TECHNICAL SPECIFICATION

OF

ARCHITECTURE FINISHES

1.1 Painting

1.1.1 Scope of work:

The work covered under these specifications consists of furnishing the various types of paints and also the workmanship for these items, instrict compliance with the specifications.

1.1.2 Materials:

Paints, oils varnishes etc. of approved brand and manufacture shall be used. Ready mixed paints as recovered from the manufacturer without any admixture shall beused.If for any reason, thinning is necessary in case of ready mixed paint, the brand of thinnerrecommended by the manufacturer or as instructed by the Engineer-In-Charge shall beused. Approved paints, oils or varnishes shall be brought to the site of work by thecontractorintheiroriginalcontainersin sealed condition.

The contractor shall associate the chemist of paint manufacturers before commencementof work, during and after the completion of work who shall certify the suitability of thesurfacetoreceivepaintingand thepaintbeforeuse etc.

1.1.3 Commencing Work:

1.1.3.1 Scaffolding:

Wherever scaffolding is necessary, it shall be erected on double supports ties together by horizontal pieces, over which scaffolding planks shall be fixed. No bellies, bamboosor planks shall rest on or touch the surface which is being painted. Were ladders areused; pieces of old gunny bags shall be ties on their tops to avoid damage or scratchesto walls.Forpaintingoftheceiling,properstage scaffoldingshall be erected.

1.1.4 Preparation of Surface:

The surface shall be thoroughly cleaned. All dirt, rust, scales, smoke and grease shall bethoroughly removed before painting is started. Minor patches if any in plastered / formfinished surfaces shall be repaired and finished in line and level in CM/ 1:1 and cracksand crevices shall be filled with approved filler, to the full satisfaction of the Engineer-In- Charge. The prepared surface shall have received the approval of the Engineer-In-Charge afterinspection, beforepaintingiscommenced.

1.1.5 Application:

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in itscontainers. When applying also, the paint shall be continuously stirred in the smallercontainerssothatconsistencyiskept uniform.

The painting shall be laid on evenly and smoothly by means of crossing and laying off,the later in the direction of the grain in case of wood. The crossing and laying offconsists of covering the area with paint, brushing the surface hard for the first time and then brushing alternately in opposite directions two or three time and then finally brushing lightly in direction at right angles to the same. In this process, no brush marksshall be left after the laying off is finished. The full process of crossing and laying willconstitute one coat.

Where so stipulated, the painting shall be done with spraying. Spray machine used maybe (a) a high pressure or (b) a low pressure (large air gap), depending on the nature andlocation of work to be carried out. Skilled and experienced workmen shall be employedfor this class of work. Paints used shall be brought to the requisite consistency by addinga suitablethinner. Sprayingshould be done onlywhendrycondition prevails.

Each coat shall be allowed to dry cut thoroughly and rubbed smooth before the next coatisapplied.Thisshouldbefacilitated bythorough ventilation.

Each coat except the last coat shall be tightly rubbed down with sand paper or finepumice stone and cleaned of dust before the next coat is laid. No left over paint shall be put back into the stocktins. When not in use, containers shall be kept properly closed.

The final painted surface shall present a uniform appearance and no streaks, blisters,hair marks from the brush or clogging of paint puddles in the corners of panels, angles ofmoldings etc. shall be left on the work. In case of cement based paints / primers, theabsorbent surfaces shall be evenly damped so as to give even suction. In any weather,freshlypainted surfacesshallbekept damp forat leasttwo days.

In painting doors and windows, the putty around the glass panes must also be painted,but care must be taken to see that no paint stains etc. are left on the glass. Tops ofshutters and surfaces in similar hidden locations shall not be left out while painting.Prospect covers of electrical switch boxes have to be painted from inside by removingthem. Care shall be taken while removing them in position after painting with respectiveapproved paints. In painting steel work, special care shall be taken while painting overbolts, nuts,rivets, overlapsetc.

Any damage caused during painting work to the existing works / surfaces shall be madegoodbythe contractor.

Painting, except the priming coat, shall generally be taken in hand after all other builderswork,practically finished.

1.1.6 Precautions:

All furniture, lightings, fixture, sanitary, fittings, glazing, floors etc. shall be protected

by covering and stains, smears, splashing, if any shall be removed and any damage doneshallbe made good bythecontractor.

1.2 Painting, Priming Coat on Wood, Iron or Plastered Surfaces

The primer for woodwork, ironwork or plastered surface shall be as specified in the description of the item.

Primerforwood work /Iron& Steel/Plastered /Aluminium surfaces shall be as specified below:-

Sl. No.	Surfaces	Primertobeused
a)	Woodwork(hardandsoftwood)	Conforming to IS3536-1966
b)	Resinouswoodand plywood	Aluminium Primer
c)	Iron & Steel, Aluminium and galvanized steel Work:	Zinc chromate primer Conforming to IS104-1962
d)	Plastered surfaces, cement brickwork, Asbestos surfaces for oil bound	Cement primer

The primer shall be ready mixed primer of approved band and manufacture.

1.2.1 Preparation of Surface

1.2.1.1 Wood work:

The wood work to be painted shall be dry and free from moisture.

The surface shall be thoroughly cleaned. All unevenness shall be rubbed down smoothwithsandpaperandshallbewelldusted.Knots,ifany,shallbecoveredwithprep aration of red lead made by grinding red lead in water and mixing with strong gluesized and used hot. Appropriate filler material with same shade as paint shall be usedwhere so desired bythe Engineer-In-Charge.

The surface treated for knotting shall be dry before painting is applied. After the primingcoat is applied, the holes and indentation on the surface shall be stopped with glaziersputty or wood putty (for specifications for glaziers putty and wood putty - refer asmentioned herein before). Stopping shall not be done before the priming coat is applied as the wood will absorb the oil in the stopping and the latter is there for reliable to crack.

1.2.1.2 Iron and Steel Work:

All rusted scales shall be removed by scrapping or by brushing with steel wire brushes.Hard skin of oxide formed on the surface of wrought iron during rolling which becomesloosebyrusting, shall be removed.

Alldustand dirtshall bethoroughly wipedawayfromthesurface.

If the surface is wet, it shall be dried be for priming coat is undertaken.

1.2.1.3 Plastered Surface:

The surface shall ordinarily not be painted until it has dried completely. Trial patches ofprimer shall be laid at intervals and where drying is satisfactory, painting shall be takenin hand. Before primer is applied, holes and undulations, shallbe filled up with plasterof Paris/puttyandrubbed smooth.

a) Application:

The primer shall be applied with brushes, worked well into the surface and spread evenand smooth. The painting shall be done by crossing and laying off as described hereinbefore.

b) Other details:

ThespecificationsforPainting(General)shallholdwellso faritisapplicable.

1.3 White Washing with Lime

1.3.1 Preparation of surface:

Beforeworkwhichistowhitewashed,thesurfaceshallbethoroughlybrushedfreefrom mortardroppingandforeign matter.

1.3.2 Preparation of lime wash:

The wash shall be prepared from fresh limestone white lime. The lime shall be thoroughly slaked on the spot, mixed and stirred with sufficient water to make a thincream. This shall be allowed to stand for a period of 24 hours and then shall be screened through a clean coarse cloth.40gm. of gum dissolved in hot water or Binder which shall be added to each 10 cubic decimeter of the cream. The approximate quantity ofwater to be added in making the cream will be 5 liters of water to one kg. of lime. Indigo(Robin Blue) up to3 gm perkg. of lime dissolved in water, shall then beadded andwashstirredwell.Watershallthenbeaddedattherateofabout5litersperkg.oflimet o produce a milky solution. The lime shall be tested in a chemical laboratory and testcertificate submitted, to conform the quality of lime with regard to its physical andchemical properties.

1.3.3 Application of Whitewashing:

The white wash shall be applied with brushes or by spray in the specified number ofcoats. The operation for each coat in the case of brush application shall consist of astroke of the brush given from the top downwards, another from the bottom upwards over the first strike, and similarly one stroke horizontally from the right and another from the left before it dries.

Each coat shall be allowed to dry before the next one is applied. No portion of thesurfaceshall be leftout initiallyto bepatchedup lateron.

The finished dry surface shall not show any sign of cracking and peeling nor

shall itcome offreadily on thehand when rubbed.

1.4 Distempering

1.4.1 Acrylic Distemper

As per (IS 428-1969) of approved brand and manufacture, colour and required shade shall be used. The primer where used as on new work shall be cement primer or distemper primer as specified in the item. These shall be of the same manufacture asdistemper. The distemper shall be diluted with water or any other prescribed thinner in amannerrecommendedby manufacture. Only quality ofdistemperrequired fordaysworkshallbe prepared.

1.4.2 Preparation of surfaces

The surface shall be prepared as described herein before for painting work in so far as itis applicable and approved putty / filler shall be applied to the entire area to get uniformandsmoothsurface beforeapplication ofprimer.

1.4.3 Application

The cement primer or distemper primer shall be applied by brushing and not by spraying. Hurried priming work shall be avoided, particularly on absorbentsurfaces.The surfaces shall be finished as uniformly as possible leaving no brush marks, primingcoat shall be allowed to dry for at least 48 hours. Before applying distemper, the surfaceshall be lightly sand prepared to make it smooth for receiving, the oil bound distemper,taking care not to rub out the priming coat. A time interval of at least 24 hours shall beallowed between consecutive coats to permit the proper drying of the preceding coat.Two or more coats of distemper as are found necessary shall be applied over the primingcoatto obtainan even shade.

All paints have to be low VOC paints and certificates of the same should be provided bythecontractor.

1.5 Texture Paint

(WorktobecarriedoutasperManufacturer Specification)

1.5.1 Material

The paint shall be (Quartz reinforced Textured acrylic paint/ premium acrylic smooth waterproof exterior paint over texture finish) of approved brand and manufacture.

This paint shall be brought to the site of work by the contractor in its original containersin sealed condition. The material shall be brought in at a time in adequate quantities tosuffice for the whole work or at least a for tonight's work. The materials shall be kept inthe joint custody of the contractor and the Engineer-ln-Charge. The empty containersshall not be removed from the site of work till the relevant item of work has beencompletedand permissionobtainedfromtheEngineer-ln-Charge.

1.5.2 Preparation of Surface

For new work, the surface shall be thoroughly cleaned off all mortar dropping, dirt dust,algae, fungus or moth, grease and other foreign matter of brushing and washing, pittingin plaster shall make good, surface imperfections such as cracks, holes etc. should berepaired using white cement. The prepared surface shall have received the approval oftheEngineer-ln-Charge afterinspection beforepaintingiscommenced.

1.5.3 Application

Base coat of water proofing cement paint. All specifications in respect of base coat ofwaterproofingcement paintshallbeas describe.

Before pouring into smaller containers for use, the paint shall be stirred thoroughly in itscontainer, when applying also the paint shall be continuously stirred in the smallercontainers so that its consistency is kept uniform. Dilution ratio of paint with potablewater can be altered taking into consideration the nature of surface climate and as per recommended dilution given by manufacturer. In all cases, the manufacturer's instructions & directions of the Engineer-ln-Charge shall be followed meticulously.

The lids of paint drums shall be kept tightly closed when not in use as by exposure toatmosphere the paint may thicken and also be kept safe from dust. Paint shall be appliedwith a brush/roller on the cleaned and smooth surface. Horizontal strokes shall be given,First and vertical strokes shall be applied immediately afterwards. This entire operationwill constitute one coat. Thesurface shall be finished as uniformly as possible leavingno brush marks. The specifications in respect of scaffolding and protective measuresshallbeas described.

External Texture finish of approved makes as per approved design and pattern. Texture finish shall be applied over the plastered surface with required thickness shall 2 to 2.5mm thickness to form the necessary approved design by using trowel / putty blade and itshould be allowed for drying minimum 12 hrs., before the application of top painting, 2coats or more of external weather proof water based emulsion shall be applied over thisand a coat of primer may be applied based on the approved texture pattern. Including surface preparation like through cleaning, pre wetting & removal of loose mortars, etc.

1.6 Stainless Steel Kitchen Sink

Stainless steel kitchen sink shall be of sizes as specified and shall be conforming to IS 13983.The kitchen sink shall be of one piece construction with or without rim but without overflow.

They shall be Stainless steel of best quality and shall be supported on necessary brackets. Each sink shall be provided with waste coupling, waste pipe, wall flanges, connection pipe, angle valve, long nose bibcock etc. Including all the fixing materials.

1.7 Stainless Steel Railings

a) The scope of the work includes preparation of the drawings (based on the architectural drawings), fabrication, supply, installation and protection of the stainless steel railing and handing over of the work.

b) The stainless steel work shall be got executed through specialized fabricator having experience of similar works. The Contractor shall submit the credentials of the fabricator for the approval of the Engineer-ln-Charge.

c) The Contractor shall submit shop drawings, for approval of the Engineer-in-Charge, for fabricating stainless steel railing with detailing of the M.S.frame work to the R.C.C columns or frame. The details of the joints in the stainless steel work including location, etc. shall also be shown in the drawings.

d) The Contractor shall procure and submit to the Engineer-ln-Charge, samples of variousmaterials for the railing work, for approval. Afterapproval of samples, the Contractor shall prepare a mock up for approval of Engineer-ln-Charge. The material shall be procured and the mass work taken up only after theapproval of the mock up by the Engineer-ln-Charge. The mock-up shall be dismantledandremoved bythe contractoras perthe directionsofthe Engineer-in-Charge.

e) The stainless steel shall be of grade SS-304 with brushed steel satin finish and procuredfrom the approved manufacturer. It shall be without any dents, waviness, scratches,stains etc.

f) The required joints in the S. S Work shall be provided as per the architectural drawings,shall be welded in a workmanlike manner including grinding, polishing, buffing etc. allcomplete and compacted. The temporary clamps provided and fixed to hold the stainless steel railing, in position shall be removed after the concrete has set properly. The junction of the flooring and the cladding shall be neatly filled with weather silicone sealant of approved colour and shade.

g) One test (three specimens) for each lot shall be conducted for the stainless steel pipe inthe approved laboratory. Therefore, the material shall preferably be procured in one lotfromone manufacturer.

h) The finished surface shall be free of any defects like dents, waviness, scratches, stainsetc.and shall haveuniformbrushed steelsatin finish.

Any defective work shall be rejected and redone by the Contractor. The finished surfaceshall therefore be protected using protective tape which shall be removed at the time ofcompletion of the work. The surface shall then be suitably cleaned using nonabrasiveapprovedcleanerforthe material.

i) The item includes all inputs of labour, materials (including stainless steel pipes, welding, brazing, concrete, protective film, weather silicone sealant etc. including providing and fixing M.S. frames), T&P other incidental charges, wastages etc. The items also included providing and fixing stainless steel anchor fasteners for fixing railing.

j) The railing shall be fixed in position using stainless steel pipes, stainless steel posts of required diameters and thickness as shown on drawing and polished to satin finish including cutting, welding, grinding, bending to required profile and shape, hoisting, butting, polishing etc.

k) The item includes all inputs of labour, materials, T&P, other incidental charges, wastage etc. The entire work shall be carried out to the satisfaction of Engineer-

ln-Charge.

l) Sanding of veneer surface with sand paper (320no.)
m) Rubbingand waxing.

1.8 Granite

It shall be of any colour and size as directed by Engineer-In-Charge. Granite shall be plain machine cut and mirror polished. It shall be smooth and of even surface without holes or pits.

1.8.1 Sizes and Tolerances

The size of blocks, slabs and tiles shall be as mentioned in Table below.

TABLE

1.8.1.1 Sizes of Blocks, Slabs and Tiles

		Length	Width	Thickness inmm
1	Blocks	**30**to250	**30**to **100**	30to90
2	Slabs	**70**to 250	**30**to **100**	18
3	Tiles	**10**to **60**	**10**to **60**	0.8to2.4

Alldimensionsareincentimeter.

1.8.1.2 Tolerance

The following tolerances shall be allowed in the dimension of blocks, slabs and tiles:

Blocks
(a) Length +2 percent
(b) Width +2 percent
(c) Thickness ZeroTolerance

Slabs
(a) Length +2 percent
(b) Width +2 percent
(c) Thickness + 3 percent

Tiles
(a) Lineardimension +3 percent
(b) Thickness + 1 percent

The sizes other than those mentioned above may be provided as directed by the Engineer-In-Charge.

1.8.1.3 Physical Properties

The physical properties of marble for blocks, slabs and tiles and method of tests are mentioned in Table below.

TABLE
Physical Properties of Granite

	Granite

Characteristic	Granite Requirement	Method oftestas
(1) Moisture absorption after 24 hrs.by weight immersion in cold water	Max.0.50%	IS1124
(2) Hardness		
(3)SpecificGravity	Min.**2.6**	IS1122

1.8.1.4 Approval of Sample

Before starting the work, the contractor shall get samples of granite approved by theEngineer-ln-Charge. Approved samples shall be kept in the custody of the Engineer-ln-Charge and the granite supplied and used on the work shall conform to samples with regard to soundness, colour, veining and general texture.

1.8.1.5 Sampling

In any consignment all the blocks/slabs/tiles of the same group, size and finish shallbe grouped together to constitute a lot. Sample shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification.

1.9 Kota Stone Flooring and Risers of Steps and Skirting

As per CPWD Specification

1.9.1 Kota Stone Flooring

1.9.1.1 Kota Stone

It shall be as specified and approval of Engineer-ln-Charge.

1.9.1.2 Dressing of Slabs

Every stone shall be cut to the required size and shape. In case machine cut slabsare used, fine chisel dressing of machine cut surface need not be done provided a straight edgelaid anywhere along the machine cut surfaces is in contact with every point on it. The sides andtop surface of slabs shall be machine rubbed or table rubbed with coarse sand before paving. Allanglesand edges ofthe marbleslabs shall be true, squareandfree from chippings and thesurface shall be true and plane. The thickness of the slabs shall be 18, 30 or 40 mm as specified in the description of the item.

Tolerance of + 3% shall be allowed for the thickness. In respect of length and breadth of slabs a tolerance of +2% shall be allowed.

1.9.1.3 Laying

Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:4 (1 cement: 4 coarse sand) or as given in the description of the item.

The average thickness of the bedding mortar under the slab shall be 20 mm and the thickness at any place under the slab shall be not less than 12mm.

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 specified in the item. The slab shall be washed clean before laying. It shall be laid ontop, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall belifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortarat hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistencyshall be spread over the same at the rate of 4.4 kg of cement per sq. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the marble slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with woodenmallet till it is properly bedded in level with and close to the adjoining slabs with as fine a jointas possible.

Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cementon the surface of the slabsshall be cleaned off. The flooring shall be cured for a minimumperiod of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-In-Charge. Joint thickness shall not be more than 1mm.

Due care shall be taken to match the grains of slabs which shall be selected judiciously having uniform pattern of Veins/streaks or as directed by the Engineer-In-Charge.

The slabs shall be matched as shown in drawings or as instructed by the Engineer-In-Charge.

Slabs which are fixed in the floor adjoining the wall shall enter not less than 12 mm under theplaster skirting or dado. The junction between wall plaster and floor shall be finished neatly andwithout waviness.

Kota slabs flooring shall also be laid in combination with other stones and/or in simple regularpattern/designasdescribedinitemof workand/ordrawing.

1.9.1.4 Polishing and Finishing

Slight unevenness at the meeting edges of slabs shall then be removed by fine chiseling and finished in the same manner as specified except that cement slurry with or without pigments shall not be applied on the surface before each polishing.

1.9.2 Kota Stone in Risers of Steps and Skirting

Kota Stone Slabs and Dressing of Slabs shall be as specified, except that the thickness of slabs shall be 18 mm. A tolerance of + 3% mm shall be allowed, unless otherwise specified in the description of the item.

1.9.2.1 Preparation of Surface

It shall be as specified, the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in

drawings or as required by the Engineer-ln-Charge. In no case the skirting should project by more than thickness of stone.

1.9.2.2 Laying

The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12 mm andat no place the width shall be less than 10 mm, if necessary, the slabs shall be held in position by temporary M.S. hooks fixed into the wall at suitable intervals. The skirting or riser face shall becheckedforplaneand plumband corrected.

The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packedwith cement mortar 1:3 (1 cement: 3 coarse sand) or other mix as specified in the description ofthe item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.

The joints shall be as fine as possible but not more than 1 mm. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.

The risers and skirting slab shall be matched as shown in drawings or as instructed by the Engineer-ln-Charge.

1.9.2.3 Curing, Polishing and Finishing

It shall be as specified, except that cement slurry with or without pigment shall not be applied onthe surface and polishing shall be done only with hand. The face and top of skirting shall be polished.

1.10 Red Sandstone (Agra) Flooring

1.10.1 Red Sandstone (Agra) Slabs

The slabs shall be of selected quality, hard, sound, dense and homogeneous in texture free from cracks, decay, weathering and flaws. They shall be hand or machine cut to the requisite thickness. They shall be of the colour indicated in the drawings or as instructed by the Engineer-ln-Charge.

The slabs shall have the top (exposed) face polished before being brought to site, unless otherwise specified. The slabs shall conform to the size required. Before starting the work the contractor shall get the samples of slabs approved by the Engineer-ln-Charge.

1.10.2 Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shallbe true and plane.

The thickness of the slab after it is dressed shall be 20, 25, 30 or 40 mm as specified in the description of the item. Tolerance of ±2 mm shall be allowed for the thickness. In respect of length and breadth of slabs Tolerance of ± 5 mm for hand cut slabs and ± 2 mm for machine cut slabs shall be allowed.

1.10.3 Preparation of Surface and Laying

The specification shall be as described, except that the edges of the slabs to be jointed shall be buttered with grey cement, with admixture of pigment to match the shade of the slab. The thickness of the joints should be minimum as possible. In any location, it shall not exceed 1 mm.

1.10.4 Polishing and Finishing

The specifications shall be as described, except that (a) first polishing with coarse grade carborundum stone shall not be done, (b) cement slurry with or without pigment shall not be applied on the surface before polishing.

1.10.5 Red Sandstone (Agra) in Risers of Steps, Skirting and Dado

Red sandstone Slabs and Dressing shall be as specified, except that the thickness of the slabs shallbe 25 mm or as specified in the description of the item. The slabs may be of uniform size ifrequired.

Preparationofsurface shallbeasspecified.

Laying shall be as specified, except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs.

Curing, Polishing and Finishing shall be as specified, except that first polishing with coarse grade carborundum stone shall not be done.

1.11 Mirror Polishing and Finishing (Stone)

Procedure

For leveling of floor, use No.'0' while level. Grinding of magnesite and synthetic abrasive afteroperationofNo.-'0'repairingto bedoneonfloor.

- Use No.1 Brown Fine Grinding of magnesite and synthetic abrasive which removes minor level difference as well as the scratches of No.0(First two stones is to be used for leveling).
- Then No.2 Green Smooth grinding of magnesite and synthetic abrasive, after this operationpracticallyno scratches remains.
- After above operation use No.3 yellow pre polish of magnesite and synthetic abrasive, afterthis operation dull shine appears. A sharp reflection will be visible of any illuminated object.Thismustbeachieved for sharpfinal finish.

- Then use No.4 Red Polish of magnesite and synthetic abrasive, after this operation sharpness improves, true colour of the object appears.

- Then use No.5 Orange Super Polish of magnesite and synthetic abrasive after this operation full true colour appears.

- Then finally use No.6 Yellow and Black coating of magnesite and synthetic abrasive itcreatesawaterlikeeffectonthesurfaceandenhancesthecolourofthemosaickota/marble/granite

- Skirting shall also be polished using hand held grinding machine with the grinding stone indicated above.

Mirror polish shall be carried out using bar no.1 to 7
Diamond polish wherever specified shall be carried out using bar 300 to 3000 and final buffing using tin oxide powder complete.

1.12 Cement Concrete Pavement in Courtyard, Ramp and Terrace Etc.

Specifications described shall hold good as far as applicable except that:

(i) The panels shall be of uniform size and no dimension of a panel shall exceed 1.25 m and the area of panel should not exceed 1.25 sq. for the thickness of panel's upto 50mm.
(ii) Concreting shall be done in alternate panels only and no glass/asbestos strips shall be provided.

1.12.1 Finishing

The finishing of the surface shall follow immediately after the cessation of beating. The surface shall be left for some-time, till moisture disappears from it or surplus water can be mopped up.

Use of dry cement or cement and sand mix on the surface to stiffen the concrete or to absorbexcessive moisture shall not be permitted. Excessive troweling shall be avoided. When thesurface becomes fairly stiff, it shall be finished rough with wooden floats or where so specified chequered uniformly by pressing a piece of expanded metal of approved size.

1.13 Tile Flooring

1.13.1 Ceramic Tile Flooring

1.13.1.1 Ceramic Tiles

The tiles shall be of approved make and shall generally conform to IS 15622. They shall be flat, and true to shape and free from blisters crazing, chips, welts, crawling or other imperfections detracting from their appearance. The tiles shall be tested as per IS13630. Classification and Characteristics of ceramic tiles shall be as per IS13712.

The tiles shall be square or rectangular of nominal size. Table 1, 3, 5, and 7 of IS 15622give the modular preferred sizes and table 2, 4, 6 and 8 give the most common non modular sizes. Thickness shall be specified by the manufacturer. It

includes the profiles on the visible face and on the rear side.

Manufacturer/supplier and party shall choose the work size of tiles in order to allow a nominal joint width up to 2mm for unrectified floor tiles and up to 1mm for rectifiedfloor tiles. The joint in case of spacer lug tile shall be as per spacer. The tiles shall conform to table"! 0of IS15622with waterabsorption3 to 6% (Group Bll).

The top surface of the tiles shall be glazed. Glaze shall be either glossy or matt asspecified. The underside of the tiles shall not have glaze on more than 5% of the area inorder that the tile may adhere properly to the base. The edges of the tiles shall bepreferably free from glaze. However, any glaze if unavoidable, shall be permissible ononlyup to 50 percentof thesurfacearea ofthe edges.

1.13.1.2 Coloured Tiles

Only the glaze shall be coloured as specified. The sizes and specifications shall be the same as for the white glazed tiles.

1.13.1.3 Preparation of Surface and Laying

Base concrete or the RCC slab on which the tiles are to be laid shall be cleaned, wetted and mopped. The bedding for the tile shall be with cement mortar 1:4 (1 cement: 4coarse sand) or as specified. The average thickness of the bedding shall be 20 mm or as specified while the thickness under any portion of the tiles shall not be less than10mm.

Mortar shall be spread, tamped and corrected to proper levels and allowed to harden sufficiently to off era fairly rigid cushion for the tiles to be set and to enable the mason to place wooden plank across and squat on it.

Over this mortar bedding neat grey cement slurry of honey like consistency shall bespread at the rate of 3.3 kg of cement per square meter over an area up to one squaremeter. Tiles shall be soaked in water washed clean and shall be fixed in this grout oneafter another, each tile gently being tapped with a wooden mallet till it is properlybedded and in level with the adjoining tiles. The joints shall be kept as thin as possible and in straight lines or to suit the required pattern.

The surface of the flooring during laying shall be frequently checked with a straightedge about 2 m long, so as to obtain a true surface with the required slope. In bath,toilet W.C. kitchen and balcony/verandah flooring, suitable tile drop or as shown indrawing will be given in addition to required slope to avoid spread of water. Further tile drop will also be provided near floor trap.

Where full size tiles cannot be fixed these shall be cut (sawn) to the required size, and their edge rubbed smooth to ensure straight and true joints. Tiles which are fixed in the floor adjoining the wall shall enter not less than 10 mm under the plaster, skirting ordado.

After tiles have been laid surplus cement slurry shall be cleaned off.

1.13.1.4 Pointing and Finishing

The joints shall be cleaned off the grey cement slurry with wire/coir brush or trowel to adepth of 2 mm to 3 mm and alldust and loose mortar removed. Joints shall then beflush pointed with white cement added with pigment if required to match the colour of tiles. Where spacer lug tiles are provided, the half the depth of joint shall be filled with non-shrink epoxy grouts mixed with pigment to match shade of tiles on top with underfilling with cement grout without the lugs remaining exposed. The floor shall then bekept wet for 7 days. After curing, the surface shall be washed and finished clean. The finished floor shall not sound hollow when tapped with a wooden mallet.

1.14 Ceramic Tiles in Skirting and Dado

The tiles shall be of approved make and shall generally conform to IS 15622. The tiles shall bepressed ceramic covered by a glaze thoroughly matured and fitted to the body. The tiles shall be sound, true to shape, flat and free from flaws and other manufacturing defects affecting their utility.

The top surface of the tiles shall be glazed. The underside of the tiles shall not have glaze onmore than 5% of the area in order that the tile may adhere properly to the base. The edges of thetiles shall be free from glaze, however, any glaze if unavoidable shall be permissible on onlyupto50percent of thesurface areaof edges.

The glaze shall be free from welts, chips, craze, specks, crawling or other imperfections detracting from the appearance when viewed from a distance of one meter. The glaze shall beeither glossy or matt as specified. The glaze shall be white in colour except in the case of coloured tiles when colours shall be specified by the Engineer-In-Charge. There may be more than one colour on tile.

1.14.1 Dimensions and Tolerances

Glazed pressed ceramic tiles shall be made square or rectangular in sizes Table 1, 3, 5 &7 of IS 15622 give the modular sizes and table 2, 4, 6 & 8 of IS 15622 gives the sizes of non-modular tiles. The tiles shall conform to IS15622 for dimensional tolerance, physical and chemical properties.

Half tiles for use as full tiles shall have dimensions which shall be such as to make thehalf tiles when jointed together (with 1 mm joint) match with dimensions of full tiles. Tiles may be manufactured in sizes other than those specified above.

The thickness of the tiles shall be 5 mm or 6 mm or as specified. The dimensions of fittings associated with the glazed tiles namely cover base, round edge tile, angles cornercups, ridge and legs, cornices and capping beads shall be of the shape and dimensions as required and the thickness of fittings shall be the same as the thickness of tiles given above.

1.14.2 Preparation of Surfaces

The joints shall be raked out to a depth of atleast15 mm in masonry walls.

In case of concrete walls, the surface shall be hacked and roughened with wire

brushes.The surface shall be cleaned thoroughly, washed with water and kept wet before skirting is commenced.

1.14.3 Laying

12 mm thick plaster of cement mortar 1:3 (1 cement: 3 coarse sand) mix of as specified shall be applied and allowed to harden. The plaster shall be roughened with wire brushes or by scratching diagonal at closed intervals.

The tiles should be soaked in water, washed clean, and a coat of cement slurry appliedliberally at the back of tiles and set in the bedding mortar. The tiles shall be tamped andcorrected to proper plane and lines. The tiles shall be set in the required pattern and jointed. The joints shall be as fine as possible. Top of skirting or dado shall be truly

Horizontal and joints truly vertical except where otherwise indicated. Odd size / cut size of tile shall be adjusted at bottom to take care of slope of the flooring.

Skirting and dado shall rest on the top of the flooring. Where full size tiles cannot befixed these shall be cut (sawn) to the required size and their edges rubbed smooth. Skirting /dado shall not project from the finished "surface of wall" by more than the tile thickness, undulations if any shall be adjusted in wall.

1.14.4 Curing and Finishing

The joints shall be cleaned off the grey cement grout with wire/coir brush or trowel to adepth of 2 mm to 3 mm and all dust and loose mortar removed. Joints shall then be flush pointed with white cement added with pigments if required to match the colour of tiles.

The work shall then be kept wet for7 days.

After curing, the surface shall be washed and finished clean. The finished work shall not sound hollow when tapped with a wooden mallet.

1.15 DoorFrames

A door frame consists of three members, i.e. Two up writes or posts, called jamb post, which are secured at the top to a cross piece called a head or transom. The sizes of doorframe are according to use and material used in the doorframe and standard sizes are used in the doorframe. In doorframe, a rebate or recess 15 mm deep is kept for receiving the door shutter. For aluminum door following standard size of frames are in use.

- Width of frame (Single leaf)
    - For 35mm to 40 mm thick shutters
      The width of frame is 100 mm.
    - For 25mm to 30 mm thick shutters
      The width of frame is 90 mm.
- Width of frame (Double leaf)
    - For 30mm,35mm and 40 mm thick shutters
      The width of frame is 120 mm.
      b)For 25mm thick shutters

The width of frame is 90 mm.
The Thickness of frame should be 60 mm.

1.16 Engineered Wood In Door, Window

Woodshouldmeetfollowingproperty&shouldbebestavailableinthe marketdulyapprovedbyEngineer-in charge.

i) Densityrange:600-750 Kg/m3
ii) Adhesive -AsperIS:848BWP Grade
iii) TechnicalSpecificationAsPer IS:14616:1999

1.16.1 Panelled Glazed or Panelled and Glazed Shutters

Paneled or glazed shutters for doors, windows, ventilators and cupboards shall be constructed in the form of timber frame work of stiles and rails with panel inserts oftimber, plywood, block board, veneered particle board, fiber board wire gauze or floatglass. The shutters may be single or multi-paneled, as shown in the drawings or as directed by the Engineer-ln-Charge. Timber for frame work, material for panel inserts and thickness of shutters shall be as specified. All members of the shutters shall be straight without any warp or bow and shall have smooth well planned face at right angles to each other.

Any warp or bow shall not exceed 1.5 mm for door shutter and 1 mm for window andventilator shutter. The right angle for the shutter shall be checked by measuring the diagonals and the difference between the two diagonals should not be more than 3 mm.
Generally paneled glazed or paneled and glazed shutter shall conform to IS1003 (Pt.1&2).

1.16.2 Frame Work

Timber for stiles and rails shall be of the same species and shall be sawn in the directions Of grains. Sawing shall be truly straight and square. The timber shall beplaned smooth and accurate to the required dimensions. The stiles and rails shall bejoined to each other by plain or haunched mortise and Tenon joints and the rails shall beinserted 25 mm short of the width of the stiles. The bottom rails shall have double Tenonjoints and for other rails single Tenon joints shall be provided. The lock rails of doorshutter shall have its center line at a height of 800 mm from the bottom of the shuttersunless otherwise specified. The thickness of each Tenon shall be approximately one-third the finished thickness of the members and the width of each Tenon shall not exceed three times its thickness.

1.16.3 Gluing of Joints:

The contact surfaces of ten on and mortise shall be treated, before putting together,with bulk type synthetic resin adhesive conforming to IS 851 suitable for construction inwood or synthetic resin adhesive (Phenolic and amino plastic) conforming to IS 848 orpolyvinyl acetate dispersion based adhesive conforming to IS 4835 and pinned with 10mm dia hardwood dowels or bamboo pins or star shaped metal pins; after the frames are put together and pressed in position by means of press.

Stiles and bottom rail shall be made out of one piece of timber only. Intermediate rail exceeding 200mm in width may be of one or more pieces of timber. The width of a Piece shall be not less than 75 mm. Where more than one piece of timber is used forrails, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels at regular intervals not exceeding 200mm.

1.17 Flush Door Shutters

Flush door shutters shall have a solid core and may be of the decorative or non-decorative (Paintable type as per IS 2202 (Part I). Nominal thickness of shutters may be 25, 30 or 35 mm. Thickness and type of shutters shall be as specified.

Width and height of the shutters shall be as shown in the drawings or as indicated by the Engineer-ln-Charge. All four edges of the shutters shall be square. The shutter shall be free fromtwist or warp in its plane. The moisture content in timbers used in the manufacture of flush door shutters shall be not more than 12 percent when tested according to IS 1708.

1.17.1 Core

The core of the flush door shutters shall be a block board having wooden strips held in aframe constructed of stiles and rails. Each stile and rail shall be a single piece without any joint. The width of the stiles and rails including lipping, where provided shall not beless than 45 mm and not more than 75 mm. The width of each wooden strip shall not exceed 30 mm. Stiles, rails and wooden strips forming the core of a shutter shall be of equal and uniform thickness. Wooden strips shall be parallel to the tiles.

End joints of the pieces of wooden strips of small lengths shall be staggered. In a shutter, stiles and rails shall be of one species of timber. Wooden strips shall also be ofone species only but it may or may not be of the same species as that of the stiles and rails. Any species of timber may be used for core of flush door. However, any non-coniferous (Hard wood) timber shall be used for stiles, rails and lipping.

1.17.2 Face Panel

The face panel shall be formed by gluing, by the hot-press process on both faces of the core, either plywood or cross-bands and face veneers. The thickness of the cross bands as such or in the plywood shall be between 1.0 mm and 3.0 mm. The thickness of the face veneers as such or in the plywood shall be between 0.5 mm and 1.5 mm for commercial veneers and between 0.4 mm and 1.0 mm for decorative veneers, provided that the combined thickness of both is not less than 2.2mm.The direction of the veneers

Adjacent to the core shall be at right angles to the direction of the wooden strips. Finished faces shall be sanded to smooth even texture. Commercial face veneers shall conform to marine grade plywood and decorative face veneers shall conform to type I decorative plywood in IS1328.

1.17.3 Lipping

Lipping, where specified, shallbe provided internally on alledges of the shutters.Lipping shall be done with battens of first class hardwood or as specified of depth notless than 25 mm. For double leaved shutters, depth of the

lipping at meeting of stiles shall be not less than 35 mm. Joints shall not be permitted in the lipping.

1.17.4 Rebating

In the case of double leaves shutters the meeting of stiles shall be rebated by 8 mm to 10mm. The rebating shall be either splayed or square type as shown in drawing where lipping is provided. The depth of lipping at the meeting of stiles shall not be less than 30mm.

1.17.5 Opening for Glazing

When required by the purchaser opening for glazing shall be provided and unless otherwise specified the opening for glazing shall be 250 mm in height and 150 mm or 200 mm in width unless directed otherwise. The bottom of the opening shall be at a height of 1.4 m from the bottom of the shutter. Opening for glazing shall be lipped internally with wooden batten of width not less than 25mm.

Opening for glazing shall be provided where specified or shown in the drawing.

1.17.6 Venetian Opening

Where specified the height of the Venetian opening shall be 350 mm from the bottom ofthe shutter. The width of the opening shall be as directed but shall provide for a clearspace of 75 mm between the edge of the door and Venetian opening but in no case the opening shall extend beyond the stiles of the shutter. The top edge of the opening shall be lipped internally with wooden battens of width not less than 25 mm. Venetian opening shall be provided where specified or shown in the drawing.

1.17.7 Tolerance

Tolerance on width and height shall be + 3 mm and tolerance on nominal thickness shallbe ± 1.2 mm. The thickness of the door shutter shall be uniform throughout with a permissible variation of not more than 0.8mm when measured at any two points.

1.17.8 Adhesive

Adhesive used for bonding various components of flush door shutters namely, core, core frame, lipping, cross-bands, face veneers, plywood etc. and for bonding plywood shall conform to BWP type, phenol formaldehyde synthetic resin adhesive conforming to IS848.

1.17.9 Tests

Samples of flush door shutters shall be subjected to the following tests:

(a) End Immersion Test
(b) Knife Test
(c) Glue Adhesion Test

One end of each sample shutter shall be tested for End Immersion Test. Two specimensof 150 x 150 mm size shall be cut from the two corners at the other

end of each sample shutter for carrying out Glue Adhesion Test. Knife Test shall be done on the remaining portion of each sample shutter.

1.17.10 Sample Size

Shutters of decorative and non-decorative type from each manufacturer, irrespective oftheir thickness, shall be grouped separately and each group shall constitute a lot. The number of shutters (sample size) to be selected at random from each lot for testing shallbeas specified in below Table. If the total number of shutters of each type in a work (and not the lot) is less than twenty five, testing may be done at the discretion of the shutter provided the sample does not fail in any of the test specified.

For knife test, glue adhesive test, slamming test, the end immersion test, the number of shutters shall be as per col. 4 of belowTable.

TABLESample SizeandCriteriaforConformity

Lot Size	SampleSize	Permissibleno.of defective	Sub.Sample size
[1]	**[2]**	**[3]**	**[4]**
Upto 26to50	8	0	1
51-100	13	1	2
101-150	20	1	2
151-300	32	1	3
301 -500	50	2	4
501 andabove	80	2	5

1.17.11 Criteria for Conformity

All the sample shutters when tested shall satisfy the requirements of the tests laid downas specified. The lot shall be declared as conforming to the requirements when numbers of defective sample does not exceed the permissible number given in col. 3 of table above. If the number of sample shutters found unsatisfactory for a test IS one, twice thenumber of samples initially tested shall be selected and tested for the test. All sampleshutters so tested shall satisfy the requirement of thetest. If the number of samples found unsatisfactory for a test is two or more, the entire lot shall be considered unsatisfactory.

1.17.12 Fixing

As per CPWD Specifications.

1.17.13 Shelves

Shelves and vertical partitions of cupboards shall be of timber planks fiberboard, particle board, block board or veneered particle board as specified. Thickness and typeof planks or boards shall be as specified. Each shelf shall be a single piece and vertical partitions between two consecutive shelves shall be without any joint. Exposed edges of boards having particle board core shall be sealed with 3mm thick single piece teak wood strips of width equal to the thickness of

board with headless pins. The arrangement of shelves and vertical partitions shall be as per drawings or as directed by the Engineer-in-Charge.

1.17.14 Fixing

Planks for shelves shall be planned on all faces and edges. In case of boards they shall be sawn to the required size truly straight and square. Timber battens 25 x 40 mm unless otherwise specified shall be planed smooth and fixed inside the cupboard with wooden

Plugs and screws. Shelves shall be fixed to the battens and vertical portions shall be heldin position by fixing them to the battens and shelves using screws. Teakwood strips for edge sealing of the boards shall be planed smooth and fixed with headless nails. Tolerance in width shall be±1.5 mmand in thickness1 mm.

1.17.15 Hold Fasts

These shall be made from mild steel flat 40 * 5 mm size conforming to IS 7196 withoutany burns or dents. 5 cm length of M.S. flat at one end shall be bent at right angle andone hole 11 mm dia shall be made in it for fixing to wooden frame with 10 mm dia nut bolt. The bolt head shall be sunk into the wooden frame, 10 mm deep and plugged withwooden plug. At the other end 10 cm length of the hold fast flat shall be forked and bentof length as specified at right angle in opposite direction and embedded in cement concrete block of size 30 x 10 x 15 cm of mix 1:3:6 (1 cement: 3 coarse sand : 6 gradedstoneaggregate, 20 mmnominal size)or as specified.

1.17.16 Fittings

Fitting shall be of mild steel brass, aluminium or as specified. Some mild steel fittings may have components of cast iron. These shall be well made, reasonably smooth, and free from sharp edges and corners, flaws and other defects. Screw holes shall be countersunk to suit the head of specified wood screws. These shall be of the following types according to the material used.

(d) **Mild Steel Fittings:** These shall be bright finish black stone enameled or copper oxidized (black finish), nickel chromium plated or as specified.

(e) **Aluminium Fittings:** These shall be anodized to natural matt finish ordered anodic coating not less than grade AC10 of IS1868.

(f) **Stainless Steel Fittings:** These shall be of SS grade 316.

The fittings generally used for different type of doors and windows are indicative and shall be used as specified. The fittings to be actually provided in a particular work shall, however, be decided by the Engineer-ln-Charge.

Screws used for fittings shall be of the same metal, and finish as the fittings.However, chromium plated brass screws or stainless steel screws shall be used for fixing aluminium fittings.

Fittings shall be fixed in proper position as shown in the drawings or as

directedby the Engineer-in-Charge. These shall be truly vertical or horizontal as the casemay be. Screws shall be driven home with screw driver and not hammered in.Recesses shall be cut to the exact size and depth for the counter sunking of hinges.

1.17.16.1 Butt Hinges

Theseshallbeofthefollowingtypes accordingto thematerial used.

a) Mildsteel butt hinges (Medium).
b) Cast brass butt hinges light/ordinary or heavy.
c) Extruded aluminium alloy butt hinges.
d) StainlesssteelGrade316

1.17.16.2 Mild Steel (Medium): These shall be medium type manufactured from M.S. sheet.

These shall be well made and shall be free from flaws and defects of all kinds. All hinges shall be cut clean and square and all sharp edges and corners shall be removed. These shall generally conform to IS 1341.

1.17.16.3 Hinge Pin: Hinge pin shall be made of mild steel wire. It shall fit inside the knuckles firmly and riveted head shall be well formed so as not to allow any play or shake, and shall allow easy movement of the hinge, but shall not cause looseness.

1.17.16.4 Knuckles: The number of knuckles in the hinges of different size shall be as per IS1341. The size of knuckles shall be straight and at right angle to the flap. The movement of the hinges shall be free and easy and working shall not have any play or shake.

1.17.16.5 Screw Holes: The screw holes shall be clean and countersunk. These shall be suitable for countersunk head wood screws and of the specified size for different types, and sizes of hinges. The size of the holes shall be such that when it is counter sunk it shall be able to accommodate the full depth of countersunk head of the wood screws. The nos. of screw holes shall as specified in IS1341.

1.17.16.6 Sampling and Criteria for Conformity. The number of butt hinges to be selected from a lot shall be depend on size of lot and shall be in accordance with Table below. Butt hinges for testing shall be selected at random from atleast 10 percent of the randomly selected packages subjected to minimum of three equal number of hinges being selected from each package. All butt hinges selected shall be checked for dimensions and tolerance requirements. Defects in manufacture and finish shall also be checked and lot shall be considered conforming to the requirement of thisspecifications, if the number of defective hinges among those tested does not exceed the corresponding number given in Table.

TABLEScaleofSamplingandCriteriaforConformity

Sl.No.	*Lot size*	*Sample Size*	*Permissible No. ofDefectivehinges*
1.	Upto15050	5	0
2.	151 to 30020 1	20	1

3.	301 to 50032 2	32	2
4.	501 to 1000503	50	3
5.	1001 andabove 80 5	80	5

Spring Hinges (Single or double acting)

These shall be of SS/mild steel, cast brass, aluminium or as specified, and shall be capable of smooth sliding action.

1.17.16.7 **M.S. Sliding Door Bolts;** The se shall be made of M.S. sheets and M.S. rod sand shallgenerally conform to IS 281. M.S. sliding door bolts shall be copper oxidized (blackfinish) oras specified.

1.17.16.8 **Aluminium Sliding Door Bolts;** These shall be made of aluminium alloy and shall generally conform to IS 2681. Aluminium sliding door bolts shall be anodized. Allscrew holes shall be counter sunk to suit the counter sunk head of screws of specifiedsizes. All edges and corners shall be finished smooth. In case of single leaf door, wheniron socket plate or a brass or aluminium fixing bolts (or sliding door bolt) cannot befixed, hole of suitable size shall be drilled in the door frame and an iron or brass platecut toshape shall be fixed at the face ofthe hole. The leading dimensions of the sliding door bolts are illustrated.

1.17.16.9 **Sampling and Criteria for Conformity;** The number of sliding door bolt to be selected from a lot shall depend on the size of lot and shall be in accordance with Table given below. For testing shall be taken at random from at least 10 percent of the package subject to a minimum of three, equal number of door bolts being selected from each package. All door bolts selected from the lot shall be checked for dimensional and tolerance requirements. Defects in manufacture and finish shall also be checked. A lot shall be considered conforming to the requirement of this specification if the number of defects sliding door bolts among those tested does not exceed the corresponding number given in Table below.

TABLE

Lot. size	*Sample Size*	*Permissible speed Decorativeslidingdoor bolts*
Upto 150	5	0
151 to 300	20	1
301 to 500	32	2
501 to 1000	50	3
1001 and above	81	5

1.17.16.10 **Tower Bolts**

These shall generally conform to IS 204 (Part. I) & IS 204 (Part. II). Tower bolts shall be well made and shall be free from defects. The bolts shall be finished to the correct shape and shall have a smooth action. All tower bolts made with sheet of 1.2 mm thickness and above shall have counter sunk screw holes to suit counter sunk head of wood screws. All sharp edges and corners shall be removed and finished smooth.

The height of knob of tower bolt when the door, window etc. is in closed position from the floor level shall be not more than 1.9 meter.

Tower bolts shall be of the following types:

a) Aluminium barrel tower bolts with barrel and bolt of extruded sections of powder coated of approved shade aluminium alloy. The knob shall be properly screwed to the bolt and riveted at the back.

b) Mild steel barrel tower bolts with mild steel barrel and mild steel bolt, or Mild steel tower bolts with mild steel barrel and cast iron bolts.

c) Stainless steel barrel tower bolts with mild SS barrel and SS steel bolt, or Stainless steel tower bolts with SS barrel and SS bolts of specified grades.

The plates and straps after assembly shall be firmly riveted or spot welded. The rivet head shall be properly formed and the rivet back shall be flush with the plate. These shall be made in one piece.

Unless otherwise specified bolt shall have finish as given below:

(a) Mild steel tower bolts (Types1and2) Bolts bright finished or plated as specified and barrel and socket stove enameled black.

(b) Aluminium alloy tower bolts (type6) Bolt and barrel anodized.

The anodic film may be either transparent or dyed as specified. The quality of anodized finish shall not be less than grade AC-10 of IS1868.

Sampling and Criteria for Conformity; It shall be same as specified.

1.17.16.11 Indicating Bolt (Vacant/Engaged);

These shall be of **SS,** cast brass finished bright chromium plated, or oxidized or as specified. The shape and pattern shall be approved by the Engineer-ln-Charge.

1.17.16.12 Mortice Latch (with Locking Bolt)

These are generally used indoors of bathrooms, WC's and private rooms.

Mortice latch shall, in respect of shape, design and mechanism of the latch and its components parts, generally conform to IS 5930. The material used for the different component parts of the latch shall comply with Tables 1 and 2 of IS 5930, unless otherwise specified.

The size of the latch shall be denoted by the length of the body towards the face and shall be 65 mm, 75 mm or 100 mm as specified. The depth of the body shall not be more than 15 mm.

The latch shall be of size 1 0 x 1 8 mm of shape as shown in Fig. 1 of IS 5930. The locking bolt shall be of section not less than 8 x 25 mm for all size of locks. The mechanism of the latch bolt, its spring, striking plate etc. shall be as

described in IS5930. The handles provided shall conform to IS 4992.

1.17.16.13 Mortice Lock and Latch (Rebated)

These are slightly different from mortice lock described in 2.30.16.40 and are designed for use in double leaved doors. These should generally conform to IS6607.

1.17.16.14 Handles, Keys, Sampling, Criteria for Conformity and Test; These shall be same as specified.

1.17.16.15 Mortice Night Latch

This is a mortice lock having a single spring bolt with drawn from the outside by using the key and from inside by turning the knob and with an arrangement wherebythe lock can be prevented from being opened by its key from outside while the nightlatchis used frominside the room.

This should generally conform to IS 3847.

It shall be cast or sheet brass, cast or sheet aluminium alloy or Mild steel as specified and of best quality of approved make. These shall be bright finished or copper oxidized (black) finish as specified. Nominal size of the latch shall be denoted by the length of the face over the body in millimeters. These shall have not less than two levers. False (Dummy) levers shall not be allowed.

Keys: Each latch shall be provided with two keys which should work smoothly and without any appreciable friction in the lock.

1.17.16.16 Door Handles (Doors and Windows)

These should generally conform to IS 208. The door handles shall be well made and free from defects. These shall be finished correct to shape and dimensions. All edges and corners shall be removed and finished smooth so as to facilitate easy handling. Cast handle shall be free from casting defects. Where the grip portion of the handle is joined with the base piece by mechanical means, the arrangement shall be such that the assembled handle shall have adequate strength comparable to that of integrally cast type handles.

Door handles shall be of the following types according to the material used:

a) **Cast or Sheet Aluminium Alloy Handles;** These shall be of aluminium of specified size, and of shape and pattern as approved by the Engineer-in-Charge. The size of the handle shall be determined by the inside grip of thehandle. Door handles shall be of 100 mm size and window handles of 75 mmsize unless, otherwise specified. These shall be fixed with 25 mm long woodscrews of designation No. 6. Aluminium handles, shall be anodized and theanodic coating shall not be less than grade AC 15 - IS 1868 as specified. The finish can be bright natural, matt or satin or dyed as specified.

b) **Mild Steel Handles;** These shall be of mild steel sheet, pressed into ovalsection. The size of the handles will be determined by the inside grip of thehandle. Door handles shall be 10 mm size and window

handles of 75 mm size unless otherwise specified. These shall be fixed with 25mm long wood screws of designation No. 6., Iron handles shall be copper oxidized (black finish) or stove enameled black or as specified.

1.17.16.17 Floor Door Stopper

The floor door stopper shall conform to IS1823. This shall be made of cast brass of overall size as specified and shall have rubber cushion. The shape and pattern of stopper shall be approved by the Engineer-ln-Charge. It shall be of brass finished bright, chromium plated or oxidized or as specified.

The size of floor stopper shall be determined by the length of its plate. It shall be well made and shall have four countersunk holes for fixing the door stoppers to the floor by means of wood screws. The body for housing of the door stopper shall be cast inone piece and it shall be fixed to the cover plate by means of brass or mild steel screwsand cover plate shall be of casting or of sheet metal. The spring shall be fixed firmly tothe pin. Tongue which would be pressed while closing or opening of the door shall beconnected to the lower part by means of copper pin. On the extreme end a rubber pieceshall be attached to absorb shock. All parts of the door stopper shall be of goodworkmanship and finish, burrs and sharp edges removed. It shall be free from surfaceand casting defects. Aluminium stopper shall be anodized and anodic film shall not be less than grade AC-10 of IS1868.

1.17.16.18 Hanging Rubber Door Stopper

These shall be of cast brass, finished bright, chromium plated or as specified. Aluminium stopper shall be anodized and the anodic coating shall not be less than grade AC-10 of IS 1868. The size and pattern of the door stopper shall be approved by the Engineer-ln-Charge. The size shall be determined by its length.

1.17.16.19 Universal Hydraulic Door Closer (ExposedType)

These shall be made of cast iron/aluminium alloy/zinc alloy and of shape and pattern as approved by the Engineer-in-Charge. These shall generally conform to IS Specifications for door closers (Hydraulically regulated) IS 3564. The door closers may be polished or painted and finished with lacquer to desired colour. Aluminium alloy door closer shall be anodized and the anodic coating shall not be less than grade AC 15 of IS 1868. All dents, burrs and sharp edges shall be removed from various components and they shall be pickled, scrubbed and rinsed to remove grease, rust, scale or any other foreign elements. After pickling, all the M.S. parts shall be given phosphating treatment in accordance with IS 3618. The nominal size of door closers inrelation to the weight and the width of the door size to which it is intended to be fitted shall be given in Table-C below.

TABLE-C

TypeandDesignationofDoorClosers

Designationof closers	***Mass of thedoor (kg)***	***Width of thedoor(mm)***	**Remarks**
1.	Upto 35	Upto 700	For light doors such asdouble Leaved and toilet doors.
2.	36to60	701 to 850	Interior doors, such as of bedrooms, kitchen And store
3.	61 to 80	851to1000	Main doors in a building, such as entrance doors

Sampling and Criteria for Conformity; All the door closer of the same nominal size and shape and from the same batch of manufacture, in one consignment shall constitute a lot. The number of door closers to be taken at random from a lot shalldepend upon the size of the lot. The sample shall be tested for construction, finish, dimensions, interchangeability of parts and performance in accordance of Table below. Any door closer failing in any one or more of these characteristics shall be considered as defective. If in the first sample, the number of defective door closer isless than or equal to corresponding acceptance number, the lot shall be declared asconforming to the requirement of these characteristics. If the number of defective doorcloser is greater than or equal to the rejection number, the acceptance number but lessthan the rejection number, lot shall be deemed as not meeting with requirements of these characteristics. If the number of defectives is greater than the acceptance number, but less than the rejection number, a second sample of the size equivalent tothat of the first shall be taken to determine the conformity or otherwise of the lot. Thenumber of defective door closers found in the first and the second sample shall becombined and if the combined number of defective thus obtained is less than or equalto the corresponding acceptance number, the lot shall be declared as conforming to the requirements of these characteristics.

1.18 Aluminium & Glazing Works

1.18.1 Aluminium Sections

Aluminium sections used for fixed/openable windows, ventilators, partitions, framework & doors etc. as per finishing schedule shall be suitable for use to meet architecturaldesigns to relevant works and shall be subject to approval of the Engineer-In-Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AI SI 304.

The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of door and windows.

Aluminium glazed doors, windows etc. shall be of sizes, sections and details as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-In-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing doors, windows, ventilators and partition etc. for the approval of the Engineer-

In-Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in-Charge.

1.18.2 Powder Coating

1.38.2.1 **Material:** The powder used for powder coating shall be Epoxy/polyester powder of make approved by the Engineer-In-Charge. The contractor shall give detailed programmed for powder coating in advance, to facilitate the inspection by Engineer-In-Charge or his authorized representative.

1.38.2.2 **Pre-treatment;** Each aluminium alloy extrusion or performed section shall be thoroughly cleaned by alkaline or acidic solutions under the conditions specified by chemical conversion coating supplier and then rinsed. A chemical conversion coating shall be applied by treatment with a solution containing essentially chromate ions orchromate and phosphate ions as the active components as applicable. The amount of the conversion coating deposited depends on the type used by the conversion coating chemical supplier. The conversion coating shall be thoroughly rinsed either with the solution specified by the conversion coating chemical supplier or with de-mineralized water and then dried at the temperature for the time specified by the conversion coating chemical supplier. The contractor shall submit the detail specifications and application procedure or application of conversion coating for approval of Engineer-In-Charge. The metal surface after the conversion coating pretreatment and prior to the application of the coating shall be free from dust or powder deposits.

1.38.2.3 **Process:** The polyester powder shall be applied by electrostatic powder spray method. Before start of powder coating the contractor shall submit detail specification for application of polyester powder from manufacturer of the polyester powder for approval of Engineer-In-Charge. The powder coating shall be applied as per the specification approved by Engineer-In-Charge.

1.38.2.4 **Thickness:** The thickness of the finished polyester powder coating measured by micron meter shall not be less than 50 micron nor more than 120 micron at any point.

Performance Requirements for the Finish

(i) **Surface appearance:** The finish on significant surfaces shall show no scratches when illuminated and is examined at an oblique angle, no blisters, craters; pinholes or scratches shall be visible from a distance of about 1 m. There shall not be any visible variation in the colour of finished surfaces of different sections and between the colours of different surfaces of same section.

(ii) **Adhesion:** When a coated test piece is tested using a spacing of 2 mm between each of the six parallel cuts (the cut is made through the full depth of powder coatings of that metal surface is visible) and a piece of adhesive

tape, approximately 25 mm x 150 mm approved by the Engineer-ln-Charge is applied firmly to the cut area and then removed rapidly by pulling at right angles to the test area, no pieces of the finish other than debris from the cutting operation shall be removed from the surface of the finish.

Protection of Powder Coated / Anodizing Finish: It is mandatory that all aluminium members shall be wrapped with self-adhesive non-staining PVC tape, approved by Engineer-ln-Charge.

1.18.3 EPDM-Gaskets

The EPDM Gaskets shall be of size and profile as shown in drawings and as called for, to render the glazing, doors, windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer-ln-Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-ln-Charge. The EPDM gasket shall meet the requirements as given in Table below:

TABLE

Sl. No.	*Description*	*Standard Follow*	*Specification*
1	Tensile strength Kg. f/cm2	ASTM-D412	70Min.
2	Elongation at break%	ASTM-D412	250Min.
3	Modulus100% Kgf/cm2	ASTM-D412	22 Min.
4	Compression set% at Oo CC 22 Hrs.	ASTM-D395	50 Max.
5	Ozone resistance	ASTM-D1149	No visible cracks

1.18.4 Sealant

The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminium section and RCC/Stone masonry) shall be of make approved by the Engineer-ln-Charge.

1.18.5 Method of Application

Surface Preparation ; Clean all joints and glazing pockets by removing all foreign matter and contaminants such as grease, oil, dust, water, frost, surface dirt, old sealants or glazing compounds and protective coatings.

1.18.6 Masking

Areas adjacent to joints shall be masked to ensure neat sealant lines. Masking tape shall not be allowed to touch clean surfaces to which the silicone sealant is to adhere. Toolingshall be completed in one continuous stroke immediately after sealant application and beforeaskin formsand maskingshall beremoved immediatelyafter tooling.

1.18.7 Application

Install backer rod of appropriate size and apply silicone sealant in a continuous operation using a positive pressure adequate to properly fill and seal the joint. The silicone sealant shall be tooled with light pressure to spread the sealant against backing material and the joint surfaces before ask in forms.

A tool with convex profile shall be used to keep the sealant within the joint. Soap orwater shall not be used as a tooling aid. Remove masking tape as soon as silicone joint is tooled.

Tolerance: A tolerance of + 3 mm shall be allowed in the width of silicone joints. The depth of the joints at throat shall not be less than 6 mm.

1.18.8 Glazing

1.18.8.1 Packing

All doors, windows and ventilators shall be dispatched with the opening parts suitablysecured to preserve alignmentwhen fixing and glazing. Fixing lugs, coupling fittings and all hardware shall be dispatched separately. Composite windows shall be dispatched uncoupled.

1.18.8.2 Marking

All doors, windows and ventilators shall be suitably marked on the frames with a mark identifying the manufacturer and the type. The units may also be marked with the BIS Certification Mark.

1.19 Finish Hardware

1.19.1 Work Included

A. Provide material, labour, equipment, services, and perform operations in connection with the furnishing and delivering of Finish Hardware and related work as indicated on the drawings, and specified herein.

B. The work shall include, but not be limited to, the following:

1. Furnish finish hardware in accordance with the drawings, and as specified herein.

2. Keying requirements shall be as per owner. Furnishing key schedule.

3. Templates to the various trades for accurate setting and fitting.

4. Screws, bolts, expansion shields and other devices necessary for the proper application of the hardware.

5. Cabinet to hold finish hardware keys, as specified herein.

6. Construction master key.

C. Related Work Specified Else where

1. All wooden flush/Hollow Metal Doors and Frames

1.19.2 Quality Assurance

A. Code and Regulations

1. Except as otherwise indicated on the drawings or specified herein, work under this section shall conform to the applicable requirements of the local Building Code and regulations of governmental authorities having jurisdiction.

2. Where requirements indicated on the drawings or specified herein differ from the Building Code or the requirements of the governmental authorities having jurisdiction, the more stringent requirements shall govern.

B. Provide mock-up of whole doors with proper hardware installed.

1.19.3 Submittals

A. Product Data:

Submit to the Owner's Representative for approval manufacturer's catalog cuts on items specified herein and obtain approval prior to delivery.

B. Samples

1. Prior to submittal of the final hardware schedule and prior to the final ordering of materials, submit one sample of each type of hardware unit, finish as required for project, and tagged with full description for coordination with schedule.
2. Samples will be returned upon there quest and at the expense of the Contractor.
3. Additional samples of each type of door hardware requiring machining of doors shall be delivered to the door manufacturers. Samples will be returned at completion of factory machining.

C. Schedule

1. Hardware: Immediately after the award of the contract, the Contractor shall prepare, and submit for approval hardware schedule listing showingrequirementsofeach door.
2. Keying: Immediately after the approval of the Hardware Schedule, the Contractor shall prepare and submit for approval, complete keying schedule. Co-ordinate with Owner's representative.
3. Approval of hardware schedule shall not relieve the Contractor of necessity of furnishing finish hardware designated to be furnished under this contract.

D. Templates: Furnish hardware templates to each fabricator of doors and frames forhardware required in order to make proper provisions for accurate setting and fitting of such hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

1.19.4 Delivery, Storage and Handling

A. Deliver hardware in manufacturer's original packages. Hardware shall have the required screws, bolts and fastenings necessary for its installation packed in the same package with the hardware, including instructions. Each package shall be legibly marked and adequately labelled, indicating the part of the work for which it is intended. Each marking shall correspond to the number shown on the approved Hardware Schedule, including door number.

B. Wrapping furnished by the manufacturer on knobs, handles, push plates and pulls shall be of adhesive coated paper, of a type easily removed without marring the finish of the hardware.

C. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.

D. Provide secure lockup for hardware delivered to the project, but not yet installed.Control handling and installation of hardware items which are not immediately replaceable, so that completion of the work will not be delayed by hardware losses, both before and after installation.

1.20 ParticularSpecifications

General

Refer drawings and schedules: Work shall be carried out with specifications in this document with project specific requirement and most stringent requirements shall be followed in case of discrepancy between documents such as specification, Scope of work, DPR, drawings. The minimum standards required to be achieved are defined here in this document.

Specifications as Ready Reference with details covered in technical specifications

S.No.	Description	Specifications

1.	**Door & Window Frames, Flush Shutters and Hardware Fittings**	
(i)	Door frames/ shutters/ /Fittings	Refer to Doors and windows schedule of individual buildings and particular specifications.
2.	**Water Proofing**	
(i)	Terrace of Top floor	EPDM membrane + Polyurethane insulation (PUF) + Geotextile membrane + Slope in concrete + Heat Resistant tiles
(ii)	Sunken Area	Liquid water proofing polymeric coating.
(iii)	Over deck (for grassing and plantation) on Top and underground structures	Cold applied polyurethane elastomer (PU) water proof membrane with slope in concrete, filter and drain board. Underground structures with pre-construction chemical injection with subsequent coatings as per specification.
3.	**Railing**	
(i)	Railing Ramps	As per particular specifications (Factory Made Modular Type)
4.	**Miscellaneous**	
(i)	Plinth Protection	50mm CCM-15 grade over 75mm bed of CC M-10 grade
5.	**Park Roads, Open Parking & Paths**	

(i)	KerbStone	High grade concrete precast block. M-35Grade

s. No.	**Description**	**Specifications**
(ii)	Inter-locking pavers	Heavy duty pavers, shape & pattern in cement colour (red, green, grey, yellow etc.) M-60 Grade Preferably made of recycled material
(v)	Pedestrian foot path	Stones/chequered CC tile / pavers or concrete in color & pattern preferably made of recycled material as shown on drawings/schedules. Or Loose Gravels

	(i)Stone Masonry Walls	External walls shall be provided with local stone masonry in thicknesses as shown on drawings. The mortar to be used should be good quality and in the specified faces. The construction work of stone masonry should be raised uniformly. The plumb bob should be used to check the verticality of erected wall. The stone masonry section should always be designed to take compression and not the tensile stresses. The masonry work should be properly cured after the completion of work, for a period of 2 to 3 weeks. Scaffolding should be used for working at higher level. The masonry hearting should be properly packed with mortar and chips if necessary to avoid hallows. The properly wetted stones should be used to avoid mortar moisture being sucked. **Laying:**Ensure that the headers in the heart of the wall are the same size as in the face and extend at least 12 in (300 mm) into the core or backing. (Avoid Dumb-bell shaped stones). The headers shall occupy at least 20 percent of the face of the wall. Lay the masonry in roughly leveled courses. Ensure that the bottom of the foundation is large, with selected stones. Lay the courses with leaning beds parallel to the natural bed of the material. Regularly diminish the thicknesses of the courses, if varied, from the bottom to the top of the wall. Keep a surplus supply of stones at the site to select from. Before laying the stone in the wall, shape and dress it so that it will not loosen after it is placed. Clean each stone and saturate it with water before setting it. Clean and moisten the bed that will receive it. Bed the stones in freshly made mortar with full joints. Carefully settle the stones in place before the mortar sets. Ensure that the joints and beds have an average thickness of not more than 1 inch. (25 mm). Ensure that the vertical joints in each course break with the adjoining courses at least 6 in. (150 mm). Do not place vertical joints directly above or below. If a stone is moved or if the joint is broken after the mortar has set, take the stone up and thoroughly clean the mortar from the bed and joints. Reset the stone in fresh mortar. Whenever possible, properly point the face joints before the mortar sets. If

		joints cannot be pointed, rake them out to a depth of 1 in (25 mm) before the mortar sets. Thoroughly wet the joints pointed after the stone is laid with clean water and fill with mortar. Drive the mortar into the joints and finish with an approved pointing tool. Keep the wall wet while pointing. In hot or dry weather, protect the pointed masonry from the sun and keep it wet for at least three days after the pointing is finished.

LIST OF PREFERRED MAKES

CIVIL & ARCHITECTURE

Sr. No.	Description	Vendor
1	Fastener	Hilti/Fischner, Approved Local Brand & Equivalent
2	Ceramic tiles	Nitco, RAK, Johnson, Kajaria, Somany
3	Paver Block	Endura, Spectra, Approved localbrand
4	Rolling shutters	Shakti Hormann, Gandhi Automations, Jayesh Automation, Approved localbrand
5	Aluminium Sections	Hindalco,Jindal,SSAIL (SatyaSurya)
6	Paints distemper/acrylic emulsion	Berger paints, Asian paint, Nerolac, Dulux(Acczonoble)
7	Waterproofing cement paint	Bergerpaints, Asianpaint, Nerolac
8	Enamel Painting for Wood	Asian/ Berger/ Dulux
9	Synthetic enamel paint for steel	Berger/ Asianpaint/ Dulux
10	Glass/FloatGlass /Toughened	Saint Gobain/AIS/Pilkington
11	All Hardware And Fittings	Assa Abloy/ Dorma/ Hafele/ Geze Approved local brand
12	Patch fittings / friction fittings, Doorcloser	Assa Abloy /Dorma, Hafele, Geze, Hettich
13	Aluminium Door Frames	Jindal, Hindalco
14	DoorLock&Handle	Dorma, Geze, Haffele, Hettiche
15	SealingCompounds	FOSROC/Apoorva/STP
16	MSPipe	M/S Steel authority of India(Sail)/M/STataSteel/Jindal
17	Marineply/ Plywood	Century, Greenply, Kitply, Greenlam, & Equivalent
18	Flushdoors	Century, Greenply, Kitply, Greenlam, & Equivalent

Development of facilities at Eco-Park, Jharkhand

Sr. No.	Description	Vendor
19	Stainlesssteelrailingsystem	Dorma /Q Railing / M/S Techno rail, Approved Local Brand & Equivalent
20	WaterProofingCompound	Fosroc/ Laticrete/BASF/Cipy/Sika/Dr. Fixit
21	Cement	Dalmia/Ultratech/ A.C.C/Ambuja/J K Laxmi
22	Bitumen	Indianoil/Hindustanpetroleum/BPCL
23	ReinforcementSteel	SAIL/TATA/Jindal
24	StructuralSteel	Tata steel/ Sail/ Jindal
25	Stainlesssteel	SS-304 grade from Salem steel plant, SAIL, Jindal steel
26	Chickenmesh	Arpitha Export, Approved Local Brand & Equivalent

TECHNICAL SPECIFICATION

OF

CIVIL WORK

Contents

1.0 BRIEFSCOPEOFCIVILWORK

1.1 GENERAL

Scope of Civil Work includes but not limited to Planning, Designing, Fabrication, Supply, Erection, Testing, Estimating, supervising construction, managing construction and as per detailed scope of work for few structuresas broadly listed below and as shown in all drawings with this proposal -

- Buildings
  - Bhakta Niwas building
  - Cafeteria building.
  - Ticketing Booth Building
  - Shopping Complex Building
  - Anna-Kshetra Building
  - Committee Office Building
  - Prasadalaya Building
  - Public Restroom (07 Nos.)
  - Arched Gateway Security Cabin (02 Nos.)

- FoundationsandSub-structures
  - Raft/FootingFoundation
  - Brickworkfoundation

- ParkGates&Boundarywalletc.
- Hard-Scapework,
  - Parkingspaces.
  - pathways

2.0 STRUCTURALDESIGN

2.1 GENERAL

The design shall aim to achieve an acceptable probability that structures being designed will perform satisfactorily during the irintended life. Design of all the structures and elements are to be set mainly taking into consideration of the following-

- Purpose of the structure
- Constructability
- Structuralstability
- Structuralsafety
- Geohydrological condition of site
- Cost-effective structure
- Reduction in Maintenance Cost

2.2 CODES STANDARDS AND SPECIFICATIONS

The design shall comply with the latest editions and revisions of the codes, specifications, and standards listed below:

Table2-1List of Codes&Standards

	ISCodeNo.		Subject
A	**DESIGNLOADS**		
□	IS:875-Part-1-(1987)	:	Code of practice for design loads for buildings & structures - Deadloads
□	IS:875-Part-2-(1987)	:	Code of practice for design loads for buildings & structures -Imposed loads
□	IS:875-Part-3-(2015)	:	Code of practice for design loads for buildings & structures -Wind loads
□	IS:1893-Part-1-(2016)	:	Criteria for earthquake resistant design of structures –General Provisions & buildings
□	IS:1893-Part-2-(2014)	:	Criteria for earthquake resistant design of structures - Liquidretaining structures
□	IS:1893-Part-3-(2014)	:	Criteria for earthquake resistant design of structures – Bridges and Retaining walls
□	IS:4326-(2013)	:	Code of practice for earthquake resistant design and Construction of buildings.
B	**PLAIN&REINFORCEDCEMENTCONCRETE WORK**		
□	IS:456-(2000)-Reaffirmed2021	:	Code of practice for plain and reinforced concrete.
□	IS:3370-Part-1-(2021)-	:	Code of practice for concrete structures for storage of liquids-General Requirements
□	IS:3370-Part-2-(2021)	:	Code of practice for concrete structures for storage of liquids –Reinforced Concrete Structures

	ISCodeNo.		Subject
□	IS:3370-Part-4-(2021)-Allsections	:	Design Tables
□	IS:13920-(2016)	:	Code of practice for ductile detailing of reinforced concrete Structures subjected to seismic forces
□	IS:4926-(2003)-Reaffirmed2017	:	Ready- MixedConcrete
□	IS:1343-(2012)	:	Pre-stressed Concrete-Code of Practice
C	**STRUCTURALSTEEL WORK**		
□	IS:800-(2007)-Reaffirmed2017	:	Code of practice for use of structural steel in general insteel construction
□	IS:2062-(2011)-Reaffirmed2016	:	Steel for general structural purpose
□	IS:806-(1968)-Reaffirmed2017	:	Code of practice for use of steel Tubes in general building construction
D	**FOUNDATIONDESIGN**		
□	IS:1080-(1985)-Reaffirmed2016	:	Code of practice for design & construction of shallow foundations in soil
□	IS:1904-(1986)-Reaffirmed2020	:	Structural safety of buildings, shallow foundation
□	IS:2950-Part-1-(1981)-Reaffirmed2018	:	Code of practice for design & construction of raft Foundations
□	IS:6403-(1981)-Reaffirmed2016	:	Code of Practice for determination of bearing capacity of shallow foundations
□	IS:2911-Part-1(Sec-II)-(2010)-Reaffirmed2020	:	Bored Castin-Situ Piles.
L	**INDIANROADCONGRESSCODES**		
□	IRC:6-Sec-II (2016)	:	Road Bridges. Loads and Load combination
□	IRC:78-(2014)	:	Foundations & Substructure

2.3 MATERIAL

The proposed structure will consist of concrete, steel reinforcement, natural stonefacia stones and structural steel as the three main materials used for construction ofthe structure.

2.2.1 Concrete

Reinforced concrete conforming to Table 2; IS 456 shall be used with 20mm anddown size graded crushed stone aggregate unless noted otherwise. The proposedminimumgradecementconcreteis asper**Table2-2**.

Table2-2MinimumGradeofConcrete

StructuralElement	Gradeofconcrete	MinimumCement contentkg/m³
For Buildings		
Beams andSlabs,RCCsteps	M30	350
Columns and Shear walls	M30	350
Footings& Raft	M30	350

2.2.2 ReinforcingSteel

The grade of steel to be used as reinforcement in the structural concrete membersTMT bars of grade Fe 500Dconforming to IS -1786 and Mild Steel bars conformingto IS:432(GradeI)

2.2.3 Aggregates

Selected aggregates of proper sizes shall conform to IS:383.

2.2.4 Structural Steel

Material for steel structure shall be in accordance with the Indian Standards IS:2062. Profiles and dimensional properties of structural steel sections complying withIS: 808/ IS 12778 shall be used. Besides, universal sections etc. manufactured byM/sJindal Steel or equivalent canals obeused.

(a) Hotrolled sections–E250 QualityBR, IS:2062

(b) Coldformedlightgaugesections conformingtoIS811.

(c) Steel Tubes- Steel Tubes for structural purposes, including handrail shall be medium duty unless noted otherwise& shallconformtoIS:1161

(d) Pipe Sleeves & Pipe Handrail - Pipe Sleeves & Pipe Handrail shall be SS.Tubes (Medium Duty) (Grade 304)asperIS:1239 (Part-1)

(e) Chequered Plate-Steel chequered plate shall conform toIS:3502.

(f) Grating –Steel used for Grating shall conform to IS:2062 Grade E250A.

(g) Connection Bolts- Connection bolts shall conform to following –

- High Strength Bolts (Property Class 8.8) shall conform to IS:3757,IS:4000& IS:6649
- High strength nuts shall conform to IS:6649
- Hexagonal head bolts, screws & nuts of product Grade-B shall conform to IS:1364
- Ordinary Strength Bolts (Grade4.6) shall conform to IS:1367.

(h) Anchor Bolts

- Anchor bolts shall be mild steel bars, Grade I conforming to IS432.
- All bolts ≥ 20mm dia. shall be of grade C conforming to IS 1367 & IS3757Propertyclass 8.8.
- All bolts ≤ 16mm dia. shall be of grade S conforming to IS 1367 & IS3757,Propertyclass4.6.
- All nuts & washers for class 8.8 bolts shall conform to IS 6623 & IS6649 Respectively. All nuts & washers for class 4.6 bolts shall conformtoIS 1363& IS6610respectively.
- Requirement of rebar around anchor bolt shall be checked and ifrequired will be provided around anchor bolts subjected to higher pullout loads.
- Anchor bolts for structural steel column shall be embedded into thepedestal. Minimum diameterofanchorboltshallbe16mm.
- Insert Plates -Insert plates shall be of structural steel quality of grade Aconforming to IS: 2062-2006 and shall be provided with mild steel lugsas per standard drawings / design standards. Mild steel bars shallconformtoIS:432Grade-1.

2.4 DESIGN LOADS

The various structures/ buildings for this project shall be designed for the followingloadsandeffects duetoshrinkage,creep,temperature, etc.,whereapplicable.

Contractor must submit Design Basis report for all individual structures for approvaland no design calculation or good for construction drawing shall be accepted forapproval before the Design Basis is approved. The load combinations for all the structures shall be clearly mentioned in the design basis report.

(a) DeadLoad(D.L.)

The DL is calculated based on unit weights of materials given in IS: 875(Part1).

(b) LiveLoad(L.L.)

All the live loads shall be as per IS: 875 (Part 2), IRC: 6- 2017and other relevant codes wherever applicable.

(c) WindLoad(WL)

All buildings and structures shall be designed to withstand the forces of windpressure, assumed in any horizontal direction, in accordance with the appropriate provisions of IS: 875 (Part 3)-2015. The effect of wind load for the generation of wave shall also be considered for calculation of wave pressure on the structures. Mean probable design life of structure shall be considered as 50 years.

Table2-3WindLoadParameter

Item	Value
BasicWindspeedforGuwahati	V_b=50m/sec
DesignWindSpeedatanyheight:	$V_z=K_1K_2K_3K_4V_b$m/sec
Where;	K_1=Probabilityfactor
	K_2 = Terrain height & structure sizefactor
	K_3=Topographyfactor
	k_4 = Importance factor for thecyclonicregions
WindpressureatheightZ	$P_z=0.6xV_z^2$
DesignwindpressureatheightZ	$P_d=k_dxk_axk_cxP_z$
Where;	K_d=WindDirectionalityFactor
	K_a=Areaaveragingfactor
	K_c = Combinationfactor
WindLoad	$WL=C_fxP_zxA_e$

Based on the above wind pressure and exposure of the building, further load calculations will be carried out with respect to profile of building as per IS: 875 (Part3).

(d) SeismicLoad(SL)

All buildings, structures, foundations shall be designed to resist the effects of earthquakes in accordance with IS: 1893-2016 - Criteria for Earthquake Resistant Design of Structures for Design Basis Earthquake (DBE). The structure is primarily deck slab with column and beam framing system and since due considerations willbegiven tothe major suggestions/clausesfromIS:13920.

Seismic design forces shall be determined based upon the following parameters. Buildings or structures of different materials of construction and lateral force resisting systems shall be investigated separately.

Table2-4SeismicParameter

Item	Value
SeismicZone	Zone – V
ZoneFactor(z)	0.36
ImportanceFactor(I)	As applicable for the structure type
ResponseReductionFactor(R)	5for allstructures
FundamentalNaturalPeriod(Ta)	As per structural framing and Arrangement
Average Response AccelerationCoefficient(Sa/g):	S_a/g forsoftsoils
DampingCoefficient	0.05
The design horizontal seismiccoefficient(Ah)	$\frac{Z \quad I \quad S}{2 \quad R \quad g}$
DesignSeismicBaseshear	$V_B=A_hW$

Contribution of permanent dead loads and live loads and calculation nodal masses shall be as perIS:1893(Part1).Response spectrum analysis method shall be used for analysis of regular structures.

(e) ImpactLoads

All structural framing and concrete foundations subject to vibration, impact, impulse,shock, etc., shall be designed to withstand the generated forces within the limits ofacceptable stress, deflection, and/or amplitude of vibration. Boat impact load of100kNatanyonepointshallbe consideredonthe boulevardpiers.

(f) WheelLoad

For any structure or pipeline below roads, IRC Class of loading for which the road has been designed will be considered.Load of fire tender (45T) will be considered on the designated route of fire tender over the boulevard slab, if any. Appropriate surcharge due to fire tender load will be considered for retaining wall design, wherever applicable.

(g) SurchargeLoad

Minimum surcharge of 10KN/m^2 shall be considered for design of all undergroundstructures to take in to account the construction load and vehicular traffic nearstructure. Fire tender load will be added at applicable locations. The soil parameters and ground water table will be considered as per soil investigation report.

(h) EarthPressure

Earth pressure for walls of covered tanks etc. with propped support condition will be calculated using coefficient of earth pressure at-rest. Earth pressure for cantilever walls like cable trenches will be calculated based on activeearth pressure. Unit weight of soil, soil parameters such as cohesion and angle of internal friction shall be considered as per soil investigation report. All the walls shall be analyzed and designed for both submerged and dry earth pressure condition.

(i) Water Pressure:

The ground water table shall be considered at ground level and water load shall beapplied on the substructure as super imposed dead load in addition to the earthpressure. The dry density of soil shall be considered in this combination pressure isthe horizontal pressure ofthe water acting on the structure. Pressure on wall shallbe calculated for both dry and submerged conditions and maximum of both resultsshallbe takenfordesign.

(j) Upliftpressure:

Ground water table shall be considered at ground level. Uplift pressure due to ground water on foundation is calculated as specified in IS 875-Part-5.

(k) Dragforce

The Drag force on river front structures, due to flowing river water shall be calculated as per standard Indian code or internationally accepted standard literatures. The velocity shall be consideredas4m/s for calculating drag force.

2.4.1 PermissibleStresses

- Whenever seismic/wind forces are considered along with other normal design forces, the permissible stresses in material shall be governed by the respective codes as per which the structure/equipment is being designed.
- For the other provisions of the codeCl.No.6.3 of IS:1893(part-1) andCl.No. 7.4ofIS:1893(Part-4)shall be followed.

Earthquake loads shall not be considered to acts imultaneously with wind.

2.5 DESIGN AND CONSTRUCTION OF RCC BUILDING, BOULEVARD & STEPS FOR GHATS

The design of all elements of structures will be such that all individual membershave enough ultimate strength and fulfill serviceability condition of deflection andcrack widths as per accepted engineering practice.All designs will follow standard codes, references and good engineering practice to keep the maintenance requirements to a minimum.

AllBuilding structures,Boulevardsshallbedesignedforthefollowingconditions:

- Limit state method of design as per IS: 456 shall be adopted for design offoundationandRCCsuperstructure.
- The limit state of serviceability and collapse shall be as per IS: 456 duringnormaloperationsandtest-loadconditions.
- Unless otherwise specified in the drawings and in this specification minimumand maximum area of reinforcement shall be in accordance with IS: 456, IS:1983,IS:13920 andNationalBuildingCode ofIndia.
- Structures shall also be checked against maximum stresses developed (inreinforcement and concrete) due to any combination of loads and stressdevelopedshall belessthanthatspecifiedin IS:456 forthespecifiedclimaticandloading conditions
- All members of structure shall be designed for the worst combination offorcessuchasbendingmoment, axialforce,shearforce,torsionetc
- Framing systems shall be arranged so that the stiffness of structure can bewellbalanced,andthestructuralstabilitycanbesecured.
- Expansionjointsforthestructuresshallbeprovidedatevery45mdistanceinthe longitudinaldirection.
- The foundation design criteria such as type of foundation, foundation depth,allowablesoilbearingcapacities,foundationsettlementshallbeinaccordan cewithIndiancodesforfoundationandthespecificationmentionedinthis document.
- The whole structural arrangement/Concept shall be submitted and get approved from the Engineer-In-Charge before doing detailed structural analysis and design.
- The structural system adopted for the buildings shall be concrete/structuralsteel (As per the tender Drawings) framed conventional beam slab and column structures.

2.6 DESIGNCONDITIONSFORRCCEARTHRETAININGWALL

All underground or partly underground liquid containing structures shall be designed for thefollowingconditions:

- Partition wall between two compartments: to be designed as one compartment empty and other full.
- Structures shall be designed for up lift in empty conditions with the water table as indicated in geo technical report.
- Walls shall be designed under operating conditions to resist earthquake forces from earth pressure mobilization and dynamic water loads;
- Under ground or partially underground structures shall also be checked against stresses developed due to any combination of full and empty compartments with appropriate ground/uplift pressures from below to bases lab. A minimum factor of 1.2 shall been sured against up lift or floatation.
- For general retaining walls and large sized tanks where the walls are designed as retaining walls, sliding check shall also be performed along withover turning checks.
- All RCC liquid retaining structural walls shall be checked for the allowable stresses in direct tension and combined bending& tension.
- All the liquid retaining structures shall be designed for maximum design crack widths of 0.2mm for direct tension and flexure.
- All the structures wherever applicable shall be checked for overturning. Minimum factor of safety of 1.4 against overturning shall be considered. Overturning shall be checked for empty condition with 90% of deadload.
- All the structures wherever applicable shall be checked for sliding. Minimumfactor of safety of 1.4 against sliding shall be considered. Sliding shall becheckedfor emptycondition with 90% ofdeadload.
-

2.7 DESIGNANDCONSTRUCTIONOFFOUNDATION

- The minimum depth of foundations for all structures, buildings and frame foundations and load bearing walls shall be as per IS: 1904 but in any case, this shall not be less than 1.5meter in the original soil.
- Parameters required for design of foundations of soil strata shall be taken as indicated in geo technical report.
- Care shall be taken to avoid the fouling with the foundations of adjacent buildings or structure foundations, either existing or not within the scope of this Contract. Suitable adjustments in depth, location and sizes shall have to be made depending on site conditions. No extra claims for such design adjustments shall be accepted by the Employer.

- Special attention is drawn to danger of uplift being caused by the groundwater table. All underground structural slabs shall be designed for uplift forces due to ground water pressure.
- EGL(Existing ground level)and FGL(Finished ground level)shall be marked on all drawings showing foundation/sub-structure details and related design documents. Machine/static equipment foundations shall be separated from adjoining parts of buildings, other foundations and floor/pavement slabs.
- Foundation shall be proportioned in such away that the allowable oil bearing capacity is not exceeded and the resulting settlement is within the acceptable limit in case of shallow foundation.
- Foundation sizes and depths shall be planned considering subsurface conditions and surrounding underground constructions such as adjacent foundations, underground pipes and cables, trenches, pits, roads as well asthe slope of ground.
- Isolated footing shall be planned for each foundation. However, where adjacent footings interfere with acho ther,combinedfootingmaybeprovided.
- Masonry walls shallbe supportedon continuousplain cement concretemats / plinth beams. Top of plinth beams shall be located at least 300 mm belowthefinishedgradelevel.

2.8 DESIGNANDCONSTRUCTIONOFSTRUCTURALSTEELBUILDINGS

a) Structures and structural elements shall be designed byLimit StateMethod.

b) Design, fabrication and erection requirements for design, material and fabrication including connections of steel framing for buildings, façade, steel structures, miscellaneous structural steelwork like stairs, hand railing etc. all structural steelwork shall be carried out in accordance with the following IS Codes as applicable to the specific structures, viz.IS:800,IS:814,IS:875,IS:1893, and Due consideration shall be given to the accepted theories, experience and modern design philosophy and practices.

c) Basic consideration of structural framework shall be primarily be stability, ease offabrication/ erection and overall economy satisfying relevant Indian Standard CodesofPractice andSpecifications.

d) Simple and fully rigid design as per IS:800 shall be used. Where fully rigid joints are adopted they will generally be confined to the major axis of the column member.

e) All fillet welds shall have a minimum 6 mm size for shop weld and 8mm for site weld unless noted otherwise and shall be checked for Magnetic Particle Testing (MPT).

3.0 EARTHWORKINEXCAVATION, GRADING,ANDBACKFILLING

3.1 SCOPE

This specification covers the general requirements of earthwork in excavation indifferent materials, site grading, filling in areas as shown in drawing, filling backaround foundations and in plinths, conveyance and disposal of surplus soils orstacking them properly as directed by the Engineer-In-Charge and all operations covered within the intent and purpose of this specification.

3.2 APPLICABLECODES

The following Indian Standard Codes, unless otherwise specified herein, shall be applicable. In all cases, the latest revision of the codes shall be referred to.

Table3-1List of Codes&Standards

	ISCodeNo.		Subject
□	IS783	-	Code of practice for laying of concrete pipes.
□	IS1200	-	Method of measurement of building and civil engineering works.
□	(Part 1)		Part 1 Earthwork
□	(Part27)		Part27 Earthwork done by mechanical appliances.
□	IS3764	-	Excavationwork-codeof safety.
□	IS2720	-	Methods of test for soils:
□	IS2720(Part1)	-	Part1 Preparation of dry soils amples for various tests.
□	IS2720(Part2)	-	Part2 Determination of water content.
□	IS2720(Part4)	-	Part 4 Grain size analysis.
□	IS2720(Part5)	-	Part5 Determination of liquid and plastic limit.
□	IS2720(Part7)	-	Part7 Determination of water content-dry density relation using light compaction.
□	IS2720(Part9)	-	Part 9 Determination of dry density - moisture content relation by constant weight of soil method.
□	IS2720(Part14)	-	Part 14 Determination of density index (relative density)of cohesionless soils.
□	IS2720(Part28)	-	Part 28 Determination of dry density of soils in place, bythe sand replacement method.
□	IS2720(Part33)	-	Part 33 Determination of the density in place by the ring and water replacement method.
□	IS2720(Part34)	-	Part 34 Determination of density of soil in place byrubberballoon method.
□	IS2720(Part38)	-	Part38 Compaction control test(HilfMethod).
□	IS4081: 2013		Blasting and related drilling operations – code of safety

3.3 DRAWINGS

The Engineer-In-Charge will furnish drawings wherever, in his opinion, such drawings are required to show areas to be excavated/ filled grade level, sequence of priorities etc. The CONTRACTOR shall follow strictly such drawings.

3.4 GENERAL

(a) The CONTRACTOR shall furnish all tools, plants, instruments, qualified supervisory personnel, labour, materials, any temporary works, consumables, anyand everything necessary, whether or not such items are specifically stated here in for completion of the job in accordance with the specification requirements.

(b) The CONTRACTOR shall carry out the survey of the site before excavationand set properly all lines and establish levels for various works such as earthworkin excavation for grading, foundations, plinth filling, roads, drains, cabletrenches, pipelines etc. Such survey shall be carried out by taking accurate crosssections of the area perpendicular to established reference/ grid lines at 5 m.intervals or nearer as determined by the Engineer-In-Charge based on groundprofile. These shall be checked by the Engineer-In-Charge and thereafter properlyrecorded.

(c) The rates quoted shall also include for dumping of excavated materials inregular heaps, bunds, riprap with regular slopes as directed by the Engineer-In-Charge, within the lead specified and levelling the same so as to provide natural drainage. Rock/soil excavated shall be stacked properly as directed by the Engineer-In-Charge. As a rule, all softer material shall be laid along the center ofheaps, the harder and more weather resisting materials forming the casing on the sides and the top. Rock shall be stacked separately.

3.5 CLEARING

The area to be excavated shall be cleared of fences, trees, plants, logs, stumps,bush, vegetation, rubbish, slush, etc. and other objectionable matter. If any roots or stumps of trees are met during excavation, they shall also be removed after getting approval from Engineer-in-Charge. The materials ore moved shall be burnt or disposed off as directed by the Engineer-In-Charge. Where earth fill is intended, thearea shall be stripped of all loose/ soft patches, top soil containing objectionable matter/materials before fill commences.

3.6 PRECIOUSOBJECTS,RELICS,OBJECTSOFANTIQUITY,ETC.

All gold, silver, oil, minerals, archaeological and other findings of importance, treescut or other materials of any description and all precious stones, coins, treasures,relics, antiquities and other similar things which may be found in or upon the siteshall be the property of the OWNER and the CONTRACTOR shall duly preserve the same to the satisfaction of the OWNER and from time to time deliver the same to such person or persons as the OWNER may from time to time authorize or appoint to receive the same.

3.7 CLASSIFICATION

All materials to be excavated shall be classified by the Engineer-In-Charge, into oneof the following classes and shall be paid for at the rate tendered for that particular class of material. No distinction shall be made whether the material is dry, moist orwet. The decision of the Engineer-In-Charge regarding the classification of the material shall be final and binding on the CONTRACTOR and not be a subjectmatter of any appeal or arbitration.Earthwork will be classified under any of the following categories:

a) OrdinaryandHardSoils:

These shall include all kinds ofsoils containingsand, silt,shingle, gravel, clay,loam, peat, ash, shale, etc., which can be easily excavated either manually ormechanically and which is not classified under "Soft and Decomposed Rock" and"Hard Rock" defined below. This shall also include embedded rock boulders notlonger than 1 meter in any one direction and not more than 200 mm in any one ofthe othertwo directions.

b) SoftandDecomposedRock:

This shall include completely to highly weathered/fractured rock, boulders, slag,chalk, slate, hard mica schist, laterite and all other materials, which in the opinion ofENGINEER is soft rock, difficult to excavate manually with a pick axe or requiredvery light mechanical excavating machines but does not need blasting. The merefact that the CONTRACTOR resorts to blasting without prior approval from local authorities or ENGINEER, shall not qualify for classification under 'HardRock'.

This shall also include excavation in macadam & tar roads and pavements, rockboulders not longer than 1 meter in any direction and not more than 500 mm in anyoneoftheother two directions.

c) HardRock:

This shall include all rock occurring in large continuous masses, which can only beexcavated by blasting or by Pneumatic hydraulic breakers. Harder varieties of rock with or without veins and secondary minerals, which in the opinion of the ENGINEER require blasting, shall be considered as hard rock.

Where hardrock is met with and blasting operations are not permitted, the CONTRACTOR shall use other methods such as use of chemicals or Pneumatichydraulic breakers or any other method approved by the ENGINEER for looseningthe rock mass, developing cracks, etc. The loosened material shall be thereafterremoved mechanically. Boulders of rock occurring in such sizes and not classifiedunder (a) and (b) above shall also be classified as hard rock. Buried concrete workboth reinforced and unreinforced to be dismantled will be measured under this item, unless a separate provision is made in the tender.

3.8 EXCAVATION

(a) All excavation work shall be carried out by mechanical equipment unless, inthe opinion of the Engineer-In-Charge, the work involved, and time schedulepermitmanualwork.

(b) Excavation for permanent work shall be taken out to such widths, lengths,depths and profiles as are shown on the drawings or such other lines and gradesas may be specified by the Engineer-In-Charge. Rough excavation shall be carriedout to a depth 150 mm above the final level. The balance shall be excavated withspecial care. Soft pockets shall be removed even below the final level and extraexcavation filled up as directed by the Engineer-In-Charge. The final excavation, ifso instructed by the Engineer-In-Charge, should be carried out just prior to layingthe mud-mat.

(c) The CONTRACTOR may, for facility of work or similar other reasons excavate, and also backfill later, if so approved by the Engineer-In-Charge, at hisown cost outside the lines shown on the drawings or directed by the Engineer-InCharge. If any excavation to be taken below the specified elevations, the CONTRACTOR shall fill it up, with concrete of the same class as in the foundation resting there on, up to the required elevation. No extra shall be claimed by theCONTRACTORon this account.

(d) All excavation shall be done to the minimum dimensions as required for safety and working facility. Prior approval of the Engineer-In-Charge shall be obtained by the CONTRACT OR in each individual case, for the method he proposes to adopt for the excavation, including dimensions, side slopes, dewatering, disposal, etc. This approval, however, shall not in any way relieve theCONTRACTOR ofhis responsibility for any consequent loss or damage. Theexcavation must be carried out in the most expeditious and efficient manner. Side slopes shall be as steep as will stand safely for the actual soil conditions encountered. Every precaution shall be taken to prevent slips. Ifslips occur, theslipped material shall be removed, and the slope dressed to a modified stableslope. Removal of the slipped earth will not be paid for if the slips are due to thenegligenceof the CONTRACTOR.

(e) Excavation shall be carried out with such tools, tackles and equipment asdescribed herein before. Blasting or other methods may be resorted to in the caseofhard rock; however not without the specific permission of the Engineer-In-Charge.

(f) The Engineer-In-Charge may alsodirectthatin someextremecase,therock may be excavated by heating and sudden quenching for splitting the rock.Fire-wood shall be used for burning and payment shall be made for such work ascalledforin thescheduleof quantities.

3.9 BLASTING

(a) In ordinary rock blasting operations shall not be generally adopted. However,the contractor may resort to blasting with the permission of the Engineer-in-charge,but nothingextrashallbepaidfor suchblastingoperations.

(b) Where hardrock is met with and blasting operations are considered necessary, the contractor shall obtain the approval of the Engineer-in-Chargein writing for resorting to blasting operation.

(c) The contractor shall obtain license from the competent authority for undertaking blasting work as well as for obtaining and storing the explosiveas per the Explosive Act, 1884 as amended up to date and the ExplosiveRules,1983.

(d) The contractor shall purchase the explosives fuses, detonators, etc.only from a licensed dealer.

(e) The contractor shall be responsible for the safe transportation, storage and custody as per explosive rules and proper accounting of the explosive materials. Fuses and detonators shall be stored separately and away fromthe explosives.

(f) The Engineer-in-Charge or his authorized representative shall have the right to check the contractor's store and account of explosives. Ifrequired, the contractor shall provide necessary facilities for this.

(g) The contractor shall be responsible for any damage arising out of accident to workmen,public or property due to storage, transportation and use of explosive during blasting operation.

3.10 BLASTINGOPERATIONS

Blasting operations shall be carried out under the supervision of a responsibleauthorized agent of the contractor (referred subsequently as agent only), duringspecified hours as approved in writing by the Engineer-in-Charge. all the blastingmaterial, operation and safety shall be as per IS 4081 or other Indian code ofpractice.

3.11 STRIPPINGLOOSEROCK

All loose boulders, semi-detached rocks (along with earthy stuff which might movetherewith) not directly in the excavation but so close to the area to be excavated asto be liable, in the opinion of the Engineer-In-Charge, to fall or otherwise endangerthe workmen, equipment, or the work, etc., shall be stripped off and removed awayfrom the area of the excavation. The method used shall be such as not to shatter or render unstable or unsafe the portion which was originally sound and safe.Any material not requiring removal as contemplated in the work, but which, in the opinion of the Engineer-In-Charge, is likely to become loose or unstable later, shallalso be promptly and satisfactorily removed as directed by the Engineer-In-Charge.The cost of such stripping will be paid for at the unit rates accepted for the class of materials in question.

3.12 FILL, BACK FILLING AND SITE GRADING

3.12.1 General

(a) All fill material will be subject to the ENGINEER's approval. If any material is rejected by the ENGINEER, the CONTRACTOR shall remove the same

forthwith from the site at no extra cost to the OWNER. Surplus fill material shall be deposited/ disposed off as directed by the Engineer -In-Charge after the fillworkis completed.

(b) No earth fill shall commence until surface water discharges and streams havebeen properly intercepted or otherwise dealt with as directed by the Engineer-In-Charge.

3.12.2 Material

(a) To the extent available, selected surplus soils from excavated materials shall be used as backfill. Fill material shall be free from clods, salts, sulphates, organic or other foreign material. All clods of earth shall be broken or removed. Where excavated material is mostly rock, the boulders shall be broken intopieces not larger than 150 mm size, mixed with properly graded earth to fill upthe voids andthe mixtureusedforfilling.

(b) If any selected fill material is required to be borrowed, the CONTRACTOR shallmake arrangements for bringing such material from outside borrow pits. Thematerial and source shall be subject to prior approval of the Engineer -In-Charge. The approved borrow pit area shall be cleared of all bushes, roots oftrees, plants, rubbish etc. top soil containing salts/ sulphate and other foreign material shall be removed. The materials so removed shall be burnt or disposed off as directed by the Engineer -In-Charge (but the responsibility lies with the contractor). The CONTRACTOR shall make necessary access roads to borrow areas and maintain the same, if such access road does not exist, a this own cost (Rate quoted shall be inclusive of all such preliminary works).

(c) The CONTRACTOR shall send the material from borrow pit for testing to thelaboratories. CONTRACTOR shall be allowed to bring the material only afterapproval of test reports (The expenses towards such testing is deemed to included in the rates quoted).

(d) CONTRATOR shall submit following test reports of the approved borrow pit toEngineer-In-Chargefor approval

a) C&Values

b) SieveAnalysis

c) Moisturecontent

d) In-situdensity

e) Standardproctordensity.

- (Note: Contractors shall have to carry these tests as many times as required.)

(e) Filling in pits and trenches around foundations of structures, walls etc.

(f) As soon as the work in foundations has been accepted and measured, the spaces around the foundations, structures, pits, trenches etc. shall be cleared of all debris, and filled with earth in layers not exceeding 15cm.,each layer

Being watered, rammed and properly consolidated to 95% proctor density,before the succeeding oneislaid. Each layer shall be consolidated to the satisfaction of the Engineer -In-Charge. Earth shall be rammed with approved mechanical compaction machines. Usually no manual compaction shall be allowed unless the Engineer -In-Charge is satisfied that in some cases manual compaction by tampers cannot be avoided. The final backfill surface shall be trimmed and leveled to proper profile as directed by the Engineer-In-Charge or indicated on the drawings.

3.12.3 Plinthfilling

(a) Plinth filling shall be carried out with approved material as described hereinbefore in layers not exceeding 15 cm, watered and compacted with mechanicalcompaction machines. The Engineer -In-Charge may however permit manual compaction by hand tampers incase he is satisfied that mechanical compaction is not possible. When filling reaches the finished level, the surfaceshall be flooded with water, unless otherwise directed, for at least 24 hours allowed to dry and then the surface again compacted as specified above to avoid settlements at a later stage. The finished level of the filling shall be trimmed to the level/slope specified.

(b) Where specified in the schedule of works, compaction of the plinth fill shall becarried out by means of 12 tons rollers smooth wheeled, sheep-foot or wobblywheeled rollers. In case of compaction of granular material such as sands and gravel, vibratory rollers shall be used. A smaller weight roller may be used only if permitted by the Engineer -In-Charge. As rolling proceeds, water sprinklingshall be done to assist consolidation. Water shall not be sprinkled in case of sandy fill.

(c) The thickness of each unconsolidated fill layer can in this case be upto a maximum of 300 mm. The Engineer -In-Charge will determine the thickness ofthe layers in which fill has to be consolidated depending on the fill material andequipmentused.

(d) Rolling shall commence from the outer edge and progress towards the centerand continue until compaction is to the satisfaction of the Engineer -In-Charge,butinnocaselessthan10passesof therollerwillbe acceptedforeachlayer.

(e) The compacted surface shall be properly shaped, trimmed and consolidated toan even and uniform gradient. All soft spots shall be excavated and filled andconsolidated.

(f) At some locations/ areas it may not be possible to use rollers because of space restrictions etc. The Contractor shall then be permitted to use pneumatic tampers; rammers etc. and he shall ensure proper compaction

3.12.4 Sand filling in plinth and other places

At places backfilling shall be carried out with local sand if directed by the Engineer -In-Charge. The sand used shall be clean, medium grained and free from impurities.The filled-in-sand shall be kept flooded with water for 24 hours to ensure maximum consolidation. Any temporary work required to contain sand under

flooded condition shall be to the Contractor's account. The surface of the consolidated sand shall be dressed to required level or slope. Construction of floors or other structures on sand fill shall not be started until the Engineer -In-Charge has inspected and approved the fill.

3.12.5 Filling in trenches

(a) Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. The back filling material shall be properly consolidated by watering and ramming, taking due care that no damage is caused to the pipes.

(b) Where the trenches are excavated in soil, the filling from the bottom of the trench to the level of the centerline of the pipe shall be done by hand compaction with selected approved earth in layers not exceeding 8cm; backfilling above the level of the centerline of the pipe shall be done with selected earth by hand compaction or other approved means in layers not exceeding 15cm.

(c) In case of excavation of trenches in rock, the filling up to a level 30 cm. above the top of the pipe shall be done with fine materials, such as earth, murrum etc. The filling up of the level of the centerline of the pipe shall be done by hand compaction in layers not exceeding 8cm. Whereas the filling above the centerline of the pipe shall be done by hand compaction or approved means inlayers not exceeding 15 cm. The filling from a level 30 cm. above the top of the pipe to the top of the trench shall be done by hand or other approved mechanical methods with broken rock filling of size not exceeding 15 cm mixed with fine material as available to fillup the voids.

(d) Filling of the trenches shall be carried simultaneously on both sides of the pipe to avoid unequal pressure on the pipe.

3.13 GENERALSITEGRADING

Site grading shall be carried out as indicated in the drawings and as directed by the Engineer-In-Charge. Excavation shall be carried out as specified in the specification. Filling and compaction shall be carried out as per CPWD specifications for civil work and else where unless other wise indicated below.

To ensure that the fill has been compacted as specified, field and laboratory tests shall be carried out by the CONTRACTOR at his own cost.

- The tests shall be carried out after each layer of filling.
- Equipment’s for the following in-situ tests shall be made available at site by CONTRACTOR

a) CorecutterMethod
b) Sandreplacementmethod

3.14 FILLDENSITY

The compaction only where so called for, in the schedule of quantities/ items shall comply with the specified (Standard Proctor/Modified Proctor)density at moisture

content differing not more than 4 percent from the optimum moisture content. TheCONTRACTOR shall demonstrate adequately at his cost, by field and laboratorytestsbthatthespecifieddensityhasbeenobtained.

3.15 LEAD

Lead for deposition/ disposal of excavated material, shall be as specified in therespective item of work. For the purpose of measurement of lead, the area to beexcavated or filled or area on which excavated material is to be deposited/ disposedoff shall be divided into suitable blocks and for each of the blocks, the distancebetween centerlines shall be taken as the lead which shall be measured by theshorteststraightlinerouteontheplanandnottheactualroutetakenbytheCONTRACTOR. No extra compensation is admissible on the grounds that the leadincluding that for borrowed material had to be transported over marshy or 'katcha'land/ route.

3.16 TOLERANCES

The finished levels shall be within +/- 50 mm with respect to the levels mentioned inthe drawing.

3.17 MODEOFMEASUREMENT

Following procedure shall be followed for measuring quantity of Soil/Hardrock.

a) After completion of cleaning and grubbing activity CONTRACT OR shall take levels at every 5M X 5M grid on the natural ground in presence of Engineer -In-Charge. The record shall be signed jointly by CONTRACTOR and Engineer -In-Charge.

b) After completion of the land grading activity as per the drawings, final levels shallbe taken at previously marked grid in presence of Engineer -In-Charge& shall berecorded.

c) The quantities shall be worked out based on the initial and final levels and by using mutually agreed quantity calculation procedure such as Simpsons rule or as approved byEngineer-In-Charge.

4.0 TREATMENTOFEXCAVATEDSURFACES

The bottom surface and the sides(uptoaheightofabout300mm)of the excavations made for column pits, wall trenches and basements shall be treated with aqueous emulsion having concentration 1:19 with chlorpyriphos solution(trial or equivalent) and water, i.e. 1% solution for anti-termite treatment at the rateof5L/sqmofthesurfacearea.

After the column foundations and the retaining walls of the basement come up, thebackfill in immediate contact with the foundation structure shall be treated with anti-termite chemical at the rate of 7.5liters per sq.m of the vertical surface of the sub-structure for each side. If water is used for ramming the earth- fill, the chemicaltreatment shall be carried out after the ramming operation is done by rodding theearth at 150 mmcenters close to the wall surface and sprayingthe chemical withthe above dose. The earth shall be returned in layers and the treatment shall becarried out in similar stages. The chemical emulsion shall be directed towards theconcrete or masonry surfaces of the columns and walls so that the earth in contactwiththesesurfacesis well treatedwith thechemical.

In the case of R.C.C. framed structures with columns and plinth beams and R.C.C.basements,withconcretemix1:2:4orricher,thetreatmentshallstartatthedepthof 500 mm below ground level for columns and plinth beams. From this depththeback-fill around the columns, beams and R.C.C basement walls shall be treatedattherateof7.5liters/sq.mofverticalsurface.

4.1 SAFETYPRECAUTIONS

All chemicals used for anti-termite treatment are poisonous and hazardous to health. These chemicals can have an adverse effect upon health when absorbedthrough the skin, inhaled as vapours or spray mists or swallowed. Person using orhandling these chemicals should be warned of these dangers and advised thatabsorption through the skin is most likely source of accident poisoning. They should be cautioned to observe carefully the safety precautions given below.

These chemicals are usually brought to site in the form of emulsifiable concentrates. The containers should be clearly labelled and should be stored carefully so thatchildrenand petcannot getat them.Theyshallbekeptsecurelyclosed.

Particular care shall be taken to prevent skin contact with concentrates. Prolonged exposure to dilute emulsions shall also be avoided. Workers shall wear clean clothing and wash thoroughly with soap and water, especially before eating and smoking. In the event of severe contamination, clothing shall be removed at once and the skin washed with soap and water. If chemicals splash into eyes they shall be flushed with plenty of soap and water and immediate medical attention shall besought.

The concentrates are oil solutions and present a fire hazard owing to the use of petrol eumsolvents.Flames shall not be allowed during mixing.

Care shall be taken in the application of chemicals to see that they are not allowed to contaminate wells or springs which serve as source of drinking water.

5.0 CONCRETEANDALLIEDWORKS

5.1 SCOPE

This Specification covers the general requirements for ready mixed concrete and forconcrete using on-site production facilities including requirements in regard to thequality, handling, storage of ingredients, proportioning, batching, mixing, transporting,placing, curing, protecting, repairing, finishing and testingofconcrete; formwork; requirements in regard to the quality, storage, bending and fixing of reinforcement; grouting as well as mode of measurement and payment for completed works.

It shall be very clearly understood that the specifications given herein are brief and do not cover minute details. However, all works shall have to be carried out in accordance with the relevant standards and codes of practices or in their absence inaccordance with the best accepted current engineering practices or as directed byEngineer-In-Charge from time to time. The decision of Engineer-In-Chargeasregards the specification to be adopted and their interpretation and the mode of execution of work shall be final and binding on CONTRACTOR and noclaim what so ever will be entertained on thisaccount.

5.2 APPLICABLECODESANDSPECIFICATIONS

The following specifications, standards and codes, including all official amendments/revisions and other specifications & codes referred to therein, should be considered apart of this specification.

Table7-1List of Codes&Standards

	IS CodeNo.		**Subject**
MATERIALS			
□	IS:269	-	Specification for ordinary Portland cement.
□	IS:455	-	Specification for Portland slag cement.
□	IS:1489	-	Specification for Portland pozzolana cement(Parts1&2)
□	IS:12330	-	Specification for sulphate resisting Portland Cement.
□	IS:383	-	Specification for coarse and fine aggregates from natural sources for concrete.
□	IS:432	-	Specification for mild steel and medium tensile (Parts steelbars and hard drawn steel wires for 1 & 2) concretereinforcement.
□	IS:1786	-	Specification for high strength deformed steel bars and wiresforconcrete reinforcement.

	IS CodeNo.		Subject
□	IS:1566	-	Specification for hard drawn steel wire fabric for (Parts II)concretereinforcement.
□	IS:9103	-	Specificationfor admixturesforconcrete.
□	IS:2645	-	Specificationfor integralcementwaterproofingcompounds.
□	IS:4900	-	Specificationfor plywoodfor concreteshutteringwork.
□	IS:4926	-	Readymixedconcrete
□	IS:8041	-	Specification for rapid hardening cement.
□	IS:12600	-	Specificationfor lowheatcement.
□	IS:6909	-	Specification for super sulphated cement.
□	IS:12089	-	Specification for granulated ground blast furnace slag.
□	BS:6699	-	Specification for granulated ground blast furnaceslag.
□	BS:6073	-	Specifications for pre cast concrete masonry units(Part1)
□	BS:6073	-	Methods for specifying pre cast concrete masonry(Part2)
MATERIALTESTING			
□	IS:4031	-	Methods of physical tests for hydraulic cement.(Parts1to15)
□	IS:4032	-	Method of chemical analysis of hydraulic cement.
□	IS:650	-	Specification for standard sand for testing of cement.
□	IS:2430	-	Methods for sampling of aggregates for concrete.
□	IS:2386	-	Methods of test for aggregates fo rconcrete(Parts1to8)
□	IS:3025	-	Methods of sampling and test (physical and chemical) waterusedinindustry.(Part1to 51)
□	IS:6925	-	Methods of test for determination of water soluble chlorides inconcreteadmixtures.
MATERIALSTORAGE			
□	IS:4082	-	Recommendations on stacking and storing of constructionmaterialsat site.

	ISCode no.		Subject
CONCRETEMIXDESIGN			
□	IS:10262	-	Recommended guidelines for ConcreteMixDesign.
□	SP:23	-	Handbook on ConcreteMixes.
CONCRETETESTING			
□	IS:1199	-	Method of sampling and analysis of concrete.
□	IS:516	-	Method of test for strength of concrete.
□	IS:9013	-	Methodofmaking,curinganddeterminingcompressivestrengthofacceleratedcuredconcretetestspecimens.
□	IS:8142	-	Method of test for determining setting time of concrete bypenetrationresistance.
□	IS:9284	-	Method of test for abrasion resistance of concrete.
□	IS:2770	-	Methods of testing bond in reinforced concrete.
EQUIPMENT			
□	IS:1791	-	Specificationforbatchtypeconcretemixers.
□	IS:2438	-	Specificationforrollerpanmixer.
□	IS:4925	-	Specificationforconcretebatchingandmixingplant.
□	IS:5892	-	Specificationforconcretetransitmixerandagitator.
□	IS:7242	-	Specificationforconcretespreaders.
□	IS:2505	-	GeneralRequirementsforconcretevibrators:Immersiontype.
□	IS:2506	-	GeneralRequirementsforscreedboardconcretevibrators.
□	IS:2514	-	Specificationforconcretevibratingtables.
□	IS:3366	-	Specificationforpanvibrators.
□	IS:4656	-	Specificationforformvibratorsforconcrete.
□	IS:11993	-	Codeofpracticeforuseofscreedboardconcretevibrators.
□	IS:7251	-	Specificationforconcretefinishers.
□	IS:2722	-	Specifications for portable swing weigh batchers for concrete(singleand double buckettype).
□	IS:2750	-	Specificationsforsteelscaffoldings.
CODESOFPRACTICE			
□	IS:456	-	Codeofpracticeforplainandreinforcedconcrete.
□	IS:457	-	Code of practice for general construction of plain andreinforcedconcretefordamsandothermassivestructures.

□	IS:3370	-	Code of practice for concrete structures for storage of liquids(Parts 1to4)
	ISCode No.		**Subject**
□	IS:3935	-	Codeofpracticeforcomposite construction.
□	IS:2204	-	Code of practice for construction of reinforced concrete shellroof.
□	IS:2210	-	Criteria for the design of reinforced concrete shell structuresandfolded plates.
□	IS:2502	-	Code of practice for bending and fixing of bars for concretereinforcement.
□	IS:5525	-	Recommendation for detailing of reinforcement in reinforcedconcreteworks.
□	IS:2751	-	Code of practice for welding of mild steel plain and deformedbarsusedforreinforcedconcreteconstruction.
□	IS:9417	-	Specification for welding cold worked bars for reinforcedconcreteconstruction.
□	IS:3558	-	Code of practice for use of immersion vibrators forconsolidatingconcrete.
□	IS:3414	-	Code of practice for design and installation of joints inbuildings.
□	IS:4326	-	Code of practice for earthquake resistant design andconstructionofbuildings.
□	IS:4014	-	Codeofpracticeforsteeltubularscaffolding.(Parts1 &2)
□	IS:2571	-	Codeofpracticeforlayinginsitucementconcreteflooring
□	IS:7861	-	Part1- Recommendedpracticeforhotweatherconcreting
		-	Part2–Recommendedpracticeforcoldweatherconcreting
□	IS:3370	-	Code of practice for concrete structures for the storage ofliquid(Part I toIV)
CONSTRUCTIONSAFETY			
□	IS:3696	-	Safetycodeforscaffoldsandladders.(Parts1 &2)
□	IS:7969	-	Safetycodeforhandlingandstorageofbuildingmaterials.
□	IS:8989	-	Safetycodeforerectionofconcreteframedstructures.
MEASUREMENT			
□	IS:1200 (Part 1to 12)	-	Method of measurement of building and engineering works(Part 2 and5)

5.3 GENERAL

Engineer-In-Charge shall have the right at all times to inspect all operations including the sources of materials, procurement, layout and storage of materials, theconcrete batching and mixing equipment, and the quality control system. Such aninspection shall be arranged, and Engineer-In-Charge's approval obtained, prior tostarting of concrete work. This shall, however, not relieve CONTRACTOR of any ofhis responsibilities. All materials, which do not conform to this specification, shall berejected.Materials should be selected so that they can satisfy the design requirementsofstrength,serviceability,safety,durabilityandfinishwithdueregardstothef unctional requirements and the environmental conditions to which the structure willbe subjected. Materials complying with codes/standards shall only be used. Other materials may be used after approval of theEngineer-In-Charge and after establishing their performance suitability based on previous data, experience ortests.

5.4 MATERIALS

5.4.1Cement

- Unless otherwise specified or called for by Engineer-In-Charge/Client, cement shall be ordinaryPortland cement conforming toIS269.
- The Portland pozzolana cement shall conform to IS 1489 and it shall be used as directed by Engineer-In-Charge. Where Portland pozzolana or Portland slag cements are used, it shall be ensured that consistency of quality is maintained and there will be no adverse interactions between the materials and the finish specifiedisnot marred.
- Only one type of cement shall be used in any one mix unless specifically approvedby Engineer-In-Charge. The source of supply, type or brand of cement within thesame structure or portion thereof shall not be changed without prior approval fromEngineer-In-Charge.
- Cement, which is not used within 90 days from its date of manufacture, shall betested at a laboratory approved by Engineer-In-Charge and until the results of such tests are found satisfactory, it shall not be used in any work.

5.4.2Aggregates

- Aggregates shall consist of naturally occurring stones and gravel (crushedoruncrushed) and sand. They shall be chemically inert, strong, hard, clean, durable against weathering, of limited porosity, free from dust/silt/organicimpurities/deleterious materials and conform to IS:383. Aggregates such as crushedover burntbricks,bloatedclayash, sinteredflyash andtilesshallnot beused.
- Aggregates shall be washed and screened before use where necessary or if directed by the Engineer-In-Charge.
- Aggregates containing reactive materials shall be used only after tests conclusivelyprove that there will be no adverse effect on strength, durability and finish, includinglongterm effects,ontheconcrete.
- The fineness modulus of sand shall neither be less than 2.2 nor more than3.2.If

use of sand having fineness modulus more than 3.2 is unavoidable then it shall besuitableblended with crusher stone dust.

- The maximum size ofcoarse aggregate shall be as stated on the drawings, but inno case greater than 1/4 of the minimum thickness of the member, provided that the concrete can be placed without difficulty so as to surround all reinforcement thoroughly and fill the corners of the form. For most work 20mm aggregate issuitable. Where there is no restriction to the flow of concrete into sections, 40mm orlargersize is permitted.
- In concrete elements with thin sections, closely spaced reinforcements or small cover,consideration should be given to the useof10mmnominalmaximum size.
- Plums 160 mm and above of a reasonable size may be used where directed.Plumsshall not constitute more than 20% by volume ofconcrete unless specified byEngineer-In-Charge.

5.4.3Water

- Water used for both mixing and curing shall conform to IS: 456.Potable water isgenerally satisfactory. Watercontainingany excess ofacid,alkali, sugaror saltshallnotbeused.
- The pH value of water shall not be less than 6.
- Seawater shallnot beusedforconcretemixing andcuring.

5.4.4Reinforcement

- Reinforcement bars shall conform to IS: 432 and/ or IS: 1786 and welded wire fabrictoIS:1566 asshown onthedrawing.
- All reinforcement shall be clean,free from pitting, oil, grease, paint, loosemillscales, rust,dirt, dust or any other substance that will destroy or reduce bond.
- SpecialprecautionlikecoatingofreinforcementmaybeprovidedwiththepriorapprovalofEngineer-In-Charge.

5.4.5Samples andTests

- All materials used for the works shall be tested before use. The frequency of suchconfirmatorytests shall bedecided byEngineer-In-Charge.
- Manufacturer's test certificate shall be furnished for each batch of cement/steel andwhendirectedbyEngineer-In-ChargesamplesshallalsobegottestedbytheCONTRACTOR in a laboratory approved by Engineer-In-Charge at no extra cost toOWNER. However, where material is supplied by OWNER, all testing charges shallbe borne by OWNER, but transportation and preparation of material samples for thelaboratoryshallbedonebyCONTRACTOR atnoextracost.
- SamplingandtestingofaggregatesshallbeasperIS:2386underthesupervisionofEngineer-In-Charge.Thecostofalltests,sampling,etc.shallbebornebyCONTRACTOR.Forcoarse

aggregatecrushingvalueshallbetested.

- Waterto beusedshall be testedtocomplywithclause5.4 of IS:456.
- Contractor shall furnish manufacturer's test certificates and technical literaturefor the admixture proposed to be used. If directed, the admixture shall be got testedat anapproved laboratoryat noextracost.

5.4.6CUBETESTS

- The contractor shall ensure that the crushing of the concrete when tested within twenty-eight days after mixing in accordancewithIS:516-1959 shall not be less than that specified inthedrawings.
- The crushing strength of the concrete used in the works shall be determined by means of works cube tests which shall be taken from samples as before specified and tested in accordance with the procedure laid down in IS :516 and complete records relating to the samples and test cubes shall be made by the contractor in accordance with this specification. A slump test shall be carried out on each sample. The works test cubes shall be of 150 mm std. size and shall be made inbatches of four from each selected concrete sample. Two cubes from each set offour shall be tested at seven days and two at twenty-eight days. Each cube shall bemarked with the date of casting and a reference number from which its position of origin in the works can be clearly identified.
- The crushing strength of work cubes tested at seven days after mixing shall be notless than two-thirds of the required crushing strength of the concrete at twenty-eightdays shall however be accepted as true works cube strengths at twenty -eight days.The crushing strength of the works test cubes at 28 days shall be not less than thespecified minimum crushing strength of the corresponding grade of concrete. If theresults of tests show crushing strength less than those specified all concrete workmay be stopped by the consultant. The contractor may be required to cut out andre-execute or otherwise rectify to the satisfaction of engineer-in-charge at his own expenses anyw ork failing tocomplywith this specification.
- Concreting shall not proceed untiltheengineer-in-charge is satisfied that all necessary remedial measures have been taken to ensure that the specified strength of the concrete will be consistently attained. All such remedial measuresshallbeatthecontractor'sexpenses.

5.4.7StoringofMaterials

- All material shall be stored in a manner so as to prevent its deterioration andcontamination, which would preclude its use in the works. Requirements of IS: 4082shallbe complied with.
- CONTRACTOR will have to make his own arrangements for the storage of adequate quantity of cement even if cement is supplied by OWNER. If such cementis not stored properly and has deteriorated, the material shall be rejected. Cost ofsuch rejected cement, where cement is supplied by OWNER, shall be recovered atissue rate or open market rate whichever is higher. Cement bags shall be stored indry weatherproof shed with a raised floor, well away from the outer walls andinsulated from the floor to

avoid moisture from ground. Not more than 15 bags shallbe stacked in any tier. Storage arrangement shall be approved by ENGINEER.Storage under tarpaulins shall not be permitted. Each consignment of cement shallbe stored separately and consumed in its order of receipt. CONTRACTOR shall maintain record of receipt and consumption of cement.

- Each size of coarse and fine aggregates shall be stacked separately and shall be protected from dropping leaves and contamination with foreign material.Thestacks shall be on hard, clean, free draining bases, draining away from the concrete mixingarea.
  - CONTRACTOR shall make his own arrangements for storing water at site in tanks of approved capacity. The tanks shall be cleaned at least once a week to prevent contamination.
  - The reinforcement shall be stacked on top of timber sleepers to avoid contact withground/water. Each type and size shall be stacked separately.

5.4.8Concrete

General

Concrete grade shall be as designated on drawings. Concrete in the works shall be“DESIGN MIX CONCRETE”OR“NOMINALMIX CONCRETE”.Allconcreteworks of up to grade M15 shall be NOMINAL MIX CONCRETE where as all other grades, M20 and above, shall be DESIGN MIX CONCRETE.

i. It shall be CONTRACTOR’s sole responsibility to carry out the mix designs at hisown cost. He shall furnish to Engineer-In-Charge for approval at least 30 days before concreting operations, a statement of proportions proposed to be usedforthevariousconcretemixesandthestrengthresultsobtained.Thestrengthrequirements of the concrete mixes ascertained on 150 mm cubes as per IS: 516shallcomplywith the requirementsof IS:456.

Table7-2GradeofconcreteandConcreteStrength

Grade ofConcrete M	Minimum Compressive StrengthN/Sq.mmat7days	Specified Characteristiccompressive strengthN/sq.mm at28days
20	13.5	20.0
25	17.0	25.0
30	20.0	30.0
35	23.5	35.0
40	27.0	40.0
45	30.0	45.0

ii. A range of slumps recommended for various types of construction, unless otherwise instructed by the Engineer-In-Charge, shall be as given below:

Table7-3Slumpvaluesofconcrete

Structure/Member	Slumpinmillimeters	
	Maximum	Minimum
Reinforcedfoundationwallsandfootings	75	25
Slabs,Beamsandreinforcedwalls	50	25
Pumps&miscellaneousEquipment Foundations	75	25
Buildingcolumns	50	25
Pavements	50	25

(NOTE: These values are not meant for pumped concrete placed using slip formedtechnique.)

iii. Where single size graded coarse aggregate are not available, aggregates of different sizes shall be properly combined. The contractors mix design shall showthatcombined gradingof coarse aggregate meets the requirements of Table 2 ofIS:383forgradedaggregates.

5.4.8.2 ReadyMixConcrete

All specification as per IS: 4926 – "Specification for ready mixed concrete" shall beused.

The Contractor shall identify atleast two sources of ready-mix concrete supplier and get it approved by Engineer-In-Charge prior to start of the Works. Any change in the source of the RMC, shall be got approved by the Engineer-In-Charge.

The design mix prepared by the RMC supplier shall be the responsibility of theContractor. The testing of concrete as per Codal provisions and the specificationsshallbe donebytheContractorsameasthenormalconcreting works.

5.5 PRECASTCONCRETE

Precast concrete shall comply with the preceding Sections relating to Concrete as faras they are applicable. Precast concrete blocks shall comply with the requirementsandrecommendations ofBS 6073.

5.6 FORMWORK

Form work shall be all inclusive and shall consist of but not limited to shores, bracings, sides of footings, walls, beams and columns, bottom of slabs,etc.including ties, anchors, hangers, inserts, falsework, wedges,etc.

The design and engineering of the formwork as well as its construction shall be theresponsibilityofCONTRACTOR.However,ifsodirectedbyEngineer-In-Charge,the drawings and calculations for the design of the formwork shall be submitted toEngineer-In-Chargefor approval.

Form work shall fulfill requirements as mentioned inCl-04.2.12-CPWDSpecifications.

5.7 REINFORCEMENT FABRICATIONANDPLACEMENT

(a) Reinforcing bars supplied in the form of bent coils shall be straightened coldwithout damageat anyextracost.Nobendingshallbedonewhenambient

temperature is below 5 Deg.C.Suitable preheating may be permitted if steel barbending is to be done at below 0 Deg.C. Bars supplied in bent coils shall bestraightenedonlybymachine.

(b) All bars shall be accurately bent gradually and according to the sizes andshapes shown on the drawings/ schedules or as directed by Engineer-In-Charge.Barbendingmachinesshallbe usedtoachievedesiredaccuracy.

(c) Re-bending or straightening incorrectly bent bars shall not be done withoutapprovalofEngineer-In-Charge.

(d) Reinforcement shall be accurately fixed and maintained firmly in the correctposition by the use of blocks, spacers, chairs, binding wire, etc. to preventdisplacement during placing and compaction of concrete. The tied in placereinforcement shall be approved by Engineer-In-Charge prior to concreteplacement.Spacers(PVCorConcrete)shallbeofsuchmaterialanddesignaswi ll be durable, not lead to corrosion of the reinforcement and not cause spalling ofthe concretecover.

(e) Binding wire shall be 16 gauge soft annealed wires. Ends of the binding wireshall be bent away from the concrete surface and in no case encroach into theconcretecover.

(f) Substitution of reinforcement, laps/splices not shown on drawing shall be proposed by CONTRACTOR and approved by Engineer-In-Charge.

(g) If permitted by Engineer-In-Charge, welding of reinforcement shall be doneinaccordancewith IS:2751,IS:9417andSP:34asapplicable.

(h) Tolerance on placement of reinforcement shall be asperCl.12.3of IS:456.

5.8 PREPARATIONPRIORTOCONCRETEPLACEMENT

(a) Before concrete is actually placed in position, the inside of the formworkshall be cleaned and mould oil applied, inserts and reinforcement shall becorrectly positioned and securely held, necessary openings, pockets, etc.provided.

(b) All arrangements-formwork, equipment and proposed procedure, shall beapproved by Engineer-In-Charge. CONTRACTOR shall maintain separate PourCardforeach pourasper theformatenclosed.

5.9 CONCRETING

The concreting for reinforced concrete work shall be asperCL 5.4ofCPWD Specificatios-2019.

5.10 MASSCONCRETEWORKS

Sequence of pouring for mass concrete works shall be as approved by Engineer-In-Charge. CONTRACTOR shall exercise great care to prevent shrinkage cracks and shall monitor the temperature of the placed concrete if directed.

5.11 CURING

Curing and protection shall start immediately after the compactionoftheconcrete to protect it from:

a) Pre mature drying out, particularly by solar radiation and wind;

b) Leaching out by rain and flowing water;

c) Rapid cooling during the first few days after placing;

d) Highinternalthermalgradients;

e) Lowtemperatureorfrost;

f) Vibrationand impact which may disruptthe concreteand interferewithitsbondtothereinforcement.

All concrete, unless directed otherwise by Engineer-In-Charge,shall be cured byuse of continuous sprays or ponded water or continuously saturated coverings ofsacking, canvas, hessian or other absorbent material for the period of complete hydration with a minimum of 7days. The quality of curing water shall be the same as that used for mixing.

5.12 CONSTRUCTIONJOINTSANDKEYS

Construction joints (location and type) shall be as approved by Engineer-In-Charge.Concrete shall be placed without interruption until completion of work between construction joints. If stopping of concreting becomes unavoidable anywhere, aproperly formed construction joint shall be made with the approval of Engineer-In-Charge.

Dowels for concrete work,not likely tobe taken up in the near future, shall be coated with cement slurry and encased in lean concrete as indicated on the drawings or as directed by Engineer-In-Charge.

5.13 FOUNDATIONBEDDING

All earth surfaces upon which or against which concrete is to be placed, shall bewell compacted and free from standing water, mud or debris. Soft or spongy areashall be cleaned out and back filled with either soil-cement mixture, lean concrete or cleans and compacted as directed by Engineer-In-Charge. The surfaces of absorptive soils shall be moistened.

5.14 FINISHES

General

The formwork for concrete works shall be such as to give the finish as specified. TheCONTRACTOR shall make good as directed any unavoidable defects consistent withthe type of concrete and finish specified; defects due to bad workmanship (e.g.damaged or misaligned forms, defective or poorly compacted concrete) will not beaccepted. CONTRACTOR shall construct the formwork using the correct materialsand to meet the requirements of the design and to produce finished concrete to required dimensions, plumbs, planes and finishes.

SurfaceFinishType F1

This type of finish shall be for non-exposed concrete surfaces against which back fillor concrete is to be placed. The main requirement is that of dense, well compactedconcrete. No treatment is required except repair of defective areas, filling all form tieholes and cleaning up of loose or adhering debris. For surfaces below grade whichwill receive waterproofing treatment the concrete shall be free of surface irregularities which would interfere with proper and effective application of waterproofing materialspecifiedforuse.

SurfaceFinishType F2

This type of finish shall be for all concrete work which will be exposed to view upon completion of the job. The appearance shall be that of as moothdense,well-compacted concrete showing only the slight marks of well fitted shuttering joints. TheCONTRACTORshallmakegood anyblemishes.

SurfaceFinishType F3

This type of finish shall be for concrete work which will be exposed to view but to givean appearance of smooth, dense, well-compacted concrete with no shutter marks,stain free and with no discolouration, blemishes, arises, air holes, etc. Only lined orcoated plywood with very tight joints shall be used to achieve this finish. The panelsize shall be uniform and as large as practicable. Any minor blemishes that mightoccurshall bemadegood byCONTRACTOR.

5.15 CONCRETEPOURCARD

Table7-4ConcretePourcard

(A)	CLIENT:		DATE:	POURNO.:	
(b)	PROJECT:				
(c)	STRUCTURE:				
(d)	CONTRACTOR:				
(e)	MAXAGGREGATESIZE:		mm	SLUMP:mm	
(f)	DRG.NO.:				
(g)	START/COMPLETIONTIME:		Start:	CompletionTime:	
(h)	CONCRETEGRADEQUANTITY:		M/M^3	MIXINGTIME:	
	ITEM		**CONTRACTOR's REP.SIGNATURE**	**ENGINEER'sSIGNATURE**	**REMARKS**
	CONCRETING	CENTERLINESCHECKED			
		FORMWORKANDSTAGINGCHECKED			
		REINFORCEMENTCHECKED			
		COVERTOREINFORCEMENTCHECKED			
		VERIFIED TEST CERTIFICATE FORCEMENT/STEEL	YES/NO	YES/NO	

		ADEQUENCYOFMATERIALS/EQUIPMENTFORPOUR		YES/NO	YES/NO	
		EMBEDED PARTSCHECKED(LOCATION ANDPLUMB)	CIVIL			
			MECHANICAL			
			ELECTRICAL			
POURAUTHORISEDSITEENGINEER						
	SOFFIT(S)ANDPOURTOP(T)LEVELSCHECKEDBEFORE (B) AND AFTER (A) FROM REMOVAL(ONLY OF BEAMS OF OVER 10 M SPAN ANDIMPORTANT STRUCTURESLIKETG,ETC.)			(B) T(B)S(A) T(A)		
	CONSTRUCTIONJOINTLOCATIONANDTIME(IFNOTASPERDRAWING)					
	CEMENTCONSUMPTIONINKg					
	NUMBEROFCUBESANDIDENTIFICATIONMARK					
	TESTCUBERESULTS(7DAYS/28DAYS)			///		
	CONCRETECONDITIONONFORMREMOVAL			VERY GOOD/ GOOD/ FAIR/POOR		
SITE-IN-CHARGE						

NOTES:

a) EACH ITEM TO BE CHECKED & SIGNED BY THE RESPECTIVE ENGINEER-IN-CHARGE.

b) ITEMS 8 TO 13 (BOTH INCLUSIVE) TO BE FILLED BY ONLY ENGINEER -IN-CHARGE.

c) EACH POUR TO HAVE SEPARATE CARDS, IN TRIPILCATE ONE EACH FORCLIENT,TCE& SITEOFFICE.FORM279

d) UNDER REMARKS INDICATE DEVIATIONS FROM DWGS & SPECIFICATIONS,CONGESTION IN REINFORCEMENT IF ANY, UNUSUAL OCCURENCES, SUCH AS FAILURE OF EQUIPMENT'S, SINKING OF SUPPORTS/PROPS, HEAVY RAINS AFFECTING CONCRETEING, POOR COMPACTION, IMPROPERCURING, OTHER DEFICIENCIES, OBSERVATION ETC.

6 SPECIFICATIONSFORSUPPLY&FABRICATIONOFSTRUCTURALSTEEL

6.1 SCOPE

This specification covers the general requirements for supply where specified, fabrication and delivery at site of structural steel.

This specification also covers design of all connections and substituted members, preparation of all shop fabrication drawings, inspection and shop painting of structures.

6.2 APPLICABLECODES&SPECIFICATIONS

The following specifications, standards and codes are made apart of this specification. All standards, specifications and codes of practices referred to here in shall be the latest editions including all applicable official amendments and revisions.

In case of discrepancy between this specification and other documents referred toherein,this specificationshall govern.

Table8-1List of Codes&Standards

	IS CodeNo.		**Subject**
Materials			
	IS:808	-	DimensionsforHot RolledSteelsections
	IS:814	-	Covered Electrodesfor ManualMetal ArcWeldingofCarbon and CarbonManganeseSteel
	IS: 1161	-	SteelTubesforstructuralpurposes
	IS: 1239	-	Mildsteeltubes,tubularsand otherWroughtsteelfittings
	IS: 1239	-	Part1-Mildsteeltubes
	IS: 1239	-	Part 2-MildsteelTubularsandotherwroughtsteelpipefittings
	IS: 1363	-	HexagonHeadBolts,ScrewsandNutsofproduct(Parts1to3)GradeC(SizerangeM5 to M64)
	IS: 1367	-	TechnicalSupplyConditionsforThreadedFasteners(AllParts)
	IS: 1852	-	RollingandCuttingTolerancesforHot RolledSteelProducts
	IS: 1977	-	StructuralSteel(OrdinaryQuality)
	IS: 2062	-	SteelforGeneralStructuralPurposes
	IS: 2074	-	ReadyMixedPaint,Airdrying, RedOxideZincChromeandPriming
	IS: 3502	-	SteelChequeredPlate
	IS: 3757	-	HighStrengthStructuralBolts
	IS: 5369	-	GeneralRequirementsfor PlainWashersandLockWashers

	IS CodeNo.		**Subject**
□	IS: 5372	-	TaperWashersforChannels
□	IS: 5374	-	TaperWasherforIBeams
□	IS: 6610	-	HeavyWashersforSteelStructures
□	IS: 8500	-	StructuralSteel-microalloyed(mediumandhighstrengthqualities)
Codesof Practice			
□	IS:800	-	CodeofPracticeforGeneralConstructioninSteel
□	IS:801	-	CodeofpracticeforuseofColdformedlightgaugesteelstructuralmembersingeneralbuildingconstruction
□	IS:803	-	Codeofpracticefordesign,fabricationanderectionofverticalmildsteelcylindricalwelded storage tanks
□	IS:806	-	Codeofpracticeforuseofsteeltubesingeneralbuildingconstruction
□	IS:816	-	CodeofPracticeforuse ofMetalArcWeldingforGeneralconstructioninMildSteel
□	IS:822	-	Code ofProcedurefor InspectionofWelds
□	IS: 1182	-	RecommendedPracticeforRadiographicexaminationofFusion-WeldedButtJointsinSteelPlates
□	IS: 1200	-	MethodofMeasurementinBuilding CivilEngineeringWorks
□	IS: 1477	-	CodeofPracticefor Paintingof (Parts1&2)FerrousMetalsinBuildings
□	IS: 2595	-	CodeofPracticeforRadiographicTesting
□	IS: 3658	-	CodeofPracticefor LiquidPenetrantFlawDetection
□	IS: 4000	-	HighstrengthboltsinSteelStructures-CodeofPractice
□	IS: 5334	-	CodeofPracticeforMagneticParticleFlawDetectionofWelds
□	IS: 7215	-	TolerancesforFabricationof SteelStructures
□	IS: 9595	-	RecommendationsforMetalArcWeldingofCarbonandCarbonManganeseSteel

6.3 STEEL MATERIALS

Steel materials shall comply with the specifications laid down in CPWD and/or as called for on the design drawings.

All materials used shall be new,unused and free from defects.

6.4 FABRICATION

General

All workmanship and finish shall be of the best quality and shall conform to the bestapproved method of fabrication. All materials shall be finished straight and shall bemachined/ground smooth true and square where so specified. Allholes and edgesshall be free of burrs. Shearing and chipping shall be neatly and accurately done,and all portions of work exposed to view shall be neatly finished. Unless otherwisedirected/ approved, reference may be made to relevant IS codes for providing standard fabrication tolerance. Material at the shops shall be kept clean and protected from weather.

6.4.1Connections

Shop/field connections shall be as per approved fabrication drawings.

In case of bolted connections, taper washers or flat washers or spring washers shall be used with bolts as necessary. In case of high strength friction grip bolts, hardened washersbe used under the nuts or the bolt heads which ever are turned to tighten the bolts. The length of the bolt shall be such that at least one thread of the bolt projects beyond the nut, except in case of high strength friction grip boltswherethis projection shallbeat leastthreetimesthe pitchof thethread.

In all cases where bearing is critical, the unthreaded portion of bolt shall bear on themembers assembled. A washer of adequate thickness may be provided to excludethe threads from the bearing thickness, if a longer grip bolt has to be used for thispurpose.

All connections and splices shall be designed for full strength of members or loads indicated on Engineer-In-Charge's design drawings. Column splices shall be designed for the full tensile strength of the minimum cross section at the splice.

All bolts, nuts, washers, electrodes, screws etc. shall be supplied/brought to site10% in excess of the requirement in each category and size. Rates shall cover thecost of this extra quantity.

All members likely to collect rainwater shall have drain holes provided.

6.4.2Straightening

All materials shall be straight and, if necessary, before being worked shall be straightened and/or flattened by pressure and shall be free from twists. Heating orforging shall not be resorted to without the prior approval of the Engineer-In-Chargeinwriting.Cutting, punching, drilling, welding and fabrication tolerances shall be generally asperrelevantIS codes.

6.4.3RollingandForming

Plates, channels, R.S.J. etc., for circular bins, bunkers, hoppers, gantry girders, etc.,shall be accurately laid off and rolled or formed to required profile/ shape as called for on the drawings. Adjacent sections shall be match-marked to facilitate accurate assembly, welding and erection in the field.

6.4.4High Strength Friction Grip Bolting

Inspection after tightening of bolts shall be carried out as stipulated in the appropriate standards depending upon the method of tightening and the type of bolt used.

6.4.5Welding

Welding procedure shall be submitted to Engineer-In-Charge for approval. Welding shall be entrusted to only qualified and experienced welders who shall be periodically tested and graded as per IS817, S:7310 (Part1)and IS:7318(Part 1)

While fabricating plated beams and built up members, all shop splices in eachcomponent part shall be made before such component part is welded to other partsof the members. Wherever weld reinforcement interferes with proper fit-up betweencomponents to be assembled for welding, these welds shall be ground flush prior toassembly.

Approval of the welding procedure by the Engineer-In-Charge shall not relieve theCONTRACTOR of his responsibility for correct and sound welding without un due distortion in the finished structure.

No welding shall be done when the surface of the members is wetnor during periods of high wind.

Each layer of a multiple layer weld except root and surfaces runs may be moderately peened with light blows from a blunt tool. Care shall be exercised to prevent scaling or flaking of weld and basemetal from over peening.

No welding shall be done on base metal at a temperature below -5 Deg.C. Basemetal shall be preheated to the temperature as per relevant IScodes.

Electrodes other than low-hydrogen electrodes shall not be permitted for thicknesses of 32mm and above.

6.4.5.1 InspectionofWelds

All welds shall be inspected for flaws by any of the methods described under clause 6.4.8 "Inspection". The choice of the method adopted shall be determined by thePurchaser/Engineer-In-Charge.

6.4.5.2 The correction of defective welds shall be carried out as directed by the Engineer-In-Charge without damaging the parent metal. When a crack in the weld is removed, magnetic particle inspection or any other equally positive means as prescribed by the Engineer-In-Charge shall be used to ensure that the whole of the crack and material upto 25 mm beyond each end of the crack has been removed. Cost of all such tests and operations incident alto correction shall be to the CONTRACTOR's account.

6.4.6Tolerances

The dimensional and weight tolerances for rolled shapes shall be in accordance withIS:1852 for indigenous steel and equivalent applicable codes for imported steel. The tolerances for fabrication of structural steel shall be asper IS:7215.

6.4.7EndMilling

Wherecompression jointsare specified tobe designed for bearing, the bearing surfaces shall be milled true and square to ensure proper bearing and alignment.

6.4.8Inspection

(a) The CONTRACTOR shall give due notice to the PURCHASER/Engineer-In-Charge in advance of the works getting ready for inspection. All rejected materialshall be promptly removed from the shop and replaced with new material for thePURCHASER's/Engineer-In-Charge's approval / inspection. The fact that certainmaterial has been accepted at the CONTRACTOR's shop shall not invalidate final rejection at site by the PURCHASER/Engineer-In-Charge if it fails to conform to the requirements of these specifications, to be inproper condition or has fabrication in accuracies which prevents proper assembly nor shall it invalidate anyclaim which the PURCHASER may make because of defective or un satisfactory materials and/orworkmanship.

(b) No materials shall be painted or dispatched to site without inspection and approval by the PURCHASER/Engineer-In-Charge unless such inspection is waived in writing by the Engineer-In-Charge.

(c) The CONTRACTOR shall provide all the testing and inspection services and facilities for shop work except where otherwise specified.

(d) For fabrication work carried out in the field the same standard of supervisionand quality control shall be maintained as in shop fabricated work. Inspection andtestingshall beconducted inamannersatisfactorytotheEngineer-In-Charge.

(e) Inspectionandtests onstructuralsteelmembersshall be asset forthbelow:

(f) MaterialTesting

If mill test reports are not available for any steel materials the same shall be got tested by the CONTRACTOR to the Engineer-In-Charge's satisfaction to demonstrate conformity with the relevant specification.

6.4.8.1 TestsonWelds

MagneticParticleTest

Where welds are examined by magnetic particle testing, such testing shall be carried out in accordance with relevant IScodes.If he at treatment is performed,the completed weld shall be examined after the heat treatment. All defects shall berepaired and retested. Magnetic particle tests shall be carried out using alternating current. Direct current may be used with the permission of the Engineer-In-Charge. Liquid Penetrant Inspection

In the case of welds examined by Liquid Penetrant Inspection, such tests shall becarried out in accordance with relevant IS Code. All defects shown shall be repairedand rechecked.

Radio graphic Inspection All full strength butt welds shall be radiographed in accordance with the recommended practice for radiographic testing as per relevant IScode.

6.4.9Dimensions,Workmanship&Cleanliness

Members shall be inspected at all stages of fabrication and assembly to verify thatdimensions,tolerances,alignment,surfacefinishandpaintingareinaccordance

with the requirements shown in the CONTRACTOR's approved fabrication drawingsandtheEngineer-In-Charge'sdrawings.

6.4.10 Test Failure

In the event of failure of any member to satisfy inspection or test requirement, the CONTRACTOR shall notify the Engineer-In-Charge or his authorized representative. The CONTRACTOR must obtain permission from the Engineer-In-Charg before repair is undertaken. The quality control procedures to be followed to ensure satisfactory repair shall be subject to approval by the Engineer-In-Charge.The Engineer-In-Charge has the right to specify additional testing as he deems necessary, and the additional cost of such testing shall be borne by the PURCHASER, only in case of successful testing.

The CONTRACTOR shall maintain records of all inspection and testing which shall be made available to the Engineer-In-Charge or his authorized representative.

6.4.11 Painting

All fabricated steel material, except those galvanised shall receive protective paintcoating as specified in specification for painting of structural steel. Galvanizing offabricated steel wherever specified in specifications for galvanizing of structuralsteel.

6.5 HANDRAILUSINGS.S.TUBULARPIPES

General specifications to be same as for steel work welded in built-up section asmentionedinClause-8.0ofthis document.

6.5.1MATERIALS

(a) All rails and other horizontal / inclined/vertical/post tubular components shall be constructed using the following Stainless-steel grade A ISI,type 304

(b) All rails and other horizontal / inclined/vertical/post tubular components surface shall be,320 grain/gritfinish/polish/matte/beadblasted.

(c) All rails and other horizontal / inclined tubular components tube shall be ofsize1 ½" (38mm)outside diameterby5/64"(2mm) wall thickness.

(d) All posts and other vertical components shall be of size 2" (50 mm) with 1/2"(12.5mm)flatbar.

(e) Fasteners: Anchors & Fastening bolts to be stainless steel or other highstrength material as determined by engineering requirements with capability tosustain, without failure, load imposed within a safety factor of 4, as determined bytestingperASTME488.

6.5.2QUALITYASSURANCE

6.5.3RailingStructuralRequirements:

(f) Handrail assemblies and guards shall be designed to resist to withstandloading of 0.74 KN/mtr UDL applied in any direction at the top and to transfer thisload throughthesupports tothestructure.

(g) Infill area of guardrail system shall be capable of withstanding a horizontalconcentrated load 90 Kgs to one square foot at any point in the system. Load notto act concurrently with loads on top rail of system in determining stress onguardrail.

6.5.4Bolts,RivetsandScrews

(h) When two stainless steel items are joined it is absolutely necessary to useelements of stainless steel or of other materials with an equivalent resistance tocorrosion.

(i) When stainless steel items are joined to carbon steel structural elements the carbon steel element must be well protected by suitable painting.

(j) Stainless steel rivets, screws and bolts must be used and the carbon steel element must be suitably insulated from the stainless steel element using EPDM/neoprene/Teflon

(k) Welding Prior Approval to Be Obtained If Necessary: TIG welding to beadopted for SS works. The welded areas to be passivated after welding arecompleted. When welding dissimilar ferrous metals, the respective IS code to befollowed.

6.5.5WORKMANSHIP

(l) Installation work shall not be carried out until substrates have been properlyprepared.

(m) If substrate preparation is the responsibility of another installer; notify Architect of unsatisfactory preparation before proceeding.

(n) All works shown or inferred from the Specifications and Drawings areintended to be the design criteria for the subcontract work. The detailed designdevelopment shall be submitted by the Contractor for Acceptance andEndorsement.

(o) The Contractor shall be responsible for taking exact measurements at siteprior to fabrication and installation. He shall verify all measurements inconsultationwith theConsultant

(p) The Contractor shall allow for any additional supports on framework whererequired so as to ensure the stability and capability of the installation to withstandall specified loads under normal usage encountered during the service life of theworks.

(q) Field measurements: Where handrails and railings are indicated to fit toother construction, check actual dimensions of other construction by accurate fieldmeasurements before fabrication; show recorded measurements on final shopdrawings.

(r) Coordinate fabrication and delivery schedule of handrails with construction progress and sequence to avoid delay of railing installation.

(s) Coordinate post setting drawings, templates, instructions, and directions forinstallationof anchorages, suchassleeves,concreteinserts,anchorbolts,and

miscellaneous items having integral anchors that are to be embedded in concreteandmasonryconstruction.

(t) Co-ordinate

- Delivery of anchoragestoprojectsite,
- Blocking is in place for all mounting fasteners.
- Cleansurfacesthoroughlypriortoinstallation.

(u) Prepare surfaces using the methods recommended by the manufacturer for achieving proper result for the substrate under the project conditions.

(v) Fabricate railing system for compliance with structural requirements of applicablecode.

(w) Pre-assemble railings prior to shipping to greatest extent possible tominimize field splicing and assembly. Disassemble units only as necessary forshipping and handling limitations. Clearly mark units for re-assembly and forcoordinationwith shop drawings.

(x) Stainless steel tubing cuts shall be square, without burrs and where exposed,rounded to produce smooth rigid and hairline joints

(y) Install in accordance with manufacturer's instructions by done a qualified,authorizedrepresentative ofthemanufacturer.

(z) Fit exposed connections accurately together to form tight joints, except as necessary for expansion.

(aa)Perform cutting, drilling and fitting required for installation. Set accurately inlocation, alignment and elevation, plumb, level and true, measured from established lines and levels.

(bb)For in-place construction, provide anchorage devices and fittings to secureto in-place construction; including threaded fittings for concrete inserts, togglebolts and through bolts. Separate dissimilar materials with bushings, grommets orwashersto preventelectrolytic corrosion.

(cc)Do not cut or abrade finishes which cannot be completely restored in thefield. Provide anchors, plates, angles, etc., necessary for connecting railings tostructure.

(dd)Any and all field welding shall be by a certified welder.

(ee)There shall be accuracy in dimensions, precision in fitting of matching sections to line and levels, and perfection in alignment.

(ff) All components to be installed in plumb and in-line, accurately fitted, free from distortion or defects and securely anchored to structure.

(gg)The workmanship shall be absolutely top class and of international standards, and the final finish and polish shall conform true to approved sample.

(hh)Maximum variation from plumbshallbe1/4"(6.3mm).

(ii) Maximum offset from true alignment for every 50-foot (15.0m) of railingshallbe 1/4" (6.3mm), non-accumulative.

6.5.6STORAGE,HANDLING&DELIVERY

(jj) Materials to be delivered to the job site in good condition and adequately protected against damage as handrails area finished product.

(kk) Store on site in a location and manner to avoid damage. Stacking shouldbe done in a manner that will prevent bending. Store material in a clean, drylocation away from uncured concrete and masonry. Any protection on therailingsduring transportationshouldremain untilinstalled.

(ll) Keep handling on site to a minimum. Exercise caution to avoid damage to finishes of material.

(mm) General contractor to provide protective covering on handrails and guard rails until handover.

(nn)Adequate protection and periodic inspection to be carried out if construction is not yet finished in the area where the railings are installed.

(oo)Upon delivery railing will have protective wrapping over cap only.Immediately upon completion of installation of railing, remove cap cover and clean all work for inspectionandapproval.

(pp)When cleaning surfaces use plain water containing a mild soap or detergent.No abrasive agents or harsh chemicals shall be used.

(qq)Touch up, repair orreplacedamagedproductsbeforeSubstantial Completion.

(rr)All deficiencies in work and/or items not meeting specified requirements shall be corrected in order to meet specification requirements at no additional cost to owner.

6.5.7WARRANTY

Finish Warranty: Manufacturer shall warranty installed system for the periods described herein, starting from Date of Substantial Completion. When notified in writing from Owner, manufacturer/installer shall, promptly and without inconvenience and cost to Owner, correct said deficiencies.

6.5.8MEASUREMENT

(ss) Horizontal plan length of top rail only will be measured as handrail length inRunning Unit. Verticals will not be measured. Rate shall include all labour and materials including balustrades (vertical pipes) all necessary infill details (asshown in drawing), welding (if necessary), tools, plants & buffing charges fixing arrangements etc complete as directed.

(tt) Important Note: the specifications mentioned above are the generalstandardized ones. Architectural layout plans & the detail drawings should be followed/referred for all the specified design & details & the architectural drawings submitted should be termed as final, in case of any discrepancies orvariations,what-so-ever.

7 MASONARYWORKS

7.1 SCOPE

This specification covers the general requirements for brick and stone masonrywork, flooring, doors, water- proofing, plastering, painting and such other relatedworks forming a part of this job, which may be required to be carried out though notspecifically mentioned above.The works under this specification shall consist offurnishingofalltools,plants,labour,materials,andeverythingnecessaryforcarryingoutt heworks.

7.2 APPLICABLECODESANDSPECIFICATIONS

Thefollowingcodes,standardsandspecificationsaremadeapartofthisspecification.All standards, specifications, codes of practice referred to herein shallbethelatestversiononthedateofoffermadebythe Bidder.

In case of discrepancy between this specification and those referred to herein, thisspecificationshallgovern.

Table11-1Listof Codes&Standards

	ISCodeNo.		Subject
Materials			
□	IS:110	-	Ready mixed paint, brushing, grey filler, for enamels for use overprimers.
□	IS:426	-	PastefillerforColourcoats.
□	IS:428	-	Distemper,oilemulsion,Colourasrequired.
□	IS: 1077	-	Specificationforcommonburntclaybuildingbricks.
□	IS: 1081	-	Code of practice for fixing and glazing of metal (steel &aluminium)doors,windowsandventilators.
□	IS: 1124	-	Method of test for determination of water absorption, apparentspecificgravityandporosityofnaturalbuildingstones.
□	IS: 1200	-	Methodofmeasurementof buildingandcivilengineeringworks.
□	IS: 1237	-	Specificationforcementconcreteflooringtiles.
□	IS: 1346	-	Codeofpracticeforwater-proofingofroofswithbitumenfelts.
□	IS: 1443	-	Code of practice for laying and finishing of cement concreteflooring tiles.
□	IS: 1542	-	Specificationfor sandforplaster.
□	IS: 1597	-	Code of practice for construction of stone masonry: Part 1 Rubblestonemasonry.
□	IS: 1661	-	Code of practice for application of cement and cement-limeplasterfinishes.

	ISCodeNo.		Subject
□	IS: 1838	-	Specification for preformed fillers for expansion joint in concretepavements and structures (non-extruding and resilient type): Part1Bitumenimpregnatedfibre.
□	IS: 2116	-	Specificationforsandformasonrymortars.
□	IS: 2185	-	Specificationfor concretemasonryunits(Parts 1,2&3).
□	IS: 2212	-	Codeofpracticeforbrickwork.
□	IS: 2250	-	Codeofpracticeforpreparationanduseof masonrymortars.
□	IS: 2339	-	Aluminiumpaintforgeneralpurposes,indualcontainer.
□	IS: 2395	-	Code of practice for painting Concrete, masonry and plastersurfaces(Part 1 &Part2).
□	IS: 2571	-	Codeofpracticeforlayingin-situcementconcreteflooring.
□	IS: 2690	-	Specificationfor burntclayflatterracingtiles:Part 1Machinemade.
□	IS: 2691	-	Specificationforburntclayfacingbricks.
□	IS: 2750	-	Specificationforsteelscaffoldings.
□	IS: 3036	-	Code of practice for laying lime concrete for a water-proofed rooffinish.
□	IS: 3067	-	Codeof practiceofgeneraldesigndetailsandpreparatoryworkfordamp-proofingandwater-proofingof buildings.
□	IS: 3068	-	Specification for broken brick (burnt clay) coarse aggregates forusein lime concrete.
□	IS: 3384	-	Specification for bitumen primer for use in water-proofing anddamp-proofing.
□	IS: 3495	-	Methodof testforburntclaybuildingbricks: Part1to4.
□	IS: 5410	-	Cementpaint,colouras required.
□	IS: 8042	-	SpecificationforwhitePortlandcement.
□	IS: 8112	-	Specificationfor 43gradeordinaryPortlandcement.
□	IS: 8543	-	MethodsofTestingPlastics(Part4/Section1)
□	IS:15058	-	PVCwaterstopsattransversecontractionjoints–specification.

7.3 BRICKWORK

7.3.1 Materials

(a) Bricks used in the works shall conform to the requirements laid down in IS:1077. The class of the bricks shall be as specifically indicated in the respective items of work.

(b) Standard modular size of common bricks shall be 190mm x 90mm x 90mmas per IS: 1077. The nominal thickness of one brick and half brick walls usingmodular bricks shall be considered as 200 mm and 100 mm respectively. In the event of use of non-modular bricks, standard size shall be 230mm x 110mm x70mm. The nominal thickness of one brick and half brick walls using non-modularbricks shall be considered as 230 mm and 115 mm respectively. The dimensional tolerances of modular and non-modular sized bricks over the standard sizes shallbeasperIS 1077.

(c) Bricks shall be sound, hard, homogenous in texture, well burnt in kiln without being vitrified, hand/machine moulded, deep red, cherry or copper coloured, of regular shape and size & shall have sharp and square edges with smooth rectangular faces. The bricks shall be free from pores, cracks, flaws and nodules of free lime. Hand moulded bricks shall be moulded with a frog and those made byextrusion process may not be provided with a frog. Bricks shall give a clear ringingsound when struck and shall have a minimum crushing strength of 5N/sq.mm unless otherwise specified in the item.

(d) The average water absorption shall not be more than 20 percent by weightupto class 12.5 and 15 percent by weight for higher classes. Bricks which do notconform to this requirement shall be rejected. Over or under burnt bricks are notacceptablefor use intheworks.

(e) Sample bricks shall be submitted to the ENGINEER for approval and brickssupplied shall conform to approved samples. If demanded by ENGINEER, bricksamples shall be got tested as per IS: 3495 by CONTRACTOR at no extra cost toOWNER. Bricks rejected by ENGINEER shall be removed from the site of workswithin24 hours.

(f) Mortar for brick masonry shall consist of cement and sand and shall beprepared as per IS: 2250. Mix shall be in the proportion of 1:5 for all brickworks,unlessotherwisespecifiedintherespectiveitemsofwork.Sandformasonrymortar shall conform to IS: 2116. The sand shall be free from clay, shale, loam,alkaliandorganicmatterandshallbeofsound,hard,cleananddurableparticles.Sand shall be approved by ENGINEER. If so directed by the ENGINEER,sandshallbescreenedandwashedtillitsatisfiesthelimitsofdeleteriousmaterials.

(g) For preparing cement mortar, the ingredients shall first be mixed thoroughly in dry condition. Water shall then be added and mixing continued to give a uniformmix of required consistency. Mixing shall be done thoroughly in a mechanicalmixer, unless hand mixing is specifically permitted by ENGINEER.The mortar thus mixed shall be used as soon as possible, preferably within 30 minutes from the time water is added to cement. In case,the mortar has stiffened due to

evaporation of water, this may be re-tempered by adding water as required to restore consistency, but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall berejected and shall be removed forthwith from the site. Droppings of mortar shall notbere-used underanycircumstances.

(h) The CONTRACTOR shall arrange for test on mortar samples if so directedbyENGINEER.

7.3.2Workmanship

(a) Workmanship of brick work shall conform to IS: 2212. All bricks shall bethoroughly soaked in clean water for at least one hour immediately before beinglaid.

(b) The cement mortar for brick masonry workshall be as specified intherespective item of work. Brick work 200mm/230mm thick and over shall be laid inEnglish Bond unless otherwise specified. 100mm/115mm thick brickwork shall belaid with stretchers. For laying bricks, a layer of mortar shall be spread over the fullwidth ofsuitable length ofthe lower course. Each brickshall be slightlypressedinto the mortar and shoved into final position so as to embed the brick fully inmortar. Only full-size bricks shall be used for the works and cut bricks utilized onlyto make up required wall length or for bonding. Bricks shall be laid with frogsuppermost.

(c) All brickwork shall be plumb, square and true to dimensions shown. Vertical joints in alternate courses shall come directly one over the other and be in line. Horizontal courses shall be levelled. The thickness of brick courses shall bekept uniform. In case of one brick thick or half brick thick wall, at least one faceshouldbekeptsmoothandplane,eveniftheotherisslightly roughduetovariation in size of bricks. For walls of thickness greater than one brick both faces shall be kept smooth and plane. All inter connected brick work shall be carried out at nearly one levelsothatthereis uniform distribution of pressure on the supporting structure and no portion of the work shall be left more than one courselower than the adjacent work. Where this is not possible, the work shall be rakedback according to bond (and not saw toothed) at an angle not exceeding 450. Butin no case the level difference between adjoining walls shall exceed one meter.Brick-work shall notbe raised morethan onemeterperday.

(d) Bricks shall be so laid that all joints are well filled with mortar. The thicknessof joints shall not be less than 6 mm and not more than 10 mm. The face jointsshall be raked to a minimum depth of 10mm/15mmby raking tools during theprogress of work when the mortar is still green, so as to provide a proper key forthe plastering/pointing respectively to be done later. When plastering or pointing isnot required to be done, the joints shall be uniform in thickness and be struck flushand finished at the time of laying. The face of brickwork shall be cleaned daily andall mortar droppings removed.The surface of each course shall be thoroughly cleaned of all dirt before another course is laid ontop.

(e) During inclement weather conditions, newly built brick masonry works shall be protected by tarpaulin or other suitable covering to prevent mortar being washed away by rain.

(f) Brickwork shall be kept constantly moist on all the faces for at least sevendays.The arrangement for curing shall be got approved from theENGINEER.

(g) Double scaffolding having two sets of vertical supports shall be provided tofacilitateexecutionofthemasonryworks.Thescaffoldingshallbedesignedadequately considering all the dead, live and possible impact loads to ensuresafety of the workmen, in accordance with the requirements stipulated in IS: 2750and IS: 3696 (Part 1).Scaffolding shall be properly maintained during the entireperiod of construction. Single scaffolding shall not be used on important works andwill be permitted only in certain cases as decided by the ENGINEER. Where singlescaffolding is adopted, only minimum number of holes, by omitting a header shallbe left in the masonry for supporting horizontal scaffolding poles. All holes in themasonryshallbecarefullymadegoodbeforeplastering/painting.

(h) In the event of usage of traditional bricks of size 230 mm x ll5 mm x 75 mm,the courses at the top of the plinth and sills as well as at the top of the wall justbelow the roof/floor or slabs and at the top of the parapet shall be laid with bricksonedge.

(i) Allbrickworkshallbebuilttightlyagainstcolumns,floorslabsorotherstructuralme mbers.

(j) To overcome the possibility of development of cracks in the brick masonryfollowingmeasuresshallbeadopted.

i. For resting RCC slabs, the bearing surface of masonry wall shall befinished on top with 12 mm thick cement mortar 1:3 and provided with 2layers of Kraft paper Grade 1 as per IS:1397 or 2 layers of 50 micronthickpolyethylene sheets.
ii. RCC/steel beams resting on masonry wall shall be provided with plain orreinforcedconcretebedblocksofdimensionsasindicatedinthedrawings duly finished on top with 2 layers of Kraft paper Grade 1 as perIS:1397or 2layersof50micronthick polyethylenesheets.
iii. Steel wire fabric shall be provided at the junction of brick masonry andconcreteasspecifiedelsewherebeforetakingupplasteringwork.

(k) The above items shall be measured and paid for separately under the respective items of work.

(l) Bricks for partition walls shall be stacked adjacent to the structural member to pre-deflect the structural member before the wall is taken up for execution. Further, the top most course of half or full brick walls abutting againsteither a de-shuttered slab or beam shall be built only after any proposed masonrywall above the structural member is executed to cater for the deflection of the structural element.

(m) Reinforced cement concrete transoms and mullions of dimensions as indicated in the construction drawings are generally required to be provided in half brick partition walls. Reinforced concrete for transoms and mullions shall be measured and paid for separately under the respective items of work.

(n) Where drawings indicate that structural steel sections are to be encased in brick work, the brick masonry shall be built closely against the steel section, ensuring a minimum of 20mm thick cement-sand 1:4overallthesteelsurfaces. Steel sections partly embedded in brick work shall be provided with bituminous protective coating to the surfaces at the point of entry into the brickmasonry.

(o) CONTRACTOR shall note that the unit rates quoted for the masonry workshall be deemed to include for the installation ofmiscellaneous inserts such aspipe sleeves, bolts, steel sections with anchors etc. and providing pockets, leaving openings,cutting chases etc. in accordance with the construction drawings. Miscellaneous inserts shall be either supplied FREE by the OWNER or to be furnished by the CONTRACTOR. Any of the miscellaneous inserts which are required to be fabricated and supplied by the CONTRACTOR and cementconcrete to be provided in the pockets for the hold fasts ofdoor/window framesetc. shall however, be measured and paid separately under the respective items ofwork.

(p) Facing bricks of the type specified conforming to IS: 2691 shall be laid in the positions indicated on the drawings and all facing brickwork shall be well bonded to the backing bricks/RCC surfaces. The level of execution of the facing brickworkshall at any time be lower by at least 600 mm below the level of the backingbrickwork.

(q) Facing bricks shall be laid over 10 mm thick backing of cement mortar. Themortar mix, thickness of joint and the type of painting to be carried out shall be as specified in the item of work.The pattern of laying the bricks shall be as specifically indicated in thedrawings.

(r) For facing brickwork, double scaffolding shall be used.

(s) Faced works shall be kept clean and free from damage, discoloration etc., atall times.

(t) Cutting of chases in 230 thick wall and above for routing GIpipes,CIpipesor for any other services shall preferably be in the vertical direction. Horizontalchases shall be avoided, as far as possible. The depth of vertical chases andhorizontal chases, if any, shall not exceed one third and one sixth of the thicknessof masonry respectively. Vertical chases shall not be closer than 2m in any stretch.Not more than 2 horizontal chases shall be permitted in a stretch of wall and theseshould be located in upper or lower one-third of height of wall. No continuoushorizontal chase should exceed 1m length. No horizontal chases will be permittedinhalfbrick wall.

No lintel need be provided for circular openings upto 400mm diameter in 230 mmthick wall and above. Similarly, no lintel need be provided for rectangular holes of300mm wide and below. No openings shall be provided in115mm thick brick wall.

7.4 CONCRETEBLOCKMASONRY

7.4.1Materials

Masonry units of hollow and solid concrete blocks shall conform to the requirementsofIS:2185(Part 1).

Masonry units of hollow and solid light-weight concrete blocks shall conform to the requirements of IS:2185(Part2).

Masonry units of autoclaved cellular concrete blocks shall conform othe requirements of IS:2185(Part3).

The height of the concrete masonry units shall not exceed either its length or six times its width.

The nominal dimensions of concrete block shall be as under.

(a) Length 400,500or600mm.
(b) Height100or 200mm.
(c) Width100to300mm in 50 mm increments
(d) Half blocks shall be in lengths of 200, 250 or 300 mm to correspond to thefull-length blocks. Actual dimensions shall be 10 mm short of the nominal dimensions.

The maximum variation in the length of the units shall not be more than ±5mm and maximum variation in height or width of the units shall not be more than ±3mm.

Concrete blocks shall be either hollow blocks with open or closed cavities or solidblocks.

Concrete blocks shall be sound, free of cracks, chipping or other defects which impair the strength or performance of the construction. Surface texture shall be asspecified.The faces of the units shall be flat and rectangular, opposite faces shall be parallel and all arises shal1 be square. The bedding surfaces shall be at right angles to the faces of the block.

The concrete mix for the hollow and solid concrete blocks/light weight concrete blocks shall not be richer than one part of cement to six parts of combined aggregates by volume i.e. (1:6).

Concrete blocks shall be of approved manufacture, which satisfy the limitations in the values of water absorption, drying shrinkage and moisture movement, asspecified for the type of block as per relevant IS code. CONTRACTOR shall furnish the test certificates and also supply the samples,for the approval of ENGINEER.

7.4.2Workmanship

The type of the concrete block, thickness and grade based on the compressive strength for use in load bearing and/or non-load bearing walls shall be as specified in the respective items of work. The minimum nominal thickness of non-loadbearing internal walls shall be 100 mm. The minimum nominal thickness of external panel walls inframed construction shallbe200mm.

The workmanship shall generally conform to the requirements ofIS:2572 for concrete block masonry, IS: 6042 for light weight concrete block masonry and IS:6041for auto claved cellular concrete block masonry works.

From considerations of durability, generally concrete block masonry shall be used in super structure works above the damp-proof course level.

Concrete blocks shall be embedded with a mortar which is relatively weaker than the mix of the blocks in order to avoid the formation of cracks. Cement mortar ofproportion1:6shallbeusedfortheworksunlessotherwisespecifiedintherespectiveitem sofwork.Preparation of mortar shall be asspecified in7.0ofCPWDSpecification-Vol-1.

The thickness of both horizontal and vertical joints shall be 10 mm. The first courseshall he laid with greater care, ensuring that it is properly aligned, leveled and plumb since this will facilitate in laying succeeding courses to obtain a straight and truly vertical wall. For the horizontal (bedding) joint, mortar shall be spread over the entire top surface of the block including front and rear shells as well as the webs to a uniform layer of 10 mm.For vertical joints, the mortar shall be applied on thevertical edges of the front and rear shells of the blocks. The mortar may be appliedeither to the unit already placed an the wall or an the edges of the succeeding unitwhenit is standingvertically and then placingithorizontally,well pressed againstthe previously laid unit to produce a compacted vertical joint.In case of two cellblocks with slight depression on the vertical sides these shall also be filled up withmortartosecuregreaterlateral rigidity. To assure satisfactory bond,mortar shall not be spread to of arahead of actual laying of the block as the mortar will stiffen and lose its plasticity. Mortar while hardening shrinks slightly and thus pulls away from the edges of the block. The mortar shall be pressed against the units with ajointing tool after it has stiffened to effect intimate contact between the mortar and the unit to obtain a weather tight joint. The mortar shall be raked to a depth of 10mm as each course is laid to ensure good bond for the plaster.

Dimensional stability of hollow concrete blocks greatly affected by variations of moisture content in the units. Only well dried blocks should be used for the construction. Blocks with moisture content more than25% of maximum water absorption permissible shall not he used. The blocks should not be wetted before or during laying in the walls. Blocks should be laid dry except slightly moistening their surface on which mortar is to be applied to obviate absorption of water from the mortar.

As per the design requirements and to effectively control cracks in the masonry, RCC bond beam/studs, joint reinforcement shall he provided at locations as perdetailsindicatedintheconstructiondrawings.Jointreinforcementshallbefabricatedeit

her from mild steel wires conforming to IS:280 or welded wire fabric/highstrength deformed bass as per the drawings.

Forjambsofdoors,windows and openings, solid concrete blocks shall he provided. If hollow units are used, the hollows shall be filled with concrete of mix1:3:6. Hold fasts of doors/windows should be arranged so that they occur at block course level.

At intersection of walls, the courses shall laid up at the same time with a true masonry bond between at least50%oftheconcreteblocks. The sequence for

construction of partition walls and treatment at the top of load bearing walls for the RCC slab shall be as detailed under clauseforthe brickwork.

Curing of the mortar joints shall be carried out for at least 7 days. The walls should only be lightly moistened and shall not be allowed to be come excessively wet.

Double scaffolding as per 7.0 of CPWD Specification-Vol-1. shall be adopted for execution of block masonry work.

Cutting of the units shall be restricted to a minimum. All horizontal and vertical dimensions shall be in multiples of half-length and full height of units respectively,adapting modularco-ordination for walls, opening locations for doors, windows etc.

Concrete blocks shall be stored at site suitably to avoid any contact with moisture from the ground and covered to protect against wetting.

7.4.3Measurement

Measurement shall be in cu. m. correct upto two places of decimal for walls ofthickness200mmandabove. Measurement shall be in sq.m correct upto two places of decimal for walls of 100mm/150mm in thickness. Measurement shall be for the quantities as actually executed duly deducting for openings, and concrete works. Concrete and reinforcement will be measured and paid separately. The rate quoted shall be for the type of masonry blocks specified in the respective items ofwork which shall include for the specific sequential operations as stipulated in the construction drawings.

7.5 DAMP- PROOFCOURSE

7.5.1Materials and Workmanship

Where specified, all the walls in a building shall be provided with damp-proof course to prevent water from rising up the wall. The damp-proof course shall run without a break throughout the length of the wall, even under the door or other openings. Damp-proof course shall consist of 50 mm thick cement concrete of 1:2:4 nominal mix with approved water-proofing compound admixture conforming to IS: 2645 inproportion as directed by the manufacturer. Concrete shall be with10mm down graded coarse aggregates.

The surface of brick/stone masonry work shall be levelled and prepared beforelaying the cement concrete. Side shuttering shall be properly fixed to ensure thatslurry does not leak through and is also not disturbed during compaction. The

upperand side surface shall be made rough to afford key to the masonry above and to theplaster.

Damp-proof course shall be cured properly for atleast seven days after which it shall be allowed to dry for taking up further work.

7.5.2Measurement

Measurementofdamp-proof course shall be in Sq.m correct to two places of decimal as actually executed.No separate payment will be made for form work.

8 CEMENTPLASTERING& POINTING WORK

8.1 PLASTERINGWORK

8.1.1Materials

The proportions of the cement mortar for plastering shall be 1:4 (one part of cement to four parts of sand) unless otherwise specified under the respective item of work. Cement and sand shall be mixed thoroughly in dry condition and then water added to obtain a workable consistency.The quality of water and cement shall be as per relevant IS. The quality and gradingof sand for plasteringshall conform toIS: 1542. The mixing shall be done thoroughly in a mechanical mixer unless hand mixing is specifically permitted by ENGINEER. If so desired by the ENGINEER sand shall be screened and washed to meet the specification requirements. The mortar thus mixed shall be used as soon as possible preferably within 30 minutes from the time water is added to cement. In case the mortar has stiffened due to evaporation of water this may be re-tempered by adding water as required to restore consistency but this will be permitted only upto 30 minutes from the time of initial mixing of water to cement. Any mortar which is partially set shall be rejected and removed forthwith from the site. Droppings of plaster shall not be re-used under any circumstances

8.1.2Workmanship

Preparation of surfaces and application of plaster finishes shall generally confirm to the requirements specified in IS:1661andIS:2402.

Plastering operations shall not be commenced until installation of all fittings and fixtures such as door/window panels,pipes, conduitsetc.arecompleted.

All joints in masonry shall be raked as the work proceeds to a depth of l0mm/20mmfor brick/ stone masonry respectively with a tool made for the purpose when themortar is still green. The masonry surface to be rendered shall be washed withclean-watertoremovealldirt,loosematerials,etc.,Concretesurfacestoberendered shall be roughened suitably by hacking or bush hammering for properadhesion of plaster and the surface shall be evenly wetted to provide the correctsuction. The masonry surfaces should not be too wet but only damp at the time ofplastering. The dampness shall be uniform to get uniform bond between the plasterandthemasonrysurface.

Interior Plain Faced Plaster - This plaster shall be laid in a single coat of 13mmthickness.The mortar shall be dashed against the prepared surface with a trowel. The dashing of the coat shall be done using a strong whipping motion at rightangles to the face of the wall or it may be applied with a plaster machine. The coat shall be trowelled hard and tight forcing it to surface depressions to obtain apermanent bond and finished to smooth surface. Interior plaster shall be carried outon jambs, lintel and sill faces, etc. as shown in the drawing and as directed byENGINEER. Rate quoted for plaster work shall be deemed to include for plastering of all these surfaces.

Plain Faced Ceiling plaster - This plaster shall be applied in a single coat of 6mmthickness.Application of mortar shall be as stipulated in 3.0 of CPWD Specification-Vol-1.

Exterior plain faced plaster - This plaster shall be applied in 2 coats.The first coat orthe rendering coat shall be approximately 14mm thick.The rendering coat shall be applied as stipulatedinrelevantclauseofCPWDspecifications,exceptfinishingitto a true and even surface and then lightly roughened by cross scratch lines toprovide bond for the finishing coat.The rendering coat shall be cured for at least twodaysandthenallowedtodry.Thesecondcoatorfinishingcoatshallbe6mmthick.Before application of the second coat, the rendering coat shall be evenlydamped.The second coat shall be applied from top to bottom in one operationwithout joints and shall be finished leaving an even and uniform surface.Themortarproportions for the coats shall be as specified in the respective item of work. The finished plastering work shall becuredforatleast7days.

Interior plain faced plaster 20mm thick if specified for uneven faces of brick walls orfor random/coursed rubble masonry walls shall be executedin 2coats.

Exterior Sand Faced Plaster - This plaster shall be applied in 2 coats.The first coatshall be 14mm thick and the second coat shall be 6mm thick.These coats shall beapplied as stipulated in clause 11.1.2 of this document. However, only approvedquality white sand shall be used for the second coat and for the finishing

work.Sandfor the finishing work shall be coarse and of even size and shall be dashed againstthe surface and sponged.The mortar proportions for the first and second coats shallbeas specified inthe respective itemsofwork.

Wherever more than 20mmthick plasterhas been specified, which is intended forpurposes of providing beading, bands, etc. this work shall be carried out in two orthree coats as directed by ENGINEER duly satisfying the requirements of curing each coat(rendering/floating) for a minimum period of 2 days and curing the finished work for atleast 7 days.

In the case of pebble faced finish plaster, pebbles of approved size and quality shallbe dashed against the final coat while it is still green to obtain as far as possible a uniform pattern allas directed by ENGINEER.

Where specified in the drawings, rectangular grooves of the dimensions indicatedshall be provided in external plaster by means of timber battens when the plaster isstill in green condition.Battens shall be carefully removed after the initial set of plaster and the broken edges and corners made good. All grooves shall be uniform in width and depth and shall be true to the lines and levels as per the drawings.

Curing of plaster shall be started as soon as the applied plaster has hardened sufficiently so as not to be damaged when watered.Curing shall be done by continuously applying water in a fine spray and shall be carried out for at least 7days.

When the specification items of work calls for water proofing plaster the CONTRACTOR shall provide the water proofing compound as specified while

preparing the cement mortar.Payment for water-proofing compound will be madeseparatelyifitis notincludedasacombineditemofwork.

Where lath plastering is specified, it shall be paid for at the same rate as for plaster workexcept that separate payment formetallath will be made.

For external plaster,the plastering operations shall be commenced from the top floor and carried downwards. For internal plaster, the plastering operations for thewalls shall commence at the top and carried downwards. Plastering shall be carriedout to the full length of the wall or to natural breaking points like doors/ windows etc.Ceiling plastershallbe completedfirst beforecommencingwallplastering.

Double scaffolding to be used shall be as specified in 7.0 of CPWD Specification-Vol-1.

The finished plaster surface shall not show any deviation more than 4mm when checked with a straight edge of 2mlength placed against the surface.

To overcome the possibility of development of cracks in the plastering work followingmeasuresshallbeadapted.

(a) Plastering work shall be deferred as much as possible so that fairly complete drying shrinkage in concrete and masonry work stakes place.

(b) Steel wire fabric shall be provided at the junction of brick masonry and concrete to overcome reasonably the differential drying shrinkage/thermal movement. This steel item shall be measured and paid for separately.

(c) Ceiling plaster shall be done, with a trowel cut at its junction with wall plaster. Similarly trowel cut shall be adopted between adjacent surfaces where discontinuity of the background exists.

8.1.3Measurement

Measurement for plastering work shall be in sq.m correct to two places of decimal.Unless a separate item is provided for grooves, mouldings, etc., these works aredeemed to be included in the unit rates quoted for plastering work. The quantity ofwork to be paid for under these items shall be calculated by taking the projectedsurface of the areas plastered after making necessary deductions for openings fordoors, windows, fan openings etc. The actual plaster work carried out on jambs/sillsofwindows,openings,etc.shall bemeasuredforpayment.

8.2 CEMENT POINTING

8.2.1Materials

The cement mortar for pointing shall be in the proportion of 1:3 (one part of cementto three parts of fine sand) unless otherwise specified in the respective items ofwork. Sand shall conform to IS: 1542 and shall be free from clay, shale, loam, alkaliand organic matter and shall be of sound, hard, clean and durable particles. Sandshall be approved by ENGINEER and if so directed it shall be washed/screened tomeetspecification requirements.

8.2.2Workmanship

Where pointing of joints in masonry work is specified on drawings/respective items of work, the joints shall be raked at least 15mm/ 20mm deep in brick/stone masonryrespectivelyasthe workproceedswhen themortar isstillgreen.

Any dust/dirt in the raked joints shall be brushed out clean and the joints shall bewashed with water. The joints shall be damp at the time of pointing. Mortar shall befilled into joints and well pressed with special steel trowels. The joints shall not bedisturbed after it has once begun to set. The joints of the pointed work shall be neat.The lines shall be regular and uniform in breadth and the joints shall be raised, flat,sunk or 'V' as may be specified in the respective items of work. No false joints shallbeallowed.

The work shall be kept moist for at least 7 days after the pointing is completed. Whenever coloured pointing is to be done, the colouring pigment of the colour required shall be added to cement in such proportions as recommended by themanufacturerandasapproved byENGINEER.

8.2.3Measurement

The quantity of work to be paid for under this Item shall be measured in sq.m correctto two places of decimal by taking the projected surface of the area pointed aftermakingnecessarydeductionsforopenings,etc.

8.3 WATER-PROOFINGADMIXTURE

Water-proofing admixture shall conform to the requirements of IS: 2645 and shall beof approved manufacture. The admixture shall not contain calcium chloride. Thequantity of the admixture to be used for the works and method of mixing etc., shallbe as per manufacturer's instructions and as directed by ENGINEER. Payment shallbe made for the actual quantity of such admixture used unless it is already coveredintheratefor therelevantitemofwork.

TECHNICAL SPECIFICATIONS
OF
INTERNAL PLUMBING WORKS
(SEWERAGE, STORM WATER & WATER)

Table of Contents

PLUMBING AND SANITARY TECHNICAL SPECIFICATIONS

1.0 Plumbing & Sanitary

1.1 Measures

1.1.1 Pipe sizing as per fixture unit sand flow asper NBC.

1.1.2 Water Fixtures in Toilets:
Water demand shall be reduced through selection of low-flow fixtures as per GRIHA requirements:

	Fixtures	**Max.Flowrates**
1	WaterClosets	2/4LPF
2	KitchenFaucets	4LPM
3	Urinals	1LPF
4	Lavatoryfaucets	4LPM

1.2 General

The scope of works for all internal plumbing works in building including manhole and valve chamber for drainage and water supply respectively. The plumbing system comprises Designing, supply, execution, delivery, installation, testing and commissioning, handover, training, maintenance and warranty all as described or reasonably implied in the Contract. The Contractor is obliged to provide fully functioning works and systems in conformance with the requirements of the Contract. In the event certain items arenot fully described or indicated in the Contract, but deemed essential by CLIENT in accordance with IS/NBC for the performance of the works and systems, then the provision of such items shall form part of the Contractors scope of works at no additional cost to the Employer

Shop drawings shall take into account actual measurement and setting out dimensions/ levels obtained and determined by the Contractor on site, actual equipment/ material used, actual routing of services, co-ordination with all installation, and site conditions/ constraints.

1.3 Scope of Works for Plumbing and Sanitary Installation

The scope of work mention here under are broad scope of work, however its contractor responsibility to make proposed development fully function meeting performance specifications. The Internal drainage up to first manhole (including manhole), internal

domestic, flushing water supply up to valve chamber (including valve chamber), is in thisscopeof work.

- Pumps, Equipment's, Pipes, Valves and access or ie sat terrace level with in building.
- Internal Soil, Waste and Vent pipes
- Drainage system with pumping arrangement.
- Terrace Rainwater/ Surface drainage system
- Sewerage and Drainage Connection from up to first manhole (including first manhole) of building.
- Internal water supply (Domestic & Flushing including Water Supply up to valve chamber (including valve chamber) of building.
- Level indicators for Overhead Water Tank. tanks
- All associated internal electrical works as per electrical specifications.
- Internal Works required as per local authority/ NBC to complete work.

1.4 Equipment and Materials

- Provide products and materials that are new, clean, free of defects, and free of damage and corrosion.
- Install materials and equipment with qualified trade people.
- Maintain uniformity of manufacturer for equipment used in similar application and sizes.

1.5 Equipment Selection

The capacities of all pumps and equipment described in the drawings are minimum capacities. The Contractor shall take into account of the offered equipment capacities to meet the performance requirement in the Contract and actual installation requirements.

Physical sizes of all pumps and equipment shall suit the space allocated, taking into account the requirement for access and proper maintenance.

Any proposal to deviate from the Specification and Drawings is subject to the Client approvalat his sole discretion. Upon approval, any necessary changes to the designing and installation as are silt of these deviations shall be the responsibility of the Contractor.

Proposed equipment shall be submitted for approval to the Client / Engineer in Charge before ordering. All necessary information requested by the Consultant for the review of the proposal shall besubmitted.

1.6 Excavation and Backfill

Provide trenches details, duly approved by the Client with all relevant section etc. as per IScodes.

The trench shall be of widths necessary for the proper execution of the work. Grade bottom of the trenches accurately to provide uniform bearing and support the work on undisturbed soil at every point along its entire length.

Excavate trenches for utilities that will provide minimum depths of cover from existing grade or from indicated finished grade as required by local authorities.

Trenches should be avoided within 3 meters of foundation or soil surfaces which must beresisthorizontalforces.

Do not backfill until all required tests have been performed and installation observed by the CLIENT / Engineer in Charge. Comply with the requirements of other sections of the specifications. Backfill shall consist of non-expansive soil with limited porosity. Deposit in 15 cm layers and thoroughlyand carefully tamp until the work has a cover of not less than 30 cm. Backfill and tamper mainderoftrenchat30 cm intervals until complete. Uniformly grade the finished surface.

1.7 Supports

Provide supports, hangers, auxiliary structural members and supplemental hardware requiredforsupportof thework.

Provide supporting frames or racks extending from floors lab to ceilings lab for work indicated as being supported from walls where the walls are incapable of supporting theweight.

Provide supporting frames or racks for equipment, which is installed in a free standingposition.

Supporting frames or racks shall be of standard angle, standard channel or specialty supportsystem steel members, rigidly bolted or welded together and adequately braced to form asubstantial structure. Racks shall be of amplesize to assure a workman like arrangement of all equipment mounted on them.

1.8 Fastenings

Fasten equipment to building in accordance with the best industry practice. Stainless Steel Fasteners will be used.

- Where weight applied to the attachment points is 45kg or less, conform of the following as a minimum:
  1. Concrete and solid masonry — Bolts and expansion shields
  2. Solid metal — Machine screws in tapped holes or with welded studs

- Where weight applied to the building attachment points exceeds 45kg, butis135kgor less, conform to the following as a minimum:

At concrete slabs provide approved fasteners.

Wall mounted equipment may be directly secured to wall by means of steel fasteners.

1.9 Identification/ Labels

Services runs shall be properly identified.

1.10 Spare Parts and Tools

The Contractor to submit with his Tender his recommended lists of spares parts for four yearsoperation and maintenance covering all systems and sub-systems of the specification. This list should be priced and the price fixed so that the Employer can, at his discretion, order these spare parts in part or in whole at any time up to the issue of the Performance Certificatewithoutanyincreasein price.

1.11 Samples

Samples showing fabrication techniques, quality and workman ship of component parts, compatibility of accessories shall be submitted for approval, upon request by the CLIENT / Engineer in Charge.

1.12 Warranties

The Contractor shall warrant that the capacity, rating or duty of all equipment used in theinstallation shall not be less than approved. Equipment/system not meeting this requirement shall be rejected.

1.13 Painting

a) Under Ground: All metal surfaces requiring painting shall be provided with two coats of asphalt aluminum paint, primer coated, and one coat off finished paint.

b) Exposed surface one coat primer –zinc chromate. Final paint–2coatsenamel.

No painting shall be done on damp surfaces.

Colour scheme as per IS shall be adopted.

1.14 SafetyEquipmentandNotices

Solid rubber insulated mats complying with relevant IS codes in front of and extending the full length of the control panel/ switch boards.

A copy of the main single line diagram, varnished and mounted on suitable hard backing and framed (in glass panel), showing clearly the full details of the electrical and Plumbing & Sanitary systems as supplied and installed.

Any other Notice as required by all local Authorities.

1.15 Testing and Commissioning

The Contractor shall be responsible for obtaining all necessary licenses as required by all relevant authorities before operation of any equipment/system.

All testing and commissioning to enable proper operation of the works shall be completed to the satisfaction of the CLIENT before the issuance of Taking over Certificate.

All final adjustments and final balancing of the equipment/ system operation shall be completed before the Date of Taking over Certificate.

The Contractor shall arrange for all submissions to Authorities and pay the cost of statutory inspections and certificates.

1.16 Operation and Maintenance Instructions Manual

The Operation and Maintenance Instruction manual shall be in A4 size paper and be bound inrigid covers covered and engraved with lettering giving the Employer's name, project name,ConsultantandCLIENT.

Final draft manuals must be submitted to the CLIENT for review before Taking Over Certificateis issued. After acceptance by the CLIENT, the Contractor shall submit Three (3) sets and a soft copy of this manual for record before Taking Over certificate is issued.

In general, each manual shall consist, but not be limited to the following section:-

1. Technical Specification

Schedules of equipment showing quantities, locations, types, operating duties.

Technical description of all systems and equipment, including circuit diagrams ofeach printed circuit board and component layout diagram for each printed circuitboardinstalled forthisproject.

Wiring diagrams. Manufacturer's drawings.

Equipment list, stating the make, model, serial number, accepted settings (after commissioning).

Catalogues, certificates and performance data sheets for all equipment.

2. Maintenance

To Provide: -Inspection manual for all system/ equipment;
Operation manual for all system/ equipment;
Procedure of changing components of equipment requiring regular replacement;
Maintenance instructions, calibration procedures and fault finding instructions for all systems;
Procedures for system fault finding.

1.17 Defect Notification Period

Defects Notification Period 12 months. The period commencing on the date of issue of the Taking-Over Certificate. During the Defect Notification Period, the Contractor shall provide a 24-hour'call-out'service to repair any equipment that has broken down.

2.0 Sanitary Fixtures

2.1 Part no. of sanitary work: Part No. of Sanitary ware and C.P. Fitting shave been specified. The contractor may of for equivalent of specified makes.

2.2 Toilets for Handicapped

Washroom facilities shall be designed to accommodate physically disabled as per UBBL. Accessories shall be provided as directed by CLIENT.

Stainless steel garb brass of required size suitable for exposed mounting and opened non-slip gripping surface shall be provided in all washroom. The flushing cistern shall be provided with dual plate cover.

2.3 Mock-up and Trial Assembly

The installation of the sanitary fixtures and fittings shall be as per the shop drawings approved by the CLIENT. 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 assemblyshall be developed to determine the location of puncture holes, holding devices etc. whichwill be required for final installation of all sanitary fixtures and fittings. The above assembly shall be subject to final approval by the CLIENT.

The fixtures in the trial assembly can be re-used for final installation without any additional payments for fixing or dismantling of the fixtures.

2.4 Supporting and Fixing Devices

The contractor shall provide all the necessary supporting and fixing devices to install thesanitary fixtures and fittings securely in position. The fixing devices shall be rigidly anchored into the building structure. The fasteners shall be SS304 and shall be so fixed that they do not present an unsightly appearance in the final assembly.

2.5 Final Installation

The contractor shall install all sanitary fixtures and fittings in their final position in accordance with approved trial assemblies. 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.

3.0 Soil, Waste, Vent & Rain Water, External Sewage and Drainage Pipes

3.1 Scope

The scope of this section comprises the supply, installation, testing and commissioning of internal drainage services.

3.2 BasicPipingSystem

For Soil, Waste & Rain water Drainage System - Concealed & Exposed pipes and fittings -for all hanging/suspended, vertical & embedded

Noise Insulated Polypropylene Piping

System SOCKET PIPES

Three Layer sound insulated Polypropylene piping (PP) system as per EN 1451-Part 1 & EN12056 Part 1-5, with 3-layer pipe, push-fit type, food safe, having high impact and stiffness,sound levels of not more than 16 dB, with built in Push fit factory fitted sealing ring socket with all fittings

The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outersurface being as nearly as practicable concentric. They shallbe sound andnicely cast,shallbe freefromcracks,taps, pinholes andothermanufacturingdefects.

FITTINGS:

Single- Layered fitting reinforced with mineral aggregate, factory fitted lip/sealing ring, hotwater resistant up to 95-degree centigrade in accordance to ON EN 1451-PART 1-6 EN 12056 PART1-5.

INSTALLATION:

The piping system must be clamped properly as required, pipes passing through walls, beams, slabs, columns should pass through sleeves which are padded with insulation material internally (between pipe and sleeve) covering the pipe to avoid transfer of body and structural borne sounds. The piping should not touch any wall, structure, paneling, false ceiling etc.

Traps

Floor & UrinalTraps

Floor traps shall be siphon type full bore PP, having a minimum 50 mm deep seal.The trap and waste pipes when buried below ground shall be set and encased in cement concrete blocks firmly supported on firm ground or when installed on a sunken RCC structural slab. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size).

Floor TrapGrating

Floor and urinal traps shall be provided with100-150 mm square or round stainless steel gratings, with frame and rim of approved design and shape as approved by CLIENT / Engineer-In-Charge.

PipeProtection

Soil and waste pipes under floor in sunken slab sand in wall chases shallbe encased incement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate of 12 mm size) 10 cm bed and around.

CleanoutPlugs

Floor Clean Out and line clean out plugs

Clean out plug for soil, waste or rain water pipes laid under floors shall be provided near pipe junctions bends, tees, “Y” and on straight runs at such intervals as required as per site conditions. Clean out plugs shall terminate flush with the floor levels. Line clean outs shall be supported with manufacturer provided bracket. They shall be of push fit type.

General:

The soil pipes shall be circular with a minimum diameter of 100mm. All bends, branches, swan neck and other parts shall conform to the requirement and standards as described for the pipes.

The soil pipes shall be continued upwards without any diminution in its diameter, without any bend or angle to the terrace. All vertical soil pipes shall be firmly fixed to the walls withproperly fixed clamps, and shall as far as possible be kept 100mm clear of wall as permanufacturerspecifications.

Every waste pipe shall discharge thru gully trap/master trap. The contractor will ensure that this requirement is adequately me with. Whereverfloortrapsareprovided, itshallbeensured that at least one wash is connected to such floor traps to avoid drying of water seal inthe trap. Anti-syphon vent pipes/relief vent pipes shall be of PPE pipe, conforming to the requirements laid down earlier. The pipes shall be of the 100mm dia meter minimum.

All pipe sand fittings before installation at site shall be tested hydrostatically to a pressure of 0.45Kg/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 minutes. All these tests shall be carried out in the presence of the representative of the CLIENT / Engineer In Charge. Test certificate from manufacturers be obtained before dispatch of material to site.

3.3 Underground Sewerage/Strom Water Pipes –External Network.

Double coiled wall HDPE Pipe for soil waste and storm water will be IS: 16098

Part-2. All pipe sand fittings to be HDPE manufactured as per relevant IS

Standards.

Installation

All pipes and fittings to be fusion welded by either electro sleeve coupling or butt weld.

Fixed points must be provided at a maximum of 5 meter intervals and/or changes in direction.

Intermediate sliding supports must be provided in accordance with the manufacturer recommendations/application technique manual

All operatives to be trained in welding and jointing techniques by the manufacturer.

Inspection & testing

The work shall be inspected and tested during installation at agreed stages. All work which will be concealed shall be tested before it is finally enclosed.

Work to be inspected regularly by the manufacturer who is to verify compliance with manufacturer's installation guidelines

3.4 Installation of Soil, Waste, Rainwater & Vent Pipes (Internal)

Soil, waste & vent pipes in shafts underthe floors / suspended below slab shall consist of PPE pipes. Waste pipes from bottle trap to floor/urinal traps for wash basin, urinal and sink shall be PPE pipes and fittings. All waste pipe shall not be less than 40 mm dia.

All Horizontal pipes running below the slab and along the ceiling, shall be fixed on structural adjustable clamps, sturdy hangers of the design as approved by CLIENT. The pipes shall be laidin uniform slope and proper levels. All vertical pipes shall be truly vertical fixed by means ofstout 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 byusing pipe fittings with provision 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. Where the horizontal run off the pipe is long or where the pipes cross over buildingexpansion joints etc. suitable allowance shall be provided for any movements in the pipes by means of expansion joint etc. such that any such movement does not damage the installation in anyway.

3.5 Testing

Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested.

Before use at site all pipes shall be tested by filling up with water for at least 60 minutes.

After filling, pipes shall be inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48hours.

After the installation is fully complete, it should be tested by flushing the toilets, running at least 20% of all taps simultaneously and ensuring that the entire system is self-draining, has no leakages, blockages etc. rectify and replace where required.

A test register shall be maintained and all entries shall be signed and dated by the Contractor and CLIENT.

All pipes in wall chase or meant tobe encased or buried shall be hydro tested before the chase in plastered or the pipe encased or buried.

4.0 Sewerage & Drainage System

4.1 Scope

The scope of this section comprises the supply, installation, testing and commissioning ofexternal drainage & sewage disposal services up to first manhole nearby buildings in phase-01buildings.

4.2 General Scheme

The contractor shall install a drainage system to effectively collect, drain and dispose all soiland waste water from buildings. The piping system shall finally terminate anddischarge into the STP / Municipal Drainage Line. The piping work mainly consists of laying of pipes. All piping shallbe installed at minimum depth greater than 80 cm below finished ground level. The disposalsystem shall include construction of gully traps, manholes, intercepting chambers. The workshall be executed strictly in accordance with relevant IS standards. The sewage system shallbe subjectto smoketest foritssoundness asdirected.

Pipes shall be double wall coiled HDPE class with coupler and elastomeric sealing ringinternalsurfacedouble wallnon-issuanceasper IS:16098 (Part-2).

a. Sewer lines including earthwork for excavation, disposal, backfilling and compaction, pipelines, manholes, drop connection sand connections to sewer network.

b. Storm water drainage: earth works for excavation, disposal, back filling and compaction, pipelines, manholes, catch basins.

General Requirements

All drainageworkshall bedoneinaccordancewiththelocalmunicipalbye-laws.

Contractor shall obtain necessary approval and permission for the drainage system from themunicipaloranyother competent authority.

Location of all manholes, etc shall be got confirmed from the ‘Consultant’ before the actualexecutionofworkat site.

Sewer and Storm Water Pipes up to 1000 mm: Non Smooth External Surface Type- ‘B’Double Wall Corrugated PE pipes (Smooth Inner Wall) as per ISO 21138/IS:16098 Part-2-2013.

Manhole for sewerage - RCC construction with double seal CI Manholes covers 560 mm dia.Manholefor StormWater- RCCconstructionwith perforatedSFRCcovers 600mmdia.

4.3 Alignment & Grade

The sewer and storm water drainage pipes shall be carefully laid to levels and gradients asper approved shop drawings. Great care shall be taken to prevent sand etc. from entering thepipes. The pipes between two manholes shall be laid truly in straight lines without vertical or horizontal undulations. The body of the pipes shall rest on an even bed in the trench for its length. No deviations from the lines, depths of cuttings or gradients as called for on the shop drawings shall be permitted without the written approval of the CLIENT / Engineer In Charge. All pipes shall be laid atleast 100cms below the finished ground level or as called for on the shop

drawings.

Trench Excavation

The trenches for the pipes shall be excavated with bottoms formed to level and gradients as per shop drawings or as directed by the CLIENT / Engineer In Charge.

All excavations shall be properly protected where necessary by suitable timbering, piling and sheeting as approved by the CLIENT / Engineer In Charge. 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 Consultant. It shall be carried out under thorough and competent supervision, with the written permission of the appropriate authorities taking full precautions. All excavated earth shall be kept clear of the trenches.

WidthofTrench

The CLIENT shall have power by giving an order in writing to the Contractor to increase the maximum width/depth for excavation and back filling in trenches for various classes of sewer, manholes and other works in certain length to be specifically laid down by him, whereon account of bad ground on other unusual conditions, he considers that such increased width/depths are necessary in view of the site conditions.

CastIron GullyTrap

Gully trap shall be cast iron conforming to relevant IS standards. These shall be sound andfree from visible defects such as fire cracks, or hair cracks. They shall give a sharp clear notewhen 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 willalso have a water tight CI cover with frame inside dimensions 300 x 300mm the coverweighing 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.

Fixing of Gully Trap

The excavation for gully traps shall be done true to dimensions and levels as indicated onplans or as directed by the Consultant. The gully traps shall be fixed on cement concrete foundation 65cm square and not less than 10cm thick. The mix for the concrete will be 1:4:8.The jointing of gully outlet to the branch drain shall be done similar to the jointing of Pipes described earlier. After fixing and testing gully and branch drain, a brick work of specifiedclass in cement mortar 1:5 shall be built with a half brick masonry work round the gully trapfrom the top of the bed concrete upto ground level. The space between the chamber and trap shall be filled in with cement concrete1:3:6.The upper portion of the chamber i.e. above the top level of the trap shall be plastered inside the cement mortar 1:3 finish with a floating coatof neat cement. The corners and bottom of the chamber shall be rounded off so as to slope towards the grating.

C.I cover with minimum frame 300 x 300 mm (inside) shall then be fixed on the top of the brick masonry with cement concrete 1:2:4 and rendered smooth. The finished top cover shall be so as to prevent the surface water from entering the gully trap.

4.4 Grease Trap

Sizeof GreaseTrap
The contractor shall design the grease trap as per no. of users for kitchen of civic amenities buildings. Work shall be executed as per approved shop drawings.

BedConcrete

Shall be in 1:4:8 cement concrete 150mm thick.

Brickwork

Brick work shall be with best quality bricks in 1:5 cement

mortar. Baffle walls shall be of R.C.C

Finishing

The walls of chamber shall be finished with white glazed tiles.

4.5 Chamber Covers

Covers shall be of cast iron or MS chequered plate,covered with aluminum sheet on both sides.

C.I. steps shall be provided at two corners of the chamber.

All Cast Iron and MS items shall be painted with two coats of bitumastic paint.

Stainless steel perforated trays and guide bars SS-304 Grade will be provided for removing grease.

4.6 Cast iron Manhole cover and Frame

The heavy duty Cast Iron Manhole Cover and Frame shall conform to IS:1726 and the grade.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 a raised checkered design on the top surface to provide an adequate non-slip grip.

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 brittle as to chip off at a temperature of 0°C.

4.7 Testing

Sewer and storm water lines shall be tested for straightness by:

i. The contractor shall carry smoke test to the drain and sewer a this own expense and charges to delete changes, if any.

ii. A test register shall be maintained which shall be signed and dated by contractor and Owner's site representative.

iii. Retest shall be carried after revamp.

iv. A test register shall be maintained which shall be signed and dated by contractor and owner's site representative.

v. Sufficient quality of treated water to be flushed for commissioning of lines.

5.0 Plumbing valves

5.1 Work Included

Provide and install valves as approved by 'Consultant' in shop drawing.

Submittals

Shop Drawings and Product Data:

5.2 Scope of Work

For flanged valves, provide companion flanges of same PSI rating/class of valve being used. Provide all valves rated not less than16 kg/cm2 working pressure.

Mark each valve at the factory with the following minimum information, engraved, stamped or cast on each valve or metal tag permanently attached to the valve.

Manufacturer's name. Catalogue or Figure number.

Size and pressure class.

Arrows shall indicate direction off low on check, globe, angle, non-return and eccentric plug valves.

Valves shall be ISI marked.

Generally, all the valves upto 50mm dia shall be of gunmetal/bronze body with screwedends and shall be provided with unions on both the sides for removal and repair, unlessinstructedotherwise.

Valves above 50mm dia shall be butterfly valves with flanged ends and shall be provided with flanges on both the sides for removal and repair.

Provide valves on all main branches of water supply as approved shop drawings. Provide all valves, check valves, PRV, strainers of same size as the pipes in which

they are installed.

5.3 GateValves

Gate valves shall be as per IS 778.The screwed female ends shall be to BSPT and flanged ends shall be to IS 778.

Gate valves up to 50 mm shall be of hand wheel operated with bronze body, with screwed in bonnet, non-rising spindle and solid wedge, with threaded ends.

Gate valves larger than 50 mm shall be of cast iron body with bronze mountings and shall be provided with flanged ends.

5.4 Globe Valves

Globe valves of size 40mm or less shall be as per IS 778 and of size 50mm or more shall beas per IS 780. The screwed female ends shall be to ASME B 16.11 and flanged ends shall betoASME B 16.5. Itshall have screwed in bonnet, gun metal rising spindle and gland packing.

All globe valves 50 mm and smaller shall be of bronze body with screwed in bonnet, rising spindle and with threaded ends.

All globe valves larger than 50 mm shall be of cast iron body and shall be provided with flanged ends.

5.5 BallValves

Ball Valves shall be of IS 9890, Gun metal with screwed female ends to IS 554, flanged ends to ASMEB 16.5.

Provide full bore, quarter turn, lever operated ball valves with S/S ball and SS (AISI 410) spindle with Teflon seating and gland packing. All ball valves shall have locking handles to allow servicing and removal of equipment.

Provide lever handle with plastic sleeve on all ball valves unless otherwise noted. Provide extension stem for all ball valves to be installed on insulated piping.

5.6 CheckValves

Check valves of size 40mm or less shall be as per IS 778 and of size 50mm or more shall beas per IS 780. The screwed female ends shall be to ASME B 16.11 and flanged ends shall betoASMEB 16.5.

All check valves 50mm and smaller shall be of bronze body and disc, threaded ends.

All check valves 65mm and larger shall be of slimline, swing type cast iron body with epoxy coated ductile iron/ stainless steel trim and shall be of flanged end.

All check valves shall be spring loaded.

5.7 Sluice Valves

Sluice valves shall be ductile Iron double flanged, with rising spindle. Each sluice valve shallbe provided with wheel for valves in exposed positions and Cap Top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with Cap Tops.

Sluice valves shall be conforming toI.S:780 of PN rating approved.

Sluice valves shall be high performance valves manufactured of Ductile Iron body, epoxy coated ductile iron / 316 stainless disc and stainless steel stem with SS-410 shaft.

5.8 Pressure Reducing Valves (Bellow type)

Pressure reducing valves shall be of Gun metal/bronze body with screwed female ends to BSP.

Pressure reducing valves shall have high quality Nitrile rubber "O" ring and setting pressure of 1-2Kg/cm2 in the down streamside.

Provide strainer, isolation & reducing valves.

5.9 Air ReleaseValves

Air release valves shall be single acting type air valves with cast iron body and bronze/gun metal internal parts and plastic float.

5.10 Testing

All pipes, fittings and valves shall be tested by hydrostatic pressure of min. 1.5 times the working pressure.

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site. (+10%). A test register shall be maintained and all entries shall be signed and dated by Consultant.

In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains.He shall rectify all leakages, and shall replace all defective materials in the system. Anydamage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and Fixtures shall be made good during the defects liability period without any extra cost.

After completion of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do noteffectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

7.0 Pipe Identification

Identify with symbol identification and colour-code all piping. Provide directional arrows on circulating systems separate from and adjacent to each identification. Identification in conformance with the relevant IS standards.

Colour Coding: The following colour coding shall beused:

Service	A.S.A. Colour background	Colour Of Letter	Designation
Domestic Cold Water	Green	White	DCWS
Domestic Hot Water Supply	Green	White	DHWS
Make-up Water	Green	White	
Sanitary Sewer	Green	White	
Sanitary Sewer Vent	Green	White	
Rainwater	Green	White	
Sprinkler	Red	White	Sprinkler
Standpipe	Red	White	Standpipe

7.1 Valve Identification

7.2 Equipment Identification

Properly identify each piece of equipment and controls pertaining there to by name plates mounted on equipment and controls.

8.0 Water Coolers (DrinkingWater)– Only for amenities Buildings

Scope

To design and install the RO plant as per JB water quality at site and deliver treated waterfrom the RO plant to water cooler. Sufficient contingency in the design shall be kept onaccount of variation in quality of raw water. The no of water coolers will be planned to cater to population as per JB Norms.

9.0 Design Parameter

Thereverseosmosisplantshallbesuitablefor minimumof12hoursperdayoperation.

10.0 Plumbing Performance Specifications

PLUMBING PERFORMANCE SPECIFICATIONS			
S.NO	**PARAMETERS**	**REQUIREMENTS**	
[1]	**General**	(i)	Recharge of surplus rainwater runoff into aquifer to be carriedout through appropriate filtration and treatment measures to remove minimum 80%Total Suspended Solids

		(ii)	Water Fixtures in Toilets: Water demand to be reduced through selection of low-flow fixtures by minimum 50% over the following IGBC base line flowrates: Fixtures — Max.Flowrates 1 Water Closets — 2-4LPF 2 KitchenFaucets — 4LPM 3 Urinals — 1 LPF 4 Lavatoryfaucets — 4LPM 5 Showerhead — 8LPM
[2]	**SanitaryFixtures**	(i)	Wall mounted W.C. flush pipe/bend to be connected to the W.C. by means of suitable rubber adapter
		(ii)	Wallhung W.C. to be supported by C.I. wall mounted bracket with concealed cistern.
		(iii)	Each wash basin to be provided with 32mm dia C.P. waste 32mm dia C.P Brass Bottle Trap with C.P. connection pipe towallwithflange
		(iv)	Urinals to be provided with 15 mm dia C.P. spreader, 32 mm dia C.P. domical waste and C.P. brass bottle trap with C.P pipe to wall with flange and to be fixed to wall by one C.I. bracket and two C.I. wall clips battery operated sensor.
		(v)	Each sink to be provided with 40mm dia C.P.waste with chain and plug.
[3]	**Soil,Waste,Vent& Rainwater**	(i)	PipeshallbeofPolypropylenePipe(PPE)asperEN:12056& EN: 1451, Multi – layer, Low Noise Level with built inPushfitfactoryfittedsealingringsocketwith allfittings.
		(ii)	Head (starting point) of drains and sewage / waste watersumps (as and where applicable) having a length of greaterthan 4 m up to it connection to the main drain or manhole tobeprovidedwith100mmventpipe.
[4]	Polypropylene Pipe(PPE) - for exposed & embedded areas. (Soil,Waste,Vent & Rain water)	(i)	The pipes and fittings to conform to IS:15905 per EN:12056&EN: 1451.

PLUMBINGPERFORMANCESPECIFICATIONS			
S.NO	**PARAMETERS**	**REQUIREMENTS**	
		(ii)	For pipes, access door 1m above floor level to be made up with 3mm thick insertion rubber washer.
		(iii)	All pipes and fittings before installation at site to be testedhydrostaticallytoapressureofsmoketestingwithout showinganysignofleakage,sweatingorotherdefectsofany kind. The pressure to be applied internally and to bemaintainedfornot lessthan15 minutes
[5]	GalvanizedIronPipes	(i)	Glpipes of 50mm dia and below and where called for shallbegalvanizedironpipesscrewedandsocketedconfor mingtotherequirementsof IS:1239 of mediumgrade
[6]	RainWaterPipesandF ittings	(i)	PipeshallbeofPolypropylenePipe(PPE)asperEN:12056& EN:1451,Multi–layer,LowNoiseLevelwithbuiltin Pushfitfactoryfittedsealingringsocketwith allfittings.
[7]	CastIronClass(LA)pip es	(i)	Alldrainagepassingunderbuildingfloorandpassingthroughr etainingwalltobecastironclass(LA)pipes(IS: 1536)
		(ii)	Fittingstobeusedforcastironclass(LApipesshallconformt oIS:1538-1976)
[8]	Painting	(i)	Non-Flat Paintsand Coatings: VOC not more than150g/L.Anti-Corrosive Coatings VOC not more than250g/L
[9]	Testing	(i)	Testingto bedoneinaccordancewithIS:1172andIS:5329
[10]-a	Internal Water Supply System (Exposed and Concealed)	(i)	Piping system to consist of stainless steel-304asperJIS:3448 for fittings JWWAG116:2001 standards.
	Internal Water Supply System(Exposed and Concealed) - EWS	(ii)	Piping system to consist of PPR SDR – 6.0, PN – 20 Gradewith Brass threaded fittings – For distribution rising mains and terrace
		(ii-a)	Piping system to consist of PPR SDR – 7.0, PN – 16 Grade with Brass threaded fittings–For internal distribution concealed with in toilets, kitchen etc.
[10]-b	External Water Supply Mains	(i)	PPR SDR – 6.0, PN – 20 Grade up to 80 mm dia with brass threaded fittings. For above 80 mm dia - Ductile Iron Pipes K-9 as per IS:8329/IS:9523,PN-16, epoxy coating, flanged connection for jointing.
[11]	Testing	(i)	System to be hydrostatically pressure tested at 150psi(16Bar) for one hour

[12]	G.I.Pipes &Fittings	(i)	Pipes to be galvanized mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS:1239. The Galvanizing to conform to IS:4736, the zinc coating to be uniform, adherent reasonably smooth and free from such imperfections

PLUMBINGPERFORMANCESPECIFICATIONS			
S.NO	**PARAMETERS**	**REQUIREMENTS**	
[13]	Fitting	(i)	Fixing to be done by means of standard pattern holder batclampskeeping thepipes about1.5 cm clear ofthewallwhereto belaid onsurface
[14]	Testing	(i)	Pressuretestingtobedonefor12hoursandthenputintooperationonregular basis
[15]	Piping Insulation Support(ValidforGI)	(i)	14 gauge metal sheet to be provided between the insulationand the clamp, saddle or roller, extending atleast 15 cm. onbothsides ofthe clamps, saddlesorroller
		(ii)	All buried pipes for Cold and Hot Water Supply to be cleaned andcoated with two coats of bitumen and then wrapped with two layers of 400micron polythene sheet coating
		(iii)	All valves to be of 15mm pipe size and to be associated with an equal size isolation ball valve. Automatic air valves also tobe provided on hot water risers
[16]	WaterMeters	(i)	MeterstoconformtoIndianStandardIS:779andIS:2373ora sapplicable.
[17]	Testing	(i)	All water supply system to be tested to hydrostatic pressure test of atleast one and ahalf(1.5)times the maximum pressure (but not less than 16Kg/Sq.cm) for a period of not less than 12 hours
[18]	Valves	(i)	Gate, globe and check valves to conform to Indian StandardIS:776 and non-return valves and swing check type reflux toIS:5312. Sluice valves to conform to Indian standard IS:780andIS:2906
[19]	PressureReliefValves	(i)	Pressure relief valve in a pressure reducing station to have a flow capacity equal to that of the pressure reducing valve
[20]	PressureGauge	(i)	It shall be stainless steel Bourden tube type pressure gaugewith a scale range from 0 to 16 Kg / cm square and to beconstructed as per IS:3524. Each pressure gauge to have asiphontubeconnection
[21]	Sewerage&Drainage System	(i)	Work to be executed strictly in accordance with IS: 1742. Allpipingtobeinstalledatdepthgreaterthan80cmbelowfinishedgroundlevel
[22]	Trenches	(i)	Pipesbetweentwomanholestobelaidtrulyinstraightlineswithoutvertical orhorizontalundulations
		(ii)	Trenches for the pipes tobe excavated with bottoms formed to level and gradients
		(iii)	Excavatedearthtobekeptclearofthetrenchestoadistanceequalto75 cms

[23]	HDPE Pipes(Double Coiled)	(i)	Pipes for sewerage and storm water to be HDPE DWC classSN8 pipeswithcoupler, internal surface double wall non-pressureasperIS-16098 Part-2/2013.
[24]	C.I.GullyTrap	(i)	Gully trap to be cast iron conforming to IS:651. The gullytraps to be fixed on cement concrete foundation 65cm squareand not lessthan10cmthick
[25]	Manhole Cover forSewer	(i)	Manholes covers shall be of cast iron. Heavy duty double sealMH cover 560 mm with size 1200x1200x150mm around theMHCover.
[26]	Testing	(i)	Smoketestingtobecarriedoutfortestingofsewerageandstormwater pipes.
[27]	PlumbingValves	(i)	Allvalvesratednotlessthan16kg/cm2workingpressureforplumbingsystems unlessindicatedotherwise
		(ii)	All the valves up to 50mm dia to be of gunmetal/bronze bodywith screwed ends and to be provided with unions on both thesidesforremoval and repair
		(iii)	All the valves above 50mm dia to be of CI body with flangedends and to be provided with flanges on both the sides forremovaland repair
		(iv)	GatevalvestobeasperIS778.Thescrewedfemaleendstobe to BSPTand flangedends tobeto IS778
		(v)	Allgatevalvesupto50mmtobeofhandwheeloperatedwith bronze body, with screwed in bonnet, non-rising spindleandsolidwedge,withthreadedendsasspecifiedand asrequiredbythe pipingsystem

PLUMBINGPERFORMANCESPECIFICATIONS			
S.NO	**PARAMETERS**	**REQUIREMENTS**	
		(vi)	Gate valves larger than 50 mm to be of cast iron body withbronze mountings and to be provided with flanged ends asrequiredbythe pipingsystem
		(vii)	Globe valves of size 40mm or less to be as per IS 778 and ofsize 50mm or more to be as per IS 780. The screwed femaleends to be to ASME B 16.11 and flanged ends to be to ASMEB16.5
		(viii)	All globe valves 50 mm and smaller to be ofbronzebodywith screwed in bonnet, rising spindle and with threaded endsandasrequired bythepipingsystem
		(ix)	All globe valves larger than 50 mm to be of cast iron bodywith bronze mountings and to be provided with flanged endsasrequiredbythepipingsystem
		(x)	BallValvestobeofIS9890,Gunmetalwithscrewedfemaleendsto IS554, flanged ends toASMEB16.5
		(xi)	Check valves of size 40mm or less to be as per IS 778 and ofsize 50mm or more to be as per IS 780. The screwed femaleends to be to ASME B 16.11 and flanged ends to be to ASMEB16.5
		(xii)	Checkvalves50mmandsmallertobeofbronzebodyanddisc,threaded ends orasrequired bythepipingsystem
		(xiii)	Check valves 65mm and larger to be of cast iron body withepoxy coated ductile iron/ stainless steel trim and to be offlangedend asrequired bythepipingsystem
		(xiv)	All valves 80mmdiaandabove to be Butterflyvalve
		(xv)	ButterflyvalvestobeofbestqualityconformingtoI.S13095
		(xvi)	ButterflyValves200mmorlargertohavegearoperatorwithcrankhandleorhand wheel
		(xvii)	ButterflyValvessmaller than 150mmtohavepositionlevers
		(xviii)	Where Butterfly valves are located 2 m above floor level inequipmentrooms,chain wheeloperatorsandchainstobeprovided
		(xix)	Sluice valvestoconformtoI.S:780
		(xx)	Butterfly valvestobe installed for isolating the main branches above 80mmdia
		(xxi)	Pressure reducing valves to have high quality Nitrile rubber"O"ringandsettingpressureof1-3Kg/cm2inthedownstreamsideunlessstated otherwise

PLUMBINGPERFORMANCESPECIFICATIONS			
S.NO	**PARAMETERS**	**REQUIREMENTS**	
		(xxii)	Airreleasevalvestobesingleactingtypeairvalveswithcastiron bodyandbronze/gunmetalinternalpartsandplastic float
		(xxiii)	Scourvalvestobewithcastironbodywithflangedconnections
		(xxiv)	Strainers to be Y type strainers with gunmetal/bronze body upto 50mm dia and stainless steel body above 50mm dia andhavescrewed femaleendsto BSPT,flangedendsto BS:10
[28]	Pumps	(i)	EachHydroPneumaticPumpingunittobesuppliedasacomplete set including variable/fixed speed pumps, pressurevessels suction and discharge common manifolds, non-returnvalves, isolating valves, pressure transmitters on the dischargeside and level electrode at the suction tank. Each unit to beprovided with electronic microprocessors for unit control andallnecessaryelectrical workfortheunit
		(ii)	Submersiblewaterre-circulationpumpforwaterfountain,drainagepumpsforplantroomdrainagecompletewithelectricalpanelsand necessary accessorieswith automationfor pump operation
		(iii)	PumpperformanceatvariouspumpspeedsandHydropneumaticpumpsmustbeabletosupplyatleast2barpressureatthe highest/farthest fitting
		(iv)	Pumpstobesoselectedthatthedesigndutypointiswithin5% ofthemaximumefficiencypoint
		(v)	Pump to have a speed of not more than 1500 rpm. However,pumps of 2900 rpm with high efficiency and low noise motorcanbeselected.Vibrationisolatorstobeprovidedforall pumpsets
[29]	Vertical Multi-StagePumps	(i)	Pump motors above 7.5 kW to be equipped with couplingwhich allows changing of shaft seals without removing themotor. The pump motors to be of Class "F" insulation andIP55ratingandtobe provided withbuilt-inthermistors
[30]	Variable SpeedHydropneumaticPumpingSystemforIrrigation	(i)	Unitstobeselectedsoastoprovideatminimumof3barresidualpressureatthelawn hydrant.
		(ii)	System to be under the control of an electronicmicroprocessorunit (EMU)
		(ill)	Variablespeeddrivepumpingsystemtomaintainaconstant pressureregardlessofthesystemdemand

[31]	PumpPressureVessel	(i)	Diaphragmtypepressurevesselstobeprovided&incorporated into the system so that during normal operationthepumpnotneedtobestartwithin30secondsofitswitching off in order to prevent the pump hunting capacity asspecified.

PLUMBINGPERFORMANCESPECIFICATIONS			
S.NO	**PARAMETERS**	**REQUIREMENTS**	
[32]	SubmersiblePumps	(i)	Each pump to be provided with a suitably rated inductionmotor suitable for 230V/415V, 3 phase, 50 Hz A.C. powersupply,as persize.
		(ii)	Pump motorto beasquirrel cageinduction,housedinairfilledwater-tightenclosure.Oilfilledmotorsarenotacceptable.Thestatorwindingstobe Class"F"insulation.
		(ill)	Motorstobedesignedforcontinuousrunningdutytype230V/415V, 3 phase, 50 Hz power supply and capable ofsustainingaminimumof20starts/stops per hour

NOTE:

The EPC Contractor has to carry out the detailed engineering design of services in coordination withArchitectural, Structural and other services requirement as per the duly approved layouts to beobtainedbytheEPCContractor.

The services drawing are indicative and show the detailed design parameters to be adopted: makesof sanitary fixtures and fittings to be used; by the contractor in addition to parameters specified inDBR andTechnicalSpecification.

Development of facilities at Eco-Park, Jharkhand

APPROVEDMAKESOFPLUMBINGSYSTEM

Sr.No.	Materialdescription		Approvedmakes
1.	VitreousChinaSanitaryware	:	Duravit,Kohler,Hindware,
2.	CPFitting	:	Jaguar,Kohler, Hindware
3.	CI(Spun)Pipes/fittings	:	NECO/SKF
4.	i)uPVCPipe&Fittings	:	AKG/Supreme/JainPVCPipe/Prince
5.	ii)uPVCSWRPipes&Fittings	:	AKG/Supreme/JainPVCPipe/ Prince
6.	CPVCPipe&Fittings	:	Supreme/Astral/Ajay/Ashirwad
7.	G.I.Pipes/MSpipe	:	TATASteel/Jindal(Hissar)
8.	G.I.fittings(Malleable)	:	TATASteelCrescent/Unik/Zoloto‘M’
9.	WCPanConnector	:	MCAlpine(UK)/Multikwik(UK)/Veiga
10.	StainlessSteelGrating	:	Chilly/Camry/Cardin
11.	BallValve	:	Zoloto/SANT
12.	Butterflyvalves	:	Zoloto/SANT
13.	CheckValveForgedScrewed	:	Zoloto/SANT
14.	AirReleaseValve	:	Zoloto/SANT
15.	MotorisedValve	:	Zoloto/SANT
16.	FloatValve(C.I)	:	Sant/Leader/SANT/CSA
17.	PRV	:	Honeywell/SANT/SKS

18.	PipeSupports,Clamps	:	Hilti/Chilly/Camry
19.	Anti-CorrosiveBitumasticPaint	:	Asian/Berger
20.	EpoxyPaint	:	Asian/Berger
21.	Pipe Protection for WaterSupply Pipes	:	Pypkote/Makpolykote/Coaltek
22.	PressureGauges	:	Fiebig/HGuru
23.	Fasteners	:	Hilti/Fischer/Canon
24.	R.C.CPipe	:	JainSpunPipe/Pragati/DewanSpun Pipe
25.	SFRCManholeCover/Grating	:	K.K.Manhole
26.	C.IManhole Cover(IS:1726–1991)	:	NECO/CrescentFoundry
27.	D.I.ManholeCover/Grating	:	NECO/RIF/BIC
28.	RecessedManholeCover	:	NECO/RIF/SKF
29.	C.I.Grating	:	NECO/RIF/SKF
30.	GullyTraps	:	Perfect/RK/Anand
31.	Plastic Encapsulated FootRests	:	KGM/Patel
32.	CleanoutPlug	:	Neer/GMGR
33.	WaterMeter	:	Kent/SANT/Actaris
34.	SSBellows	:	Kanwal.
35.	RainwaterOutlet	:	Aco/Neer
36.	GIPipeSealment	:	Henkel-LOCTITE55

38.	HDPEPipes&Fittings	:	Kissan/Finolex
39.	SSPipes	:	Remi/Viega
40.	Paint	:	AsianPaints
41.	GateValve/Non-returnValve	:	Zoloto/Audco
42.	FootValve	:	Advance/Kirloskar
43.	CheckValve–DualPlate	:	Zoloto/Advance/SANT
44.	CheckValve–WaferType	:	ZolotoAdvance/SANT
45.	FlowControlDevices	:	Aquaplus/Con-serve/Jaquar/RST
46.	FloorDrainFixture&ChannelGratings	:	ACO/GMGR/Neer
47.	Floortrapframe&grating	:	Neer(Material:SS)
48.	'Y'Strainer	:	Advance/Zoloto
49.	Pumps	:	KSB,Grundfos/Mather&Platt
50.	Boosterpumpswithpressuretanks	:	KSB,Grundfos
51.	Storm water / sewagesubmersibleps umps	:	KSB,Grundfos
53.	TransferPumps	:	KSB,Grundfos
54.	Self-PrimingPumps	:	KSB,Johnson/Kirloskar
55.	DomesticWaterLiftPumps	:	KSB,DP/Grundfos
56.	MechanicalSeal	:	Burgmann/Sealol
57.	Couplings	:	Lovejoy

	FlexibleConnection		
58.	WaterTank/PlasticSteps	:	KGM/Patel/PranaliIndustries
59.	ElectronicFlowMeter	:	Krohne(forbesMarshall)/Rockwin
60.	LevelController&Indicator(Water)	:	Autopump/Technika/Techtrol/ Pumptrol
61.	GRP/FRPtanks	:	Sintex/Thermoset/Binani/Devi Polymers/Smartage
62.	LiquidLevelControllers	:	Honeywell/JohnsonControl
63.	Pipe protection tapeConcealed/Buried	:	Tapex/PipeCoat
64.	CILAClasspipe&fittings	:	Electrosteel/Neco
65.	ToiletAccessories	:	Kohler/BobRick
66.	KitchenSink	:	Nirali/Frankee/Jayna
67.	SoapDispenser	:	Jaguar/Kohler
68.	RainWatercollectionkurra	:	Neer

69.	Sch-80pipesandfittings	:	Astral/Ajay/Ashirvad
70.	PPRpipeandfittings	:	Supreme/Prince

TECHNICAL SPECIFICATION

OF

ELECTRICAL WORKS

INDEX

1.0 Contractor's Obligation after award of Contract

- CONTRACTOR shall ensure that design of equipment shall be as per specification requirements.
- The CONTRACTOR shall carry out detailed engineering including the technical specification and data sheets, for entire system including illumination system, electrical equipment, cabling system, earthing, and civil works required for completion of Works.
- Light fixtures selected by the CONTRACTOR shall be submitted to implementing agency for approval.
- The CONTRACTOR shall submit detailed electrical load calculation, sizing calculation of electrical equipment and explanation on how the fixtures identified are energy efficient before supply and execution of work.
- Walkway/ Pathways shall be considered for Pathway Lighting.
- Detail design and drawing of point wiring and indoor lighting arrangement for buildings like Ticket & information counter, Cafeteria, Rest rooms, Gaushala, Guardroom etc. shall be in the scope of the Contractor. Indoor light fixtures, fans, exhaust fans, wires, DB, switch boards in indoor areas shall be in the scope of CONTRACTOR.
- CONTRACTOR shall take due care of the site Seismic conditions while designing all equipment/ components used in lighting and electrical systems covered in this specification. CONTRACTOR shall furnish list of design parameters considered in design to fulfill the above requirement.
- Design and detail engineering of the materials procured by CONTRACTOR is included in the scope. CONTRACTOR shall submit each document/ calculation of system which is included in scope to GSCL or its representative for final review/ approval. All design documents/ calculations prepared by CONTRACTOR shall be duly signed by CONTRACTOR and stamped. Documents submitted without fulfillment of this requirement will not be considered as a submission and will be rejected.
- Expert or manufacturer supervision for Sub-CONTRACTOR supplied material shall be provided by BIDDER and included in offer.
- CONTRACTOR shall be solely responsible for any shortages or damages in transit for his supply scope, handling and/ or in storage of any materials and erection of the equipment, supply of erection tools at site. CONTRACTOR shall ensure that it will not affect any activity

or project schedule. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the CONTRACTOR.

- Arrangement of Power supply till tariff meter shall be in the scope of Jharkhand Govt. Battery limit of the CONTRACTOR starts after tariff meter. The entire distribution after tariff meter shall be inthe scope of CONTRACTOR. The necessary liaison for power supply connection shall be done by the CONTRACTOR.
- Obtaining approval including load sanction/ load release from Jharkhand Govt. shall be in the scope of CONTRACTOR. All the statutory fees for the above approvals shall be borne by Implementing Agency. Such payments shall be reimbursed to the CONTRACTOR upon submission of stamped receipts tothe Implementing Agency. The approvals will include consent for commencement of work and obtaining permission to charge/commission.
- All the cost towards liaison with statutory Bodies for seeking all necessary statutory approvals and other activities involving Govt. Agencies viz., drawing approval, testing and commissioning etc, shall be borne by the CONTRACTOR.
- CONTRACTOR's scope shall also include all civil works and structural works required for installation of all electrical equipment/ systems such as equipment foundations, Pole foundations and all excavation and backfilling works including those for lighting, earthing, cabling systems etc.
- BIDDER should visit site and get ascertained regarding the complete scope of work before submission of Bid.
- This specification is the minimum requirement and should be read in conjunction with relevant latest specifications, requirements, rules and regulations of the Local Authority. Any additional requirements as per Local Authority or latest Standards shall be considered by the BIDDER.
- All SAFETY considerations in design and manufacturing for safe operation & maintenance and safe practices during installation at site shall be in the scope of the CONTRACTOR. Cost towards accomplishing the same shall be included in the BID price and no extra claim shall be entertained later.
- Equipment furnished/ supplied under this scope of works shall be complete in every respect with all mountings, fittings, fixtures, and standard accessories normally provided with such equipment and / or needed for erection, completion and safe operation of the equipment as required by applicable codes though they may not have been specifically detailed in the Technical Specification. Materials and component not specifically stated in the specification but which are necessary for commissioning and satisfactory operation shall be deemed to be included in the scope of specification and shall be supplied without any extra cost. All similar standard components/ parts of similar standard equipment provided shall be inter-changeable with one another.
- The CONTRACTOR shall be responsible for the selection and design of appropriate equipment to provide the best co-ordinated performance of the entire system. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.
- The material supplied by the CONTRACTOR shall be subjected to approval of the designated Authorities of Implementing Agency. Samples of the Supply material under the scope of works shall be inspected by Implementing Agency or their representatives either at site or at Manufacturer's works and approve them for supply and execution. Notwithstanding any approval/ instruction given otherwise, if the Implementing Agency, during random checkup, finds any nonconformance with the quality of

material supplied by the CONTRACTOR with respect to the technical specifications, Implementing Agency shall have the Authority to reject the entire lot/ batch of that particular material and ask to replace without any cost and time impact to Implementing Agency.

- During the construction at site, it shall be the CONTRACTOR's responsibility to take care ofthe safety and security of its person and material at site. The CONTRACTOR shall be self-reliant with all the requirements including tools and tackles for digging, filling, erecting, lifting, etc. and consumables required for construction like electricity and water at his own cost.
- The CONTRACTOR shall carryout the installations in a safe and responsible manner without any inconvenience or danger to public. The CONTRACTOR shall take care not to damage any public/ private property by mistake or by intention during the course of work with its actions and shall be well insured to compensate the owner in case any such incidence happens.
- CONTRACTOR shall plan and carry out all supply, installation, testing and commissioning ofthe entire electrical system conforming to the approved drawing, technical specification and good engineering practices.
- Even if all components of a system included in this specification are not explicitly identified and/ or listed herein, these shall be supplied under this contract to ensure completeness ofthe system and facilitate proper operation and easy maintenance. Any and all other works not indicated above but necessary/ required to complete the job in all aspects, are included in the CONTRACTOR's scope.
- Implementing Agency reserves the right to issue addendum to the technical specification to indicate modification/ changes in the requirements, if so required at a later date.

2.0 DESIGN CONCEPT

- The design concept of lighting system as a whole is based on providing visually and aesthetically improved illumination; providing safe, reliable & stable power and efficient performance of electrical system.
- The design standard described herein is in accordance with latest BIS standards and National Lighting Code 2010.
- The design standards described herein are generally in compliance with the Central Electricity Authority Regulations 2010, latest Indian Standards, State Electricity board standards and code of practices already established in the country.
- The design ambient temperature for all electrical equipment shall be 45□C.

3.0 PROJECT DETAILS

- Site/ Environmental Conditions:
  - (a) Ambient Temperature: 45ºC (site specific)
  - (b) Relative Humidity: 5 - 95%
  - (c) Area Classification: Non-Hazardous
  - (d) Seismic Data: As per IS 1893: 1984 (Reaffirmed in 2018).
- Power Supply Distribution Voltage:
  - (a) HV -11kV, 3 Phase, 3 Wire, 50 Hz, AC
  - (b) LV - 415V, 3 Phase, 4 Wire, 50 Hz, AC
  - (c) Lighting - 240V, 1 Ph, 2 Wire, 50Hz, AC
  - (d) Voltage Variation: -

i. For 11kV, as per CEA Regulations

ii. For 0.415kV, as per CEA Regulations

(e) Frequency Variation: □ 3%

(f) Combined Voltage & Frequency Variation: □ 10%

- System Earthing:

(a) 11 kV, 3 Ph AC system: Neutral Solidly Earthed

(b) 415 V, 3 Ph, AC system: Neutral Solidly Earthed

(c) 240 V, 1 Ph, AC system: Neutral Solidly Earthed

(d)

4.0 POWER DISTRIBUTION ARRANGEMENT

- A dedicated two pole structure, Lightning arrestor, Dropout fuses and Distribution Transformer shall be installed at these two points for HT supply requirements by Jharkhand Govt.
- Tariff metering shall be provided as per the latest guidelines and specification of the Jharkhand Govt.
- All power supply arrangement including installation of two pole structure with transformer upto tariff meter shall be in the scope of Jharkhand Govt. and shall be carried out by Jharkhand Govt. on depository basis. Further, the distribution from tariff metering to load point shall be in the scope of CONTRACTOR.
- One Outdoor Main LT Distribution Board shall be provided at each supply point. The LTDB shall have MCCB at Incomer and MCB's at outgoings for further distribution of the load.
- The feeder pillars shall be provided for power distribution over the landscape area and other area. The zone of the feeder pillar shall be limited to outgoing circuit of length not more 300 meters on either side.
- Individual Diesel Generator set shall be considered for 0-500 mtr, 500-1000mtr and 1000-1380 mtr stretch in the River Front to provide 100% load back up for Pathway/ Walkway Lighting, Parking, Toilets, Admin office, Electrical room, Ticket & information Center and Area Lighting along with Entry-Exit points & Streets etc.
- The feeder pillars shall be provided with two 4P MCB's with Auto change over switch the incomer. The auto changeover switch shall control the incoming supply in such a way that inone time only one incomer supply shall feed the bus. The incoming supply shall be from MainLT distribution board and from DG.
- The Local Distribution Board (LDB) shall have one 4P MCB in incomer. Incoming supply shall be fed from feeder pillar. Astronomical timer shall be considered in the incoming for each LDB. LDBs shall be mounted on structural support/ column wall with bottom of panel at1200mm from FGL. Four pole RCBO shall be considered in the outgoing feeders of the LDB.
- Separate LDB shall be considered to supply power to Toilets, Admin office, Electrical Room and Ticket & Information center without timer.
- Single Line Drawing (SLD) - TCE.10477A-EL-3000-AU-40041is attached for reference.
- Cabling system shall be provided with 1.1 kV grade, XLPE/ PVC insulated, multi-stranded Al/ Cu, GI round wire/ flat strip armoured power cable. All the Cables shall be laid in DWC/ HDPE pipe and buried underground at 750mm.

- Separate and individual power cable of 1.1 kV grade, XLPE/ PVC insulated, multi-stranded Al/ Cu, GI round wire/ flat strip armoured shall be provided for illumination of Pathway lighting and landscape lighting. The size of the cable provided shall not be less than 4 Sq mm Al.
- Internal point wiring shall be done as per Jharkhand PWD building norms.
- The size of the cable provided shall not be less than 2.5 Sq mm for small lights like down lighters, step lights etc.
- Three-way Junction boxes of IP67shall be provided for the distribution of the power to the load points.
- Power supply arrangement for the Lease out areas such as Cafeterias, Restaurants, Commercial Shops, Food Kiosk and Jetty area shall be provided from outgoings of Main LT Distribution Board.
- Based on the load distribution over the Landscape area and Boulevard, adequate numbers of Local Distribution Board shall be considered for further distribution of the power. The Local Distribution Board supply power to the various elements of Landscape and other areas as required.

5.0 DESIGN CRITERIA

➢ ILLUMINATION SYSTEM

- Latest version of related IS Standards and National Lighting Code 2010 (NLC) shall be referred for designing Illumination for different areas.
- Lighting design shall be performed using Dia Lux Software version 4.12 or its latest version.
- The illumination shall be designed creatively for enhancement and improvement of the look and feel of the various elements of the project area aesthetically and visually. This criteria for such illumination cannot be defined in terms of standard values or factors as specified in the standards for all elements however certain elements like pathway / walkway etc. shall be designed as per required standards as specified.
- While designing the lighting system major principles of designs to be followed are as follows

  (a) Lighting Lux Level.

  (b) Luminance Distribution.

  (c) Direction of Incidence of Light and Shadow effect.

  (d) Free Public movement.

  (e) Hazard free space for Visitors and Pedestrians.

  (f) Daytime Appearance of the Installation - It is very important to ensure that the luminaire positions determined for night time lighting are aesthetically appropriate and do not spoil the view of the site during the day.

  (g) Glare - It is necessary to eliminate direct and/or reflected glare which could give discomfort to the vision of the visitors and pedestrians.

  (h) Accessibility for Maintenance - For periodical maintenance, lamp replacement, cleaning of luminaires and readjustment of disturbed luminaires should be as easy as possible. Care shall be taken during the designing stage to make the installation accessible and ensure easy handling of luminaires.

  (i) No Light Pollution including the Night sky.

- Lighting Design

(a) Following factors shall be considered while arriving at the utilization factor to determinethe number of fixtures for each area.

(i) Maintenance Factor

a. Indoor Area Lighting with LED Luminaire: :0.8
b. Outdoor Area Lighting with LED Luminaire: : 0.7

(ii) Uniformity factor shall be considered as per National Lighting code 2010.

(iii) The illumination levels given in below table shall be considered for the illumination ofthe respective area.

Table 1: LUX Requirement

Sr. No.	Area	Illumination Level (Lux) - Average values
1	General Garden Area	4-10 Lux
2	Path Way/ Walk Way/ Cycle Track/ Ramp	15 Lux
3	Parking	50 Lux
4	Internal Road	15 Lux
5	Toilet Block/ Public Toilet	150 Lux
6	Bhakta Niwas/ Ticket Information Counter, Prasadalaya	200 Lux

(b) For Pathway/ Walkway Lighting-

- Pathway Lighting shall be designed such that, it enables a visitor to navigatedown the walkway safely.
- It shall provide better aesthetic to overall landscape.
- It shall be designed with LED luminaries.
- The walkway/pathway shall be lit up with Post Top lantern (PTL). The PTLs shall be mounted on the Five (5) meter GI poles. The wattage of the PTL shall not be less than 35 Watt and placement of the PTL shall be designed insuch a way that it shall achieve the required LUX level.
- Bollards are also considered to illuminate the walkway / pathway.
- Width of the pathway /walkways / shall befrom 2 to 15 mtr.
- The lighting Level to be achieved on pathways/walkways shall be 15 Lux with Uniformity ratio of 0.4. Luminaire with colour temp of minimum 3000K shall be used

(c) Indoor Lighting –

- Indoor Lighting shall be provided in bhakta Niwas, Ticketing Area, Shopping Complex Public Toilets(07 Nos.), Food Court, Committee Office, security office etc.
- Extruded Aluminium batten LED fixture shall be considered for indoor lighting.
- The luminaire wattage shall not be less than 20W.

- Selection Of Luminaries-
  - Selection of the luminaries for Landscape and Riverfront lighting shall be done on the basis of specifications provided in Datasheet.
  - CONTRACTOR shall submit the detail lighting plan in consultation with landscape architect and take prior approval from Implementing Agency or its representative after award of contract.
  - CONTRACTOR shall provide better options for lighting concept and LED luminaries with optimized cost.

➢ **CABLE SIZING**

- The CONTRACTOR shall ensure that cable and wires associated with the power distribution and control systems, point wiring and all other installations are adequately rated for their use. Following main aspects shall also be considered while deciding the final size of the cables.

a) Supply voltage and frequency.

b) All cables shall be selected to carry the corresponding full load current under site conditions.

c) Route length and disposition of cables.

d) Maximum allowable temperature rise under normal full load condition based on the materialof cable insulation (XLPE/ PVC).

e) For Cables emerging from LTDB, fault clearing time shall be considered as 0.5 second.

f) For Cables emerging from MCCB / MCB outgoing, fault clearing time shall be considered as 0.01 second.

g) CONTRACTOR shall note that, the above fault clearing times are minimum to be considered& fault clearing time shall be according to Power system.

h) Appropriate de-rating factors as per cable manufacturer's catalogue and enlisted below shallbe considered for sizing the cable:

➢ **DG SIZING**

i. The capacity of the DG shall be based on the total simultaneous maximum demand of the loads. The loads which shall be considered for DG sizing are flood lights, post top lights, Up down lights, uplights, Step lights, bollards, LED Batons lights.

ii. After consideration of 10% contingency over the above maximum demand (MD), sizing of the selected DG shall be such that the maximum loading of the DG shall not exceed 80% at 0.8 PF.

➢ FAULT LEVEL CALCULATIONS

Fault level at the secondary of the transformer and at 415V LT panels shall be calculatedbased on the transformer rating and impedances of transformer and connecting cables.

➢ EARTHING SYSTEM

- The safety earthing shall be on the basis of following codes and standards
  - IS 3043 -2018; Code of practice for Safety Earthing.
  - CEA guidelines - 2010
- The fault levels considered shall be as follows:

System	Fault level in kA
a) 415V System	*25 kA for 1 sec

(*) CONTRACTOR to design on the basis of actual impedance & adequacy calculations forsufficiency of earth conductor size shall be provided.

- Following factors shall be considered for sizing the earthing conductor:
  - Design Ambient Temperature : 45□C
  - Allowable temperature rise of steel welded joints : 500□C
  - Fault Clearing Time : 1 Sec
  - Overall earthing resistance : ≤ 1 Ohms

➢ CIVIL DESIGN

- All the Civil foundation design shall be suitable for the Seismic requirement of the specific district of Jharkhand State as per latest IS.
- The design shall be done considering the maximum wind speed of min 180 kmph as per IS 875-Part 3-(2015)
- As foundation may encounter the river water in rainy season, hence Grade of concrete to be used shall not be less than design Mix M30 and grade of reinforcement steel shall be Fe500D.
- Minimum requirement for Civil Foundations for Lighting poles up to a height of 12.5m are as follows;

  (a) Four anchor bolts shall be of M24 and 750 mm total length is required.

  (b) Concrete pedestal Size -500 mm x 500 mm

  (c) 40NB Flexible HDPE/ DWC Pipe of appropriate length shall be embedded to draw the power cable.

- Minimum requirement for Civil Foundations for the Lighting Pole of height 5 m are as follows;

  (a) Size of base plate considered is 250 mm X 250 mm having thickness 12 mm.

  (b) Four anchor bolts of 16mm dia and 700 mm total length.

(c) 20NB Flexible HDPE Pipe of appropriate length shall be embedded to draw the power cable.

6.0 TECHNICAL SPECIFICATION

➢ LIGHTING LUMINARIES

- Applicable Standard for LED Luminaries

Sr. No.	Brief Title	IS/IEC Code
1.	Testing procedure of photometric testing for LED luminaires	LM 79
2.	Testing procedure on the lifespan of LEDs	LM 80
3.	National Lighting Code	SP72-2007
4.	Method of Measurement of Lumen Maintenance of Solid-State Light (LED) Sources	IS:16105-2012
5.	Method of Electrical and Photometric Measurements of Solid-State Lighting (LED) Products	IS:16106-2012
6.	Limits of Harmonic Current Emissions	IS 14700-3-2-2008
7.	DC or ACsupplied electronic control gear for LED modules performance requirements	IEC 62384-2006
8.	Lamp control gear: particular requirements for DC or AC supplied electronic control gear for LED modules	IEC 61347-2-13-2014
9.	Environmental Testing: Test Z- AD: composite temperature/ humidity cyclic test	IEC 60068-2-38-2009
10.	Electro Magnetic compatibility (EMC)- Limits for Harmonic current emission-– (equipment input current ≤ 16 A per phase)	IEC 61000-3-2-2018
11.	EMC Immunity requirement	IEC 61547-2009
12.	LED modules for general Lighting-Safety requirements	IEC 62031-2018
13.	Classification of degree of protections provided by enclosures(IP Codes)	IEC 60529-1989,Amd2013
14.	Fixed general purpose luminaries	IEC 60598-2-1-1979
15.	General Lighting - LEDs and LED modules – Terms and Definitions	IS:16101-2012 / IEC TS62504-2011

Sr. No.	Brief Title	IS/IEC Code
16.	LED Modules for General Lighting Part 1 Safety Requirements	IS:16103(Part1)-2012
17.	LED Modules for General Lighting Part 2 Performance Requirements	IS:16103(Part2)-2012
18.	Safety of Lamp Control Gear, Part 2 Particular RequirementsSection 13 D.C. or A.C. Supplied Electronic Control gear for Led Modules	IS:15885(Part2/Sec13)-2012

- Environmental Conditions

The average atmospheric condition during the year is mentioned below. The equipment shall be designed to work in such environmental conditions:

(a) Maximum ambient air temperature: 45° C

(b) Minimum ambient air temperature: 5° C

(c) Max. Relative humidity: 90%

(d) Atmosphere: Dusty and Humid

(e) Rainfall data:1600 mm

The equipment shall be suitable to sustain and work in the humid and dusty atmosphere of Guwahati.

- Luminary/Fixture Description

(a) All Luminaires shall be BIS certified, robust & sturdy, manufactured out of Quality raw material/ inputs with proper Quality checks at each step designated to last long in the kind of application they are selected to work.

(b) All selected outdoor Luminaires shall be minimum IP65 protected except indoor luminaires and certified for IK 07.

(c) All RGB luminaires shall be manufactured from well binned LEDs to provide and maintain same Colour consistency over long duration of operations.

(d) The Luminaires shall offer Flicker free output for long duration.

(e) All Luminaires shall be Suitable to operate at auto-switching input voltage for 100 – 240 VAC, 50 Hz power supply with the tolerances as mentioned in the data sheet.

(f) The luminaire light output (lumen) shall be constant and shall be able to withstand allowable supply source voltage variations/ fluctuations, spikes.

(g) The entire fixture shall consume rated wattage as per data sheet maximum at full output.

(h) The LED luminaries shall be single, self-contained device with integral electronic control

gear, without requiring on-site assembly for installation.

(i) Fixture shall have lens options.

(j) All the Luminaire shall be completed with necessary accessories & mounting arrangements.

(k) The Luminaries shall have housing as mentioned in datasheet.

(l) The LED system should be digitally driven using noise-shaping pulse width modulation (PWM) techniques and use integral and differential nonlinear control.

(m) LED fixture shall merge line voltage with control data and deliver them to the fixture over a single standard cable from the power and data interface to ensure minimum cabling work to aesthetic and safety purpose.

(n) A microprocessor-controlled Solid State Lighting driver shall be considered, which will efficiently and accurately condition and manage power output to LED systems directly from line voltage.

(o) The Luminaries Housing shall be suitable for termination of 4C X 2.5 sqmm copper conductor PVC insulated flexible Cable with Double Compression Cable Glands.

(p) All the connecting wires inside the Luminaire shall be low smoke halogen free, fire-retardant cable.

(q) Luminaires should conform to the IS standards for Safety & Performance and test certificates as per IS 16107-2012 should be provided by the manufacturer. In case of luminaires are imported, the CONTRACTOR shall conform to test parameters as per equivalent standards.

(r) The electrical component of the LED and LED driver must be suitably enclosed in sealed unit to function in environment conditions mentioned earlier.

(s) Design of the thermal management shall be done in such a way that it shall not affect the properties of the diffuser.

(t) All LED fixtures shall undergo a minimum 24-hour burn-in test during manufacturing.

(u) The LED fixture shall be operated at constant and carefully regulated current levels. LEDs shall not be designed to be driven beyond their specified nominal voltage and current.

(v) High-power LED fixtures shall be thermally protected using metal core board, gap pad, and/or internal monitoring firmware thermal management techniques.

(w) LED fixture housing shall be designed to transfer heat from the LED board to the outside environment.

(x) The equipment should be compliant to IEC 60598-1, IEC 62031 and IEC/ PAS 62612 depending on the type of luminary.

(y) All the material used in the luminaries shall not contain any toxic material and fire retardant confirming to relevant standards.

(z) The control gear shall comply to the provisions of IEC 61347-2-13-2014, IEC 62031-2018 and IEC 62384-2006 as appropriate.

(aa) LED luminaries, should conform to the various National / International standards for safety & performance. Manufacturer should submit LM 79 & LM 80 test reports fromNABL accredited laboratory.

(bb) Outdoor LED fixtures shall meet lumen maintenance standards as per LM-80, pass water ingress testing, and pass general endurance testing.

(cc)

(dd) (cc) All hardwired connections to LED fixture shall be reverse-polarity protected and shall provide high-voltage protection in the event that connections are reversed or shorted during installation.

(ee)

(ff) (dd) In Jharkhand the switching surges are expected in the power supply system. Appropriate surge protection shall be provided by the CONTRACTOR for all the Luminaires offered. Such protections can either be provided centrally at the Feeder Pillar or at each individual luminaire level or a combination of both, as may be decided by the CONTRACTOR. No claim for failure of Luminaires, on account of voltage surges other than Lightning surges, will be considered.

(gg)

(hh) (ee) The Luminaires shall be suitable for operation within the input supply voltage range specified. The driver of the light should be able to sense and cut-off power to the light in case of phase-to-phase/ 440 V fault. No claim in this regard shall be considered.

(ii)

(jj) (ff) The lighting fixtures offered shall comply with the data sheet. (gg) The luminaire shall have a warranty period of 5 years.

(kk) (hh) The CONTRACTOR shall develop and submit working and as built drawings of entire electrical system. All the operational manuals for all the fixtures installed to implementing Agency after the completion of work.

(ll)

(mm) (ii) All Luminaries under CONTRACTOR's supply scope shall be guaranteed against quality (including any component failure and deterioration/appearance of corrosion symptoms. This shall also cover any fading (reduction)/ deterioration of reflector coating). In such case the defective luminaire shall be replaced without any cost. In case identical defects are observed on more than 5% of particular type of luminaire (installed quantity), thenthe complete lot of supplied/ installed luminaires of similar type shall be replaced free of cost.

- **<u>TECHNICAL SPECIFICATIONS OF HIGH MAST</u>**

- Structure: The High mast shall be of continuously tapered, polygonal cross section, 20 sided, presenting a good and pleasing appearance and shall be based on proven In-Tension design conforming to the standards referred to above to give an assured performance and reliable service. The height of the mast and other details shall be as mentioned in BOQ.

- Construction: The mast shaft shall be manufactured from high tensile steel plates confirming to BS EN 10025 having minimum yield strength of 355N/Sq. mm. Each mast shaft section shall have only one longitudinal weld and without any circumferential weld joint. Sections with more than one longitudinal weld shall not be accepted. The mast base flange shall be free from any lamination or incursion and provided with supplementary gussets between the bolt-holes to ensure elimination of helical stress concentration.
  The minimum A/F dimension of top shall be 150 mm and bottom as per the design and data sheet enclosed. The minimum section length except for the top section shall be 10.98 m and top shall depend on the length required to make the specified height. The masts sections shall

be joined at site by slip-stress-fit method and minimum overlap distance shall be 1.5 times the diameter at penetration.

- A door reinforced with welded steel section, vandal resistant, weather proof with Allen bolts and pad locking facility of dimension 1200 mm x 250 mm shall be provided at a height 2 times the width of door from the base of mast to provide clear access to base compartment equipment winch, motor, cable, connector etc.
- For the environmental protection of the mast, the entire fabricated mast shall be hot dip galvanized internally and externally in single dip having a uniform average thickness of 85 microns for plates more than 5 mm and 70 microns for 5 mm or less thickness.
- Dynamic Loading for the Mast: The mast structure shall be suitable to sustain an assumed maximum reaction arising from a wind speed (47 m/sec) as per IS 875 (three second gust), and shall be measured at a height of 10 meters above ground level. The design life of the mast shall be 25 years. The force co-efficient taken for design of the polygonal structure is tobe established from the wind tunnel test data.
- Luminaries Carriage:Hot dip galvanized Luminaries carriage designed to install luminaries as per illumination design, its control gear boxes and junction box. The same is to be fabricated from ERW tubes in two halves and flanges joined at site with stainless steel bolts and nyloc nuts. Holes are to be provided in the bottom side of tubes to act as conduit for wiring cable. PVC lining is to be provided in the inner side of carriage to avoid metal contact with mast surface.
- Cast Aluminium weather proof junction box shall be provided on the Carriage Assembly for terminating the trailing cable and power cable to luminaries.
- Raising and lowering mechanism:

➢ Winch:

The double drum winch shall be completely self-sustaining without the need for brake shoe, springs or clutches and self-lubricating type by means of an oil bath. The worm gear ratio shall be 53:1 and safe working load 750 Kg. The drums are to be grooved to provide perfect seat for stable and tidy rope lay and arrangement for distortion free rope end termination.

The winch shall have provision to operate manually by a handle or electrically through power tool. The capacity, operating speed, safe working load, recommended lubrication and serial number of the winch shall be marked on each winch.

➢ Head Frame:

The hot dip galvanized head frame is to be designed as a capping unit of the mast is of welded steel construction and provided with guides and separators between the ropes and cable. The LM6 Aluminum pulley's with bush bearing mounted through stainless steel shaft shall be suitable to accommodate wire ropes and multi core trailing cable. The head frame shall be provided with guides and stops with PVC buffer for the docking of luminaries carriage. The pulley assembly shall be covered by a hot dip galvanized canopy.

➢ Stainless Steel Wire Ropes:

The stainless-steel wire ropes shall be in AISI 316 grade, 7/19 construction with central core in the same material of 8mm diameter. The breaking load of each rope shall not be less than 3450 Kg giving a factor of safety of over 5 for the system at full load as per the TR-7. The end construction of rope for the winch drum shall be fitted with tal urit and for two continuous ropes the end termination in luminary's carriage shall be with stainless steel thimble and copper splicing and for others with stainless steel thimble and bull dog grips.

a) Electrical System, Cable and Cable Connections:

The multi core trailing cable from base compartment to junction box at luminaries carriage shall be 1.1 KV grade EPR insulated, PCP sheathed copper conductor with male female connectors of size minimum 5 core x 2.5 sq. mm. There shall be two nos. cables per mast. Wiring from junction box to luminaries is to be done using 2 core 1.5 sq. mm PVC insulated, PVC sheathed, copper conductor flexible cable.

Suitable arrangement is to be provided in the base compartment to receive and terminate incoming power cable and MCB in a box for isolation of incoming power supply.

- Power Tool for the Winch: Three phase, single speed, 6 pole high-powered motor of rating suitable to lift the load mounted on adjustable plate to adjust the length of winch motor coupling chain is to be provided in base compartment.
- Mechanical torque limiter is to be mounted on motor shaft to stop transmission of motion from motor to winch in case of excess load and thus prevent the damage to winch and breakage of rope.
- Lightning Finial: One number heavy duty 1.2 m long hot dip galvanized lighting finial shall be provided for each mast on the head frame to get a direct conducting path to the earth through the mast.
- Aviation Obstruction Lights: Two number Low intensity LED Aviation Obstruction Lights shallbe provided on luminaries' carriage.
- Earthing Terminals: Earth terminal using 12 mm diameter hot dip galvanized bolts shall be provided on the door stiffener of the mast for lightning and electrical earthing of the mast.

➢ **TECHNICAL SPECIFICATIONS OF LIGHT POLE**

- The Product should be designed for the specific climatic and environmental conditions of the region to ensure full durability and safety throughout its designed life.
- Poles shall be designed to withstand the maximum wind speed of 180 kmph as per IS 875-1987(Reaffirmed1997). The top loading i.e. area and the weight of fixtures are to be considered to calculate maximum deflection of the pole and the same shall meet the requirement of BS EN 40-3-3:2013.
- The pole shaft shall have octagonal cross section and shall be continuously tapered with single longitudinal welding. There shall not be any circumferential welding of the pole shaft. The welding of the pole shaft shall be done by Submerged Welding process.
- All octagonal pole shafts shall be provided with the rigid flange plate of suitable thickness with provision for fixing minimum 4 foundation bolts of size not less than M24. The base plate shall be fillet welded to the pole shaft at two locations i.e. from inside and outside.
- All poles shall be decorative type.
- The materials of the pole as follows:

  a. Pole - Conforming to grade S355J0,

  b. Base Plate: - Fe 410 Conforming to IS 226-1975(Reaffirmed1983)/ IS 2062-2011,

  c. Foundation Bolts: - 6.8 Gr. as per IS 1367-2002,

  d. Ring Type Bracket

  e. Pole Sections: - The Octagonal Poles shall be in single piece with single longitudinalwelding joint,

- Galvanization: - The poles shall be hot dip galvanized as per IS 2629-1985(Reaffirmed1994) / IS 2633-1986(Reaffirmed2006) / IS 4759-1996(Reaffirmed2006) standards with average coating thickness of 65 micron. The galvanizing shall be done in single dipping. The zinc Ingot raw material shall be 99.99% pure and procured from reliable sources with Quality Test Certificates. The pole manufacturing & galvanizing unit shall be ISO 9001: 2000 & ISO 14001 certified to ensure consistent quality & environmental protection.
- The poles shall have integrated Junction box with openable door of adequate size at the elevation of 750 mm from the base plate. The door shall be hinged type with mechanical interlock, dust proof, weather proof and vandal resistant and shall ensure safety of inside connections and components. The door shall be flush with the exterior surface and shall have suitable locking arrangement. The pole shall be adequately strengthened at the location of the door to compensate for the loss in section.
- The door of the Junction Box shall permit clear access to the components inside viz., termination strips, connectors, MCBs, cables etc. There shall also be suitable arrangement for the purpose of earthing.
- For street Light poles four-way connectors shall be provided along with Slide lock suitable for connecting 1.1 kV grade,minimum 4 core X10 sqmm AL cable. It shall also inhouse DP MCB's of suitable size,2.5 sqmm connectors for looping with 2.5 Sqmm Copper wires for connecting to the luminaries through 1.1 kV grade, 3 core X 2.5 mm² PVC insulated copper conductor flexible un-armoured Cable from the terminal block to the fixture within the pole. All the cables laid through the pipe shall be without any joint. The final sizes of cable shall be selected based on the voltage drop limitation.
- Two nos. Earth Boss shall be provided at the bottom of the pole (diagonally opposite) suitable for connecting 25X5 mm GI/ CU earth strip or 8 SWG wire for earthing of the poles. Similar Earth Boss suitable for connecting 4 sqmm copper wire shall be provided on the control plate inside the Junction Box for earthing of the electrical components.
- Two nos. 40 mm NB HDPE sleeves of suitable length shall be provided through the foundation upto the Junction Box for entry of power cable.
- One earth pit shall be provided for 5 set of poles. The earth electrode shall be GI pipe electrode as recommended in the latest version of IS 3043-2018. The earth electrode shall be connected with GI strips to the two distinct earth bosses on the pole. Poles of each set shallbe inter connected with minimum 8 SWG GI wire.
- Aesthetic appearance - All the grooves and carvings of the pole unit shall be free from any kind of distortion for a pleasing aesthetic appearance.
- The Poles shall be bolted on a pre-cast foundation with a set of foundation bolts of size notless than M24 for greater rigidity.
- All the material/equipment/accessories shall be supplied with manufacturer's test certificates.
- BIDDER shall submit the Proposed Product Catalogue, Detail Data sheet, spare parts list anddrawing of Pole &accessories after award of contract for each product quoted.
- BIDDER shall arrange for all the tools and equipment's.
- Concrete foundations shall be provided for all the light poles as per design criteria mentionedfor Civil work above.

➢ **TECHNICAL SPECIFICATIONS OF DISTRIBUTION BOARDS**

- Applicable Standards:

The design, manufacture and performance of equipment shall conform to the latest standards specified below.

Sr. No.	Brief Title	IS/IEC Code
1.	Metal Enclosed Switchgear	IS 3427-1997 (Reaffirmed2002)
2.	Miniature Circuit Breakers	IS 8828-1996 (Reaffirmed2006)
3.	Low Voltage Fuses	IS 13703-1993 (Reaffirmed2004)
4.	Control Switches & Push button	IS 6857-1972
5.	Current Transformer	IS 2705-1992 (Reaffirmed 2002)
6.	Voltage Transformer	IS 3156-1992 (Reaffirmed 2002)
7.	Indicating instruments	IS 1248-2003

- LTDB shall be as per Jharkhand Govt. specification.
- Feeder Pillars (FP) and LDB shall be Outdoor type, Steel Support/foundation mounting, Weatherproof, double door, single front, compartmentalized enclosure with locking facilities.
- Feeder Pillars (FP) and LDB shall be made of Galvanised sheet steel enclosure. All the feeder pillars shall be Outdoor type with permanent rain canopy and shall be dust, damp and vermin proof. All feeder pillars shall conform impact resistance of IK7 and above and shall be minimum IP55.
- Feeder Pillars (FP) and LDB shall be provided with compartmentalized enclosure. One separate compartment shall be for Incomer, incoming cable and Busbar. One separate compartment for outgoing MCB's. One separate compartment for outgoing terminals and cables.
- Feeder Pillars (FP) and LDB shall be of sheet steel enclosed and shall be fully dust and vermin proof, with canopy. The sheet steel used shall be cold rolled and min 2mm thick. The gland plate shall be min 2mm thick.
- The fabricated enclosure shall not have any welds or bolt heads apparent from outside. All fabrication work like cutting, drilling, punching, shearing & welding etc. related to the enclosure shall be complete before proceeding to 7 tank process. The fabricated body shall be thoroughly cleaned and treated by chemical agents as required to produce a smooth surface free of scales, grease and rust.
- The LT Distribution Board shall consist of Incoming Four Pole (FP) MCCB with Thermal magnetic OL, SC and EF release,phase indicating lamps. Metering shall be done as per APDCL specification. However, the Outgoing shall have at least 6 numbersFP MCB.
- The LT Distribution Board shall have cable entry at the bottom suitable for terminating double

compression glands for minimum 1 Run of 3.5 C X 95 sq.mm Aluminium conductor, XLPE insulated armoured cable at the incoming terminal and minimum 5 Runs of 4 core 25 sq.mm. Aluminium conductor, XLPE insulated armoured cable at the outgoing terminal.

- The feeder pillar shall consist of Incoming of 2 nos Four Pole (FP) MCB,phase indicating lamps and the Outgoing shall have at least 7 nos FP MCBs. It shall have cable entry at the bottom suitable for terminating double compression glands for minimum 2 Runs of 4 core 25 sq.mm. Aluminium conductor, XLPE insulated armoured cableand minimum 5 Runs of 4 core 4 sq.mm. Aluminium conductor, XLPE insulated armoured cable at the outgoing terminal.
- The LDB shall consist of Incoming of 1 (One) no 4P MCBalong with 24-hour timer, phase indicating lamps and the Outgoing shall have at least 6 nos 4P RCBO. It shall have cable entry at the bottom suitable for terminating double compression glands for minimum 1 Runs of
  4 C X 4 sq.mm Aluminium conductor, XLPE insulated armoured cable at the incoming terminal and minimum 5Runs of 4 core 4 sq.mm. Aluminium conductor, XLPE insulated armoured cable at the outgoing terminal.
- There shall be balanced distribution of load among the all LTDB, feeder pillars and LDBs. Load on each circuit shall be equally distributed.
- All MCCB/MCBs/ RCBOs/RCCBs shall be comply with the relevant IS and IEC standards. It shall be current limiting type and shall provide a cut off in, < 10 ms for prospective currents during faults. It shall be provided with fixed thermal overload, short circuit and earth fault release as appropriate. The breaking capacity of the MCB shall be 10KA for 1 sec.
- Both the doors shall have panel type lock with keys in duplicate as per the requirements of the Implementing Agency.
  All the outdoor Electrical panels shall be mounted at least 800mm above the ground level or finished floor level. The panels shall be mounted on steel structure or on elevated foundation.
- A danger notice board written in English, Hindi and Assamese shall be made of 2mm thick GIplate and shall be provided on the front door of the feeder pillar.
- The power and control components are as listed below;

  (i) Copper bus bar with SMC support insulators shall be provided for power distribution within the feeder pillar. The size of phase and neutral shall be equal.

  (ii) All connecting power & control wiring shall be carried out with stranded copper conductor PVC insulted wires. Minimum size of control wiring shall be 1.5 sq. mm and power wiring shall be 4 sq. mm.

  (iii) An Aluminium / GI Earth bus shall be run at the bottom of the Feeder Pillar which shall be connected to the earth leads at the two extreme ends for connecting the GI earthing strip from the electrode.

- HDPE/ DWC pipe of suitable size (minimum 40 mm) for conveniently accommodating the above incoming and outgoing cables shall be laid upto the feeder pillar for carrying the buried cables upto the feeder pillar for termination. The GI strip for earthing shall be laid with proper dressing.
- The LTDBs and feeder pillar shall be mounted on prefabricated Galvanised Steel Support structure duly fastened with a concrete foundation with M20 concrete suitable to sustain the local geological conditions, seismic conditions and max wind speed requirements.
- Painting:

  (a) All sheet steel work shall be paint through 7 tank electrostatic powder coating process in

accordance with the required procedure and with the applicable standards. The DB enclosures shall be powder coated with shade as per RAL-7032.

(b) The final finished thickness of paint film on sheet steel enclosure shall not be less than 80 microns. Finished painted appearance of equipment shall present an aesthetically pleasing appearance, free from dents and uneven surfaces.

- Earthing

(a) Al/ GI earth bus bars of adequate size shall be provided for the entire length of the panel. The framework of the enclosure shall be connected to this earth bus. Provisions shall be made for connection form this earth bus to the main earthing bus bar coming from the earth pit on both sides of the DBs.

(b) The earth continuity conductor of each incoming and outgoing feeder shall be connected to this earth bus bar. The armour of cables shall be properly connected with earthing clamp and the clamp shall be ultimately bonded with the earth bus bar.

- Cable Entry:

(a) The DBs shall have provisions of cable entry from bottom. The removable cable gland plate shall be provided to make entry dust and vermin proof.

(b) The DBs shall have provisions for fixing the multi-core cable glands.

(c) The cable glands support plates shall be 3 mm thick.

(a) Cable entries to the DBs shall be from the bottom unless otherwise specified. Cable gland shall be double compression screwed type and made of brass.

- Molded Case Circuit Breakers (MCCB)

(a) The MCCBs shall conform to IEC 60947 & the latest applicable standards.

(b) All MCCBs shall be of fixed type unless otherwise specified in the specifications elsewhere.

(c) MCCBs shall be of four pole with neutral construction arranged for simultaneous four/ three-pole manual closing and opening and for automatic instantaneous tripping on short circuit.

(d) The ON, OFF and TRIP positions of the MCCB shall be clearly indicated by using LED indications.

(e) MCCBs shall be with ICS = ICU = 100%

(f) MCCB shall be capable of withstanding the thermal stresses caused by overloads and the mechanical stresses caused by the peak short circuit current of value associated with the switch gear rating.

(g) All the MCCBs shall be of current limiting type and shall provide a cut off in 4-8 milli seconds for prospective currents during faults.

(h) All the MCCBs shall be provided with rotary operating handle with door interlock.

(i) MCCB terminals shall be shrouded and designed to receive cable lugs for cable sizes relevant to circuit ratings.

(j) All MCCBs shall be provided with additional 2 NO + 2 NC contacts, exclusively for Purchaser's use.

- Power & Control Wiring Connections:

(a) Terminals for both incoming and outgoing cable connections shall be suitable for 1.1kV grade Al/ Cu conductor XLPE armoured cable and shall be suitable for connections of solder less sockets for the cable size.

(b) Both control and power terminals shall be properly shrouded. Power terminals shall be of stud type.

(c) 20 % spare terminals shall be provided on each terminal block. Sufficient terminals shall be provided on each terminal block so that not more than one out going wire is connected to per terminal.

(d) Suitable barriers of enclosures shall preferably separate terminals strips for power and control from each other.

(e) Wiring inside the modules for power, control, protection and instruments etc shall be done with use of 1.1 kV grade, multistranded Cu, PVC FRLS wiring.

(f) Wires for connection to the door shall be flexible. All conductors shall be crimped with solder less sockets at the ends before connections are made to the terminals.

(g) Particular care shall be taken to ensure that the layout of wirings is neat and orderly. Identification ferrules shall be filled to all the wirings terminations for ease of identification and to facilitate checking and testing.

(h) Washers shall be used for all Copper and Aluminum connections.

(i) Final wiring diagram of power and control circuit with ferrule no shall be submitted along with the DBs as one of the documents against the contract.

- Terminals:

(a) The outgoing terminals and neutral shall be brought to a cable alley suitably located and accessible from the panel front.

(b) The current transformer for instruments metering shall be mounted on the disconnecting type terminal blocks. No direct connection of incoming or outgoing cables to internal components of the distribution board is permitted; only one conductor may be connected in one terminal.

- Current Transformers:

(a) Current transformers shall be of cast resin type. Insulation Class shall be Class 'E' or better.

(b) Unless otherwise specified, the minimum performance requirement of current transformers is as follows:

I. Measuring CTs -Burden as per requirement with 20% buffer, accuracy class 1.0.

II. Current transformer (CT) shall have polarity markings indelibly marked on each transformer and at the lead terminations at the associated terminal block.

III. CT shall be able to withstand the thermal and mechanical stresses resulting from themaximum short circuit current

IV. Test links shall be provided in both secondary leads of the CTs to easily carry out current and phase angle measurement tests.

V. Identification labels giving type, ratio, output and serial numbers shall be provided.

- Indicating Lamps shall be,

I. Clustered LED type and of low watt consumption.

- Junction Box

(a) 3-way junction boxes with terminals shall be provided for branching and terminating lighting cables when required for Landscape area lighting.

(b) The junction boxes shall be dust and vermin proof and shall be made up of Thermoplastic with removable cover plate, two earthing terminals each with nut, bolt and washer. Boxes shall be additionally weather proof. The Junction Box shall have ingress protection of IP67.

The boxes shall have provision for wall, column, pole or structure mounting or buried underground and shall be provided with cable/conduit entry knock outs, terminal blocks,as required.

(c) The terminal blocks, with specified number of terminals, shall be mounted securely on brackets welded to the back sheet of the box. The terminals shall be 1100 V, grade, one piece construction complete with terminals, insulation barriers, galvanised nuts, bolts and washers and provided with identification strips of PVC. The terminals shall be made of copper alloy and shall be of box clamp type.

➢ CABLING SYSTEM

- All the LV Power cables shall be 1100V grade, multi-stranded, Al / Copper conductor, XLPE insulated, extruded inner & outer PVC sheath compound type ST2 and galvanised steel strip armoured cables.
- All cables shall conform to IS 7098 –Part I-1988 (Reaffirmed 2003) and all armouring shall confirm to latest version of IS: 3975-1999.
- For all LT power and control cables, double compression glands with aluminium lugs for Aluminium cables and tinned Copper lugs for copper cables shall be used in indoor and outdoor application.
- The termination shall be inclusive of miscellaneous items such as clamps, cleats, cable tags, cable markers etc.
- In general cable installation works shall be carried out in accordance with IS 1255 – 1983(Reaffirmed 1996).
- For Underground cables, all cables shall be laid in HDPE and DWC pipes laid by excavation. The top of the pipe shall be at least750mm below the finished ground level. There should not beany joints between two lighting fixtures.
- Separate cables shall be provided for Pathway lighting, shrub lighting and area lighting. The cables shall be laid in HDPE pipe of size not less than 40 mm by excavation 750mm below finished ground level.

- LTD Bincoming cables shall be provided in Double walled corrugated pipes (DWC) of size not less than 110 mm by excavation 750mm below finished ground level.
- Cables within the Landscape area shall be laid buried in HDPE pipe not less than 40mm dia. Thecables shall be looped between the fixtures with the help of Junction box.
- Cable Glands

  (a) Double compression type cable glands with rubber hoods shall be used for the termination of all the power and control cables. Cable glands shall be brass casting, machine finished and nickel-plated to avoid corrosion and oxidation. Rubber components used in cable gland shall be of neoprene.

  (b) For single core cables, gland shall be with brass ring.

  (c) Cable glands shall be with metric threads.

  (d) Cable glands shall be conical (& not flange type).

  (e) All glands shall be provided with rubber hoots.

- Cable Lugs

  (f) Cable lugs shall be of tinned Copper, solder less crimping type for Cu cables & Al lugs for the Al cables.

  (g) The current rating of the lugs shall be same as that of the respective cable conductors.

  (h) Ring type cable terminations shall be used.

  (i) Insulated lugs are not acceptable for any cable terminations.

  (j) Bi-metal strip/ Bi-metallic lug shall be used whenever two different metals are to be connected together.

  (k) Fork terminals shall be used for luminaries& decorative switch/ socket. Pin terminals may be acceptable during execution only in case other terminals/ lugs cannot be accommodated.

  (l) Reducer / wire pin terminals shall be avoided for MCB terminations. MCB terminations shall be with ‘long palm terminals.

  (m) All terminations in Feeder Pillars / enclosure for earthing & neutral busbars / terminals shall be with ring type terminals.

  (n) All earthing terminations shall be with ring type lugs only.

  (o) All control & interlock cable terminations shall be with ring type lugs.

  (p) Anticorrosion/ anti-oxidation compounds shall be used for crimping lugs. This shall especially be ensured for Al cable terminations & any bimetallic terminations (Cu cable termination using tinned Copper lugs).

- If termination is done with crimping tool employing crimping die then forming dies shall beused to make the sector shaped conductor into a round conductor before crimping the lugs on the conductor. The lug must not be crimped directly on the sector conductor. Before crimpingthe lug, the conductor shall be thoroughly cleaned and special jelly applied over it to prevent further oxidation.

- Point Wiring

(a) Point wiring work shall include the, PVC conduit, joints, connectors, conduit accessories, FRLS PVC insulated stranded copper conductor wires and earthing wires, pull boxes, ceiling rose, clamps, cleats, hardware, accessories, anchor fasteners, modular switch boards with cover plates, switches, sockets, box, blank plates, receptacles and all other necessary accessories as per specifications etc.

(b) Wiring shall be done in wire colour codes. Colour code of wire for Phases, Neutral and Earth shall be separate. The necessary connector if found required for looping of wires from one switchboard to another switchboard shall be included in the scope.

(c) Lighting fixtures and toilet exhaust fans shall be grouped on the single circuit wherever required. However, separate circuits shall be used for receptacles wiring.

(d) Wires of the different phases shall not be laid in the same conduit.

(e) Switchboard shall be recessed mounted.

(f) The switch boxes, receptacle boxes etc. shall be made up of 16 SWG sheet steel.

(g) The wire and cable indicated below for distribution of the power are the minimum requirement. The CONTRACTOR shall arrive at the actual size based of the design criteria mentioned above.

(h) Point wiring in the Shops, Electrical room, Admin office, Public Toilet and other indoor areas shall be done as per the following points,

(i) Point Wiring for the luminaries from the DB to the switchboard and from the switchboard to the luminaries shall be done with 1.1KV grade min 2.5 Sq.mm (2Nos.-Ph.+N) & 1.5 Sq.mm (for earthing of socket) PVC insulated, multistranded Cu conductor flexible wires running through 25mm inner dia.1.6mm thick, black stove enamelled painted PVC conduit running concealed/exposed in false ceiling and concealed on brick wall

(ii) Point Wiring for the 6A Raw power socket from the DB shall be done with 1.1KV grade 2.5 Sq.mm (2Nos.-Ph.+N) & 1.5 Sq.mm (for earthing of luminaire) FRLS PVC insulated, multistranded Cu conductor flexible wires running through 25mm inner dia.1.6mm thick black stove enamelled painted PVC conduit running concealed/exposed in false ceiling and concealed on brick wall.

➢ **DG SET**

- The scope of works include supply, installation, testing and commissioning of DG-Set withweather proof acoustic enclosure, AMF panel for providing stand-by source of power supply.
- The DG Set shall be complete with Diesel engine coupled with Alternator, DG Controller panelmounted on common base frame with anti-vibration pads, etc.

a) The Diesel engine shall be complete with Lube oil system, HSD Day tanks, Radiator cooling system, Electrical starting system along with control panel suitable for Automatic Mains Failure (AMF), Air intake and Exhaust system, Fuel oil system, engine mounted accessories, day tank, nameplate and piping and associated instrumentation etc.

b) The Alternator shall be complete with excitation system, Automatic Voltage Regulator (AVR) and Governing system.

c) Common base frame for Engine and Alternator coupled together complete with DG controller, interconnecting piping, anti-vibration pads etc.

- The diesel engine shall be suitable for High-Speed Diesel (HSD) firing.
- The acoustic enclosure shall be compatible to restrict noise level below 75 dB at distance of 1
  m. Contractor to provide extra cover if required for acoustic enclosure.
- The complete DG set with common base frame shall be provided with adequate number ofanti-vibration pads for mounting on a foundation block.
- DG set shall be capable of black start and shall be designed without any limitations on thenumber and frequency of starts.
- The DG sets shall be capable of automatic starting in advent of main electric supply failure.Additional provision for manual starting shall be provided.
- The DG Set should be designed to eliminate harmful vibration stress during normal operation, acceleration & deceleration.
- The complete DG Set should be mounted on a rigidly fabricated steel base and longitudinal beams shall be rigidly deployed with cross braces to avoid buckling during transportation, installation & operation.
- The DG Set moving parts should withstand 15% of the rated synchronous speed. However, the Generator, exciter & fly wheel should be designed to withstand over speed of 25% without damage.
- Casting & Forging shall confirm to the respective material specifications as per standard and details of the same should be submitted to implementing Agency for verification and record.
- The parts subjected to friction & large variation in temperature should be designed to support/permit expansion and contraction without resulting in leakage & damage.
- Fuel Oil Lines(part of DG Set) should be designed to locate as far as possible away from the engine exhaust lines so that the damage to the neighboring part or equipment is prevented in the event of pipe break or leakage.
- All the piping used for DG Set Construction should be hydro-tested at 1.5 times of the rated pressure for a minimum of two hours and report for the same should be submitted to GSCL. All terminal connections and joints shall be of welded type. Flanged, screwed connections and joints should be avoided.
- HP rating, Fuel Consumption guarantee should be as per standard.
- CONTRACTOR shall have rigid inspection procedure laid down to ensure quality of workmanship, material specifications, painting quality, drawings, mechanical and electrical accuracy of components in his works.
- The Direction of Rotation of the Machine should be marked properly in visible/strategic locations.
- Starting of the DG set shall be with Electric starting system and same shall be complete, but not limited to the following.

➢ Starter motor.
➢ Maintenance free batteries, with capacity suitable for minimum six (6) starts.
➢ Engine driven Battery charger.

- Diesel engine
- Diesel Engine shall be of proven design, direct injection; radiator cooled conforming to ISO3046 / BS 5514 and complete with following system:

a) Lube Oil System with initial fill of lube oil.
b) Engine cooling system with Radiator and engine driven fan.
c) Electric starting system with starter, maintenance free batteries and AC mains charger.
d) Air intake and Exhaust system
e) Fuel Oil system with day tank.

- AIR INTAKE SYSTEM

The Air Intake System shall be complete, but not limited to the following:

a) Engine mounted Air intake filter and silencer.
b) All necessary piping including, specialities like bends, flanges, expansion joints, etc.; and supports.

- LUBE OIL SYSTEM

Itshall be complete in all respects but not limited to the following:

a) Engine Mounted Lube Oil Sump.
b) Engine operated lube oil pump.
c) Plate/ Shell and tube type water cooled lube oil cooler.
d) Full flow paper cartridge type oil filters.
e) All necessary piping, valves, specialities, instrumentation and supports
f) First fill of lube oil and all other lubricants, greases and consumables.
g) Pressure switches shall be provided to give alarm if pressure falls below a set value and subsequently TRIP the unit when the minimum safe pressure limit is reached. Level Indicator/Dip stick shall be provided for level measurement.

- ENGINE COOLING SYSTEM

Radiator cooled engine shall be provided. For Radiator cooled engine, the engine coolingsystem shall complete, but not limited to the following:

a) Radiator with engine driven fan
b) All necessary piping, valves, specialities, instrumentation and supports

- FUEL OIL SYSTEM

Day tank with fittings and instruments shall be provided for each DG set.

- The day tank, as minimum, shall have following accessories:

a) Inlet connection with filter and flange
b) Inlet connection for return from fuel pump
c) Outlet connection with valve
d) drain connection with valve
e) overflow connection with flange
f) Vent connection
g) Manhole/Handhole for cleaning
h) Level gauge with isolation valves
i) Two (2) numbers level switches with two independent switch contacts each, for 'High'and 'Low' oil Level.

- Fuel system

Fuel (Diesel) system to the engine shall be supplied from a fuel tank. The supplier should provide a fuel tank of adequate capacity, including 10% reserve capacity to be installed in a weather proof enclosure. The supplier should provide mechanical fuel level indicator with 'Low' and 'High' markings. Also fuel level indication should be provided in the AMF panel with alarm for Fuel level 'low'. The fuel tank shall be free standing, floor mounting type with mounting brackets, fuel inlet and outlet, air vent, drain plug, opening with cover for direct filling from the top of the tank.

- Engine starting system

Starting of the diesel engine shall be of electric starting. The electric starting system should have starter motor, Lead acid starter Batteries, battery charger and necessary instrument and accessories to indicate the condition of the batteries.

- Batteries

The batteries shall be sized taking in to account the starting load requirement of the DG set. Lead acid batteries, of suitable capacity to start the engine by 24V DC electrical starting Motor without struggling, and with suitable capacity of battery cable. The batteries must be capable to try 3 unsuccessful starts continuously. The batteries have to be placed on a suitable well painted steel stand.

- Air intake system:

Air intake system should have requisite air filters and complete interconnecting piping, supports etc.

- <u>EXHAUST PIPING AND STACK</u>
- Each DG set shall be provided with heavy-duty residential type silencer. Exhaust stack, shall be self-supported and designed as per IS 6533-1989 (Reaffirmed 2010).
- The exhaust of each DG Set shall be led through separate exhaust air ducting. The ducting shall comprise of necessary fittings, expansion joints, Residential type silencer, Rain Hoods etc. This ducting shall be routed out of the acoustic enclosure & structurally supported. Vertical run of exhaust ducting shall be as per the statutory requirements of central and local pollution control board. The structural support could be common for more than one vertical run of exhaust of DG sets. The exhaust ducting and supporting structure shall be supplied and installed by the CONTRACTOR complete with all supports, hangers, hardware, expansion joints and insulation with cladding. Bending radius of pipes/ducts should be more than three times of the NB of chosen pipe.
- Engine governing system: The engine governing system shall be of class 'A' hydraulic governor. An over speed trip mechanism shall be provided to automatically shut off the fuel supply in case of set speed reading above 110% of rated speed.
- The Alternator

The Alternator shall be screen protected, drip proof, separately excited system (with PMG) of brush less, continuously rated to give an output at 0.8 pf at 415V, 50Hz, 1500rpm,3 phase, 4wire. The alternator should be provided with automatic voltage regulator with voltage regulation of ± 0.5% (MX321) and is designed, tested for confirming to IS 4772-1983 (Reaffirmed 2001) or IEC 34-2016.

The insulating material of the alternator shall be non-hygroscopic and fully tropicalized. The Alternator shall be suitable for operation with its neutral solidly grounded. The neutral shall be formed at the terminal box.

Alternator windings shall be of Class H insulation with Class F temperature rise antiracialized. The alternator shall have pre-packed grease lubricated ball or roller bearings and provided with facilities for re-greasing whilst in service.

The alternator shall be capable of maintaining a short circuit current of three times full load current for a period of 10 seconds. The alternator shall be fitted with an anti-condensation heater.

No individual harmonic shall exceed 1% and the total harmonic shall not exceed 3%. The alternator, its neutral and control panel shall be earthed as per relevant standards.

The alternator rotor assembly shall comprise exciter rotor, full wave silicon bridge rectifier surge protection device and salient pole rotating field system. The rotor shall be fitted with interconnected pole face damping windings. Voltage regulation shall be maintained to within ±2.5% for a power factor of 0.8 to unity, including hot to cold variations. The steady state frequency droop between no load and full load shall not exceed 5%. Transient voltage deviation following a step load of 60% of rated at a power factor of between 0.4 and zero shall not exceed 15% with a voltage recovery time to 97% rated voltage not exceeding 0.5 second. The set shall be capable of continuous operation with a phase current imbalance of 33% of rated current whilst maintaining the output voltage within ±5% of rated.

- Mounting

Design, fabricate suitable base frame, which is a welded construction using channel iron etc. to mount DG set. The whole set and base frame should be mounted on 12 Nos. (min) of heavy duty type Anti vibration mounts of DUNLOP' (b – SERIES) or its equivalent make.

- AMF control panel

The automatic mains failure (AMF) panel should be made out of well painted 16SWG sheet steel enclosure with necessary components like MCCB for local isolation, control relays, timers, busbars, protective relays, metering, battery charger, indication, annunciation system etc should be provided.

The panel shall be inbuilt in the DG acoustic enclosure, mounted on the surface such that it canbe operated and monitored from outside/ without entering the enclosure.

The AMF should be operating in Test/ manual / auto mode and 3 attempt starting facility withnecessary control relays.

- Earthing

The Generator Neutral should be earthed with 2Nos. of copper plate electrode and GI pipeelectrode for Body earthing as per IS 3043-2018.

- Tests

Supplier shall perform all standard tests (Shop tests) on Engine and alternator and the testreports pertaining to the engine and alternator should be submitted.

- Acoustic and Weather proof Enclosure

Acoustic enclosure for DG set along with DG controller. The DG set with the acoustic enclosure shall be type tested and certified from approved testing agencies.

The acoustic enclosure or acoustic treatment of enclosure shall be designed for minimum 25dB (A) insertion loss or for meeting the ambient noise standards, whichever is on the higher side.

The DG set shall be provided with proper exhaust muffler with insertion loss of minimum 25dB (A) as per applicable CPCB norm requirements.

- <u>STATUTORY APPROVALS</u>

The CONTRACTOR shall obtain approval from the Statutory Bodies listed herein. All the input data, documents and drawings etc. required for obtaining approvals from the Statutory Bodies shall be prepared and submitted by the CONTRACTOR:

a) Electrical Inspector
b) Local Electric Supply Company

c) Local Pollution Control Authority
d) Airport authority (if required)

- TRAINING OF PURCHASER's PERSONNEL

a) The CONTRACTOR shall undertake to train two Supervisors selected and sent by PURCHASER. These Supervisors shall be given special training in shop laboratory and drawing office of the CONTRACTOR where the equipment will be designed, manufactured and in any other plant where similar capacity and type of system designed, manufactured and supplied by CONTRACTOR are under installation, testing, operation and maintenance to enable the Supervisors to get completely conversant with the system / equipment supplied under this contract.
b) The period of training shall be minimum one (1) week per engineer.
c) The CONTRACTOR's supervisory personnel at site shall continuously and intensively instruct and train adequate number of PURCHASER's operating and maintenance personnel at site during commissioning of the plant to enable them to take over the proper operation and maintenance of the plant after commissioning.

- PAINTING

All the exposed, un-insulated surfaces shall be painted as per following:

a) Paint shall be 2 coats of primer followed by 2 coats of epoxy paint. Paint thickness shall be minimum 120-micron DFT.
b) The grade of paint shall be chosen such that it will withstand the maximum temperatures to which the components painted will be subjected to.
c) Any intermediate cleaning required between successive coats of paint shall also be carried out as per the manufacturer's standard.
d) All the machined surfaces should be protected against rust and corrosion by applying Rust Inhibitor before assembling. All the casted items should be sand blasted, degreased and thoroughly cleaned before painting.

- GUARANTEES AND PERFORMANCE REQUIREMENTS

A) GENERAL

The DG Set shall perform satisfactorily to meet the guarantee requirements specified to the entire satisfaction of the PURCHASER / ENGINEER.

B) DESIGN LIFE

a) Design Life of rotating equipment (like Engine, alternators etc) and static equipment (Acoustic Enclosure, HSD storage tank) shall be minimum fifteen (15) years and twenty (20) years respectively.
b) The bidder shall furnish schedule of routine maintenance, periodic maintenance and major overhaul of the equipment.
c) The Bidder shall guarantee availability of spares for the equipment offered in his bid for the entire design life.
d) The bidder to furnish address and contact details of nearest service centre and indicate the period taken by the service Engineer to attend the service call.

- SYSTEM PERFORMANCE GUARANTEE

The CONTRACTOR shall guarantee that upon completion of work, all installed systems there of shall be in full accordance with the requirements of the contract and shall be perfect as to materials and workmanship and shall remain so for a minimum period of namely twenty-

four months or 5000 running hrs from the date of successful commissioning and performance testing of the plant whichever is earlier.

CONTRACTOR shall submit charts / performance curves for selected equipment with the operating points duly marked on them. If during the shop test it is found that the equipment does not meet specification, any modification/ replacements of any part or equipment as a whole are required, the same shall be done by the CONTRACTOR at no extra cost to the

PURCHASER. For any failures during performance warranty period, the parts shall be supplied at supplier cost including fright, tax and servicing/repair (including labour).

- SPECIFICATION OF HIGH-SPEED DIESEL (HSD)

The specification of fuel for performance guarantees shall be as follows:

(a)	Type of fuel oil	HSD
(b)	Specification and grade	IS: 1460-2005
(c)	Kinematic Viscosity @ 40 deg. cSt.	2.0 - 4.5
(d)	Density, @ 25 ^{O}C, Kg/ m^3	827
(e)	Flash point, minimum	35 ^{O}C
(f)	Pour point (Winter/ Summer)	3 ^{O}C / 15 ^{O}C
(g)	Ash content, % by weight Max.	0.01
(h)	Water content, % by volume Max.	0.05

- QUALITY ASSURANCE/QUALITY CONTROL PROGRAMME

a) Only critical inspection stages have been indicated in the enclosed “Minimum Inspection Requirements” documents. This is however, not intended to form a comprehensive programme as it is the CONTRACTOR’s responsibility to draw up and implement such programme duly approved by the PURCHASER. The detailed Quality Plans for manufacturing and field activities should be drawn up by the BIDDERS, separately in the format attached and shall be submitted to PURCHASER at the time of submitting his offer.

b) All the sub-CONTRACTORs proposed by the CONTRACTOR for procurement of major bought out item including castings, forgings, semi-finished and finished components/equipment shall be subject to PURCHASER’s review/clearance for systems and packages.

c) A consolidated list of all major equipment including bought outs like pumps, valves, fans etc. shall be submitted by the CONTRACTOR along with the offer for PURCHASER’s review/comments.

d) The PURCHASER reserves the right to carry out quality audit and quality surveillance of the systems and procedures of the CONTRACTOR’s or their SUB-CONTRACTOR’s quality management and control activities. The CONTRACTOR shall provide all necessary assistance to enable the PURCHASER to carry out such audit & surveillance.

e) The CONTRACTOR shall undertake an inspection and testing programme during

manufacture in his works and that of his sub-contractor to ensure the mechanical accuracy of components, compliance with drawings, conformance to functional and performance requirements, identification and acceptability of all materials, parts and equipment. He shall carry out all tests/inspections required to establish that the items/equipment conform to requirements of contract specification and the relevant codes/standards specified therein, in addition to carrying out tests as per the approved Quality Plan.

f) CONTRACTOR shall use calibrated instruments for testing, with traceability to NATIONAL /INTERNATIONAL levels. If not the PURCHASER/CONSULTANT will not witness the tests till the same is organised.

g) Only latest edition of the codes/standards and specifications shall be used for materials and testing. The latest edition is reckoned with the date of contract awarded.

h) Copies of all the test certificates/calibration reports/internal inspection reports shall be furnished by the CONTRACTOR during the relevant inspection stages to the PURCHASER/ CONSULTANT.

i) The BIDDER shall furnish his fully documented, operational manual on the quality assurance programme (QAP) indicating the following minimum details:

- Organizationchart for the following quality inspection activities:
  - i) Purchasing of raw materials and bought out items
  - ii) Engineering and design
  - iii) Manufacturing
- Applicable quality standards and procedures for material, design and manufacture includingnon-destructive testing.
- QAP for design engineering and documentation control system
  The inspection and tests programme indicating details of inspections/tests to be carried out during various manufacturing stages indicating acceptance norms, extent of inspection by the CONTRACTOR as given in the enclosed format. PURCHASER will review and approve the programme indicating his 'HOLD' points. These stages will be witnessed by the PURCHASER's ENGINEER/AUTHORISED REPRESENTATIVE.
- Procurement of control system for equipment or services purchased outside including approval of sub-suppliers/sub-contractors and surveillance on sub-suppliers/sub-contractors.
- Material control to ensure that only the approved materials are used in the manufacture.
- Details of final stages of inspection and tests at shops.
- Corrective actions on items or systems containing significant conditions adverse to quality.
- Control and inspection of material handling, storage, packing and shipping.
- Quality records/test certificates/calibration reports of testing & measuring instruments with traceability to National Standards, to provide objective evidence that all quality assurance requirements have been met.
- Quality assurance based on feedback received from the previous operating installations.

➢ **EARTHING SYSTEM**

- Applicable Standard:

The general design shall be on the basis of following codes and standards (their latest amendments) in line with design criteria & specification requirements.

(a) IS 3043-2018 –Code of practice for Safety Earthing

(b) Central Electricity Authority (CEA) Regulations – 2010

(c) National Building Code 2016

The maximum values of earth fault current for the design of the earthing system shall be calculated as per the design criteria.

- The design basis for designing earthing conductor is indicated under design criteria for electrical system.
- GI Pipe electrodes shall be provided for all the equipment and system earthing.
- For DG,2 (two) pipe earth pits shall be provided for the body earthing and two copper plateearth pits shall be provided for the neutral earthing.
- The earth plate shall be buried in specifically prepared earth pit 3 mtr. below ground with alternate layers of charcoal and salt, 40 NB GI pipe with funnel with a wire mesh for watering and bricks masonry block CI Cover complete as per IS 3043-2018 with necessary length of double Copper earth flat bolted with lug to the plate complete connected to the transformer neutral with end socket as per direction and duly tested by earth tester conforming to IS asper drawing and specifications complete with 600 x 600 x 3.15 mm Copper earth plate or as specified by CEIG.
- Earth electrodes shall be of heavy duty galvanized mild steel pipe of not be less than 40 mm NB or as specified by CEIG. The earth electrode shall be complete with alternate layers of charcoal/ coke, salt and Black cotton soil; GI pipe with meshed funnel for watering; brick masonry block and CI Cover, with necessary test link conforming to IS 3043-2018 or as specified by CEIG.
- The minimum spacing between two adjacent earthing pits shall not be less than 2000mm and shall be kept 1500 mm away from footings of the structure.
- Earthing chamber shall be of RCC/ brick chamber of 600 mm x 600 mm, with hinged cast Iron chequered cover plates. The covers shall have holes for handling. Earthing pits (chambers) shall be painted Green and the earth-pit number shall be marked on it.
- Two separate earth pits shall be provided to outdoor feeder pillars with earth flat.Size of theflat shall be determined with respect to fault level.
- 1 (One) GI Pipe electrode shall be provided for every consecutive 5 post top light poles as perIS 3043 - 2018 or better. Electrode shall be connected to the equipment by two runs of GI strip laid in HDPE/ DWC pipes. Size of the flat shall be determined with respect to fault level. Minimum 8 SWG wire looping shall be done for the group of 5 post top light poles.
- Minimum 8 SWG GI wire shall be carried along with the cable in the HDPE pipe laid for distributing power to the landscape area.
- Wherever earthing conductor passes through HDPE pipe, sleeves shall be provided. Both ends of the sleeve shall be sealed to prevent the passage of water through the sleeves.

7.0 MAKE LIST

- The makes shall be as approved by MPWD/ CPWD/ shall be as approved by PWD of minimum three (3) States.

8.0 LIST OF DRAWING AND DOCUMENTS

- Following list of the documents and drawings shall be submitted to GSCL or its representative with Bid documents

(a) SLD of Power distribution

(b) Lighting Design & Calculations for each Area (Dialux IES Files shall be provided alongwith PDF)

(c) Illumination Concept for each element

(d) Bill of quantity of identified fixtures.

(e) UL/CE/BIS certification of selected luminaries.

(f) Test report of luminaries as per LM79 & L80.

(g) NABL accredited test report of luminaries.

- Following list of the documents and drawings shall be submitted to GSCL or its representative after award of contract,
- **Calculations**

(a) Electrical Load List and demand Calculations

(b) Earthing Calculations for Electrical System

(c) Cable schedule with Sizing Calculations

(d) Lighting Calculations for each Area (Dialux IES Files shall be provided along with PDF)

- **DG**

(a) DG sizing Calculations

(b) General Arrangement and Sectional Drawing of the DG Set with Acoustic Enclosure,
Fuel tank and Foundation

(c) Data sheets of Engine, Alternator, Battery, AVR, AMF panel

(d) General Arrangement of Foundation

(e) Civil Construction drawing of Foundation

(f) Earthing Layout

(g) Engine Drawings and Test Certificates

(h) Alternator Drawings and Test Certificates

(i) AMF Panel

(i) GA Drawing

(ii) Power and control Wiring Diagram

(iii) Type test certificate for IP protection

(j) Bill of Quantities along with Make and Model of each item.

(k) Type test certificates of DG set including Heat Run test and IP protection with Acousticenclosure**.**

- **For Light fixtures and luminaries**

(l) Illumination Concept for each element

(m) Lighting Calculations for each Area - Dialux /AGI calculations, visualizations and glarecontrol lumen maintenance. (Software Files shall be provided along with PDF)

(n) Type of Fittings, Soft Copy of Catalogues, Data Sheet, Polar Diagrams, Cone Diagrams,

IES Files of the luminaries should be submitted

(o) Pictorial formations / digital renders themes/ Views from all angles and close ups using 3Dsoftware.

(p) Lighting layout of area as per application.

(q) Rendered view of identified fixtures.

(r) Bill of Quantities.

(s) UL/CE/BIS certification of selected luminaries.

(t) Test report of luminaries as per LM79 & L80.

(u) NABL accredited test report of luminaries.

- **For Electrical equipment**

(v) Single Line Diagram for Power Distribution

(w) Equipment Sizing calculations.

(x) Cable layout, Earthing layout.

(y) Bill of Quantities

- **LTDB/ Outdoor Feeder Pillar/ LDB**

(i) GA Drawing

(ii) Type test Certificate for Short Circuit withstand capacity

(iii) Type test certificate for IP protection

(iv) Door open view of Distribution boards

(v) Data sheet of major Equipment

(vi) Wiring Diagram

(vii) Bill of Quantities

(viii) Makes Of Components offered

(ix) Foundation drawings and supporting arrangement drawing

- **Octagonal Poles**

(i) GA Drawing

(ii) Type test Certificates

(iii) Foundation drawings

- **Construction Drawings of the following**

(a) Cable schedule

(b) Circuit distribution scheme

(c) Cable routing drawing

(d) Equipment Layout

(e) Power Distribution Scheme

(f) Switch Board Schedule

(g) Point Wiring Drawing for Lighting and power

(h) General arrangement of equipment Layout of the shops / rooms/ Landscape area/ Pathways/ Walkways.

DATA SHEET

For Indoor Luminaries

Parameters	Requirements
Type	LED Luminaries complete with all accessories for recess /surface mounting
Rated Voltage	240V
Operating Voltage Range	220–240-volt AC.
Frequency	50±3 Hz
Driver Type	Constant Current based Electronic Driver
Housing Material	Metallic CRCA Powder Coated Body/Extruded aluminumframe
Mounting	Recess/Surface Mounted
Optics	Symmetric
System Power Efficiency	≥ 85%
Operating Temperature Range	-20 Deg C to + 50 Deg C
Operating Humidity	10% to 90% RH
System efficacy	≥100 Lm/Watt; (≥65 Lm/Watt)
LED chip Efficacy	LM80 report, to be submitted.
LED Drive Current	>350 – <750 mA
Leakage Current	As per IEC 60598
LED Wattage	1-3 W
Power Factor	≥0.90
Colour Rendering Index	≥70
Rated Minimum LED Life	50,000 Burning Hours

Parameters	Requirements
Driver Life	>50000 Burning Hours
Maximum temperature rise for the Driver	≤ 30 Deg C from ambient
Heat Sink Temperature	≤ 15 Deg C from ambient
Total Harmonics Distortion (THD)	<10%;

IP Protection	IP 20
IK protection for Optic Cover	>IK05
Minimum Surge Protection	>3kV
Protection Required in Driver Module	
Short Circuit	Yes; Constant current limit mode.
Over Voltage	Yes;
Over Temperature	Yes; Auto Shut Off.
Under Voltage	Yes;
String Open Protection	Yes;

For Walkway and Pathway Luminaries

Parameters	Requirement
Type	LED Luminaries complete with all accessories for Pathway and Walkway Lighting
CCT	Minimum 3000K
Ingress Protection	IP65
Impact protection	IK07
Mounting	Pole top entry suitable for dia 114mm
Rated voltage	220-240V AC
Wattage	Not less than 35 W
Lumen O/P	85 lm/watt
CRI (typical)	70 (nominal)
Power factor	>0.9
Operating Voltage Range	140 V — 270 V at 50Hz (+/- 5%)
Working temperature	0 to +45 degree Centigrade
Housing Material	Die-Cast aluminium housing
Diffuser Material	Polycarbonate
Lifetime	50000 hrs @ L7050 Degree C
Surge Protection	Minimum 5kV

Mandatory Certification	Luminaire should be BIS certified.
Mandatory test reports	LM-79,LM80

10.0 PRE COMMISSONING-TESTS ON ELECTRICAL EQUIPMENT TO BE CARRIED OUT AFTER INSTALLATION:

- PRE-COMMISSION TESTS: Pre-commissioning tests in the specification requirements for various equipment but not limited to following shall be carried out by CONTRACTOR in presence of GSCL/ GSCL's representative. Commissioning shall be carried out only after obtaining satisfactory results, acceptable to Purchaser/ Purchaser's representative.
- **LT Distribution Boards**:
  - (a) IR Values of power & control circuits.
  - (b) Interlocks circuits
  - (c) Indication / Panel space heater circuit
- **DG:**
  - (a) Testing the set in Auto / Manual / Test modes.
  - (b) Testing for all Interlocks
  - (c) Full load test on the set for Eight hours
- **Power and Control Cables:**
  - (a) IR Values
- **Lighting System:**
  - (a) Visual inspection for operating problems
  - (b) System activation -burning in the lamps for 100 Hrs
  - (c) Measuring light level & reflectance.
- **Earthing System:**
  - (a) Earthing resistance of each electrode.
  - (b) Overall earthing resistance of the system for a group which is interconnected.

TECHNICAL SPECIFICATIONS

FOR

LANDSCAPING & HORTICULTURE WORKS

Table of Contents

1.0 SPECIFICATIONSFOR PLANTING

1.1. PLANT MATERIAL

Providing and display of following plant material details as given below. All supplied plants are well developed and well formed, bushy and healthy.

1.1.1 LIST OF TREES, SHRUBS AND GROUNDCOVER

S.no	TREES	Quantity
01	Dalbergiasissooplant of height 150-165 cm. in big poly bags of size 30 cm	10
02	Melia azedarachplant of height 120-130cm in big polybag of size 25 cm	09
03	Pelptophorumpetrocarpumplant of height 150-130cm in big polybag of size 25 cm	08
04	Azadirachtaindicaplant of height 120-130cm in big polybag of size 25 cm	12
05	Delonixregiaplant of height 150-165 cm. in big poly bags of size 25 cm	21
06	Mangiferaindicaplant of height 150-165 cm. in big poly bags of size 30 cm	40
07	Bambusavulgaria	48
08	Schleicheraoleosaof height 150-165 cm. in big poly bags of size 30 cm	16
09	Thespesiapopulne aplant of height 150-165 cm in big poly bag of size 25 cm	17
10	Jacaranda mimosifolia plant of height 150-240 cm. in big poly bags of size 25 cm	27
11	Cassia fistulaplant of height 150-165 cm. in big poly bags of size 25 cm	13
12	Musaceae Banana	08
13	Bauhinia variegate plant of height 120-150 cm. in big polybags of size 25 cm	11
14	Butea monosperma of height 150-165 cm. in big poly bags of size 25 cm	15
15	Psidiumguajana	29
16	Plumberiaobtusa plant of height 150-165 cm in big poly bag of size 20 cm	06
17	Citrus lemonplant of height	07
18	Tamarindus indica	24
S.no	GROUNDCOVER PLANTS (taking 20% of green area)	
01	Moschata ht.ofplants 30-45cminpolybag.	
02	Alternanthera Ruby well-developedofheight15-20cminpolybag.	
03	WediliaTrilopata well-developedofheight 15-20cmin polybag.	
04	PhyllanthyaNivosusRoseopicta well-developedofheight15-20cmin polybag	
05	Zebrina Pendula well-developedof height 15-20cminpolybag.	
06	Tradescantia Pallida ht of plants 30-45cm in poly bag.	
07	Hibiscus rosa sinensis ht of plants 75-100cm in poly bag.	
08	Lilium longiforum	
09	Helianthus	
10	Zinna elegans	
11	Ambiguous	
12	Nelumbo nucifera	
13	Petunias	
14	Alyssum	
15	Dahilia	
16	Tropaeolum majus	
17	Calendula	

18	Antirrhinum	
19	Phlox subulata	
20	Nemesia	
21	Osteropermum	
22	Aster	
23	Cineraria	
24	Clarkia	
	Grassing for Lawn area	10780.13sq.m.

1.1.2 CUTTING & REMOVING OF WILD VEGETATIONS:

The item includes cutting of wild vegetation's, bushes/grasses, seasonal/perennial weeds etc. from ground level, collecting and stacking the same in heaps at least 10 metres away from the place of working so as to give a neat and clean appearance complete as directed by Head, Horticulture dept.

1.1.3 BASE PREPARATION

By scrapping of surface and even spreading, removal of clods, building debris, dirt etc on the surface., and carting of debris to the periphery of the site, to provide a clean surface to dump soil for grading works etc., complete.

1.1.4 DRESSING OF AREAS

Dressing of areas by scraping, spreading, levelling by removing all vegetation's/unwanted material and stacking the same up to 50 Mtr. So as to give a well neat and clean appearance at site complete as per specifications and as directed by the Head, Horticulture dept.

1.1.5 APPLICATION OF WEEDICIDE/HERBICIDE:

The item includes spraying of weedicide/herbicide by deploying trained manpower using manual(knapsack)spray pumps in desired concentrations by properly mixing to form uniform solution on foliar plant parts/vegetation's using water as media including arranging water from within RRCAT campus at site for use. Spraying at site shall be carried in the wind direction to avoid any body contact following safety precautions like use of mask/gloves, goggles etc during spray operation preventing any accident /health hazard.

Note:

1. Department shall not responsible for any injuries/disorders arising out of misuse/mishandling of weedicide and equipment put to use.
2. The contractor shall keep the record of weedicide issued by the Department updated
3. The contractor shall carry out spray operation on site identified by Head, Horticulture Cell. Measurements Payments shall be based on the herbicide/weedicide issued by dept.& consumed by contractor at the site of work from time to time correct to 0.001 Litre. Rate The rate shall include the cost of all the labour and material involved in all the operations described above including cost towards safety measures,

transportation of water, cost of spray pumps, buckets etc. (excluding the cost of herbicides, fertilizers, sticking agent and water to be supplied by the dept. free of cost.)

1.1.6 TRANSPORTATION OF SOIL:

The item includes the cost of excavation of soil, loading, transportation, unloading at all leads with in the site. The contractor shall transport the soil/murum from the areas identified for various Gardens/Parks etc by the department. The soil excavated shall be certified by the Department for its suitability i.e., as per requirements as per the directions and instructions issued by Head, Horticulture Cell. Measurements: Length, breadth and height of dumper/tractor trolley shall be measured correct to a cm. The volume of the dumper/tractor trolley shall be reduced by 20% for voids for payment. Rate: The rate shall include the cost of excavating the earth from areas lying at distance from the site, loading, transporting the same at site, unloading at places indicated.

1.1.7 SUPPLY OF GOOD QUALITY FINE TEXTURED SOIL:

The item includes the cost of supply of fine textured soil suitable for Lawns, plant propagation and pot culture etc. at site, including royalty, loading, transportation, unloading, stacking at site. Soil shall be free from stones, pebbles, weeds, unwanted garbage, grass etc. Before affecting bulk supply contractor shall get the sample of soil approved for its quality/suitability. The soil shall not be unloaded unless approved by departmental representative failing which the material shall not be paid. In case of rejection of material for quality etc the contractor shall not unload the same and if done shall remove it at his own cost from the site. It shall be transported to the site in Truck/dumper with efficient arrangement to prevent spilling en route. It shall be stacked at site.

1.1.8 MAINTENANCE & UPKEEPING OF GRASSED PLAYFIELDS:

Maintenance of Lawn (Cynodondactylon) includes follow up of cultural practices as specified below on day today basis.

1.1.8.1 Watering:

The lawn shall be watered regularly using sprinklers/hoses provided at site through distribution network laid down. While making use of hose the direction of hose out let shall be towards sky so as to have a rain effect. In no case flooding shall be done except it is required for some reason.

1.1.8.2 Weeding/Mowing:

The lawn shall be moved regularly and worked for removal of weeds therein on regular basis. All efforts shall be made to timely weed out nut grass and broad leaved weeds in the lawns by uprooting alternatively using herbicidal treatment under the instructions. The average interval for lawn moving shall be once a week or on requirement at site depending on season. Lawn moving shall be done in same direction /no cross cutting is allowed. Immediately after moving with lawn mower, the grass edges etc shall be trimmed off by shears to maintain uniformity in grass growth. Constant supervision shall be kept to keep the lawn area clean and weed free. As a regular feature lawns shall be swept and maintained clean from rubbish material/leaves and other material etc all the time.

1.1.8.3 Providing lawn mower:

The contractor shall make elaborate arrangement for providing lawn mower for cutting lawn grass at his own cost. The lawn mower may be diesel operated suitable for large lawn area fitted with back roller to ensure

timely cutting of grass. It shall be the responsibility of the contractor to keep the machines in up-to-date condition and ready to use with periodical sharpening of blades to ensure smooth and uniform cutting of grass. The person using the power lawn mower shall be technically skilled to look into the aspects of adjustments of cutter which should be around 2.00 cm high grass level. Cutting of lawn at lower level shall only be carried out once in a year as per the directions/instructions issued by Officer in Charge Horticulture.

1.1.8.4 Rolling

Rolling operation for compactness shall be done using manual roller in the direction of mowing with cross rolling to be followed once in 4 months. Rolling or mowing shall not be done when the lawns are in wet condition as this shall spoil the areas. All the operations stated above shall be strictly followed in continuous manner.

1.1.8.5 Topping up/Pest control:

Half yearly top dressing with garden earth/FYM/fertilizers shall be carried out Pest /disease management shall be done as per the requirement & care must be taken for keeping the lawns in green lush condition. 6 Measurements: Length & breadth of the lawns in cricket field shall be measured on monthly basis correct to 0.1 meter and the area shall be calculated in sqm correct to two places of decimal. 7 Rate: The rate shall include cost of all the labour and material (Lawn mower, tools and tackles) involved in all the operations described above. (Excluding the cost of water, soil, FYM, fertilizers, pesticides, Sprinklers, hose, Manual roller to be made available by the dept free of cost.)

1.1.9 TOPSOIL (GOOD EARTH)

Topsoil or good earth shall be a farmable loam, typical of cultivated top soils of the locality containing at least 2% of decayed organic matter (humus). It shall be taken from a well-drained arable site. It shall be free of subsoil, stones, sticks roots or other objectionable extraneous matter or debris. It shall contain no toxic materials. No topsoil shall be delivered in a muddy condition.

- The loamy topsoil used for the soil mix shall be loose and friable. It must be free from stones, noxious seeds, weeds, roots and subsoil in any quantity.
- Any other organic matter and additives to balance the pH value of the soil mix shall not be more than 15% of the total soil mix.
- The Contractor shall mix the soil mix composition thoroughly before placing it into the planting pit.
- Excavated unsuitable silty clay, site materials must not be used in backfilling.
- The soil mix must be free from heavy clay or coarse sand, stones, lumps, other vegetation, roots, sticks and other foreign material.

Soil mix shall be of the same composition and structure throughout.

- The soil mix shall not be delivered, handled or placed in a muddy condition.

1.1.10 MANURES AND FERTILISERS

Dry sludge or Cow dung or similar shall be used. Measurement of manure shall be in stacks with 8% reduction for payment. It shall be free from extraneous matter harmful Bacteria, insects or chemicals.
Supply of Garden soil mix (Garden soil, Sand and manure in the ratio 3:1:1. supply shall be paid based on measurements taken jointly by Client's and Contractor's representative. Quantity of material brought shall be measured in trucks itself and shall be the basis of measurement and payment. There shall be no deductions for voids.)

1.1.10.1 Cow dung manure-

Supplying and stacking cow dung manure at site including royalty and carriage (manure measured in stacks will be reduced by 8% for payment). The project labour cost to supply & stack dump at various level of ground as per site requirement.

H	Manures and fertilizers (Supply, Stacking, Mixing and spreading)
1	Manure for Ground Floor Areas- Supplying and stacking cow dung manure at site including royalty and carriage (manure measured in stacks will be reduced by 8% for payment). The project labour cost to supply & stack dump at various level of ground as per site requirement.
2	Sweet earth for Ground Floor- Supply will be provided as/site. Only quote for shifting of sweet earth in the radius of 1Km.
3	Vermi Compost -Supplying spreading and mixing vermi compost manure in planting bed for healthy growth of plants
4	Sand -Supplying spreading and mixing sand for achieving better soil texture
5	Coco peat -Supplying spreading and mixing coco peat for better aeration and water retention
6	Mulching- Mulching with coco chip

1.1.10.2 Specific Fertilizer / Media/ Pesticide / Insecticide ad Anti Termite Application doses.

S.N.	Description	Unit	Dose
A	FYM		
	Trees / Palms	Cuft.	1/8 per Cumt.
	Specimen and Accent Plants	Cuft.	1/8 per Cumt.
	Shrubs	Cuft.	1/8 per Cumt.
	Lawn	Cuft.	1/8 per Cumt.
B	Neem Oil Cake		
	Trees / Palms	each	0.25 Kg per Cumt.
	Specimen and Accent Plants	Kg	0.25 Kg per Cumt.
	Shrubs	Kg	0.25 Kg per Cumt.
	Lawn	Kg	0.25 Kg per Cumt.
C	Bone meal		
	Trees / Palms	Kg	0.25 Kg per Cumt.
	Specimen and Accent Plants	Kg	0.25 Kg per Cumt.
	Shrubs	Kg	0.25 Kg per Cumt.
	Lawn	Kg	0.25 Kg per Cumt.

D	Pesticide		
	Trees / Palms	Litres	0.1 ml/gm per Cumt.
	Specimen and Accent Plants	Litres	0.1 ml/gm per Cumt.
	Shrubs	Litres	0.1 ml/gm per Cumt.
	Lawn	Litres	0.1 ml/gm per Cumt.
E	Insecticide/ Anti- termite		
	Trees / Palms	Litres	0.1 ml/gm per Cumt.
	Specimen and Accent Plants	Litres	0.1 ml/gm per Cumt.
	Shrubs	Litres	0.1 ml/gm per Cumt.
	Lawn	Litres	0.1 ml/gm per Cumt.

1.1.11 ROOT SYSTEM

The root system shall be conducive to successful transplantation. Where necessary, the root ball shall be preserved by support with hessian or other suitable material. On soils where retention of good ball is not possible, the roots should be suitably protected in some other way which should not cause any damage to roots.

1.1.12 NOMENCLATURE

Names of plants shall conform to names generally accepted in the local nursery trade.

1.1.13 CONDITION

- Trees and shrubs shall be substantially free from pests and diseases, and shall be materially undamaged. Torn or lacerated roots shall be pruned before dispatch. No roots shall be subjected to adverse conditions, such as prolonged exposure to drying winds or subjection to water logging, between lifting and delivery.
- All plant materials shall be healthy, Bushy, vigorous, free from plant diseases, insect pests, or their eggs, and shall have healthy well-developed root systems. All plants shall be hardy under climatic conditions similar to those in the locality of the project. Plants supplied shall conform to the names listed on both the plan and the plant list.
- No plan materials will be accepted if branches are damaged or broken.
- All material must be protected from the sun and weather until planted.
- All nursery stock shall have to be inspected and approved by the Landscape Architect before planting.
- All plants shall conform to these requirements specified in the plant list. Except that plants than specified may be used if approved, but use of such plants shall not increase the contract price. If the use of the larger plant is approved the spread or roots or ball of earth shall be increased in proportion to the size of the plant.
- All trees, palms, shrubs, lawn etc. shall have a normal habit of growth and shall be healthy, vigorous and free from insect and / or disease infestation.
- The minimum acceptable size of all trees after pruning, with branches in normal positions, shall conform to the measurement specified in the Schedule of Works unless stated otherwise.

- Plants that meet the specified measurement, but do not possess a normal configuration or balance of height and spread shall be rejected. All trees supplied shall be branched as specified in the Schedule of Works. Natural form of the trees must be kept after pollarding. De-topped trees shall be rejected. All trees supplied must have terminal shoots.
- Plant material larger in size than specified may be used subject to the approval of the Employer's Representative. The use of larger plant material shall make no change in the Contract price. Height shall not be substituted for balanced form.
- All plant material shall have a root ball of sufficient size to support the plant recovery from transplanting. Any plant material delivered to the Site Nursery with small or inadequate root balls shall be rejected.
- All trees must not be pollarded when delivered and planted on site. Only light pruning is allowed and subject to approval of Employer's Representative.
- All lawn areas shall be turfed, unless otherwise stated as spot turfing.
- All stolons must be healthy and free from other foreign grasses.
- All stolons shall be minimum 50mm length.

1.1.14 PACKAGING

Packaging shall be adequate for the protection of the plants and such as to avoid heating or drying out.

1.1.15 MARKING

Such specimen of tree and shrub, or each bundle shall be legibly labelled with the following particulars:

- Its name;
- The name of the supplier, unless otherwise agreed;
- The date of dispatch from the nursery.

1.2. PLANTING PROCESS

1.2.1. EXCAVATION

Trees should be supplied with adequate protection as approved after delivery. If planting is not to be carried out immediately, balled plants should be placed cheek to cheek and the ball covered with sand to prevent drying out. Bare rooted plants can be heeled in by placing the roots in a prepared trench and covering them with earth which should be watered in to avoid air pockets around the roots.
Excavation of Pits/beds of desired shape& size in ordinary soil up to a depth of 1mt. in soil/murrum by staggering serviceable material and removing Stones, brick bats, unsuitable earth and other rubbish, all roots and other undesirable growth stacked/spread for disposal up to 50 meters. Good earth in quantities as required to replace such discarded stuff shall be unloaded at site by the contractor which shall be paid for separately. The tree beds/pits shall be back filled with farm yard manure/fertilizers/pesticides by uniformly mixing with the soil in the specified proportion, to the level of adjoining ground and then profusely watered to enable the soil to subside the refilled soil shall then be dressed evenly with its surface about 50 to 75 mm below the adjoining ground level complete as directed by the Head, Horticulture Cell. Measurements: Length, breadth and depth of excavated pits/beds shall be measured correct to a cm and the volume of pit shall be calculated in cubic meter. Correct to two places of decimal, to be paid on back filling as per above. Rate: The rate shall include the cost of all the labour and material involved in all the operations described above (excluding the cost of soil, FYM, Fertilizer/Pesticides water to be made available by the dept free of cost.)

1.2.2. DIGGINGOFPITS FOR TREES, SHRUBS AND GROUNDCOVER

1.2.2.1 FOR TREES

Pits of size 750 mm x 750 mm x 750 mm filled with 50% of mother earth and balance 50% filled with a mixture of garden soil, manure and sand in the ratio of 3:1:1. Rate to include supply of tree species (Rate does not include supply of garden soil, manure and Sand which is separately quoted for) labour charges for pitting, mixing soil media, filling the pits with soil media, maintenance for a period of 90 days from planting.

1.2.2.2 FOR SHRUBS

Pits of size 300 mm x 300 mm x300 mm filled with 50% of mother earth and balance 50% filled with a mixture of garden soil, manure and sand in the ratio of 3:1:1. Rate to include supply of Shrub species of average height. Rate does not include supply of garden soil, sand and manure which is separately quoted for, labour charges for pitting, mixing soil media, filling the pits with soil media, planting the sapling, maintenance for a period of 90 days from planting.

1.2.2.3. FOR GROUND COVERS

Pits of size 250 mm x 250 mm x250 mm filled with 50% of mother earth and balance 50% filled with a mixture of garden soil, manure and sand in the ratio of 3:1:1. Rate to include supply of ground cover species of average height. Rate does not include supply of garden soil, sand and manure which is separately quoted for, labour charges for pitting, mixing soil media, filling the pits with soil media, planting the sapling, maintenance for a period of 90 days from planting.

1.2.2.4 GRASSING FOR LAWN

Dibbling of Bermuda grass - Garden soil is to be spread on garden surface up to a depth of 50mm and mixed with manure and Sand to attain a total depth of 75mm to form the final garden surface. Surface preparation is by raking and mixing to attain a smooth finished surface and planted with rooted slips of the specified Grass species, maintenance for a period of 90 days from planting.

1.2.3. BACKFILLING

The soil is backfilled, watered through and gently pressed down; a day previous to planting to make sure that it may not further settle down after planting. The soil shall be pressed down firmly by treading it down, leaving a shallow depression all round for watering.

1.2.4. PLANTING

No tree pits shall be dug until final tree position have been pegged out for approval.
Care shall be taken that the plant sapling when planted is not buried deeper than in the nursery or in the pot.

Planting should not be carried out in water logged soil.
It is most important to plant trees at the original soil depth; the soil mark on the stem is an indication of this and it should be maintained on the finished level allowing for setting of the soil after planting. All plastic and other imperishable containers should be removed before planting. Any broken or damaged roots should be cut back to sound growth.

The bottom of the planting pit should be covered with 50mm to 75mm of soil. Bare roots should be spread evenly in the planting pit; a small mound in the centre of the pit on which the roots are placed will aid an even spread. Soil should be placed around the roots, gently snaking the tree to allow the soil particles to shift into the root system to ensure close contact with all roots and to prevent air pockets. Backfill soil should be

firmed as filling proceeds layer by layer care being taken to avoid damaging the roots. Organic material should be applied, according to soil requirements.

1.2.5. STAKING

Newly planted trees must be held firmly although not rigidly by staking to prevent a pocket forming around the stem and newly formed fibrous roots being broken by mechanical pulling as the tree rocks.

Methods:
The main methods of staking shall be:
A single vertical stake 900mm longer than the clear stem of the tree, driven 600mm to 800mm into the soil.
Two stakes as above driven firmly on either side of the tree with a cross-bar to which the stem is attached. Suitable for bare - rooted or balled material.
A single stake driven in at an angle of 45 degrees and leaning towards the prevailing wind, the stem just below the lowest branch being attached to the stake. Suitable for small bare - rooted or balled material.
For plant material 3m to 4.5m high with a single stem a three-wire adjustable guy system may be used in exposed situations.
The end of stake should be pointed and the lower 1m to 1.20m should be coated with a non
Injurious wood preservative allowing at least 150mm above ground level.

1.2.6. TYING

Each tree should be firmly secured to the stake so as to prevent excessive movement. Abrasion must be avoided by using a buffer, rubber or hessian, between the tree and stake. The tree should be secured at a point just below its lowest branch, and also just above ground level; normally two ties should be used for each tree. These should be adjusted or replaced to allow for growth.

1.2.7. WATERING

The contractor shall allow for the adequate watering in of all newly planted trees and shrubs immediately after planting and he shall during the following growing season, keep the plant material well-watered.

All shrubs which are supplied pot grown shall be well soaked prior to planting.

Watering in and subsequent frequent watering of summer planted container - grown plants is essential.

1.3. SHRUB PLANTINGINPLANTERS ANDBEDS

All areas to be planted with shrubs shall be trenched to a depth of 600mm.Tall shrubs may need staking; which shall be provided if approved by the Contracting Architect, depending upon the conditions of individual plant specimen. Shrubs and ground cover shrubs in beds and planters. Positions of shrubs to be planted shall be marked out in accordance with the planting plan. Shrubs are set out; precautions should be taken to prevent roots drying. Planting holes 40cm dia and 40cm deep should be excavated for longer shrubs. Polyethene and other non-perishable containers should be removed and any badly damaged roots carefully pruned. The shrubs should then be set in holes so that the soil level, after settlement, will be at the original soil mark on the stem of the shrub. The hole should be backfilled to half its depth and firmed by treading. The remainder of the soil can then be returned and again filled by treading.

1.4. GRASSING

1.4.1. PREPARATION

During period prior to planting the ground shall be maintained free from weeds.

Grading and final levelling of the lawn shall be completed at least three weeks prior to the actual sowing. Regular watering shall be continued until sowing by dividing the lawn area into portion of approx. 5mts. square by constructing small bunds to retain water. These `bunds shall be levelled just prior to sowing of grass plants. At the time of actual planting of grass, it shall be ensured that the soil has completely settled.

1.4.2. SOIL

The soil itself shall be ensured to the satisfaction of landscape Architect to be a good, fibrous loam, rich in humus.

1.4.3. SOWING THE GRASS ROOTS

Grass roots (Cynodondectylon or a local genus approved by the landscape architect) shall be obtained from a grass patch, seen and approved beforehand.

The grass roots stock received at site shall be manually cleaned of all weeds and water sprayed over the same after keeping the stock in a place protected from sun and dry winds.

Grass stock received at site may be stored for a maximum of three days. In case grassing for some areas is scheduled for a later date fresh stock of grass roots shall be ordered and obtained.

1.4.4. EXECUTION

Small roots shall be dibbled about 15 cms apart into the prepared grounds. Grass areas will only be accepted as reaching practical completion when germination has proved satisfactory and all weeds have been removed.

1.4.5. MAINTENANCE

As soon as the grass is approximately an inch high it shall be rolled with a light wooder, roller in fine, dry weather and when it has grown to 2 to 3 inches above the ground, weeds must be removed and regular cutting with the scythe and rolling must be begun. A top dressing of announce of guano to the square yard on well decomposed well broken sludge manure will help on the young grass. The scythe must continue to be used for several months until the grass is sufficiently secure in the ground to bear the mowing machine. It should be possible to use the inch above the normal level for the first two or three cuttings. That is to day the grass should be cut so that it is from 1 to 2 inches in length, instead of the 1/2 to 3/4 of an inch necessary for mature grass.

In the absence of rain, the loan shall be watered every ten days heavily, soaking the soil through to a depth of at least 25 cms.

Damage failure or dying back of grass due to neglect of watering especially for seeding out of normal season shall be the responsibility of the contractor.

Any shrinkage below the specified levels during the contract or defects liability period shall be rectified at the contractor's expense.

The contractor is to exercise care in the use of rotary cultivator and mowing machines to reduce to a minimum the hazards of flying stones and brickbats. All rotary mowing machines are to be fitted with safety guards.

1.4.6. ROLLING

A light roller shall be used periodically, taking care that the lawn is not too wet and sodden.

1.4.7. EDGINGS

These shall be kept neat and must be cut regularly with the edging shears.

1.4.8. FERTILIZING

The lawn shall be fed once a month with liquid manure prepared by dissolving 45 grams of ammonia sulphate in 5 litres or water.

1.4.9. WATERING

Water shall be applied daily during dry weather. Watering whenever done should be thorough and should wet the soil at least up to a depth of 20 cms.

1.4.10. WEEDING

Prior to regular mowing the contractor shall carefully remove rank and unsightly weeds.

1.5. MAINTENANCE

1.5.1. GENERAL

The landscape contractor shall maintain all planted areas within the landscape contract boundaries until the period of one year after the complete plantation. Maintenance shall include replacement of dead plants. Watering, weeding, cultivating, control of insects, fungicide and other diseases by means of spraying with an approved insecticide or fungicide, pruning and other horticulture operations necessary for the proper growth of the plants and for keeping the landscape sub- contract area neat in appearance.

1.5.2. PRUNING & REPAIRS

Upon completion of planting work on the landscape sub-contract all trees should be pruned and all injuries repaired where necessary. The amount of pruning shall be limited to the minimum necessary to remove dead or injured twigs and branches and to compensate for the loss of roots and the results of transplanting operations. Pruning shall be done in such a manner as not to change the natural habit or special shape of the trees.

1.5.3. TREE GUARDS

Where tree guards are necessary, care should be taken to ensure that they do not impede movement or restrict growth.

1.5.4. NURSERY STOCK

Planting should be carried out as soon as possible after reaching site. Where planting must, of necessity, be delayed, care should be taken to protect the plants from pilfering or damage from people or animals. Plants with bare roots should be healed in as soon as received or otherwise protected from drying out, and others set closely together and protected from the wind. If planting should be unpacked, the bundles opened up and each group of plants heeled in separately and clearly labelled. If for any reason the surface of the roots becomes dry the roots should be thoroughly soaked before planting.

1.5.5. PROTECTIVE FENCING

According to local environment shrubs may have to be protected adequately from vandalism until established.

1.5.6. COMPLETION

On completion the ground should be formed over and left tidy.
Note: Refer Landscape Drawing

2.0 SPECIFICATION FOR LANDSCAPING

(Refer Landscape Drawing):

2.1 EARTH WORK

Earth work in excavation in all types of soils (i.e., soft loose soil / hard dense soil / moorum / gravel etc.) in foundation, trenches or drain in required width dressing of sides and ramming of bottom including strutting, timbering, shoring and getting out the excavated soil and disposal of surplus excavated earth as directed by the Project-in- charge.

2.2 BACK FILLING

Back filling with available excavated earth (excluding rock) in lawns, foundations etc, in layers not exceeding 20 cm in depth, consolidating each deposited layer by watering and ramming including all leads and lifts complete.

2.3 SUB GRADE WORKS

Preparation of subgrade by excavating earth to an avg. depth of 225mm.Dressing to camber and consolidation with 8-to-10-ton roller as required and disposal of surplus earth within the site.

2.4 HARDCORE WORKS

Providing and laying of WBM of 100mm thick layer with 63-45mm aggregate, spreading to template patching with smaller stone rolling, binding with selected earth and morrum, watering and consolidating with roller 0f 8MT.

Providing and laying of WBM of 150mm thick layer with 90-63mm aggregate, spreading to template patching with smaller stone rolling, binding with selected earth and morrum, watering and consolidating with roller 0f 8MT.

Providing and laying of soling of 160mm thick layer with 90-63mm aggregate, spreading to template patching with smaller stone rolling, binding with selected earth and morrum, watering and consolidating with roller 0f 8MT.

Providing and laying fine Sand including watering, ramming, consolidating and dressing etc. as per the direction of Engineer-in-charge.

2.5 CONCRETE WORK (CAST - IN - SITU)

Providing & laying in position plain cement concrete of specified grade in raft, bases of column footings, brick wall footing, base of floor, as screed over areas to make up levels or to form slopes, laid to required levels and grade at all locations, consolidated finished fair and cured including side forms as required complete.

Concrete mix 1:4:8(1 cement: 5 coarse sands: 10 graded stone aggregate 40 mm nominal size)

Providing and laying damp-proof-course 40 mm thick with cement concrete 1:2:4 (1cement: 2 coarsesand: 4 graded stone aggregate 12.5 mm nominal size mixed with water proofing compound in cement concrete @ 1 kg per 50 kg of cement.

2.6 RCC WORK (CAST - IN - SITU)

Providing and laying in position reinforced cement concrete of specified grade in walls (any thickness) including attached pilasters, buttresses, plinth and string courses, fillets, columns, pillars, Pires, abutments, posts, struts, beams, suspended floors, roofs having slops up to 15° , balconies, shelves, chajjas, lintels, bands, plain window sills, staircases and spiral staircases up to floor five level excluding the cost of centering, shuttering, finishing and reinforcement with 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size).

2.7 FORM WORK

Providing erecting shuttering of good quality/ approved sheets in RCC beams, columns, footings, walls etc. including Centering, strutting, propping and bracing, bolting, welding and keeping the same to the lines and levels indicated on the drawings and removing the same as per specifications, drawings including provisions for grooves, drip throats, chamfers, inserts, sleeves, conduits, junction box, recesses, projecting dowels etc. at all levels, heights, depths.

2.8 STEEL REINFORCEMENT

Laying and fixing in position TMT 500d bar reinforcement for RCC inside & precast work including cost of supplying straightening, cutting, bending and binding with 16-gauge MS annealed binding wire, cement mortar spacer blocks etc. complete as per drawings specifications and as directed by Engineer-in-Charge (For all heights & diameters).

2.9 BRICKWORK

Providing and Constructing Brick masonry work with common burnt clay F.P.S. (non modular) bricks of class designation 7.5 in foundation and plinth in Cement mortar 1:6 (1 cement: 6 coarse sand)

Providing and constructing Cement block work in foundation and plinth laid in cement mortar 1:6 (1 cement: 6 coarse sand) mix, joints finished, flush/ raked to 6mm depth including scaffolding, curing complete as per specification and drawing or as directed by Project Manager.

2.10 LIGHT WEIGHT FILLING

Providing and laying of Autoclaved aerated concrete blocks as a filler on top of slab to the specified height mentioned in drawings.

2.11 PLASTERING

Providing and applying plaster 20mm thick in cement mortar 1:4 (1 cement: 4 coarse sand) in all internal areas of planters complete as per specification and drawing or as directed by Project Manager.

2.12 WATERPROOF PLASTERING

Providing and laying waterproofing treatment on Brick wall / RCC by applying cement slurry mixed with - First layer of slurry of cement and acrylic base approved polymer mixed in ratio 1:2 (1 polymer: 2 cement). This layer will be allowed to air cure for four hours. Second layer of slurry of cement and acrylic base approved polymer mixed in ratio 1:2 (1 polymer: 2 cement). This layer will be allowed to air cure for four hours followed with water curing for 48 hours.

2.13 DRAIN BOARD

Providing and laying of HDPE Drain BOARD 12-15 mm thk. With geotextile membrane. Once the waterproofing treatment has been done and protected with screed. Install Prefabricated sheet drain Gutta Drain V or equivalent having the following specification: Studs Height: 8 mm; Compressive Strength: 23 t/sqm; Flow Rate: 4.6 L/s/m. The Drain Cell to be factory fitted with 110 gsm Polypropylene geotextile or equivalent. The filter fabric is to be bonded to each dimple so as to prevent soil particles from entering the flow channels while allowing water to freely enter the drainage core from one side. The drain boards are to be unrolled on top of the substrate with overlaps of minimum 100mm and with upturns of minimum 200mm on the vertical edges.

2.14 FLOORINGANDCLADDING: FINISHES

2.14.1 PRE-CAST CONCRETEPAVERS

General Specifications for 60 mm thick Interlocking Concrete Paving Blocks with ISI mark (IS 15658:2006)

- Supply of High Strength high finish Interlocking Concrete paving blocks with ISI mark, with wear resistant aggregates colour coordinated aggregates in face mix.
- Colours specified by the architects, using UV resistant colour pigments.

Sr.	Parameters	Minimum Requirements
1.	Percentage Water Absorption	Average not over 6%
2.	Compressive strength	Average not less than 400 Kg/cm2
3.	Tensile Splitting Strength (as per EN 1338)	Average not less than 3.6Mpa
4.	Average wear in Thickness- Abrasion	Conforming to Grade ‘H’ of EN 1338
5.	Tolerance in size (length + breadth)	± 1.5mm
6.	Thickness of wearing layer	Not less than 5mm
7.	Tolerance in Thickness of block	± 3mm

- The blocks must be manufactured on factory made, high precision steel moulded automated Hydraulically pressed type machine, coloured concrete paving blocks of approved size in paved

areas wherever required as/drawing, having compressive strength > 40 N/mm² (M40 grade) in FTP areas an > 25 N/mm² (M25 grade) in non-FTP areas only. The manufacturer

- must demonstrate feeding of material into the machines by automatic batching plants
- The manufacturing company must be an ISO 9001:2008 certified Company or should have equivalent quality management systems in place to ensure quality product.
- The blocks will be made using wear resistant materials in the face mix as specified by the architects.
- The colours of the blocks (wearing layer) will be as selected by the architects.
- The blocks must be cured in controlled environment to ensure efflorescence free material.
- The manufacturer must have in house testing laboratory to carry out all testing including Compressive strength testing, Tensile strength testing, Water absorption, abrasion resistance etc.
- Pavers will be placed in position in position on 40 mm sand base and 40 mm mortar base on edge pavers.

2.14.1. PRECAST CONCRETE PAVERS FOR TACTILE AREAS

Providing and laying CEMENT CONCRETE Tactile Pavers (for vision impaired persons as per standards) of size 300x300x80mm depth having with water absorption less than 0.5% and conforming to IS: 15622 of approved make in all colours and shades in for outdoor floors such as footpath, court yard, multi modals location etc., laid on 20mm thick base of cement mortar 1:4 (1 cement : 4 coarse sand) in all shapes & patterns including grouting the joints with white cement mixed with matching pigments etc.
Complete as per direction of Engineer-in-Charge.

2.14.2 PRE-CAST CONCRETE KERBSTONE

Specifications for Vacuum Wet Pressed Kerbstones in Half Batter (HB) profile

SupplyofENtypeHalfBatterProfileKerbstonesoasperttheprofiledrawing, manufactured on Vacuum wet Press Machine with hydraulic pressing of wet concrete mixture to a minimum of 400 tons with simultaneous vacuuming.

Sr.	Parameters	Minimum Requirements
1.	Percentage Water Absorption	Not over6%
2.	Tolerance in size (length + breadth)	±1.5mm
3.	Tolerance in Thickness of block	±4mm

The face of the kerb shall not exhibit defects such as cracking or flaking when examined.

For faces described as flat and edges described as straight, the permissible deviations on flatness and straightness are given in Table 1

Length of gauge (mm)	Permissible deviation of flatness and straightness (mm)
300	±1.5
400	±2.0
500	±2.5
800	±4.0

Characteristic bending strength MPa	Minimum bending strength Mpa
4.5	4.0

Table 1- Permissible deviations of flatness and straightness

The manufacturing company must be an ISO 9001 certified Company or should have equivalent quality management systems in place to ensure quality product.

The Kerbstone material must be tested at the manufacturer's laboratory before dispatch for: Bending strength, Water absorption, and dimensional accuracy. Internal test report needed with every supply.

2.15 PAVING MATERIAL

2.15.1 PRECAST CONCRETE PAVERS- INTERNAL PATHWAYS

Providing and laying Light grey Shot Blasted pavers of size 200mmx100mmx60mmin internal pathways in herringbone pattern over 20mm thick mortar above100mm thick p.c.c base and compacted earth.

2.15.2 PRECAST CONCRETE PAVERS- TICKETING AREA

Providing and laying Dull Yellow/beige Shot Blasted pavers of size 200mmx200mmx60mm at ticketing area in grid pattern over20mm thick mortar above100mm thick p.c.c base and compacted earth.

2.15.3 PRECAST CONCRETE PAVER BAND- PATHWAYS

Providing and laying Dark grey Shot Blasted pavers of size 200mmx200mmx60mm in internal pathways in required pattern over20mm thick mortar above100mm thick p.c.c base and compacted earth.

2.15.4 SNOW LIMESTONE – PATHWAYS

Providing and laying snow limestone in polished Natural finish of size 600mmx600mm20mm in entrance plaza in in required design and pattern with 4mm gap filled with off white colour epoxy grout as per approved sample.

2.15.5 BLACK LIMESTONE- ENTRANCE PLAZA

Providing and laying Black limestone in Natural finish of size 600mmx600mm20mm in entrance plaza in in required design and pattern with 4mm gap filled with off white colour epoxy grout as per approved sample.

2.15.6 LIMESTONE RIVERWASH FINISH – FOUNTAIN

Providing and laying Mint green limestone in river wash finish in fountain area in required design and pattern.

2.15.7 KOTA STONE – O.A.T

Providing and laying of Yellow Kota Stone of size 450mmx450mm with 8mm gap filled with off white colour epoxy grout as per approved sample, laid over 20 mm thick base of cement mortar 1:2:2(1cement :2coarse sand :2fine sand) including making groove, grouting the joints with white cement.

2.15.8 RED SANDSTONE – CAFETERIA

Providing and laying of red sandstone of size 600mmx400mmx20mm in cladding and 600mmx400mmx18mm in coping, laid over 20 mm thick base of cement mortar 1:2:2(1cement :2coarse sand :2fine sand) including making groove, grouting the joints with white cement

2.15.9 BROOM FINISH CONCRETE – O.A.T

Providing and laying Dark grey Medium-broomed finish—1/32 to 3/64 in. in depth and created with a horsehair or synthetic bristle concrete finishing broom.

2.15.10 RUBBERIZED FLOORING – KID'S PLAY AREA & OPEN GYM

Providing and laying of 15mm thick rubberized flooring of different colours over 100mm thick p.c.c base above water proofing, compacted earth and 100mm thick hard core base.

2.15.11 LOCAL STONE CLADDING & FLOORING

Providing and fixing paper joint stone cladding with local stone finely dressed and chiselled of stone thickness 75-125mm over average 50 mm mortar.

3.0 SPECIFICATION FOR TOY TRAIN

3.1 FUNCTIONS

The toy train set must:

- Be able to move freely through the full rotation of wheels on a somewhat rough surface such as carpet, and concrete paving
- Be able to easily attach and attached cartridges from the engine and transport cart
- Allow for the door compartment on the transport cart to open and close easily through finger interactions
- Be raised 1 cm from the ground and underside base of each carridge.
- Be strong and durable for everyday use in a kindergarten environment such as drops.

3.2 AESTHETICS

The train toy set must be finished to a finished to a high standard by

- Being correctly and appropriately constructed using right joints/fastenings to maintain the products integrity while not compromising the aesthetic value
- Being the appropriate shape and form for playing.
- Visually inform its user that the toy is a train through its design and defining characteristics

3.3 SKILLS

- Must be designed and manufactured using the appropriate tools and machines available within the school workshops with assistance from teachers available.

3.4 SAFETY

- Must comply with any legal or moral requirement
- Must state any warnings or safety messages that users may need to be aware of

3.5 MATERIAL

- Must be constructed predominantly from pine wood.

3.6 SIZE

- Must not exceed 30 cm in length or height and width in 10 cm

4.0 SPECIFICATIONS FOR WATER FEATURE WORKS

The scope of work under this RFQ broadly covers, but not limited to following;

- It is a design-built offer, developed further with design and working details based on design intent drawings, and performance specification.
- Preparing shop drawings and obtaining approval from our consultant on detailed engineering, working on alternatives, value addition options.
- Procuring and sourcing materials, supplying, installing system as approved by our consultants, installing, testing, commissioning and running the system under trial runs for specified duration and finally handing over fully functional system complied with design intent, after de-snagging.
- Co-ordination of your installations work with that of other agencies, resolving the conflicts of
- clashing of services, and your services with civil/ finishing works.
- The scope also includes training the facility maintenance team for operating the system,
- conducting the objective test at the end of training.
- Making “As built Drawings”, obtaining approval on same from consultants, handing over
- operating, maintenance manuals, list of essential spares, original guarantees/ warranties and insurance covers etc, to owners.
- Salient features of the system are as follows;
- Water velocity of 1.5m/s is recommended for pipe sizes.
- Final intended fountain effect is indicated against each type. Vendor is expected to propose suitable Nozzles, diffusers, furnishing manufacturer’s catalogues clearly indicating makes, model Nos., and performance details.
- Puddle flanges in hot deep galvanized MS for inlet, outlet, drains, and makeup water are mandatory across the concrete / masonry basins.
- PVC piping should be used everywhere except areas specified otherwise. In those selected areas GI pipe shall be used.
- Some fountains have expansion joint running across them. The jointing materials should be primarily water tight and shall be able to take lateral movement. It shall be a flexible connection, which should be able to withstand 10kg/cm2 working pressure.
- Bidders are expected to design and select the appropriate pumps and filters, with respect to flow rates, maximum operating heads, and suction and discharge conditions. The selection criterion and pumps curves shall be enclosed along with the offers.
- The circulating pumps of approved vendors (indigenous/ imported-having adequate strong after Sales service network in Jharkhand) are preferred.
- Fountain lights are optional and should be separately quoted.
- All nozzle heads shall be Gun-metal or bronze unless otherwise specified.

- Electrical control panels shall be in close proximity to the fountains as per drawing
- Water supply is by water pump from water tanks on basement, the tapping is left at one point at podium level as indicated in the drawings attached.
- Pipes are laid inside the waterproofing system with half round cement pipe covered on top for protection.

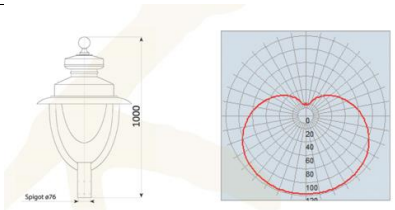
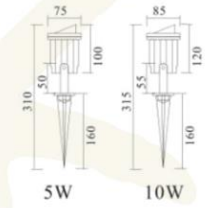
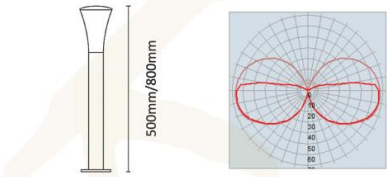
Please note following while preparing and submitting your Offer;

- Circuits and valves to be decided by vendor as per detailed engineering design and development. The schematics and single line drawings shall be submitted along with the offer, now. The shop drawings shall be prepared and submitted based on these drawings after the award of contract.
- On award of work, contractor shall furnish shop drawings covering detailed layouts, pipe routing, technical data sheets, single line diagram, schematics layouts, performance ratings, control diagrams, etc.
- Connections to pumps, motors, etc. from sub panels or isolators and from main panels to sub panels/isolators shall be done by fountain contractor. However main panel shall be energized by main electrical contractor.
- Pipe routing shall need coordination with other agencies, approval from consultant prior to ordering of materials. Your proposal and submit it in hard and soft copy (CD) while submitting the offer.
- Confirmation about adequacy of water head available at site for safe operating of the system proposed by vendor.

5.0 SPECIFICATION FOR LIGHT AND SOUND SHOW

Projectors- 32,000 ANSI Lumen, 15,000:1 Dynamic Contrast Ratio WUXGA Resolution with lens.
SHOW ACCESSORIES:
Equipment Rack - 19"- 24 U Rack, 800 mm wide, with Aluminium frame and 800 mm depth.
Background Music- Audio equipment's like speakers, woofers, amplifiers, signal processors, Audio Interface etc strategically distributed all over the ECO PARK, as per requirement. Integrated PA system.
Projector enclosure Mounting Stand & Poles- Dust tight and protected against water, with Control Interface for setup and monitoring of temperature, humidity and status indicators. Tilt Pan arrangement, Pole Mount. 6" Pole, Height is 3 meters.
RDM- Control panel with Independent Digital Led Display for Monitoring of Temperature and Humidity, exhaust control circuit, heating circuit, and power distribution.
Master Servers server with interfaces as per the tech specs of 16GB RAM, Intel® C612 chipset, compatible audio video interface Graphic card Mini Display Out, Monitor screen, optical mouse, keyboard etc.
Small Business 24 port Gigabit switch and 2 x Mini GBIC fibre uplinks.
Show Control software complete with necessary software interface including lifetime license and accessories.
HDMI Extender Transmitter Receiver Set Using Cat6 Cable.
Control Cables (2 Set)
Power distribution panel, Electrical & Network cabling.
SITC of complete CCTV surveillance system, including 10 nos. of bullet IP cameras
Installation, Testing, Commissioning & Integration of equipment.

6.0 SPECIFICATION FOR LIGHTING

S.NO	ITEM	SPECIFICATION	REFERENCE	QTY./L
01	TOP POST LIGHT	SAVI, VAK-PT-SAV POST-40, 3100 LUMENS, 40W, IP66	 Square & Pedestrian Area, Heritage Buildings & Street, Hotels, Residential Areas etc.	120NOS.
02	UP-LIGHTER	VAK-WW-AST-R-UD-S-5+5		74NOS.
03	SPIKE LIGHT	DIVA- VAK-SL-DIV-SPIKE-05, 350 LUMEN, 5W, IP66	 Shurb, Tree, Landscape, Parks, Sculptures, Monuments, Facade etc.	78NOS.
04	BOLLARD LIGHT	AMBER- VAK-BL-AMB-50-S-06, 500L, 6W, IP65	 Parks, Squares and pedestrian areas, Urban roads and streets, Bike paths, Precincts	25NOS.
05	POLE LIGHT DOUBLE ARM	VAK-ST-EAG-POLE-30, 35W, IP66		74NOS.
06	SOLAR POLE LIGHT DOUBLE ARM	VAK-ST-SAN-POLE-10, 35W, IP66		71NOS.
07	POLE LIGHT SINGLE ARM	VAK-ST-EAG-POLE-30, 35W, IP66		23NOS.
08	SOLAR POLE LIGHT SINGLE ARM	VAK-ST-SAN-POLE-10, 35W, IP66		22NOS.

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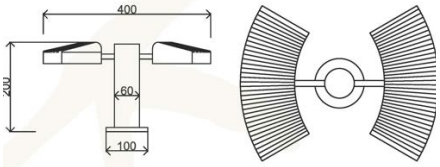
09	WALL WASHER LIGHT	BLOAT S- VAK-WW-BLO-4FT-S-28, 2520 LUMEN, 28W, IP65	 Building Facade, Pedestrian Area, Columns, Balconies, Bridges, Lift Lobby, Walk Ways etc.	64RM
10	STEP LIGHT	VAK-WR-DIO-STEP-5W,IP66		600RM
11	WATER TIGHT LIGHT	VAK-UW-MAR-R12, 6W,IP68		20NOS.
12	FOCUS LIGHT	BLOAT S- VAK-WW-BLO-1FT-S-07, 560 LUMEN, 7W, IP65	 Building Facade, Pedestrian Area, Columns, Balconies, Bridges, Lift Lobby, Walk Ways etc.	04NOS.
13	GATE LIGHT	CERPIA, VAK -GL-CER-GATE-10, 10W, 1600LM, IP66	 Parks, Squares and pedestrian areas, Urban roads and streets, Bike paths, Precincts	06NOS.

7.0 SPECIFICATION FOR KID'S PLAY AREA

Kid's play equipment	Specifications	Qty.
3-seater merry-go-roundre	-01-mgr. actual equipment size: dia 4 ft. Minimum recommended area: dia 8 ft. Children capacity: 3 children	1 nos.
6 chair merry-go-roundre	-02-mgr. actual equipment size: dia 6 ft. Minimum recommended area: dia 12 ft. Children capacity: 6 children	1 nos.
Glob merry-go-roundre	03-mgr. actual equipment size: dia 4 ft. Minimum recommended area: dia 8 ft. Children capacity: 4 children	1 nos.
challenging multi activity play systemcm	-04- MP actual equipment size: 56 x 42 x 16 ft. Minimum recommended area: 62 x 48 x 20 ft. Children capacity: 90 children	1 nos.
challenging multi activity play systemcm	-05- MP actual equipment size: 44 x 20 x 13 ft. Minimum recommended area: 50 x 26 x 16 ft. Children capacity: 60 children	1 nos.
Sound plays equipment		
Musical pollsdc-008 -me	Actual equipment size: 6 x 2 x 8 ft. Minimum recommended area: 10 x 6 x 10 ft. Children capacity: 4 children	1nos.
Drum trackdc-009 -me	Actual equipment size: 2.6 x 2 x 4 ft. Minimum recommended area: 4 x 4 x 6 ft. Children capacity: 2 children	1nos.
Congo trackdc-010 -me	Actual equipment size: 7 x 2 x 4 ft. Minimum recommended area: 12 x 6 x 6 ft. Children capacity: 5 children	1nos.
Musical panel dc-010 -me	Actual equipment size: 4 x 2 x 6 ft. Minimum recommended area: 6 x 4 x 8 ft. Children capacity: 1 child	1nos.
DC-023-MGR	Actual equipment size: DIA. 14 FT. Minimum recommended area: DIA. 18 FT. Children capacity: 2 children	1nos.
DC-022-MGR.	Actual equipment size: DIA. 4 FT. Minimum recommended area: DIA. 8 FT. Children capacity: 4 children	1nos.
DC-012 -PP	Actual equipment size: 4 X 1 X 4 FT. Minimum recommended area: 6 X 3 X 6 FT. Children capacity: 2 children	1nos.
Adventure play equipment		
Climbertp-01-cl	Actual equipment size: 40 x 20 x 12 ft. Minimum recommended area: 46 x 26 x 16 ft. Children capacity: 50 children	1nos
Climbertp-02-cl	Actual equipment size: 50 x 12 x 12 ft. Minimum recommended area: 56 x 18 x 16 ft. Children capacity: 100 children	1nos
Climbertp-03-cl	Actual equipment size: 15 x 6 x 10 ft. Minimum recommended area: 21 x 12 x 14 ft. Children capacity: 10 children- 1nos	1nos

Adventure play equipment-climbertp-04-cl	Actual equipment size: 24 x 6 x 10 ft. Minimum recommended area: 30 x 12 x 14 ft. Children capacity: 20 children	1nos
Challenging climbercc-01-cl	Actual equipment size: 28 x 14 x 10 ft. Minimum recommended area: 34 x 20 x 12 ft. Children capacity: 30 children- 1nos.	1nos
Challenging climbercc-02-cl	Actual equipment size: 26 x 26 x 12 ft. Minimum recommended area: 32 x 32 x 15 ft. Children capacity: 25 children	1nos
Challenging climbercc-03-cl	Actual equipment size: 36 x 36 x 14 ft. Minimum recommended area: 42 x 42 x 20 ft. Children capacity: 40 children	1nos

8.0 SPECIFICATION FOR OUTDOOR GYM AREA

Outdoor gym equipment	Specifications	Qty.
Palm wheelre-001-gym	Dimension: - 1260 x 800 x 1650 mm.max user weight 120 kg.	1 nos.
Shoulder wheelre-002-gym	Dimension: - 900 x 600 x 1650 mm.max user weight 110 kg	1 nos.
Multi-twisterre-003-gym	Dimension: - 1620 x 340 x 2350 mm.max user weight 110 kg	1 nos.
Mini ski & waist twisterre-004-gym	Dimension: - 1250 x 1400 x 1650 mm.max user weight 120 kg	1 nos.
3-level chin-upre-005-gym	Dimension: - 3500 x 200 x 2500 mm.max user weight 110 kg.	1 nos.
2-level chin-upre-006-gym	Dimension: - 2350 x 200 x 2500 mm.max user weight 110 kg.	1 nos.
Push-up & dip stationre-007-gym	Dimension: - 2000 x 950 x 1750 mm.max user weight 110 kg.	1 nos.
Double sit & pullre-008-gym	Dimension: - 2500 x 750 x 2220 mm.max user weight 110 kg.	1 nos.
Parallel barre-009-gym	Dimension: - 2500 x 800 x 1500 mm.max user weight 110 kg.	1 nos.
Triple standing twisterre-010-gym	Dimension: - 1100 x 1100 x 1600 mm.max user weight 110 kg	1 nos.
Double mini skire-011-gym	Dimension: - 1150 x 850 x 1650 mm.max user weight 110 kg	1 nos.
DC-019 -GYM	Actual equipment size: 5 X 1 X 5 FT. Minimum recommended area: DIA. 10 X 3 X 8 FT. Children capacity: 2 children	1 nos.
DC-020 -GYM	Area: 5 x 5 x 5 ft. Actual equipment size: 5 x 5 x 5 ft. Minimum recommended area: 8 x 8 x 8 ft. Children capacity: 2 children	1 nos.
DC-021 -GYM	Actual equipment size: 5 X 2 X 5 FT. Minimum recommended area:8 X 4 X 8 FT. Children capacity: 1 child	1 nos.

9.0 GARDEN FURNITURES AND MISCELLANEOUS WORKS

9.1 BENCHES

- Seater 1: Park Bench, Material: Stainless Steel, Grade: SS 304, Fixings: Root fixed Fixing: Surface / base plate fixed Seat length (mm):2000/2600 Seat depth (mm) 480 Above ground height (mm) 427 Seat height (mm) 427- 40nos.
- Seater 2: Wooden and metal Garden bench, 1500mm in length for 3-seater- 40nos.
- Seater 3: Round table with diameter of 5 feet with a capacity of 8 people- 10nos.

9.2 DUSTBIN

- Supply and providing of Street Waste Bin,Material: Stainless Steel, Grade: SS 304, Size: Height 4tf x Width 2.5ft, Capacity: 50 Litres, Finishing: Matte, - 40nos.

9.3 SIGNAGE

- Supply and installation of Signages with Acrylic with LED Back lit.Inside cover letter 1"Emboss LED warranty1-year power supply 1-yearwarranty block coated wiring. Including fabrication and installation charges. (Big Signages15(Size:1.2X.8m) and small signages-25(0.8mX0.6m)

9.4 STATUE

- 20’ Tall Sitting Sculpture of Chhatrapati Shivaji in Fibreglass (Casting of fibreglass material with 4 layers or more of 450 gsm)

10.0 TOPIARY garden

- Landscapes can personalize their garden art by making topiary animal frames that allows the imagination to illuminate an artic zoo for example if you display the below animals.
- Providing and Installation of topiary-Polar Bear 7-10 feet long(2) Seals 5-6 feet long
- Providing and Installation of topiary-Penguins 4 feet tall
- Providing and Installation of topiary-Walrus 12 feet long
- Providing and Installation of topiary-Wooly Mammoth 8-10 feet tall x 10-12 feet long
- Providing and Installation of topiary -Sabertooth Tiger 6 feet tall x 12 feet long
- Providing and Installation of topiary- Deer(length 4ft, height 5 ft)- - 1nos.
- Providing and Installation of topiary- Crane pair (length 4ft, height 6 ft)-- 1nos.
- Metal Wire Topiary Frames - It is made of hand-crafted wires of various sizes and has a mesh to fill out the particular bird or animal.

11.0 BOTANICAL GARDEN

- Providing and Installation of green house and space for nursery for plant germination and propagation.
- Planting of native flora. Different sections of various category of gardens on the basis of environment and climate like tropical garden, succulent garden, flower show, ornamental garden, rain forest garden, desert gardens, wetland garden
- Public amenities will be provided.
- Signage and display boards for Interpretation and entertainment zone will be a part of botanical garden

12.0 SCULPTURE GARDEN

- 12 poses of Surya namaskar statue on 1:1 scale, made of fiberglass (Casting of fibreglass material with 4 layers or more of 450 gsm)will be provided and installed at site

13.0 SPECIFICATIONS FOR SLOT DRAINWORKS

SPECIFICATIONS
GENERAL

The surface drainage system shall be 10,000 Series Food Safe Slot Drain complete with slotted linear trench opening as manufactured by Food Safe Drains

MATERIALS:
T304 Stainless Steel, T316 Stainless Steel

SLOPE:
0.5% Standard

DESIGN OPTIONS:
Material ($): SS304(5), SS316(6) Slot Opening (#): ½" (0), 1" (1), 1 ¼" (5) End (*): Open (0), End Cap (1), Flush Nipple (5) Section Lengths: Full 9'8", Half 4'10" (Customize Lengths available)

FLOW RATE:
½" 11 gpm (per foot of drain)
1 18 gpm (per foot of drain)
1 ¼" 27 gpm (per foot of drain)

LOAD CLASS:
Load Class E

ACCESSORIES:
Cleaning paddle, Cleaning Brush, Flush Flo, CIP, Slot Hog, Tri-Clamp

INSTALLATION:
The 10,000 Series Slot Drain System shall be installed in accordance with the manufacturer's installation instructions and recommendations.

TECHNICAL SPECIFICATIONS
OF
O&M SCHEDULE & MANPOWER
REQUIRED DURING O&M

MAINTENANCE AND OPERATION

GENERAL ARRANGEMENTS

a. Agency shall set up a Service Centre which will operate in full between flight operations for complete year including Sundays, GH, NH and Labor Day.

b. The Agency shall hire adequate Man powers from Civil, Electrical, Electronics & IT field who shall have a mobile phone to enable the Engineer-in-charge for timely communication.

c. The Agency shall hire a computer operator cum Service Coordinator who shall maintain all complaints at Service Centre in Desk top that will also be provided by the Agency with Internet connection.

d. The staff employed at Service center for complaint monitoring and attending complaints by the agency shall be present at the site round the clock.

e. All T&P including ladder/s, wire drawing equipment, chase cutting equipment, drilling machine megger insulation, earth resistance testing equipment etc. required for the work shall have to be arranged by the agency. No T&P shall be issued by the Department.

f. Staff employed by the agency shall be well behaved, polite & courteous. In case of any complaint against staff such staff shall be replaced by the agency on demand from Engineer-in- Charge. Agency will submit police verification of worker employed for the maintenance work.

g. The agency shall make allsafety arrangement required for the labor engaged By him at his own cost. All consequences due to negligence or due to lapse of security/safety or otherwise shall remain with the agency.The department shall not be responsible for any mishap, injury, accident or death of the agency's staff. no claim in this regard shall been tertained /accepted by the department.

h. The agency shall take immediate action to attend to any complaint assigned to him through site order book/verbal instructions from Engineer-in-Charge or on telephones / Internet from occupants.

i. Agency shall be fully responsible for any damage caused to Govt. property or allotter's property by him or his labor in carrying out the work and the same shall be rectified by the agency at his own cost. Chases, holes & drilling works etc. shall be done using only power operated tools. The defective items, materials, finishes, fitting shall be replaced with items of same specifications and compatible to the work.

j. All the dismantling or otherwise during the execution of the work shall be brought down through the staircase and shall not be thrown to the ground directly from the floors etc. After the collection of full truck load of the, the same shall be disposed of by the agency to the authorized municipal dumping ground.

k. In case of receipt of feedback from user regarding his complaint as

"unsatisfactory/shown attended without attending, the complaint, compensation @ 300/- (Rs. Three hundred only) per such feedback will be levied. This levy will be made after due verification of such feedback by Engineer-in-Charge.

l. The material fetched as a replacement / or dismantled material shall be the property of the Agency. The facilities to be made available at the Service Centre: One Counter for Computer Operator cum Service Coordinator to sit and receive complaints. All furniture required for agency's staff shall be arranged by the agency on his own cost. Electric connection for general purpose at the service center shall be taken and Bills for the electricity consumed shall be paid by the agency.

m. The assistance shall be provided by the agency to Engineer-in-Charge in the following:

   i. Assisting the department in detection of unauthorized encroachments in the area being maintained.

   ii. Informing the Engineer-in-Charge regarding the failure of any service being provided by other agencies, in so far as they affect the assets being maintained under this contract so that they can be taken up with the concerned local body/departments for rectification.

n. The agency shall provide an inventory list of items in campus/complex to be maintained. The agency shall be responsible for watch and ward of such items. The loss, if any shall be made good by the agency at his cost. The decision of Engineer-in-Charge in this respect shall be final and binding on the agency.

o. Stores and bins shall be provided by the agency for storing the Materials.

p. The labor deployed for attending complaints should carry necessary tool kit, container (Tasla), required for mixing any cement sand or other material and should carry with them water bottle and waste bag for collection of minor rubbish material if received during attending the complaints, so that the site of work shall remain neat and clean.

q. Each worker shall maintain a complaint diary and get the feedback recorded from the allotters regarding attending the complaint. In case, it is found that the complaint has been attended unsatisfactorily, it will be considered as unattended. List of such complaint shall be submitted to the Assistant Engineer-in-charge or his representative in daily basis.

r. The agency will maintain attendance records of the staff through biometric attendance system, which may be checked by the Engineer-in-charge or his representative of the work. In case of absence of any staff, recovery shall be made as directed by engineer-in charge based on minimum wages/fair wages as applicable.

s. Bad workman ship whenever noticed and conveyed to the agency shall be rectified by the agency to the satisfaction of the Engineer-in-charge. After the expiry of the contract, the Agency shall hand over the complete installations to the department in proper working order. All defects and

deficiencies shall have to rectified by the firm to the entire satisfaction of Engineer-in-charge failing which the work shall be got done at the riskand cost of the firm.

t. The submission of applications for Temporary Photo Identification Cards (PICs) in advance along with Certificate of Police Verification etc. as per the prevailing practice and regulations of BCAS will be the responsibility of contractor. Any financial expenditure involved such as fees for PICs, Photos, fees for Police Verification, if any, will be borne by the contractor. The PICs has to be re– validated in advance to ensure that the employees are always in possession of their entry passes. No employee will be permitted in the terminal buildings and operational areas without valid PICs. The contractor has also to issue his own identity card with his authorized signature to his staff for displaying while on duty. Employees without valid PICs will be considered as equivalent to absence of staff and necessary recovery will be made from bills of the contractor for this period. The decision of the EIC in this regard will be final and binding.

u. The agency shall provide uniform along with Badge and shoes wearing logo of WAPCOS. In the event of non-compliance, a recovery of Rs. 25/- per day per employee shall be made. Agency will provide neat & clean uniform to all workers. Color& pattern of uniform shall be as per decision of Engineer- in charge.

v. The agency shall have registration with Employees Provident Fund Commissioner and employees State Insurance Corporation for safeguarding interest of his workmen. He shall obtain allother necessary approvals from statutory bodies as per law in force. The contribution made towards EPF and ESI shall be reimbursed on the production of receipts for workers engaged on this work.

w. No residential accommodation shall be provided to any of the staff engaged by the agency.The agency shall also not be allowed to erect any temporary set up for staff in the campus.

SCOPE OF MAINTENANCE OF CIVIL WORKS

The Agency shall maintain all assets of civil works created through this agreement. The various types of maintenance works should be grouped into three categories, viz:

a) Day-to-daymaintenance b) Periodic maintenance

a) Day-to-day maintenance

The Agency shall be responsible to attend all complaints arises through any medium in the spirit of maintaining the campus/complex and all assets in impeccable condition. Accordingly, depending upon the number of complaints, the agency shall employ the number of workers to attend the complaint within prescribed time for which no extra payment will be admissible. However,

Minimum number of work men / staff to be deployed shall be as follows: -

S. No.	Category	Strength
1.	Supervisor	01 Nos
2.	Mason	1 No. As and when required
3.	Carpenter	1 No. As and when required
4.	Fitter/Plumber	1 No. As and when required
5.	Sewer Men	01 Nos
6.	Beldar	02 Nos
7.	Welder	1 No. As and when required

The aforesaid manpower shall be distributed in such a way that minimum 1 plumber/fitter, 01 sewer man and 1 beldars during local transport operations with the approval of Engineer- IN-Charge.

i) In all cases he shall attend the complaint in the specified duration as mentioned below:
ii) The following complaints (Known as “No delay”) shall be attended within 02 hours onreceipt:

- Removing chokage of drainage pipes, manholes.
- Restoration of water supply.
- Leakage of water supply pipes.
- Repair of overflowing cisterns/tanks.
- Replacement of sanitary fixtures in toilets.
- Repairs to roof leakage.
- Repairs to security fencing
- Any other complaint as directed by Engineer-in-charge.

(b) The following complaints (Known as “Minor”) shall be attended within 24 hrs. on receipt:

- Replacement of glass panes.
- Carpenter complaints.
- Mason complaints, such as patch plaster, corner repair, etc.
- Repairs to potholes or other minor damages developed on pavements
- Any other complaint as directed by Engineer-in-charge

i. Major Complaints – Complaints other than no delay and minor complaints shall beattended with in shortest reasonable time in consultation with Engineer-in
ii. Bidder shall also make arrangement for disposal of collected municipal waste from garbage chute collection chambers to the dedicated area/s within the periphery of campus/complex as per waste management scheme approved by Engineer-in- charge.

PERIODICAL MAINTENANCE/ANNUAL MAINTENANCE
MAINTENANCE NORMS/ FREQUENCY OF APPLICATION OF FINISHING ITEMS SHALL BE AS PER TABLE BELOW:

Development of facilities at Eco-Park, Jharkhand

Sr. No.	Item	Frequency from date of start of maintenancework
1.	Painting with plastic/Acrylic Emulsion paint, Acrylic Synthetic enamel paint, Oil bound distemper etc. or as per original finish provided during construction	2 Years
2.	Painting external surface with exterior Texture or as per original finish provided during construction	3 Years
3.	Cleaning and disinfecting of water storage/distribution tanks,water mains.	06 Months
4.	Cleaning of storm water drains.	1 Years
5.	Collection of water samples for physical, chemical and bacteriological analysis of water.	06 Months
6.	Grinding and polishing of flooring.	2 Years
7.	Any other maintenance works as directed by Engineer-in-charge	As & when required

SCOPE OF MAINTENANCE: LANDSCAPING AND HORTICULTURE WORKS

Complete maintenance of the entire garden features of the garden area i.e. lawn, trees, shrubs, hedge, potted plants, flowers beds, creepers etc. and other garden feature including watering hoeing, making of plants basic manuring, trimming and cleaning of hedges/plants, Beds, spraying of insecticides, fungicides, weeding, mowing, and top dressing of lawn with good earth and manure and hedge clipping and removal of the garden waste, composting of green waste from plants, trees, lawn mowing, etc asper direction and satisfaction of the officer-in charge to maintain the plants, hedge and lawns in goodandhealthyconditionsatallthetimeduringtheDLPof1yearandthereafter04year.

The following activities are covered under this contract.

S.No	Item of work	Nos./Qty/Frequency Required
1	Irrigation	Daily
2	Manuring	Seasonal (Manure from STP and solid waste management shall be used, in case any additional requirement Sludge manure/Cow dung manure shall be arranged by contractor from its own resources without any extra cost to WAPCOS.
3	Fertilization	In winter Summer and rainy season-Asper requirement (Urea and DAP @ 12 Cum per year each minimum)
4	Lawn Moving	
5	Summer	Fortnightly
6	Winter	Monthly
7	Rains	Weekly
8	Plant	Need Based as directed by concerned Engineer-In-Charge,
9	Protection	
10	Pruning &Trg. Of Trees/Shrubs Creepersetc.	Yearly/Need base
11	Cultivation & Weeding	As and when required as directed by concerned Engineer-In-Charge,
12	Seasonal Flowers	
13	Winter	Yearly
14	Summer	Yearly
15	Rains	Yearly

16	Top dressing with soil&/or manure	Yearly
17	Repair & replacementof plants leveling etc.	As and when required as directed by concerned Engineer-In-Charge,
18	Hedges Cutting	
19	Summer	Fortnightly
20	Rains	Fortnightly
21	Winter	Monthly
22	Any other item (Hort., Civil, Elect., U/F water supply) required forproper maintenance	On need basis as directed by concerned Engineer-In-Charge,
23	Outdoor potted plants	Need base as per requirement of site as directed by concerned Engineer-In-Charge,
24	Indoor potted plants &planters	Need base as per requirement of site as directed by concerned Engineer-In-Charge,
25	Planter beds	Need based as directed by concerned Engineer-In-Charge,
26	Rockeries	Need based as directed by concerned Engineer-In-Charge,
27	Flower vases	Need based or as directed by concerned Engineer-In-Charge,
28	Annual Tree Plantationunder Van Mohotsav Program	Once in year during monsoon (sapling Developed in nursery shall be provided minimum 200 without at any extra cost.

Nursery Upkeep

A nursery is required to be maintained to keep spare stock of plants to facilitate replacement in case of mortality, the same shall be maintained by properly by watering the plant stock, weeding, shifting of bags every two weeks, change of bags from smaller bags to bigger bags, cleanliness of the nursery area.

MINIMUM MANPOWER DEPLOYMENT HORTICULTURE & LANDSCAPE MAINTENANCE

The bidder shall provide well-trained, disciplined, honest and sincere workforce, which shall be maintained throughout the contract period. The minimum manpower as detailed below shall be deputed in 1 shift.

Supervisor: 01 nos.

Mali: 04 Nos

No additional payments will be made if there is need to increase the workforce, at a later stage to meet the requirements of the work.

The following conditions shall be followed:

a. In case of any causality of shrubs, trees or any other plants has been found duringmaintenance the Agency should replace the trees/ shrubs/ other plants of the same height and specification by another at his risk and cost and nothing extra shall be paid for the same in this regard or recovery of Rs 60/- per shrubs, Rs. 250/- treesplants, Rs.140/- for other foliage/ decorative plants and Rs. 100/- per Sqm. for lawns, shall be made for each such occasion. The decision of the Engineer-In Charge shall be final and binding in this regard.

b. The required quantity of insecticides/ Pesticides will be arranged by the bidder for proper maintenance (only during the maintenance period) if needed.

c. The rejected & substandard material should be removed from the site of work immediately; the Department shall not be responsible for any damage/ loss of rejected material. If the same will not be removed within five days after issuing notice in writing competent authority, then necessary recovery shall be made @ Rs. 2000 per day.

d. The bidder shall supplement the requirement of water for irrigation purposes in case supply from STP is not adequate or stopped. In no case the irrigation / watering of plants and greenery should be deprived.

INVENTORY OF TOOLS AND CONSUMABLES

The bidder shall satisfy himself regarding the specific requirements of Tools & Tackle and Consumables. No additional payments will be made if contractor needs to increase the number of Tools &Tackle or for increase in use of Consumables at a later stage to meet the requirements of the work.

Final Handover

a) Two weeks before the end of the maintenance period, a joint inspection shall be held toreview the requirements for alteration or replacement in order to gain approval for final handover.
b) At the time of final inspection, all areas under maintenance shall be free of Neatly cultivated and raked and all plants shall be in good order. Grass shall be neatly cut and all clipping removed. No bare patch of earth shall be visible in turfor planting areas unless specified.

OPERATION & MAINTENANCE OF E&M WORK

SCOPE OF WORK

The Scope of work covers as per items specified in schedule of work (SOW)enclosed.

a) Providing one shift (for complete year including Sundays, GH, NGH and Labor day) for preventive maintenance of complete E&M works and associated equipment's provided under the main contract for Four years;

a. `Providing (three shifts) round the clock (for complete year including Sundays, GH, NGH and Labor day) for operation and routine maintenance of
   i. completeE&Mworksandassociatedequipment'sprovidedunderthemaincontra
   ii. for Four years;

b. All-inclusive comprehensive maintenance contract (AICMC) for specialized Works to be executed from OEM or their authorized channel partner provided under the main contract during Defect liability period (DLP) & after
   i. Defect liability period (DLP) for the period as
   ii. Contract for E&M works.

The contract covers Operation and maintenance of Electrical Installations provided under the main contract.

- Operation of various E&M systems.
- Ensuring serviceability/satisfactory working condition of Electrical Installation system
- Attending to complaints / fault / breakdowns / carrying out necessary rectification /repair works.
- Making minor additions & alterations where required
- Dismantling of old / defective mounting / accessories & installation of newones.
- Periodical / Preventive Maintenance works
  - As per enclosed WAPCOS maintenance schedules
  - As per OEM's recommendations
  - As per the instructions of WAPCOS form time to time
- Undertaking periodical safety checks
- Repairing/ calibration of protective relays.
- Repairing / servicing of all types of E&M installations etc.
- Providing of Tools & Plants.
- Maintenance of Records / documents and submission of Reports.
- Supply of cleaning materials like cotton cloth, duster etc.
- Co – ordination in carrying out the works with other agencies working at the.
- Carriage of materials from their stores to various work sites for carrying outvarious works.
- Ensuring all necessary electrical & fire safety procedures, precautions whilecarrying out the work including making use of safety gadgets like

hand gloves, torch light, rain coat, leather shoes boots, safety helmets etc. as persite requirements. Meeting the requirement of labor regulations / registration, Local laws / by laws etc., making insurance for the employees.

- Any other works assigned from time to time by Engineer – in-charge.
- Supply of materials / spares like Lube oil / grease, glands packing, seal, kerosene, Oil, petrol, carbon, Tetrachloride, old dhotis, distilled water, brasso /hack- required for servicing / cleaning.

Consumables: All consumable required for day to day maintenance & operations shall be provided by EPC Contractor.

i) Spares: All spares during DLP and AICMC period shall be provided by EPC Contractor.

ii) T&P: Tools & plants (T&P) required for successful operation & maintenance and to attend any breakdown shall be arranged by the EPC contractor and it must be available at site at all the time.

On receipt of instructions from Engineer-in-charge, the EPC contractor shall deploy their operation and maintenance staff within fifteen days who shall set right any malfunctions and test run the complete system provided under main contract to prepare the same after a period of idleness, if any. Payments shall be released based on actual period of work done subject to meeting the specified terms and conditions as detailed under succeeding paragraphs. However, AICMC shall be continued after completion of main capital work as per contract.

EPC contractor shall provide lockable store to the staff, etc.as per requirement at site, however, WAPCOS shall provide electricity free of cost.

All the printed stationery for recording various checks & maintenance carried out during complete period of DLP and after DLP is within the derived ratesof respective items. Nothing extra shall be paid to the EPC contractor on thisaccount.

The EPC contractor shall enter into a separate supplementary agreement with Engineer-in- charge, WAPCOS responsible for maintenance of E&M installations for operation & Maintenance of the works at the derived rates on pre-fixed percentage (%) on Capital cost for E&M Subheads only (As mentioned on Schedule of Cost & Billing) of this tender on a non-judicial stamp paper of INR 100/-. The cost of the stamp paper shall be borne by theEPC contractor. This agreement shall be signed immediately before commencement of DLP but not later than 30 days of certified date of completion of SITC work.

Development of facilities at Eco-Park, Jharkhand

Facility to be provided by WAPCOS

WAPCOS will provide the following free of cost to the contractor: -

Electricity for operation of the system.

Particulars Specifications

The work shall be carried out as per the WAPCOS specifications and latest MHSSR/DSR for E&M works, where WAPCOS specification is not available MHSSR/DSRspecifications/IndianElectricityRulesasapplicableshallbefollowed.The work shall be carried out as per the instructions of engineer-in- charge.

The original installations shall not be disturbed / modified without instructions in writing by Engineer-in-charge.

In case of any emergency break down, the contractor maybeasked to supply the other materials like cable jointing kits, switch gears etc. as an extra item on chargeable

Basis subject to written order of WAPCOS indicating the material specifications, terms & conditions.

The timings of operation/maintenance work etc. shall be as decided byEngineer-in-charge from time to time depending upon operational & technical requirement.

The contractor shall carryout the work strictly as per the specification and schedule of work (quality and quantity), failing which WAPCOS shall be empowered to carry out such works (after serving notices in this regard) through any other agency at the risk&costofthecontractor.ThedecisionofEngineer-in-chargeshallbefinalandbinding on the contractor in this regard.

Special Conditions of Contract

a. Rates of Operation and AICMC Items for E&M Subheads:

The rates shall be derived on the basis of pre-fixed % on Capital cost for E&M Subheads only for each of the items shall be firm during the entire contact period & should be inclusive of all applicable taxes, duties & levies,National Holidays, Labor days, etc. but excluding the GST, PF, ESI and bonus.

b. ESI & PF: ESI & PF subscription as applicable for this work shall be deposited directly by agency to the concerned authorities and same will be reimbursed as per actuals on submission of documentary proofs/ challans clearly indicating the details like name, account no., amount, of beneficiariesetc.

c. Minimum Wages: The contractor has to pay the wages as per the minimum wages act tothe staff deployed under this contractor. The prevailing Minimum labor wages w.e.f. CPWD/MHSSR.

If there is an increase in the minimum wages during the contract period the contractor has to pay the wages to the staff deployed as per increased wagesandthedifferenceofincreasedwagesandcurrentwagesexcludingcontracto Profit & overhead shall be reimbursed to the contractor.

d. Completion Period: This contract shall be for a period of 15 Months (12 months DLP + 48 months of AICMC contract period of E&M Subheads except Grid connected Solar System& for 60 months DLP + 24 months of AICMC contract period for Grid connected Solar System).

WAPCOS reserves the right to terminate the contract fully or partially by giving 30 days' notice in writing to the contractor. If in the opinion of the Engineer-in- Charge,it is observed that the contractor is not doing the works satisfactorilyas per the terms and conditions of contract, then the Contract can be terminated with immediate effect without giving any reasons thereof.

e. Agreement: The contract agreement shall be executed on a non-judicial stamp paperof value of Rs.100/- and the cost of stamp paper shall be borne by the contractor within 10 days of placing of award of work. No running bill shall be paid before signing the agreement

f. Security: The Contractor and their employees shall abide by the security regulations framed by WAPCOS from time to time. They shall apply for site entry permits submitting the list of personnel being engaged for this work along-with police verification certificates from local police authority. Any incidental charges for this purpose are required to be borne by the Contractor.

The contractor and/or his staff when moving inside the site premises shall display the entry pass, failing which, they may not be allowed to enter or move about in the Site premises . If this leads to failure of any service or prolongs the period of such un- serviceability it will attract a penalty which will be decided at the discussion of the Engineer-in-charge whose decision will be final and binding to the contractor, Loss of any pass shall also attract a penalty as stipulated by the Issuing Authority.

Any employee of the Contractor who is found to be incompetent to carry out the work(s) or misbehaves shall be intimated to the Contractor, who in turn, has to remove the employee and arrange for a substitute. Apart from arrangement of substitute the Contractor shall ensure that the pass issued to the original employee is returned to the Issuing authority, failing which, penalty as decided by the Authority shall be imposed.

The contractor has to take moral responsibility for the overall character of the staff employed by him or intends to engage.

Agency has to make sure that no staff should be remaining in the premises after his duty is over.

g. Compliance of the provisions of statutory requirements: The contractor shall comply with all necessary rules & regulations of central/ local state government related to the contract and the contractor shall be responsible to maintain all requisite documents for reference to statutory authorities and WAPCOS as & when asked for any expenditure in compliance with the statutory requirements related to the contract shall be borne by the contractor.

Documents / Records to be maintained by the contractor:

I. Operation Log books.
II. Preventive maintenance work register
III. Earth resistance value register of various earth-pits.
IV. Other documents/records as per the instructions of Engineer-in-charge.

Requirements of Employees for Operation and Minor Maintenance:

The contractor shall deploy the required minimum competent staff on all days (for complete year including Sundays, GH, NGH and Labor day) in shift as detailed below during entire contract period on site and shall attend to all malfunctions so as to ensure that there is no disruption to services.

Sr. No.	Category of manpower	Nos. of persons XShift	Purpose
I	General shift for Preventive Maintenance of Complete E&M Installation (as per operational requirement of the) (for complete year including GH, NGH and Labor day)		
1.	Highly Skilled (Supervisor)	1 No.	To look after the day to day maintenance of all other E&M installations & overall supervision.
2.	Skilled (Wireman)	1 No.	For attending all day to day internal& external EI works
4.	Unskilled (Helper)	1 Nos.	To provide help/ assistance to Supervisor / Wireman / AC Mechanic / maintaining E & M installations neat & clean and operational.
II	2 shifts for Operation & Routine Maintenance of Complete E&M Installations except Sub-station Equipments, DG sets (for complete year including Sundays, GH, NGH and Labour day)		
5	Skilled (Wireman)	1 No. X 2Shifts	For operation & routine maintenance

7	Semi-Skilled (E & M Operator)	1 No. X 2 Shifts	For operation & routine maintenance
8	Unskilled (Helper)	1 Nos. X 2 Shifts	To provide help / assistance to Supervisor / Wireman / the duty Electrician/ maintaining E & M installations neat & clean and operational.
III	3 shifts for Operation & Routine Maintenance of Sub-station Equipment's, DG sets (for complete year including Sundays, GH, NGH and Labor day)		
9	Skilled (Wireman)	1 No. X 3 Shifts	For operation & routine maintenance
10.	Semi-Skilled (E&M Operator)	1 No. X 3 Shifts	For Operation of DG sets, Water Supply, STP & attending trouble shooting if any complete.
11	Unskilled (Helper)	1 Nos. X 3 Shifts	To provide help / assistance to Supervisor / Wireman / the duty Electrician/ AC Mechanic / maintaining E & M installations neat & clean and operational.

Note:

a) The arrangement of Manpower Deployment may need to be revised on need basis in consultation with WAPCOS Engineer-In-Charge which shall be binding on the contractor.
b) HT/LT sub-station installations including DG sets , manpower to be deployed in 3 shifts operation round the clock (for complete year including Sundays, GH, NGH and Labor day)
c) The round the clock shift manpower shall also be responsible to carry out / attend any fault in the system provided in main contract, if required.

Qualification of Staff:

Minimum Educational Qualification requirements for different category of manpower to be deployed as under:

Highly Skilled(Supervisor)	ITI qualification in electrical engineering with two years (minimum) working experience and wide knowledge of control panels and HT (upto 33KV)& LT substation equipment maintenance. Heshould have valid license for working upto 33KV HT supply.

Skilled (Wireman)	ITI qualification in electrical trade with minimum two years working experience and wide knowledge of maintenance of Internal & external EI, etc.
Semi-Skilled (E&M Operator	ITI qualification in electrical / Mechanical trade with minimum two years working experience and wide knowledge of maintenance & operation of DG Sets, control panels etc.
Unskilled (Helper)	Minimum class VIII the pass and physically fit to carry out mechanical / electrical job

For AICMC of various E&M Subheads:

The EPC contractor shall get executed AICMC of various E&M Subheads through OEM / specialized agencies though which the capital work was getexecuted by entering into tri-parties agreement.

a) Uniform: The contractor shall provide uniform of approved quality and color to his staff. No extra payments shall be made in this regard. All workmen will attend duty only in the approved uniform along with logo / firm name, which has to be maintained neat and clean and it is the responsibility of the contractor to issue the required number of uniform sets to the workers during the execution of the contract. The uniform shall consist of 2 pair of shirt, Pant along with Cotton Socks – 2 Sets, Safety Shoes ISI Marked – 1 pair to each staff as approved by Engineer-in-charge.

b) Consumables: All the consumables such as insulation tape, cotton waste, soap, dusters, distilled water, grease, hack-saw blade, screws, raw plugs etc. will be provided by the contractor. The contractor has to keep sufficient quantity of consumables in stock depending on the actual requirement. Stationeries such as log books, maintenance registers, work diaries to workmen etc. also will be provided by the contractor.

c) Job requirement: The contractor shall ensure that installations under the contract are maintained / operated as per scope of works / specifications & manpower to ensure availability of facility throughout the contract period as per the site requirement and complaints are attended on top most priority within minimum possible time as per the instructions of WAPCOS.

d) Tools & Plants: Details of tools & plants to be made availability at site. The contractor shall ensure the availability of cutting pliers, Screw Drivers, Test Lamps, Spanner Set, Hammers, Crimping tools, Nose pliers, Punch /Chisel, Electric Drilling machine, Blower, Vacuum Cleaner, Hack Saw, Hand Gloves, Files, Multi-meter, IR tester (500 V, 1000 V & 5000V), Digital EarthMeggar, Clip on meter & Gum boot.

e) Penalty Clause: The contractor shall carry out preventive maintenance as per

maintenance schedule and ensure the serviceability of each system as per specifications and as directed by Engineer-in-Charge, failing which he shall be liable for penalty as specified below :

Category -1: - Non Performance of Periodical Preventive maintenance works- The contractor is required to carry out the work as per the schedules/specifications issued by WAPCOS and as per the instruction of Engineer-in-charge or his authorized representative from time to time, failingwhich he shall be liable for a penalty @ double the proportionate contract value for the system. For example, if there are four different systems under the contract like internal electrification, operation and maintenance of pumps and operation and maintenance of AC plants and the contractor carry out preventive maintenance as per maintenance schedule for only three systems in a month, in such a case the contractor will be liable for a penalty at the rate of 50% per month of the total contract value for not carrying out the preventive maintenance of one system. Further in a particular system, if preventive maintenance is done partly, proportionate ratio percentage wouldbe worked out to arrive at penalty to be levied. The penalty to be levied shall be determined on monthly basis and it shall not be accounted or carried forward to other month. Contractor shall be communicated in writing.

Category -2:-Emergency nature of work –The contract or is supposed to ensure That the installations are fully serviceable throughout the contract period.

However if due to in-efficiency/ negligence or any other reasons attributable to the Contractor which leads to total system failure out the any system including its standby,he shall be liable for a penalty of Rs.2000/-per such

Penalty provisions (if any) provided in the contract. The systems

Cover end under this category are briefly described as blow:

a) Failure including standby of any essential facility/ system like breakdown of power supply system.

b) Failure of lighting system

c) Failure of water supply system

If the contractor failed to depute the operating staff leading the above situation and to restore the facilities, Engineer-in-charge will determine the inefficiency and improper maintenance work done by the contractor and inform the contractor in writing on each such occasion and levy the penalty accordingly.

These emergency nature of works shall be attended by the Contractor immediately/on temporary basis followed by prompt
Action for permanent restration as per the site requirements, Failing which the decision of Engineer-in-charge to carry out the
Work departmentally outhrough any other agency at the risk and
Cost of the contractor shall be final and binding on the contractor.

Category -3: - Critical works in nature – If the facility /service as
Stated above has been restored but the stand by of the main system
remains unserviceabl beyond 48Hrs. or within the time e
Frame (beyond48Hrs.) as approved by E-I-C. The contractor shall be
Liableforapenalty@500/-per day of delay in restoration of the Standby facility. At the s where no stand by system is available and there is a failure of the only available facility is made partially serviceable at least 75% he will not be liable for penalty under this category.

Category -4: - General works in nature – If any component of a system (not the whole system) for example, non-availability of lightings in any particular area, un-serviceability of any one of the pumps, lighting of apron or car park lighting etc., is unserviceable and serviceability of installations during a month goes below 90% the contractor shall be liable for penalty @0.1% of the contract value per month for every percentage of overall serviceability below 90%.

The percentage serviceability of each type facility /system shall be calculated as per the below mentioned formula.

$$\text{Serviceability:-} \quad \frac{1}{xn} \quad \sum_{n=1}^{n} (n1xd1)$$

(Where n = number of equipment distillated, d = no of days serviceability, x = no of days in the month)

(Sample calculation: If total unit (say pumps) -10 30 days in a month

5 units are serviceability for 30 days, 3 units are serviceable for 20 days and2 units are serviceable for 10 days-

$$\text{Serviceability \%} = \{ (5 \times 30)+(3x20)+(2x10) \} \times 100 = 76.67\%$$

$$(10x30)$$

Note: In case of electrical complaints, serviceability shall be calculated based on number of valid complaints received and attended during each month as per complaint register.

The overall serviceability shall be calculated based on the average ofpercentage of different facilities calculated as above.

Category -5: - Recovery of Rs. 50/- per man per shift for non-Wearing of uniform on duty will be made.

Category -6: - Recovery of Rs. 600/- per man per shift if found absent on duty will be made.

Category -7: - Recovery of Rs. 100/- per day will be made for not providing Uniform after 15 days of commencement of work.

Category–8:-RecoveryofRs.100/-per day will be made for not

Providing T& P etc. after 15 days of commencement of work.

Category – 9:-The contractor has to deposit PF&ESI as applicable
of their staff regularly, failing which recovery/with heldatprevailing
rate against PF& ESI / Accident cum Medi claim Policy respectively
From their gross R/A/ Final Bills shall be made. If Firm covers their
Staff under accident cum medi claim policy, the premium amount
Should not be less than ESIC subscription amount. In case amount
Is less, then difference for the same willdeducted.

Category – 10: - The contractor has to pay Bonus as applicable to their manpower deployed at work within 06 months after the award of work failingwhich recovery of Rs. 2000/- per month will be made from 7th month. The amount equivalent to prevailing amount of all the deployed manpower in lieuof Bonus will be withheld from the gross Bill of final month which shall be released only after the submission of documents showing the complete bonus payment to the manpower.

Category – 11: - The contractor has to execute all maintenance work as wellas supply of all spares failing which amount equivalent to 5% of non- executed items' amount will be recovered from their Final Bills. During the currency of contract, if any item is not executed due to site constraint or anyother justified reason, the same shall be got approved from the Engineer-in-charge.

11. Handing over / taking over of the installations under the contract:

The EPC contractor shall be responsible to handover the installations(aspercontractspecificationprovided)backto WAPCOSinworkingconditionafterthecompletion ofcontract.

12. Addition of new minor installations:

During the contract period, WAPCOS may include minor installations

To the existing installations and the contractor shall be responsible to

Operate & maintain those installations also as per the specifications.

13. Issue of Instructions:

The Engineer-in-charge or his authorized representative of WAPCOS shall be competent to issue the instructions to the contractor/supervisor/staff for the performance of work.

14. Precedence of Conditions of Contract :

These conditions of the contract shall be read in conjunction with the "General conditions of contract document issued together with the amendments, corrections, enclosures, etc. along with the tender document and the provision of this condition shall take precedence over the general conditions.

15. Safety measure & responsibilities:

It shall be the responsibility of the contractor that all necessary safety measures and precautions are invariably ensured while performance of the contract work and WAPCOS shall not be responsible for any injuries / accidents suffered by contract labour.

16. Payments Terms:

The payment for operation & maintenance contract during DLP and
Post DLP services shall be made on quarterly basis by department
After submission of monthly service reports which are to be counter
signed by Engineer-In- charge of WAPCOS or his authorized representative, submission of salary register duly signed by workers,
And submission of ESI & PF statement up to previous month etc

The payment shall be released after making all necessary/statutory
deductions, 10% security deposit(till submission of BG) and anyother
deduction for which the firm has made themselves liable for.

17. Security Deposit:

A Security Deposit in the form of irrevocable Bank Guarantee which Shall be furnished before signing of agreement for this head, to the extentof10%(Ten percent)of the entire contract amount towards The entire period of the maintenance contract from a Nationalized/ Scheduled Bank(as per RBI schedule but not from co-operative or Gramin banks),having office in India,acceptable to WAPCOS. The Bank Guarantee will remain valid for a period of 90Months (24 Months DLP+60 months of operation & maintenance contract period+6months:E&MSub heads except Grid connected Solar System/60months DLP+24 months of operation & maintenance Contract period+6months:Grid connected Solar System)as per Contract provisions. Security deposit for Maintenance part shall be Released only after 6months post successful completionof operation &maintenance contract period.

The Security deposit amount will be released on the completion of 06 (Six months) of defects liability period which shall be reckoned from the certified date of completion of work or on the receipt of the copy of Form No. 6 A / 3 A of P.F. and ESIC returns for the manpower deployed at site whichever is later.

18. Income Tax/Cess Deduction: The taxes will be recovered from each running bill of the contractor as per the prevailing statutory regulations at the time of payment.

19. Tools And Test Equipments

All the required tools, test equipments and safety gadgets, special T& P required for this work shall be provided by the Contractor.

20. Issue/Dismantled materials:

i) The contractor shall make entry of all the materials issued for the work from time to time in the material issue register (to be separately maintained by the contractor).

ii) After completion of the work necessary entries shall also be made in the register indicating the location where the materials are installed and the balance materials left out after completion of work.

iii) The balance materials and the dismantled materials shall be duly handedover to Engineer-in-charge or his authorized representative and necessary endorsement shall be obtained in both material issue register and also the Dismantled material register.

21. Commercial Specifications

- The price derived as mentioned above shall be firm inclusive of all Taxes forth econtract periods. However, the difference in minimum wages based on the actual payment (minimum wages) made to the labour will be paid to the contract or on revision of minimum wages by the office of Regional Labour Commissioner (Central). The contractor has to submit the proof for the payment of wages to the labour for reimbursement of difference of wages. However, no additional amount such as contractor'sPremium/profit etc. will be paid on this reimbursement.

The contractor shall be responsible for the following points during period of contract:-

1. Firm have to submit Affidavit on prescribed format given below on Non Judicial Stamp Paper of Rs. 100/- within 10 days of commencement of this contract.

2. All the Payment (i.e. Wages, OT, Bonus, N/H and Labour Day etc.) is to be made to the workers preferably by A/c Payee Cheque / RTGS only.

3. The payment to the workmen engaged by the contractor has to be Made on or before 7th of every month and necessary documents (Cheque nos./RTGS copies/receipts along with wage register) to submitted to EIC.

4. The contractor has to maintain the wage register for his employees and has to be produced for verification of the principal employer (WAPCOS) as and when required.

5. Payment will be made to the contractor after submitting the following documents each month.
   i) Wage register Copy, Preventive Maintenance schedule copy
   ii) EPF / ESIC Challans copies along with details of PF / ESIC Contributionofeachworkerandemployeralongwithundertaking thatworking employee and contractor's contribution is inclusive in the challans submitted.

22. The contractor shall carryout the work strictly as per the specification and schedule of work (quality and quantity), failing which WAPCOS shall be empowered to carry out such works (after serving notices in this regard) through any other agency at the risk & cost of the contractor. The decision of Engineer-in-charge shall be final and binding on the contractor in this regard.

23 No liability for WAPCOS as regards to staff deployed by contractor during contract period or thereafter. The EPC Contractor should absolve WAPCOS for any such occurrence.

24. Preventive Maintenance:

The Contractor shall submit the maintenance schedule and maintenance activity to be carried out for proper operation and upkeep of the system to achieve the desired performance on a regular basis. The periodicity of preventive maintenance shall be prepared and have to be approved by WAPCOS to the contractor before commencing the work. Firm shall ensure that all such maintenance are done regularly and recorded in the register for this purpose

The register should be available for inspection by WAPCOS officials on demand.

Maintenance Schedule for Internal / External Electrical Installations

Sr. No.	Description
	Internal Installations Daily
1	Check for loose, hanging uncovered or temporary wires unauthorized connections in terminal building
2	Check for fused lamps & tubes and replace the same
	Monthly
1	Clean the fixture, ceiling fans, pictograms and sign boards, etc
2	Check for damaged switches & sockets and replace the same
3	Check for overheating of any MCBs / RCCB in DBs due to loose connections or over loading. Check for earth connection
4	Check for overheating for any SFU/MCCB in panel board due to loose connections or over loading. Check for earth connection
5	Check indication lamps & control fuses, selector switches, voltmeter/ammeter.
6	Check for the proper functioning of ceiling fans (including regulator) & exhaust fans.
7	Check for any opening in switch boards, DBs &panels boards.
	Quarterly
1	Tighten all the termination points in distribution boards
2	Tighten all the termination points in panel boards
	Half Yearly
1	Check hanging arrangement (bolt & hook) of ceiling fan, abnormal noise or unusual vibration/smell or service needs.
2	Tighten all the earth termination points.
	Yearly
1	Measure & records their IR value of all incoming &out going cables of LT panel boards
2	Measure & records the earth resistance of earth pit connected to the panel board

S.No.	External Lighting
	Daily
1	Check for fused lamps & tubes and replace the same
	Monthly
1 2	Check for overheating of any SFU in the panel boards / feeders pillar due to loose connections or overheating Check for proper covering of loop in loop out box at each pole. Check the doors of feeder pillar.
	Quarterly
1 2 3 4	Clean all the fixtures including lamp shade, domes, reflection etc Tighten the termination in loop in loop out box at each pole Tighten the earth terminals in loop in loop out box at each pole Check the manual and motorized lowering and raising arrangement of lantern carriage including operation of power tool.
	Half Yearly
1 2 3 4	Tighten all the termination points of street light controlling panel board. Measure & record the IR values of incoming &out going cables to the panel board/feeder pillar Measure & records the IR values of loop cable from pole to pole Tighten the earth terminal point at the feeder pillars.
	Yearly
1	Dismantle & carry out thorough servicing of each fixture (at least 25% oftotal quantity every year) This can be carried out during lowering of lantern carriage
Note:	
1 2 3 4	These activities and periodicity are minimum. Any missing activities can be incorporated and implemented The periodicity of maintenance depends on the numbers of hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Development of facilities at Eco-Park, Jharkhand

Schedule of Maintenance Check for HT/LT Panels, Bus Duct change over Panel & AMF with ATS Panel

Sr. No.	Description
	Daily
1	Check cleanliness of Switch room, panel/ bus ducts
2	Check and clear unwanted materials from switch rooms
3	Check for proper spreading of insulated rubber mates in front / rear side of panels
4	Check the working of meters, indication lamps, control switches and audio-visual annunciation in the panels
5	Check for over heating / burning smell/ any abnormality in all the panels.
	Monthly
1	Check for operation of ACBs/OCBs & switches
	Quarterly
1	Check the termination /connection of all incoming &out going cables/bus ducts
2	Check the tightness of cable termination & lugs
a	LT panels, Bus ducts, AMF & change over panel
3	Check the tightness of control cables
4	Check the rating of fuses for all incoming &out going switches, control /indication circuits.
5	Check the insulated / backlight portion of switches for carbon formation
6	Check the condition/continuity of body earthing
7	Check for operation of relays
	Yearly
1	Check of the continuity of earth bus for panels/bus duct
2	Check the calibration of all relays
3	Check for the need for painting
4	Check the tightness of cable termination & lugs of HT panels
*	All the panels inside the Substation shall be checked daily. AS regard other panels in TB / other installations periodicity of the daily check could be made weekly
Note:	
1	The activities and periodicity are minimum
2	Any missing activities can be incorporated and implemented
3	The periodicity of maintenance depends on the number of Hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Development of facilities at Eco-Park, Jharkhand

Schedule of Maintenance Check for Power

Transformers

Sr. No.	Description
	Daily
1	Check cleanliness of Transformer yard
2	Check for uniform spread of Gravel & grass/vegetation growth in the yard
3	Check for any abnormal noise
4	Check for any oil leakage
5	Check the condition of Silica gel
6	Check Oil level in Conservator
7	Check the explosion vent diaphragm for any crack or breakage
8	Check the locking arrangement of transformer yard
	Quarterly
1	Check oil level in breather oil cup
2	Check Emergency Trip push button operation
	Half Yearly
1	Check / Examine Bushings for crack / dirt deposits
2	Check tightness of connections at HT, LT & earth Terminals
a	Check for free operation of Tap Changer
3	Check tightness of connections at Marshalling Box (if feasible)
4	Check the condition/continuity of body earthing
	Yearly
1	Check acidity of transformer oil
2	Check insulation Resistance of Transformer
3	Check & tighten the Casketed joints
4	Check cable box for sealing of holes
5	Check cables box for moisture condensate
6	Check Buchholz relay contracts & their operation
7	Check Magnetic oil level gauge contacts & their operation
8	Check Winding temp. Indicator contacts & their operation
9	Check Winding temp. Indicator contacts & their operation
10	Check the pockets holding Thermometer for Temp. Indication
11	Check Transformer oil dielectric strength & record.
*	Annually or earlier as per the manufacturer's recommendation.
Note:	
1	These activities and periodicity are minimum.
2	Any missing activities can be incorporated and implemented.
3	The periodicity of maintenance depends on the number of hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Development of facilities at Eco-Park, Jharkhand

Schedule of Maintenance Check for Stand by

Generators

Sr. No.	Description
	Daily
1	Do pre-start checkers, Make test run
2	Check Start time and AMF operation
3	Check for general cleanliness of DG & AMF
4	Check status of fuel reserves
5	Check measuring parameter and log
6	Check various oil level and radiator water
7	Check for leakage of oil/water
	Monthly
1	Perform 1-2 Hour load test in auto mode*
2	Check serviceability of safety / control
3	Check wiring, cable, lugs, terminations etc
	Quarterly
1	Perform Periodical checks as per manufacturer's recommendations
	Half Yearly
1	Perform periodical checks as per manufacturer's recommendations
	Yearly
1	Perform periodical checks as per manufacturer's recommendations
2	Calibration of relay
3	Check for need painting
4	Inspect tools and hardware
	* This test shall be carried out once in 15 days where the DG set is very occasionally used due to healthily commercial power supply
Note:	
1	These activities and periodicity are minimum
2	Any missing activities can be incorporated and implemented
3	The periodicity of maintenance depends on the number of hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Development of facilities at Eco-Park, Jharkhand

Schedule of Maintenance Check for Earthing System

Sr. No.	Description
	Monthly
1	Cleaning of earth pit/area
2	Check the condition of Earth pit cover
	Half Yearly
1	Check the condition of watering funnel
2	Watering of earth pits
3	Check earth resistance and records
4	Check tightness of earth connection and continuity
5	Check the identification marking of earth pits
6	Check continuity of main earthing lead from earth pit to panel/Equipment
*	The above schedule shall be strictly followed for sub-station equipments. For earth pit at other locations, this quarterly check can be carried out semi-annually.
Note:	
1	These activities and periodicity are minimum
2	Any missing activities can be incorporated and implemented
3	The periodicity of maintenance depends on the number of Hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Development of facilities at Eco-Park, Jharkhand

Schedule of Maintenance Check for Battery charges / Battery Bank

Sr. No.	Description
	Daily
1	Cleanliness of Battery room / Battery / Battery Bank
2	Check & Record Specific Gravity, Cell Voltage & Electrolyte level of Battery.
3	Check the working of exhaust fan in Battery room.
4	Check the working of meters, indication lamps and audio-visual annunciation in the Battery Charger.
5	Check the working of main & standby of Battery Charger including all functioning of battery charger.
	Monthly
1	Check the Battery Terminals.
2	Check the interconnection of cells in Battery Bank.
3	Check the condition of hydrometer, cell tester used for Battery maintenance.
4	Check for loose connections or any abnormality in DCDB
	Quarterly
1	Check the condition/continuity of body earthing.
2	Check the tightness of connections in Battery Charger.
Note:-	
1	These activities and periodicity are minimum
2	Any missing activities can be incorporated and implemented
3	The periodicity of maintenance depends on the number of hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Note: The maintenance schedule of remaining installations shall be as directed by Engineer-In-Charge.

Schedule of Maintenance Check for Fire Alarm & Detection System

Sr. No.	Description
	Daily
1	Check Cleanliness of fire alarm panels & availability of layout drawing.
2	Check & Clear unwanted materials near the panels.
3	Check the working of meters, indication lamps, control switches and audio-visual annunciation in the panels.
	Monthly
1	Check condition of battery & battery charger.
2	Test the Panel through test button for proper functioning.
	Quarterly
1	Physical Checking of termination of incoming & outgoing wires/cables.
2	Check correct rating & type of fuses.
3	Check the condition/continuity of body earthing.
4	Check operation of manual call push button, hooter, etc.
	Half yearly
1	Cleaning & Checking of detectors for proper functioning.
Note:-	
1	These activities and periodicity are minimum.
2	Any missing activities can be incorporated and implemented.
3	The periodicity of maintenance depends on the number of hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.

Schedule of Maintenance Check for Pumping System

Sr.No.	Description
	Daily
1	Check for glands of Pumps for any water leakage.
2	Check general cleanliness of the installation and its surroundings.
3	Check the system pressure if pressurized system.
	Monthly
1	Check the operation of jockey pump by releasing some pressure from the line.
2	Check automatic stoppage of jockey pump after building up of the pressure.
3	Check auto and manual operation of main pump and Diesel engine operated pump.
4	Check abnormal noise or vibration & condition of coupling in all the motor-pump set.
5	Inspect shaft, shaft sleeves/bearings, bearing housing lubrication/greasing by grease gun.
6	Check abnormal heating of motor & pump/shaft/bearing during test runs.
7	Tighten at the cables and terminations at motors including proper positioning of cable gland cover/boxes.
8	Tighten all the earth connection and terminations.
9	Check all the hydrants are equipped with real, hose pipe & locked (key available with Eng. and fire deptt.)
	Quarterly
1	Carry out dummy test run of the system to check operation of the system as a whole.
2	Carry out periodical maintenance of Diesel Engine as per engine manufacturer's manual.
	Half Yearly
1	Carry out periodical maintenance of Diesel Engine as per engine manufacturer's manual.
	Yearly
1	Carry out periodical maintenance of Diesel Engine as per engine manufacturer's manual.
2	Measure & record IR value of incoming cable and outgoing cables of Elect. Panel.
3	Check for painting requirements.
Note:- 1	These activities and periodicity are minimum.
2	Any missing activities can be incorporated and implemented.
3	The periodicity of maintenance depends on the number of hours of operation, life of the equipment and the climatic conditions. Hence, based on these the periodicity could be further improved, if found necessary.
4	On checking the individual parameters deficiency found shall be rectified immediately in a time bound manner.