall be fitted above the sheet steel case and shall be leveled on the outer edges. Control accessories for one circuit only shall be grouped on a sheet steel case. Not more than 2 ceiling fan regulators shall be mounted on a sheet steel case. Suitable earthing terminal shall be provided on the sheet steel case. All the conduits entering and leaving D.B. shall be bonded together with 4 sq.mm bare aluminium/copper wire and earth clips (as mentioned in the schedule.).
d) Point Wiring by using Flame Retardant Low Smoke (FRLS) Wires:- This shall be similar to point wiring in conduit system. The fixing of cables shall, however,be according to the specifications.
e) All the Flame Retardant Low Smoke (FRLS) wires shall have a grade 650/1100 Volts for lighting and power wiring.

2.13 Mains and Sub-Mains Wiring

This shall include the cost of all Flame Retardant Low Smoke (FRLS) wires conduit,conduit accessories, clamps spacers, Flame Retardant Low Smoke (FRLS) wires on battens depending upon the type of wiring, all masonry work, such as cutting, neat finishing of walls, floor openings etc. Only approximate lengths are included inthe Schedule of Quantities and Rates, but the actual lengths of the mains and sub- mains executed will be measured between terminating points and will be paid for. Where the mains and sub-mains pass through the flooring, or through the wall, the same shall pass as specified in 3(b) above. Mains and Sub-Mains risers in conduit shall be bonded together with 4.0 sq.mm. bare aluminium/copper as specifically mentioned in Schedule and earth clips on each floor landing/mid-landing. The FlameRetardant Low Smoke (FRLS) wires are provided as mains and sub-mains, the same shall be fixed as per specifications.

3.2 Switches, Sockets & Ceiling Roses:

3.3 Ceiling Roses

These shall be of bakelite and of approved make and colour and shall not contain fuse terminals. These shall be provided with brass ceiling plate and M. T. Brass screws and washers with cord grip for termination of wires.

4.0 **Plate type, moulded design-switches on white Urea Power pressed coverplates**

These shall be of single pole, double pole, two ways, one ways or otherwise as called for in the Schedule. These shall be manufactured as per relevant IS Codes and shall amply to Indian Electricity Rules. The minimum rating shall be 5 Amp at 250 V AC.

5.0 **Socket Outlets with Plugs**

These shall be with porcelain base, in 2 Pin and earth design of best quality, suitable for single phase, 250 volts supply. The earth pin shall be effectivelyconnected to the nearest conduit or earth connections in distribution board with notless than 3 sq.mm (No. 14 SWG) copper wire. The socket outlet shall be complete unit shall be with ratings of 5 Amps. 250 Volts or 15

Amps 250 Volts to suit individual requirement as stated in Schedule of Quantities and Rates. The socketoutlets shall be in flush mounting or on plate designs as called for in the Schedule.

6.1 Interlocked Metal Clad Switch Fuse Units :

a) The Metal Clad switch fuse unit shall be of the heavy duty type, quick makeand quick break action, of approved pattern and capable of carrying continuously the current specified. All the switch fuse units shall have 'U' type contacts on fuse carriers and the switch fuse units of capacities 30 Amps. and above shall be provided with spring type contacts on the fuse bases. Unless otherwise specifically brought out in the Schedule the metal cases shall be of cast iron and shall be provided with knock-outs for incomingand outgoing pipes or cables and earthing terminals. The cover of the switch shall be interlocked with the switch handle so that the cover cannot be opened unless the switch is 'OFF' and the switch cannot be made on unless the cover is fixed.

b) The fuse shall be either rewire-able type or HRC type as detailed in Schedule of Quantities and Rates. The Switches with HRC fuse links shallbe supplied with insulated fuse removers.

N. SPECIFICATIONS FOR INSTALLATION OF ELECTRICAL EQUIPMENTS

1.0 Specification for Marking of Panels and Nomenclature:

All Panels shall borne the Nomenclature as suggested in the tender. The same shallbe embossed on steel plates and not painted. All Panels shall also bear the name ofthe Consultants of the project. All panels shall also indicate the line diagram and themethod of receiving Power from upstream Panel /Switch.

2.2 Specification for Installation of Main LT Panel

2.3 The Main LT Panel shall be installed in the electrical room allotted at site. The panels shall be properly assembled if dispatched in sections. All bus bars fish plateswill be thoroughly cleaned, greased and bolted to instructions. The Main Panel will be mounted on base frame of adequate size using 100x50x6 mm ISMC channels fabricated to meet the design of the base frame of the Main LT Panel. Thefabricated frame shall be welded in design and will undergo metal treatment process as stated in the specifications elsewhere. The base-frame shall have adequate size Anchor Fasteners which shall be grouted in the flooring. The base- frame of the panels will then be aligned with the fabricated base-frame already grouted. The whole structure will be rigid and will not in any way move while operating any of the switchgears. If found necessary, then, additional supports by way of angles horizontally bolted to the panel and grouted in the nearby wall shall be done. The entire erection of the panel shall have a neat and aesthetic appearance.

3.2 Specification for Installation of Power Control Centers and A.P.F.C. Panel.

3.3 The PCCs and APFC shall be installed in the electrical room allotted at site. The panels shall be properly assembled if dispatched in sections. All busbars fish plates will be thoroughly cleaned, greased and bolted to instructions. The Main Panel will be mounted on base frame of adequate size using 100x50x6 mm ISMC channels fabricated to meet the design of the base frame of the PCCs or APFC Panel. The fabricated frame shall be welded in design and will undergo metal treatment process as stated in the specifications elsewhere. The base-frame shall have adequate size Anchor Fasteners which shall be grouted in the flooring. The base-frame of the panels will then be aligned with the fabricated base-frame alreadygrouted.

The whole structure will be rigid and will not in any way move while operating any ofthe switchgears. If found necessary, then, additional supports by way of angles horizontally bolted to the panel and grouted in the nearby wall shall be done. The entire erection of the panel shall have a neat and aesthetic appearance.

4.3 Specifications for Installation of Sub-Power and Sub-Lighting Distribution Boards and Power & Lighting Distribution Boards

4.4 Before erecting the SLDB and SPDB and LDBs and PDBs at site, a thorough inspection shall be done by the Contractor and reported to the Architect / Consultants if any difficulties are envisaged for erection. Thereafter, an erection sketch shall be prepared, indicating the dimensions and the clearances between theBoards. A similar marking will also be made at site.

4.5 All Power and Distribution Boards shall be tested for mechanical endurance. After checking wiring and cable connections the entire boards, shall be erected in placesindicated and marked on the plan. All touching up work of points shall then be doneand foundation bolts granted. All necessary holes and civil works shall be done as per directions. The Panel after duly testing shall be put to commission for trial. All the lighting and power distribution boards shall be mounted directly on wall.

5.2 Specification for installation of LT Capacitors

5.3 LT Capacitor shall be neatly arranged and installed in tier formation. Proper checks should be done to ensure proper banking and number of LT Capacitors banked together. The Capacitors after installation and cable joints, shall be finally checked for any leakage etc. The LT Capacitors banks shall be fixed on angle iron frame work firmly granted in the floor and fixed as MS Channels frames. All Joints shall bechecked for proper connections and after conducting all tests, the Capacitor Banks shall be commissioned. The Capacitor Banks shall be commissioned. The operationof banks shall also be tested and terminal voltages discharge should be tested andnoted prior to commissioning.

6.16 Specifications for installation of MV/LV cables

6.17 General

6.17.1 MV Cables shall be inspected prior to laying, 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 inoriginal drums with manufacturer's name clearly written in the drum.

6.17.2 The recommendations of the cable manufacturer with regard to jointing and sealing shall be strictly followed.

6.18 Inspection

6.18.1 All cables shall be inspected upon receipt at site and checked for any damage during transit.

6.18.2 While selecting cable route for external lighting, sewage effluent pipes, Fire HydrantPipes etc. shall be avoided; where this is not feasible, special precautions as decided by the Architect/Consultants, shall be taken.

6.18.3 Proximity to communication cables

a) Power and communication cables shall as far as possible cross at right angles.Where power cables are laid in proximity to communication cables the horizontal and vertical clearances shall not normally be less than 60 cms.

6.18.4 Laying methods

a) Cables shall be laid direct in ground, in pipes/closed ducts, in open ducts or onsurface depending on environmental and site conditions.

b) During the preliminary stages of laying the cables, consideration should be given to proper location of he joint position so that when the cables are actually laid the joints are made in the most suitable places. As far as possible
water logged locations, carriage ways, pavements, proximity to telephone cables, gas or water mains, inaccessible places, ducts pipes racks etc. shall be avoided for joint position.

6.19 Laying direct in ground

6.19.1 **General :** This method shall be adopted where the cable route is along roads etc. and where no

frequent excavations are encountered and where re-excavations is easily possible without affecting other services.

6.20 Trenching

6.20.1 **Width of trench**: The width of the trench shall first be determined on the following basis:

a) The minimum width of trench for laying single cable shall be 35 cm.

b) Where more than one cable is to be laid in the same trench in horizontal formation, the width of trench shall be increased such that he inter-axial spacing between the cables, except where otherwise specified shall be at least20 cm.

c) There shall be a clearance of at least 15 cm between axis of the end cables and the sides of the trench.

6.20.2 Depth of Trench :-

The depth of the trench shall be determined on the following basis :

a) Where cables are laid in single tier formation, the total depth of trench shall notbe less than 75 cm. for cables up to 1.1 KV and 1.20 m for cables above 1.1 KV.

b) When more than one tier of cables is unavoidable and vertical formation of laying is adopted, depth of trench in above shall be increased by 30 cm for each additional tier to be formed.

6.20.3 Excavation of Trenches :-

a) The trenches shall be excavated in reasonably straight lines. Wherever thereis a change in direction, suitable curvature shall be provided complying with the requirements of the manufacturer.

b) Adequate precautions should be taken not to damage any existing cable(s), pipes or other such installation in the proposed route during excavation.Wherever bricks, tiles or protective covers or bare cables are encountered, further excavation shall not be carried out without the approval of the Architect / Consultants.

c) If there is any danger of a trench collapsing or endangering adjacent structures, the sides should be well shored up with timbering and/or sheeting as the excavation proceeds. Where necessary, these may even be left in places when back filling the trench.

d) Excavation through lawns shall be done in consultation with the staff of the department/owner concerned.

e) The bottom of the trench shall be level and free from stone, brick bats etc. Thetrench shall then be provided with a layer of clean, dry sand cushion of not less than 8 cm in depth.

6.21 Laying of Cable in trench

6.21.1 At the time of issue of cable for laying the cores shall be tested for continuity and insulation resistance.

6.21.2 When the cable has been properly straightened, the cores are tested for continuity and insulation resistance and the cable is then measured. In case of PVC cables suitable moisture seal tape shall be used for this purpose. All wastage to be contractors account.

6.21.3 a) Cable laid in trenches in a single timer formation shall have a covering of clean, dry sand of not less than 17 cms. above the base cushion of sand before the protective cover is laid.

b) In the case of vertical multi-tier formation after the first cable has been laid, a sand cushion of 30 cms. shall be provided over the initial bed before the second tier is laid. If additional tiers are formed, each of the subsequent tiers also shall have a sand cushion of 30 cms. as stated above. The top most cable shall have a final sand covering not less than 17 cms. before the protective cover is laid.

6.21.4 At the time of original installation, approximately 3m of surplus cable shall be left oneach end of the cable and on each side of underground joints (straight through /Tee/Termination) and at entries and places as may be decided by the Architect / Consultants. The surplus cable shall be left in the form of a loop. Where there are long runs of cable length, loose cable may be left at suitable intervals as specified by the Architect / Consultants.

6.21.5 Unless otherwise specified, the cables shall be protected by second class bricks of not less than 20cmx10cmx10cm (nominal size) protection covers placed on top of the sand, (bricks to be laid breadth wise) for the full length of the cable to the satisfaction of the Architect / Consultants. Where more than one cable is to be laid inthe same trench, this protective covering shall cover all the cables and projects at least 5cm. over the sides of the end cables.

6.22 Back filling

6.22.1 The trenches shall be then back filled with excavated earth free from stones or othersharp edged debris and shall be rammed and watered, if necessary, in successive layers not exceeding 30 cm. Unless otherwise specified, a crown of earth not less than 50 mm. in the center and tapering towards the sides of the trench shall be leftto allow for subsidence. The crown of earth however should not exceed 10 cm. so as not to be a hazard to vehicular traffic.

The temporary reinstatements of roadways should be inspected at regular intervals,particularly during the wet weather, and any settlement should be made good by further filling as may be required. After the subsidence has ceased, trenches cut through roadways or other paved areas shall be restored to the same density and material as the surrounding area and repaved to the satisfaction of the Architect / Consultants.

6.22.2 Where road turns or lawns, have been cut to kerb stones displaced, the same shallbe repaired and made good except turning / asphalting to the satisfaction of the Architect/Consultants and all surplus earth or rock removed to places as specified.

6.23 Route Marker:-

6.23.1 Route marker shall be provided along straight runs of the cables at locations approved by the Architect/Consultants and generally at intervals not exceeding 100 m. Markers shall also be provided to identify change in the direction of the cableroute and also for location of every underground joint.

6.23.2 Route markers shall be made out of 100mmx100mmx5mm GI/Aluminum plate, welded or bolted on to 35mmx35mmx6mm angle iron 60cm. long. Such plates marker shall be mounted parallel to and 0.5m or so away from the edge of the trench.

6.23.3 The word `cable` and other details such as voltage grading size etc. as furnished bythe Architect /Consultants shall be inscribed on the marker.

6.24 Single Core Cables :-

Three single core cables forming one three phase circuit shall normally be laid in close trefoil formation and shall be bound together at intervals of approximately 1m.The relative position of the three cables shall be changed at each point, complete transposition being effected in every three consecutive cable lengths. The joints shall be clearly marked in an approved manner to indicate the circuit and phases. The arrangement for laying a number of parallel cables shall be as detailed of IS:1255/1967.

6.25 Laying in Pipes/Closed Ducts :-

6.25.1 In locations such as road crossing, entry to buildings, on poles, in paved areas etc.cables shall be laid in pipes or closed ducts.

6.25.2 Stone ware pipes, GI, CI or Spun reinforced concrete pipes shall be used for such purposes. In the case of new construction, pipes as required shall be laid along withthe Civil Works, and jointed as per the instructions of the Architect / Consultants. The size of the pipe shall be decided by the Architect / Consultants and shall not beless than 10cm in diameter for a single cable and not less than 15cm for more thanone cable. These pipes shall be laid directly in ground without any special bed except for SW pipe which shall be laid over 10 cm. thick cement concrete 1:5:10 (1 cement : 5 coarse sand : 10 graded stone aggregate of 40 mm nominal size) bed.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 1m. from the ground level when laid under roads, pavements etc.

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 poly-phase system.

6.25.3 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 suitable sealed to avoid entry of water.

6.25.4 All chases and passage necessary for the laying of service cable connections to buildings shall be cut as required and made good to the original finish and to the satisfaction of the Architect / Consultants.

6.25.5 Cable grips/draw wires and winches etc. may be employed for drawing cables through pipes/closed ducts etc.

6.26 Laying of Cables in open ducts/Trenches

6.26.1 Trenches with suitable removable covers shall be preferred in sub-stations, switch rooms, plant rooms, etc.

6.26.2 The cable ducts should be of suitable dimensions so that the cables can be conveniently laid. If necessary, cables may be fixed with clamps on the walls of theduct or taken in troughs in duct. The duct should be covered with removable slabs orchequered plates.

6.26.3 Ducts may be filled with dry sand after the cable is laid and covered as above or finished with cement plaster specially in high voltage applications.

6.26.4 Splices or joints of any type shall not be permitted.

6.26.5 As far as possible laying of cables with different voltage ratings in the same duct shall be avoided.

6.26.6 Where considered necessary, hooks or racks shall be provided for supporting the cables in masonry/concrete cable ducts, cable troughs. Otherwise cables shall be laid direct in the trench or trough etc. While deciding the layout of cables in such ducts, care should be exercised to ensure, that, unnecessary crossing of cables is avoided.

6.27 Laying on Surface

6.27.1 The cables may be laid in troughs or brackets at regular intervals or directly cleatedto wall/ceiling. When laid over bracket supports, the cables shall be clamped to prevent undue sag.

6.27.2 Cable clamps shall be made from materials such as mild steel or Aluminum only. Incase of single core cables the clamps shall be non-magnetic materials. A suitable non-corrosive packing shall be used for clamping unarmoured cables, to prevent damage to the cable sheath.

6.28 Cable Identification Tags :-

6.28.1 Wherever more than one cable is laid/run side by side, marker tags as approved, inscribed with cable identification details shall be permanently attached to all the cables in the manholes/open ducts etc. These shall also be attached to various cables laid direct in ground at suitable intervals as decided by the Architect / Consultants before trenches are filled up.

6.29 Testing

6.29.1 All cables before laying shall be tested with a 500 Volts megger for 1.1KV grade or with a 2500/5000 Volts megger for cables of higher voltages. The cable cores shall be tested for continuity, absence of cross phasing, insulation resistance to earth/sheath/armor and insulation resistance between conductors.

6.29.2 All cables shall be subjected to above mentioned tests during laying, before covering the cables by protective covers and back filling and also before the jointing operations.

6.29.3 In the absence of facilities for pressure testing, it is sufficient to test for one minute with 1000 Volts megger for cables for 1.1KV grade and with 2500/5000 Volts megger for cables of higher voltages.

6.30 Completion Plan and Completion Certificate-

6.30.1 The work shall be carried out in accordance with the drawings enclosed with the tender and also in accordance with the modifications thereto from time to time approved by the Architect / Consultants.

6.30.2 At Completion, all layout drawings should be on Auto-cad and on 1:100 scale. The contractor is required to submit 5 sets of as built drawings on A-1 Size white paper along with 5 sets of Rewritable CDs. The Virtual Completion certificate can be issued to the contractor only when he submit all the shop drawings, As built drawings, Operation and Maintenance Manual to owner, Architect/ Consultant and PMC.

6.30.3 Layout of Cable Work.

6.30.4 Length, size, type and grade of cables.

6.30.5 Method of laying i.e. direct in ground, in pipes etc.

6.30.6 Location of each joint with jointing method followed.

6.30.7 Route marker and joint marker with respect to permanent land marks available at site.

6.30.8 Name of work, Job Number, accepted tender reference, date of completion, names of Division and Sub-Division, names of Contractor with their signature and scale of drawing.

6.31 Specifications for Earthing Grid and Earth Stations

The earthing system shall comply with the relevant standard as laid down in the Fire Insurance and Indian Standard Specifications.

The Earthing stations for Pipe and Plate Earthing shall be as per drawings. Entire Civil works, Salt, Charcoal in proper proportions, Watering chamber with wire mixingetc. shall be done. The Earth tapes wherever indicated shall be obtained by using Earth Megger. The results should comply with the Standards bid down by the IndianStandard Specifications.

The Lightning Arrestors shall be fixed on angle from frame work secured to the building walls at the top most painted and at all other points wherever indicated on the plan. They shall be connected to earth by using G.I. tapes of appropriate size. The entire unit shall have completed earth grid running around the unit and the same shall be inter-connected. The entire works of earthing should be complete in all respects such as welding the GI tape joints, tapping etc. There shall be no placewhere earthing strips are not connected to earth stations. G.I. tape shall be fixed onwalls or laid in prepared trenches or chiseled in ground and redone etc. as per directions.

7.2 Document, Certificates, Drawings and Spare Requirements :

7.3 The intent of this specification is to give a guideline of the Contractor to furnish in reproducible all sets of relevant papers and lists of spares for the continuous performance of the Owner`s Building. Nothing shall absolve the Contractor from notfurnishing any information documents and/or papers that have not been specificallystated herein.

a) **Document**:-All relevant documents for maintenance, manuals procedures anddata of all Electrical Equipment's supplied and erected by the Contractor on the site. The documents shall be bound and furnished to the Owner.

b) **Certificates**: All relevant tests certificates etc. and as more specifically statedin clause, shall be furnished. Contract shall also furnish all such certificates issued by the original manufacturer towards guarantee of performance of all equipment's supplied by the Contractor.

c) **Drawings**: All working / shop drawings and erection / as built drawings of the final erected plan of all electrical & all other services installation work as required in reproducible of equipment's such as MV Panel Distribution Boards,Cable routing, sizing, connection diagrams, circuits, wiring diagram and conductor sizes, lengths, terminations details, operational charts, recorded readings, load details, etc. shall be furnished to the Owner. The Ownerreserves the right to the mode of submission of such details being furnished by the Contractor.

d) The **Contractor** shall, notwithstanding anything stated otherwise, shall furnish list of recommended maintenance tools, spares, fuses, sets, codes, catalogues, appropriate pricing, original equipment manufacturer's addresses etc. to the Owner. Prior to such furnishings contractor shall make a proper assessment of all such requirements and then proceed to make the lists. The Contractor shall also be deemed to have understood the requirements, in sucha way that it ensures a continuous operation and functioning of the Electrical Equipment under the stated ratings, conditions and specifications.

O. TESTING, MANUFACTURER`S TESTS PRECOMMISSIONING TESTS AND COMPLETE COMMISSIONING

TESTING

1.1 General

At the completion of the work, the entire installation shall be subjected to the following tests :-

a) Insulation Continuity Test.
b) Insulation Resistance Test.
c) Earth Continuity Test.
d) Earth Resistivity Test.

Besides the above tests, any other test specified by the Local Authority shall also becarried out.

2.0 **Testing of Wiring**

All the wiring system shall be tested for continuity of circuits, short circuits and earthing after the wiring as completed and before energizing.

3.0 **Insulation Resistance Test**

The insulation resistance shall be measured by applying between earth and the whole system of conductors, or any section thereof, with all fuses in place and all switches closed and except in concentric wiring all lamps in position of both polesof the installation otherwise electrically connected together, a direct currentpressure provided that it does not exceed 60volts for medium voltage circuit. Wherethe supply is derived from AC three phase system the neutral pole of which is connected to earth, either direct or through added resistance, pressure shall be deemed to be that which is maintained 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 greater than one mega ohm.

The insulation resistance shall also be measured between all conductors connectedto one phase conductor of the supply and all the conductors connected to the middle wire of the neutral or to the other phase conductors of the supply. Such a test shall be carried out after removing all metallic connections between the two poles of the installation and in those circumstances the installation shall not be lessthan that specified above. The insulation resistance between the case of frame workof housing and power appliances, and all live parts of each appliance shall not be less than that specified in the relevant Indian Standard Specifications or where thereis no such specification shall not be less than half a mega ohm.

4.0 **Testing of Earth Continuity Test**

The earth continuity conductor metallic envelopes of cable shall be tested for electriccontinuity and the electrical continuity and the electrical resistance of the same along with the earthing lead but excluding any added resistance or earth leakage circuit breaker measured from the connection with the earth electrode to any point inthe earth continuity conductor in the completed installation shall not exceed one ohm.

5.0 **Testing of Polarity of Non linked single pole switches**

In a two wire installation a test shall be made to verify that all non-linked single poleswitches have been fitted in the same conductor through out and such conductor shall be labeled or marked for connections, to an outer or phase conductor or to thenon-earthed conductor of the supply. In the three of four wire installation a test shallbe made to verify that every non-linked single pole switch fitted in a conductor to one of the outer or phase conductor of the supply. The entire electrical installation shall be subject to the final acceptance of Architect / Consultants as well as the localauthorities.

6.0 **Earth Resistivity Test**

Earth Resistivity Test shall be carried out in accordance with Indian Standard Codeof Practice for earthing IS 3043 - 1966. All tests shall be carried out in the presenceof the Architect / Consultants/PMC.

7.6 Testing, Manufacturer's Tests Pre-commissioning Tests and Complete Commissioning

7.7 The general intent of this specification is to mention all the relevant tests to be doneand results to be furnished to Owner/Consultant/PMC by the contractor, prior to commissioning of the electrical work. These are guidelines, however, the Contractorshall carryout all such tests and complete all formalities as per relevant Indian Standard Specifications, Fire Insurance Requirements and/or Electricity Rules and Regulations as per Government as per Government Gazette and Publications.

7.8 Testing of Equipments

All equipments before installing on the site work shall be tested and all such results produced to the Owner. Nothing shall absolve the Contractor from re-performing any tests that the Contractor may be called upon specifically by the Architect / Consultants.

7.9 Manufacturer's Tests

The Contractor shall specifically perform all tests such as type, routine tests on all equipments such as Medium Voltage Panels, Light Fixtures etc. The details of suchtests shall be furnished by the Contractor to the Owner/ Architect / Consultants andobtain their approval in the matter. All costs incidental to such tests shall be deemedto have been included in the specific them for that equipment and no extra charge shall be payable by the Owner.

7.10 Pre-commissioning Tests

All tests underlined herein and/or called by the local Electrical Authorities, Government Officials and as laid down in relevant Indian Standard Specifications and/or Rules and Regulations stated in Indian Electricity Act shall be strictly complied megger, on M.V. side the reading shall not exceed 1 ohm and for H.V. sidenot exceeding 0.5 ohm.

7.11 Commissioning

d) The Contractor shall obtain the written permission and sanction of commissioning the equipment from Electrical Inspector of I.E.& L. Department of Government of Haryana State, if required under the specific rules of the Government.

e) All costs, visit fees etc. incidental to such obtaining sanctions shall be to the Contractors` Account, except statutory fees payable under relevant Indian ElectricityAct or Rules.

f) Contractor shall furnish all the necessary test and tests-reports to the Electrical Supply Authorities and furnish all formalities required to comply as per the Rules and Regulations on laid down for release of Electrical Supply to the Building. If called on, the Contractor shall carry out all such tests and prove the results to the entire satisfaction of the local and electric supply authorities. All costs and expensesincidental to the release of electric supply shall be to the Contractors account and no demand whatsoever shall be made to the Owner, except for any securitydeposits that the supply authorities would deem it necessary for charging of the lineetc.

7.11.1 All such documents forwarded and/or letters and/or correspondence exchanged to this regard shall be made available for inspection and the Contractor shall furnish 3sets of such documents and drawings for the Owner`s records.

7.11.2 After release of electric supply to Owner, the Contractor shall furnish six sets of all tests and test reports declared to the Supply authorities and shall record the initial reading of the LT Meter and shall furnish all such documents, officially exchanged between the Contractor and the Supply authorities for the record of Owners.

7.11.3 Contractor shall also attend and furnish the relevant completion certificate from the Electrical Inspector, I.E & L. Department, Government of Haryana and/or any otherauthority thereof, such as Pollution Control Board, various Government Bodies, Electrical Inspector, and supply Authorities whichever may be applicable.

7.11.4 The Contractor shall maintain a close liaison with the Supply Authorities and keep informed to the Architect / Consultants/Owners of the entire developments and planning i.e. being done by the Supply Authorities. It is the primary responsibility of the Contractor to approach Supply Authorities for obtaining Electrical Loads Sanctions. All formalities connected with this work shall be to the account of the Contractor except for official fees or deposits or any other statutory obligations.

Technical Specifications for

Industrial Kitchen in MDP Hostel/ Pragati Vihar Building for 400 Student Capacity & Swami Vivekananda Hall for 1200 Student Capacity.

1.0 Introduction

1.1 This work primarily includes the design, installation and commissioning of Kitchen equipment including, Exhaust and Ducting system (Kitchen area and garbage area) Grating of Drain as per the specified kitchen space (Drawing attached).

1.2 The Scope of SITC of Kitchen equipment Work shall be as per given below and any other item/items as per site requirement which is not covered under the above lists but as per the directions of the Engineer- In-Charge.

1.3 Tenderers are advised to see the area to get acquainted with the actual features of the land, area, location, etc. where work is to be executed and get other related information before quoting their rates for carrying out the work successfully.

1.4 Brief Scope of Work

This work primarily includes the design, installation and commissioning of Kitchen equipment including, Exhaust and Ducting system (Kitchen area and garbage area) gas bank, Grating of Drain as per the specified kitchen space (Drawing attached).

(1) **Planning Services - Kitchen and Servery**

As per Scope of Work, the bidders shall design the required equipment based on the available drawings for proper functionality of the system and fulfilling the requirement as below.

a) Facility Planning with MEP locations
b) Exhaust and ducting Planning (Kitchen area and garbage area). As per Scope of Work, the bidders shall design the required equipment based on the available drawings for proper functionality of the system and fulfilling the requirement of work.
c) LPG Pipe line layout. As per Scope of Work, the bidders shall design the required equipment based on the available drawings for proper functionality of the system and fulfilling the requirement of work.
d) Solid waste Management. As per Scope of Work, the bidders shall design the required equipment based on the available drawings for proper functionality of the system and fulfilling the requirement of work.
e) Cold storage.

(2) **Supply and Installation**

a) Food Service Equipment, (List of equipment is attached)
b) Designer may suggest some additional equipment (if needed)
c) Exhaust and Ducting (Kitchen area and garbage area)
d) LPG Pipeline, Testing and Commissioning
e) SS grating work of Drain
f) Cold Storage.

1.5 GENERAL COMMERCIAL & TECHNICAL CONDITIONS:

1.0 All the relevant electrical works shall be carried out as per CPWD General specification for Electrical Works, Part-I (Internal) 2013 & Part-II (External) 1994, amended up to date and should also comply with relevant provisions of the Indian Electricity Rules and Acts as applicable, amended up to date.

2.0 The contractor is advised to visit the site of work to have an idea of the execution of the work; failure to do so shall not absolve their responsibility to do the work as specified in agreement.

3.0 Completeness of Tender:

All sundry fittings, assemblies, accessories, hardware items, foundation bolts, termination lugs for electrical connections as required, and all other sundry items which are useful and necessary for proper assembly and efficient working of the various components of the work shall be deemed to have been included in the tender, whether such items are specifically mentioned in the tender documents or not.

4.0 Works to be done by the contractor:

Unless and otherwise mentioned in the tender documents, the following works shall be done by the contractor, and therefore their cost shall be deemed to be included in their tendered cost:-

(i) Foundations for equipments and components where required, including foundations bolts.

(ii) Cutting and making good all damages caused during installation and restoring the same to their original finish.

(iii) Sealing of all floor openings provided by him for pipes and cables, from fire safety point of view, after laying of the same.

(iv) Painting at site of all exposed metal surfaces of the installation other than pre-painted items like fittings, fans, switchgear/distribution gear items, cubical switchboard etc. Damages to finished surfaces of these items while handling and erection, shall however be rectified to the satisfaction of the Engineer-in-Charge.

(v) Testing and commissioning of completed installation.

(vi) Storage space for all equipments, components and materials for the work.

5.0 Storage and Custody of Materials:

The contractor has to make his own arrangement for the storage of the material at site & necessary watch and ward of the electrical installation during the execution of work till the same is handed over to the department. No extra payment will be made on this account. The storage space shall however be arranged by the department at site, if available.

The main contractor shall arrange for proper storage of the electrical fans and fittings at site and that double lock system shall be arranged for the fans and fittings after receipt at site until the time they are taken for installation. The contractor shall however be responsible for proper storage and safe custody of the same till their installation and handing over to the department.

6.0 Tools for handling and Erecting:

All tools and tackles required for handling of equipments and materials at site of work as well as for their assembly and erection and also necessary test instruments shall be the responsibility of the contractor.

6.1 **Care of buildings:**

Care shall be taken by the contractor to avoid damage to the building during execution of his part of the work. He shall be responsible for repairing all damages and restoring the same to their original finish at his cost. He shall also remove, at his costs, all unwanted and waste materials arising out of his work, from the site.

7.0 Work in occupied buildings:

(i) When work is executed in occupied buildings, there would be minimum of inconvenience to the occupants. The work shall be programmed in consultation with the Engineer-in-charge and the occupying department. If so required, the work may have to be done even before and after the office hours.

(ii) The contractor shall be responsible to abide by the regulations or restrictions set in regard to entry into, and movement within the premises.
(iii) The contractor shall not tamper with any of the existing installations including their switching operations or connections there to without specific approval from the Engineer-in-charge.

8.0 Drawings:
(i)The work shall be carried out in accordance with the drawings and the tender documents. However conceptual drawing with minimum equipment layout has been attached for reference only also the vendor will work in accordance with modification thereto from time to time as approved by the Engineer-in-charge.
(ii) After award of the work, the firm will be required to submit the drawings for the proposed work including layout plan, Gas pipe routes, Ducting Route etc for making the facility working. Work will be carried out as per the approved drawings.

9.0 General requirements of components:
9.1. Quality of material: All materials and equipments supplied by the contractor shall be new. They shall be of such design, size and materials as to satisfactorily function under the rated conditions of operation and to withstand the environmental conditions at site.

10.0 Inspection of materials and equipments:

10.1. Materials and equipment's to be used in the work shall be inspected by the departmental officers. Such inspection will be of following categories:
- (i) Inspection of materials / equipments to be witnessed at the Manufacturer's premises in accordance with relevant BIS /Agreement Inspection Procedure.
- (ii) To receive materials at site with Manufacturer's Test Certificate(s)
- (iii) To inspect materials at the authorized dealer's go downs to ensure delivery of genuine materials at site.
- (iv) To receive materials after physical inspection at site.

10.2. Adequate care to ensure that only tested and genuine materials of proper quality are used in work shall be ensured by firm. The firm shall ensure that:

- (v) Material will be delivered at site timely with proper care.
- (vi) The firm will be required to procure material like Bain Marie, Mixer, Freezer, etc. directly from the manufacturer/ authorized dealers to ensure genuineness & quality and as per the approved makes only. Proof in this regard shall be submitted by the contractor before installation at site to the department.
- (vii) Inspection at factory or at godown of the manufacturer, as required, shall be arranged by the firm for a mutually agreed date. Certificate for genuineness of the fittings shall have to provided duly signed by the manufacturer's officer not below the rank of Regional Manager.
- (viii) Similarly, for fabricated equipment's, the contractor will first submit dimensional detailed drawings for approval before fabrication is taken up in the factory. Suitable stage inspection at factory also will be made to ensure proper use of materials, workmanship and quality control.

11.0 Ratings of components:
11.1. All components in a electrical installation shall be of appropriate ratings of voltage, current and frequency, as required at the respective sections of the electrical installations in which they are used.
11.2. All conductors, switches and accessories shall be of such size as to be capable of carrying the maximum current, which will normally flow through them, without their respective ratings being exceeded.

12.0 Conformity to standards:

12.1. All components shall confirm to relevant Indian Standard Specifications wherever existing. Materials with ISI certification mark shall be preferred.

12.2. Relevant Indian Standards including amendments or revisions thereof up to the date of tender acceptance shall be applicable in the respective contracts for respective items, firm to ensure its compliance.

13.0 Workmanship:

13.1. Good workmanship is an essential requirement to be complied with. The entire work of manufacture/fabrication, assembly and installation shall confirm to sound engineering practice.

13.2. Proper supervision/skilled workmen: The contractor shall be a licensed electrical contractor of appropriate class suitable for execution of the electrical work. He shall engage suitably skilled/licensed workmen of various categories for execution of work supervised by supervisors / Engineer of appropriate qualification and experience to ensure proper execution of work. They will carry out instruction of Engineer-in-charge and other senior officers of the Department during the progress of work.

13.3. Use of quality materials: Only quality materials of reputed make as specified in the tender will be used in work.

13.4. In case any inferior quality material is found, the same shall be removed and the contractor shall be liable to replace it and provide to the satisfaction of PMC/ IIM Mumbai. In case the contractor fails to do so, the same may be executed by PMC/ IIM Mumbai at the risk and cost of the contractor.

14.0 Commissioning on completion:

After the work is completed, it shall be ensured that the installation is tested and commissioned. The Contractor shall carry out documentation and obtain all necessary permissions/Licence/ NoC for operation of Commercial Kitchen, Gas Bank etc. from any Central/ State Statuary bodies.

15.0 Training

After the work is commissioned, the contractor shall give handholding support and 1 month training to the IIM Representative for operation of all the Kitchen Appliamces and Equipments. If contractor fails to provide any training a fees of Rs. 5,00,000/- shall be deducted from the RA Bill.

16.0 Warranty

The installation will be handed over to the department after necessary testing and commissioning. The installation will be warranted against any defective design/workmanship. The Component, which lies under provision of Guarantee by the manufacturer shall be under consideration of Guarantee only for the provision of the period as provided by manufacturer. Similarly, the materials supplied by the contractor will be warranted against any manufacturing defect, inferior quality. **The warranty period will be for a period of 36 months from the date of handing over to the department.** Installation/ equipments or components thereof shall be rectified/ repaired to the satisfaction of the Engineer-in-charge. The firm will be required to submit warranty of material from the manufacturer to the department

17.0 General Terms and condition

17.1 The Equipment shall be purchased from Original equipment manufacturer (OEM) and their authorized dealer. Manufacturer certificate certifying all parameters as specified above and other relevant certificates. Original vouchers, challans to be submitted for release of payment. The Warranty/Defect Liability Period shall commence from the date of issue of the Taking Over Certificate or Completion Certificate whichever is later. The Warranty/Defect Liability Period shall be provided as per the

manufacturer norms or 05 years whichever is more. When the items is under Warranty/Defect Liability Period, it shall be the sole responsibility of the Contractor/Supplier to rectify defect of items, spare parts, replacement items as deemed necessary by the Employer/Owner and install the same without any cost implications to Employer/ Owner. In case of manufacturing defects repair and maintenance of product during warranty period will not be accepted and the same should be replaced with new item/items with same specification or higher specification without any cost.

17.2 General Specifications:

1. COMMERCIAL KITCHEN EQUIPMENTS (CUSTOM FABRICATED)

- The kitchen equipment vendor shall furnish shop drawing with details showing all dimensions, construction to the kitchen consultant for approval before production.
- The Kitchen equipment vendor to supply equipment's in accordance with Annexure A and as per BOQ Specifications mentioned in Annexure B and in addition to the Technical Specifications BOQ. No deviation to be done in the same unless specified by the Kitchen Consultant.
- The kitchen equipment vendor should verify all site measurement before commencement of production. The vendor will be responsible for to ensure that all kitchen equipment's fit at site.
- The Kitchen Equipment vendor shall provide all the necessary holes and/or openings in the Kitchen Equipment's, which may be, required for the proper installation of Plumbing, Electrical, Ventilation and Refrigeration connections.
- Wherever stainless steel is specified it shall confirm to SS 304 grade.
- All specifications for Custom Fabricated equipments to be as per Tender Document.
- Equipment can be supplied in PART / PHASED deliveries as per site progress.
- All motorized equipment's to be provided with starters according to the HP of motor
- All equipment to carry a warranty of 1 year from date of supply. The warranty should cover all manufacturing defects of equipment or parts and excluding consumables and wear and tear of parts such as glass and plastic parts, blades, gaskets, rubber parts, bulbs, seals, brushes, pads, filters, wheels etc.
- This warranty should include repair of defective parts, repairs to metal body for manufacturing defects except in case of damage caused due to voltage fluctuation, Equipment mishandling, misused or overused beyond capacity.

2. COMMERCIAL KITCHEN EQUIPMENTS (IMPORTED AND BOUGHTOUT EQUIPMENT)

- The Kitchen equipment vendor to strictly adhere to the brands and models as specified in this Tender.
- In case of unavailability of any equipment of a particular brand or model the same is to be brought to the attention of the Kitchen Consultant. No change to be made without their consent or approval.
- All motorized equipment's to be provided with starters according to the HP of motor.

3. KITCHEN GAS LEAK DETECTION SYSTEMS

- The gas leak detection system to be part of kitchen integrated system as per the Tender Document.
- The kitchen safety systems namely fire suppression, gas leak detection system and gas Bank to be Integrated and supplied by single vendor. Only approved brands recommended by kitchen consultant should be supplied.

- Sensor, Canopy, Panel etc. to be designed as per Specifications mentioned in the BOQ and as specified in Annexure D. No deviation to be done in the same unless specified by the Kitchen Consultant.
- Electrical: All conducting work of cabling to panels, Sensors etc. related with Gas detections shall be done as per final kitchen drawings and as mentioned tender specification.

4. GAS BANK

- Gas Piping works to be in accordance with IS 6044 Part 1 (2018).
- Gas piping to designed, supplied, tested and commissioned as per the Kitchen Equipment layout plan and in coordination with the Civil Contractor.
- Only approved Brands to be used.

5. HVAC

- HVAC works to be carried out as per design and specifications submitted by the MEP consultants and in coordination with the requirements of Kitchen Consultant.
- All Civil Work Related to Kitchen HVAC will be In Scope of the Civil Contractor. (Civil work i.e. making or breaking of wall/foundations/holes in walls etc.)

6. COMPLIANCE WITH TECHNICAL SPECIFICATIONS

- The work to be carried out in line with the annexure 1 - drawing & data sheets.
- The work to be carried out in line with the annexure 2 detailed equipment specification
- The work to be carried out in line with the annexure 3 - other specifications

7. Designer may suggest additional equipment/modify specification for superior standard if required as per the design of kitchen functioning for that Nothing extra will be paid. The materials used for the fabrication of kitchen equipment, ducting etc. should adhere to best of industry standard.

8. List of Preferred Makes for the Industrial Kitchen works are as follows:

SR NO	PARTICULARS	MAKES		
1	COLD ROOM	TRUFROST	RINAC	BLUESTAR
2	DEEP FREEZER	TRUFROST	RINAC	BLUESTAR
3	CHEST FREEZER	INDULGE	TRUFROST	BLUESTAR
4	REFRIGERATED EQUIPMENTS	CUSTOM	WILLIAMS	KLAUS
5	STORE BINS	NEELKAMAL	RUBBERMAID	REIBER
6	DUSTBIN	NEELKAMAL	M-TEX	RUBBERMAID
7	VEGETABLE PROCESSOR	SIRMAN	ROBO COUPE	ELECTROLUX
8	BLADES (1 SET OF 5 BLADES)	SIRMAN	ROBO COUPE	ELECTROLUX
9	MEAT SLICER	SIRMAN	ROBO COUPE	ELECTROLUX
10	CITRUS JUICER / EXTRACTOR MULTI JUICER	SIRMAN	ROBO COUPE	SANTOS
11	COLD PRESS JUICER	SIRMAN	ROBO COUPE	SANTOS
12	MIXER BLENDER	INDULGE	SIRMAN	ELECTROLUX
13	COMBI OVEN	RATIONAL	MKN	CONVERTHORM

SR NO	PARTICULARS	MAKES		
14	HOT FOOD HOLDING CABINETS	ALTO SHAAM	REIBER	SCAN BOX
15	TABLE TOP DEEP FAT FRYER	INDULGE	SIRMAN	ELECTROLUX
16	ICE CUBE MACHINE	WELBILT	SCOTSMAN	KOOLAIR
17	SALAMANDER PRO	SIRMAN	ELECTROLUX	INDULGE
18	TAPS	T&S	FISCHER	CHICAGO
19	INDUCTION COOKTOP	INDULGE	SIRMAN	ELECTROLUX
20	SPIRAL DOUGH MIXER	INDULGE	SINMAG	SALVA
21	TWO DECK OVEN AND PROOFER	SALVA	BONGARD	SVEBA DHALN
22	DISH WASHING MACHINE	SILANOS	MEIKO	IFB
23	TABLE TOP HOT PLATE	INDULGE	SIRMAN	ELECTROLUX
24	INDUCTION PLATE	INDULGE	SIRMAN	ELECTROLUX
25	WEIGHING SCALE	SUN SYSTEMS	ESSAE	HINDUSTAN SCALES
26	SOUP TOURINE	INDULGE	HATCO	ELECTROLUX
27	COFFEE MACHINE (FULLY AUTOMATIC)	DR. COFFEE	GAGGIA	WMF
28	AIR CURTAIN	TECHNOCRAT	EURONICS	AIR TECHNICS
29	INSECT KILLER	TECHNOCRAT	EURONICS	AIR TECHNICS
30	CAMBRO TROLLEY	CAMBRO	REIBER	ALTOSHAM
31	STEAM CLEANER	ROOTS	KARCHER	IP CLEANING
32	DISPLAY REFRIGERATOR	INDULGE	TRUFROST	CELFROST
33	SANDWICH GRILLER	INDULGE	SIRMAN	KARMA
34	MICROWAVE OVEN	SAMSUNG	LG	IFB
35	PIZZA OVEN	INDULGE	SIRMAN	ELECTROLUX
36	PLATE WARMER	INDULGE	BLANCO	ELECTROLUX
37	FOOD TRANSPORT TROLLEY	NEELKAMAL	REIBER	ALTOSHAM
38	WATER PURIFIER	ALFA UV	EUREKA FORBES	KENT
39	UPRIGHT BOTTLE COOLER	INDULGE	TRUFROST	CELFROST
40	TABLE TOP HOT PLATE WITH GRIDDLE	INDULGE	SIRMAN	ELECTROLUX
41	DRY GARBAGE BIN	M-TEX	NEELKAMAL	RUBBERMAID
42	WET GARBAGE BIN	M-TEX	NEELKAMAL	RUBBERMAID
Note:	**THE NAME OF MAKE & PRODUCT NO IS TO CLARIFY THE INTENT & SHOULD BE AS PER BRAND LIST LIST SUBMITTED; NO DEVIATION FROM THE SAME WILL BE ACCEPTED. IF NOT WRITTEN IN BOQ ITEM OR SPECIFICATIONS. IN ORDER TO MAINTAIN THE QUALITY AND STANDARD, SPECIALIZED CONSULTANT & ARCHITECT'S REPRESENTATIVE WILL REVIEW/ APPROVE ANY OTHER MAKE OR BRAND AFTER CONSIDERING THE SPECIFICATIONS & DESIGN REQUIREMENTS AT A LATER STAGE ON A PROPOSAL BY THE CONTRACTOR."**			