13.1 The nominal length of the bolt shall be the distance from the underside of the head to the other end of the shank and nominal diameter shall be diameter of shank above the screwed thread. The bolts shall be of such length as to project at least one clear thread beyond the nuts when fixed in position.

13.2 When nuts or bolts heads bear on tapered surfaces washers with corresponding taper shall be provided to give satisfactory bearing.

13.3 Bolts shall be provided with a washer of sufficient thickness so as to avoid any threaded portion failing within the thickness of the parts bolted together.

14.0. MODE OF MEASUREMENTS

14.1. For the purpose of payment the weight of the actual completed structures shall be calculated from the approved drawings for different items of work.

14.2. The allowances will be permitted for galvanizing, welding or for cutting margins. One Tonne for the purpose of payment shall mean One Metric Tonne i.e., 1000 Kg.

14.3. The weight of member made out of standard rolled section such as beam, channels, angles, etc. shall be based on the standard IS: 800. The weight of member shall be considered without deducting for holes, notches, bevels cuts etc. Where a component consists of a cut joist or channels, the full weight of the rolled section shall be considered only if more than half the depth of the original section is used. Otherwise, only half the section unit weight shall be considered for calculation of the weight of plates for skew cuts and notches of 900 square centimetre or larger.

14.4. The weight of any built-up member shall be separated into weight of each component.

K WATER PROOFING TREATMENT

To Be read in conjunction with the Technical specification under Architectural works.

L FLOOR HARDENER

1.0 GENERAL

1.1 To withstand heavy wear and tear, concrete flooring with metallic concrete hardening compound such as Ironite / hardonate shall be laid as wearing layer as detailed below.

2.0 METALLIC CONCRETE HARDENING COMPOUND

2.1 The metallic compound shall be Quartz of approved quality or other equivalent consisting of uniformly graded iron particles, free from non-ferrous metal particles, oil, grease and soluble alkaline compound.

3.0 CEMENT CONCRETE UNDER LAYER

3.1 Cement concrete flooring of specified thickness and mix shall be laid as specified and generally conforming to specifications laid down for cement concrete flooring. The top surface shall be roughened with brushes while the concrete is still green and the form shall

be kept projecting up 12 mm. over the concrete surfaces, to receive the metallic hardening compound topping.

4.0 METALLIC CONCRETE HARDENER TOPPING

4.1 This shall consist of 12mm. thick layer of mix 1:2 (1 part of cement mixed with hardener: 2 parts of stone aggregate of 6 mm. nominal size by volume). The metallic concrete hardener compound being mixed with cement in the ratio of 1:4 (1 metallic concrete hardener: 4 cement used by weight) or as specified by the manufacturer. Concrete hardener shall be dry mixed thoroughly with cement on a clean dry pucca platform. This dry mixture shall then mixed with stone aggregate 6mm. nominal size or as otherwise specified in the ratio of 1:2 (1 cement mixed with hardener: 2 stone aggregate) by volume, and well turned over. Just enough water shall then be added to this dry mix as required for floor concrete, water cement ratio not exceeding 0.4.

4.2 The mixture so obtained shall be laid in 12mm. thickness, on cement concrete floor within 1 to 4 hours of its laying. The topping shall be laid true to provide a uniform and even surface. It shall be firmly pressed into the bottom concrete so as to have good bond with it. The concrete shall be compacted well mechanically. Manual compaction will not be permitted. After the initial set has started, the surface shall be finished smooth and true to slope with steel power floats.

5.0 CURING, PRECAUTIONS, MEASUREMENTS ETC

5.1 Specifications for curing, precautions, quantity measurements etc. shall be same as specified for cement concrete flooring.

5.2 No water curing shall be permitted to industrial floor slab with hardeners.

M UNDER GROUND DRAINAGE WORK

1.0 MATERIALS

The pipes shall be RCC spun pipes NP2/ NP3 class as specified, conforming to IS 458-1988 and shall be approved by the Engineer-in-Charge for soundness before incorporation in the work.

2.0 LAYING RCC SPUN PIPES

2.1 The work consist of providing, laying, jointing and testing RCC spun pipe for rain water collection network of required diameter as mentioned in the schedule to discharge the rain water collected from roof to the rain water collection tank as shown in the drawing.

2.2 After the cement concrete cradle has been laid properly, if specified or as directed by the Engineer-in-Charge, the pipes shall be lowered gradually into the trenches over the concrete cradle or bed. Necessary working space/gap for collars shall be made at every joint. Laying of pipe shall proceed upgrade of a slope. The collars shall be slipped-on before the next pipe is laid.

2.3 The pipe drain shall rest on the bed at every point through its length. To ensure this the space between the undersides of the pipe on the invert of the cradle shall be carefully grouted solid with cement slurry consisting of one part of cement to one part of clean washed sand in such a manner that no void is left. It shall be ensured that the load of the pipes and the super imposed load of the earth filing are evenly distributed on the cradle or bed.

2.4 General Contractor shall take precautions to see that no dirt; earth or other foreign matter is allowed on the surface of the cradle or bed of the pipe resting there-on, all to the full satisfaction of the Engineer-in-Charge. After the alignment and grading of the pipes is checked by the Engineer-in-Charge, the grouting shall be done with specified stiff mix of cement mortar.

2.5 The cradle of concrete shall be allowed to set a least for three days before any pipe is placed on it and the contractor shall take due care in setting the pipe in the cradle so that no damage is occur to the cradle. If any damage to the cradle occurs, it shall be rectified to the satisfaction of Engineer-in-Charge and in any particular case where damage to the cradle is beyond repair in the opinion of the Engineer-in-Charge, the contractor shall cut out the damaged section of the cradle and re do the same at his own expenses to the complete satisfaction of the Engineer-in-Charge.

2.6 No backfilling shall be laid or placed till the alignment of the pipe drain and its levels and gradient have been carefully checked and found correct/approved by the Engineer-in-Charge.

3.0 JOINTS

3.1 The joints for the pipes shall be made by loose collars and the connecting space shall be as minimum as possible. The collars shall be specifically roughened inside to provide a better grip.

3.2 The two adjacent pipes will be so designed and manufactured that when butted together concentrically, a dowel is left between the two ends. In this dowel, cement mortar of (1:1) proportion or mix as specified in the schedule be filled and then between the ends a paste of cement mortar of the same proportions will be placed. The space remaining between the pipe ends and the collar being then caulked with cement mortar of (1:1) or other specified proportion so that an even space appears all round the external diameter of the pipes. All the joints shall be finished off smooth at an angle of 45° with the longitudinal axis of the pipe on either side of the collars.

3.3 The interior of the pipe drains shall be cleaned off all dirt, cement mortar and superfluous materials and joints shall be cured for at least 7 days.

BACK FILLING / FILLING TRENCHES:

Filling in trenches for pipes and drains shall be commenced as soon as the joints of pipes and drains have been tested and passed. Where the trenches are excavated in soil, the filling shall be done with earth on the sides and top of pipes in layers not exceeding 20 cm. watered, rammed and consolidated taking care that no damage is caused to the pipe

below. In case of excavation of trenches in rock, the filling upto a depth of 30 cm. above the crown of pipe or barrel shall be done with fine material such as earth, murrum or pulverized decomposed rock according to the availability at site. The remaining filling shall be done

with rock filling or boulders of size not exceeding 15cm. mixed with fine material as available to fill up the voids, watered, rammed and consolidated in layers not exceeding 30cm.

4.0 TESTING OF RCC SPUN PIPES

4.1 After sufficient interval has been allowed for the joints to set, the pipe drains will be tested under a water head of at least 1.2 m. and in no case under a head greater than 1.8 m. of water above the top of the pipes. In addition, the pipe drains shall be examined for leaks of land/sub-soil water making its way through the joints. The General Contractor shall make the pipe drains water tight against the entrance of land/sub-soil water from outside and also against the leakages of water from the inside of the pipe drains at the test heads specified above to the full satisfaction of the Engineer-in-Charge.

4.2 All defective or leaking pipes or joints shall be cut out and replaced and made good by the General Contractor at his own cost. In case of the joints that may be defective and cannot be made good, shall be entirely embedded/surrounded externally with cement concrete of 1:2:4 proportion to render the joint (s) water tight and this shall be allowed to set before encasing or back filling is done. A strong colour shall be added to the water used for testing of the pipes, in order to detect any leakage easily. The cost of testing of the pipe drain shall be borne by the General Contractor and is deemed to be included in the rates quoted by the contractor.

N FENCING WORK

1.0 GENERAL

The work shall generally be carried out as per these specifications, relevant drawings and as directed by the Engineer-in-Charge.

2.0 MS POSTS AND STRUTS

All the MS posts/struts shall be free from rust, scale, cracks, twists and other defects and shall be fabricated to the required shape and size out of the specified sections. The posts and struts shall be conforming to relevant specifications stipulated here-in-before under relevant sections. All the posts and struts shall be of sizes and lengths as specified in the tender schedule and drawing. The posts and struts shall have split ends for proper fixing and shall be embedded in the cement concrete as specified in the drawings / schedule. The exposed surfaces of the posts and struts shall be painted with two coats of synthetic enamel paint of approved make and shade over a coat of approved primer as specified in Architectural drawings/schedule of finishes.

3.0 RCC POSTS AND STRUTS

3.1 All the posts and struts shall be of standard size as specified in schedule. These shall be constructed on suitable foundation in cement concrete as shown in drawings and as per relevant specifications stipulated here-in-before. The reinforcement shall be provided as shown in the drawings, as directed by Engineer-in-Charge and specified here-in-before under relevant sections. The posts and struts shall be free from honeycombing, cracks and other defects.

3.2 If pre-cast posts are used, after casting, the posts/struts shall be left at the same place and cured for a minimum period of 7 days. After 7 days curing the same shall be shifted to a leveled ground and stacked for further curing for 14 days. After 21 days of curing only, the posts/struts shall be transported to work site without any damage, for fixing in position.

4.0 SPACING OF THE POSTS AND STRUTS

The spacing of posts shall be 3 m centre to centre unless otherwise specified or as directed by the Engineer-in Charge, to suit the dimensions of the area to be fenced.

Every 10th posts, last but one end posts, corner posts, and posts where the level of fencing changes in steps and end post when the fencing changes its direction shall be strutted on both sides, or as directed by the Engineer-in-Charge. End posts where barbed wire fencing is discontinued shall be strutted on one side only.

5.0 FIXING OF MS/RCC POSTS AND STRUTS

5.1 Pits of size 450 x 450 x 450 mm deep or of sizes mentioned in the drawings, shall first be excavated centrally in the direction of proposed fencing work, true to line and level to receive the posts. In case of struts, the pits shall be so excavated, as to receive minimum 150mm concrete cover at any point of the struts to suit its inclination or as shown in the drawing.

5.2 The pits shall be filled with a layer of 150 mm thick cement concrete of specified mix. The posts and struts shall then be placed in the pits, the posts projecting to the specified height above ground level, true to line, plumb and position, by providing adequate supports temporarily, and cement concrete of specified mix shall then be filled-in so that the posts are embedded in cement concrete blocks of specified sizes. The concrete in foundation shall be watered for at least 7 days to ensure proper curing.

6.0 BARBED WIRE

6.1 The barbed wire shall be of MS or GI as specified and it shall generally conform to IS 278-1978.

6.2 The base metal of the line and point wire shall be of good commercial quality mild steel. The line and point wire shall be circular in section, free from scales and other defects and shall be uniformly galvanized if specified.

6.3 The line wire shall be in continuous lengths and shall generally be free from signs of welds. It shall be able to withstand Wrapping and unwrapping 8 turns round its diameter.

6.4 The barbed wire shall consist of two splices per reel. The barbed wire shall be formed by twisting two lines wires one containing the barbs.

6.5 The barbed wire and its weight shall be as given in the table below:

Type	Nominal diameter of wire		Nominal distance between two barbs (in mm)	Mass of complete barbed wire (in gm./m.)
	Line wire (in mm.)	Point wire (in mm.)		
1.	2.50 (12G)	2.50 (12G)	75	146 (136-155)
2.	2.50	2.50	150	114 (108-120)
3.	2.50	2.00 (14G)	75	117 (108-125)
4.	2.50	2.00	150	96 (89-103)
5.	2.24 (13G)	2.00	75	102 (97-106)
6.	2.24	2.00	150	82 (78- 85)

6.6 The barbs shall carry four points and shall be formed by twisting two point wires, each two turns, tightly round one line wire, making altogether 4 (four) complete turns. The barbs shall be so finished that the four points are set and locked at right angles to each other.

6.7 The barbs shall have a length of not less than 13 mm. and not more than 18 mm. The points shall be sharp and well pointed. Barbed spacing shall be as given in the above table. Wherever required for every 50 reels or part thereof, samples of the barbed wire and the individual line wires shall be put to tensile test and in case of failure to conform to tensile properties given below, two additional tests of each kind shall be made on the samples cut from other reels.

7.0 TENSILE PROPERTIES

Size of line wire Nominal dia (in mm)	Breaking load of line wire		Min. breaking load of complete barbed wire (in Kg.)
	Min. (in Kg.)	Max. (in Kg.)	
2.50 (12G)	216	302	444
2.24 (13G)	128	179	263

7.1 On the results of these additional tests, the whole or portion of the barbed wire shall be accepted or discarded as the case may be.

8.0 FIXING OF BARBED WIRE

8.1 The barbed wire shall be stretched and fixed in number of rows and two diagonals as specified. The bottom row shall be 140 mm. above ground and the rest at 125 mm or at given spacing as per drawing. The diagonals shall be stretched between adjacent posts from top wire of one post to the bottom wire of the 2nd post. The diagonal wires will be interwoven with horizontal wires by fixing the odd rows of wires, then the diagonal cross wires and lastly the even rows of wires. The jointing of the barbed wire in between the posts shall not be permitted.

8.2 Necessary holes should be tapped in the post and the barbed wire shall be fixed in position by means of 'U' clamps or bolts and nuts as specified in drawings. In case of fixing with 'U' clamps, the legs of the 'U' clamps passing through the 10 mm dia. hole in the RCC post to hold barbed wire shall be turned up and down to get an over-lap of 25 mm. on the face of RCC post. Turn buckles and straining bolts shall be used at the end posts if specified.

9.0 MODE OF MEASUREMENT OF BARBED WIRE FENCING

9.1 The work shall be measured in running metre length of fencing correct to a centimeter for the finished work, from centre to centre of the posts.

9.2 The rate shall include the cost of labour and materials involved in all the operations described above including the cost of barbed wire, turn buckle, straining bolts, bolts and the nuts/U clamps including excavation and foundation concrete or as specified in item description for the work.

10.0 CHAIN LINK

10.1 The chain link shall be of approved manufacture and of correct size, gauge etc. It shall be of MS. or GI. as specified of approved manufacture and of required size, gauge etc.

10.2 The base materials of the wire shall be of good commercial quality mild steel. The wire shall be circular in section, free from rust, scale, cuts, welds and other defects and shall be uniformly galvanized if specified.

11.0 FIXING OF THE CHAIN LINK FENCING TO MS. OR RCC POST

11.1 The chain link of specified height of fencing shall be fixed first to the end post with necessary GI approved type U clamps threaded at both the ends and GI nut, bolts, washers etc. and with 6 mm. dia. full height MS/GI anchor bar.

11.2 After fixing the chain link at the end post, it shall be stretched tightly and fixed to next post one after the other by the above mentioned clamps and bars etc. leaving 50 mm clearance from the ground and 20mm clearance in the case of concrete coping at bottom to avoid rusting.

11.3 The point at the change in level of the fencing top/bottom, necessary links shall be adjusted suitably as per the manufacturer's specification or as directed by the Engineer-in-Charge.

11.4 The entire chain link fence shall be painted with two coats of synthetic enamel paint of approved make and shade over a coat of approved primer or as specified in the item/drawing.

12.0 MEASUREMENT OF CHAIN LINK FENCING

12.1 The work shall be measured in running metre length of fencing correct to a centimetre for the finished work from centre to centre of the posts.

12.2 The rate shall include the cost of labour and material involved in all the operation described above including the cost of chain links, turn buckle, straining bolts and bolts and the nuts/U clamps, 6 mm dia. MS/GI anchor bar etc. including excavation and foundation concrete or as specified in item description for the work.

O. ROAD AND PAVEMENTS

1.0 SCOPE OF WORK

The work contemplated under these specifications refers to Earth work in Excavation, Forming Embankments, Proof rolling, Soling, W.B.M., Bituminous Macadam, Bituminous concrete, Mecadam grouting, Wearing Course/Sealing Coat etc. for road and pavement works.

2.0 EARTH WORK EXCAVATION FOR ROAD

The specifications for "Excavation, Fill and Back fill" specified here-in-before shall hold good as far as they are applicable.

2.1 The work under this item will include excavation in all types of soil, murrum, etc. and in loose boulders not longer than one metre in any direction and not more than 200mm in any one of the other two directions. The excavated material shall be disposed off as directed by the Engineer-in-Charge.

2.2 Payment will be made for theoretical section. No claim for extra cutting in any direction is permissible unless otherwise agreed upon by Engineer-in-Charge. The contractor shall also clean of all vegetation before starting the work of excavation for the entire width and length of the road and no extra shall be paid for this.

2.3 Black agricultural soil wherever met with, shall also be removed to the required depth as directed by the Engineer. The excavation for roads shall be carried out to the gradients and cambers and sub-grade levels as indicated in plans or as decided by the Engineer-in-Charge. The excavated areas should be kept free of water at no extra cost, while work is in progress.

3.0 FORMING EMBANKMENT

3.1 The work shall include preliminaries of clearing site, setting out and preparing the ground and there after forming embankment for the roads, paths etc. with approved material available from excavations under this contract (excavation paid separately under respective items) or elsewhere, spreading in layers, watering and compacting to the required density and lines, curves, grades, camber and cross section and dimensions shown in the plan or as directed by the Engineer-in-Charge.

3.2 When the embankment is to be laid on hill sides or slopes, the existing slopes are to be ploughed deeply. If the cross slopes are steeper than 1 in 3, steps with reverse slope shall be cut into the slopes to give proper hold and seating to the bank as directed by the Engineer-in-Charge. The top 15 cm. of soil shall be scarified and watered if directed and compacted to the same density as specified for the embankment before any material is laid for the embankment work.

3.3 Only the approved excavated earth shall be placed in the embankments in successive horizontal layers not exceeding 150mm, extending to the full width of the embankment including the slopes at the level of the particular layer and 300mm more on both sides to allow compaction of the full specified section. The extra loose stuff at the edges shall be trimmed later, after completion of the bank work without extra cost leaving the correct section fully compacted. On resuming work after one interval, if the previous compacted surface has dried up or hardened, it shall be moistened and scarified before any fresh material is placed on it.

3.4 Keeping the width of the bank initially less and widening it later by dumping loose earth on the slopes shall not be permitted as the additional width and slopes will remain loose and un compacted. Similar procedure to extend the embankment by dumping the material longitudinally shall also not be allowed. Each layer of the embankment shall be watered, leveled and compacted as specified here-in-after, before the succeeding layers are placed. The surface of the embankment shall at all times during construction, be maintained in such a manner so as to prevent ponding. Water to be used shall be free from all harmful elements and approved by the Engineer-in-Charge.

3.5 If the material for embankment contains moisture less than the optimum moisture, water shall be added in the 100 mm layers of the embankment to bring moisture uniformly up to requirement. If the excavated material contain more than required moisture, it shall be allowed to dry until the moisture is reduced to required extent. If due to the wetness, the moisture content of the soil cannot be reduced to the appropriate amount by exposure,

embankment work shall be suspended till suitable conditions prevail at no extra claim/compensation.

3.6 When loose layer is leveled manually or mechanically and moistened or dried to a uniform moisture content suitable for maximum compaction, it shall be compacted by 8 to 10 tonne power roller or sheep foot rollers or heavy hauling or dozing equipment to give the specified 90% of the proctor density. If on testing, the density is found to be less than 90% of the proctor density, the General Contractor shall do additional compaction necessary to get the specified density after adding water if required. Test shall be made to determine the maximum density of the material to be used by the proctor method before starting the work. Density test shall be carried out for the embankment work during the progress of the work. One set of three core samples for every 1000 sqm area of each layer of embankment work shall be taken and tested. The average density shall not be less than 90% of the proctor density, obtained in the laboratory.

3.7 Arrangement for obtaining the samples and transporting the same to laboratory, shall be made by the General Contractor at his own cost.

3.8 Embankment not accessible to rollers, such as those adjoining bridges, culverts and other works shall be carried out independently of the main embankments and shall have the layers placed in 150 mm. to 200 mm. height and each layer shall be moistened and thoroughly compacted with mechanical or manual tamper.
Before placing the next layer, the surface of the under layer shall be moistened and scarified so as to provide a satisfactory bond with the next layer.

3.9 The embankment shall be finished and dressed smooth and even, in conformity with the alignment levels and cross sections and dimensions shown on the drawing.

On curves, section shall be provided with super elevation and increased width, as shown on the plans as directed by the Engineer-in-Charge. The last layer shall be finished off with a suitable camber etc. all as per drawing and as directed to receive the soling.

3.10 Joining of old and new embankments shall be done by stepping in an overall slope of about 1 to 5.

3.11 General Contractor shall be responsible for maintaining the embankment work in satisfactory conditions at his own cost till finally accepted including making good any damage.

3.11 Measurement and rate of embankment

The contract rate shall be per cubic metre of the finished embankment. Measurements shall normally be taken by taking cross sections at suitable intervals. The measurements of the section shall be limited to the dimensions shown on the drawing or those ordered by the Engineer-in-Charge in writing. The sectional area shall be worked out correct up to two places of decimal of square metre and the quantity worked out to two places of decimal of cubic metre on lines similar to those specified for earth work here-in-before.

4.0 SUB GRADE

4.1 Preparation of Sub-Grade:

The surface of the formation for a width of sub-base, which shall be as per drawing shall first be cut to a depth equal to the combine depth of sub-base and surface courses below

the proposed finished level (due allowance being made for consolidation). It shall then be cleaned of all foreign substances.

Any ruts or soft yielding patches that appears due to improper drainage conditions, traffic hauling or from any other cause, shall be corrected and the sub-grade dressed off parallel to finished profile to the required gradient and camber.

4.2 Proof rolling and Consolidation:

The sub-grade shall be adequately watered and consolidated with a power road roller of 8 to10 tonnes. The roller shall run over the sub-grade till the soil is evenly and densely consolidated and behaves as elastic mass (the roller shall pass a minimum of but not limiting to 5 runs on the sub-grade).

All undulations in the surface that develop due to rolling shall be made good with fresh material or quarry spoils as the case may be and the sub-grade is rerolled.

4.3 Surface Regularity: The finished surface shall be uniform and conform to the lines, grades and typical cross sections shown in the drawings. When tested with the template and straight edge, the variation shall be within the tolerances specified in the Table below:

PERMISSIBLE TOLERANCES OF SURFACE REGULARITY

Longitudinal profile	Cross profile
Maximum permissible undulation when measured with a 3 metre straight edge template.	Maximum permissible variation from specified profile when measured with a camber-
24 mm	15 mm

4.4 Where the surface irregularity of the sub-grade falls outside the specified tolerances, the contractor shall be liable to rectify these with fresh material or quarry spoils as the case may be, and the sub grade re-rolled to the satisfaction of the Engineer-in-charge.

4.5 Measurement and rate of sub-grade:

The excavation will be measured in cubic metres, correct to two places of decimal. The length and width shall be measured correct to a cm. The measurement for proof rolling shall be worked out in square metre, correct to two places of decimal. The rate shall include the cost of materials and labour required for all the operations mentioned above, unless specified otherwise.

5.0 RUBBLE SOLING

5.1 Material for soling shall be trap stone of approved variety. It shall be hard, durable and free from defects and shall be got approved by the Engineer-in-Charge before incorporation in the work. Spotted rubble stone shall not be used for the work.

5.2 On the sub-grade prepared as specified hereinbefore, soling shall be laid in regular lines. The stone shall be set as closely as possible and packed well. The stones shall be laid so as to have their bases or the largest areas resting on the sub-grade.

5.3 Soling shall be laid in one layer of 15 cm thickness (or as specified) and no stone shall be less in depth than the specified thickness of Soling.

5.4 After packing the stone properly in position, the interstices between them shall be carefully wedged with quarry spalls or stone chips. These shall be hammered well to obtain a hard and compact surface. Spreading stone chips of loose spalls or stone chips is prohibited.

5.5 The entire surface shall then be examined for any protrusions and the same shall be knocked off by a hammer.

5.6 Soling shall be laid to proper gradient and camber which shall all be checked frequently to ensure accuracy.

5.7 Rolling shall then be carried out by a 8 to 10 ton power roller and soling consolidated properly. Water shall be lightly sprinkled during rolling if ordered by the Engineer-in-Charge.

5.8 The surface thus prepared shall first be passed by the Engineer-in-Charge after which 40 to 50 mm thick layer of hard murrum or stone screenings shall be spread over the soling and rolled again such that the hard murrum or stone screening get into the interstices. It shall, however, be ensured that a thin layer of murrum or screenings shall remain on the finished surface of soling.

6.0 BITUMINOUS MACADAM & BITUMINOUS CONCRETE SURFACING FOR ROAD (GENERAL)

6.1 Scope of work

6.1.1 The work covered under these specifications provides for bituminous treatment for roads consisting of providing specified thickness of bituminous macadam, bituminous concrete and seal coat as in item in the schedule of quantities.

6.1.2 General Contractor shall make at his own cost, all the arrangements for controlling the traffic during the execution of the work. All arrangements such as proper barricading of road, diversion of road if necessary, red and green flags during the day, red lights at nights shall be made by General Contractor at his own cost to control and safeguard the traffic.

6.2 Bituminous macadam over water bound macadam

6.2.1 Preparation of Existing Water Bound Macadam Surface:
The existing water bound macadam surface shall be brushed, cleaned properly with wire brushes and coir brooms, so as to free from all loose materials, murrum, earth, silt and caked mud etc.

The surface shall then be dusted clean with gunny bags etc. If during the process of cleaning the sub grade (water bound macadam), soft spots and pockets, hollows etc. are found, such, spots/pockets will be filled with approved pre-coated bituminous chips, consolidated and finished to proper level, rolled with power roller if necessary.

The pot holes shall be excavated properly in a rectangular or rhomboidal shape with vertical edges. The bottom and sides shall be cleaned as stated above. The sides and bottom shall then be thoroughly painted with heated 60/70 (or of specified grade) penetration bitumen. The pot holes shall thereafter be filled with premixed bituminous chips so that after thorough tamping and rolling, the surface is flush with surrounding road surface all as directed by the Engineer-in-Charge. It shall be the responsibility of the General Contractor to ensure that the sub-grade is even and is finished to camber and slope as shown on the drawings or as directed by the Engineer-in-Charge.

6.2.2 The surface of the sub-grade shall be checked for its trueness by means of the scratch template set to the exact profile of the base course. The template shall be drawn along the forms at right angles to the road.

6.2.3 Unevenness of the surfaces as indicated by the scratch points shall not exceed 10mm in 30 m. The area of depression shall then be painted or sprayed with 60/70 (or of specified grade) penetration bitumen at the rate of 0.75 kg per sqm and the leveling course applied by hand or machine to grade and camber and rolled. If the depressions are deeper than 50mm, the leveling course shall be applied in two or more layers and rolled as directed by the Engineer-in-Charge.

6.2.4 The prepared surface shall be closed to traffic and maintained fully clean and no asphalting work shall be started unless this prepared surface is approved by the Engineer-in-Charge. The rate quoted by the tenderer against the item of bituminous macadam shall be inclusive of preparation of surfaces, to receive the bituminous macadam as detailed above and no extra payment is admissible on account of the same.

6.2.5 Materials

Representative samples of materials proposed to be used shall be submitted to the Engineer-in-Charge and got approved. No material shall be used unless it is approved by the Engineer-in-Charge.

6.3 Hot mixed hot laid bituminous macadam

6.3.1 Coarse Aggregate:

It shall consist of crushed hard trap stone metal, free from coatings of clay, silt and any objectionable material. Metal brought by General Contractor for different items of work shall strictly conform to I.R.C. specifications in all respects.

The aggregate shall be obtained by crushing approved stones of specified type in mechanical crusher and shall be hard, close grained, sound trap stone metal, free from decay and weathering and obtained from approved quarries.

Metal shall be collected in stacks on level ground and neatly stacked at site of mixing.

The metal shall be free from all earth, rubbish, vegetation and other foreign matter and graded before stacking and closely packed in stacks.

Tests considered necessary shall be carried out in an approved laboratory when the Engineer-in-Charge considers the quality to be doubtful or there is a dispute about the quality. The cost of testing shall be borne by the contractor.

6.3.2 Aggregate grading:

The requirements of base course shall be as under:

B.S. Sieve Designation	Equivalent I.S. Sieves	Passing percentage
32 mm. (about 1.25")	40 mm. (1.5")	100
20 mm. (about 3/4")	20 mm.	50 – 100
12 mm. (about 1/2")	12.5 mm.	30 - 60
6 mm. (about 1/4")	6.3 mm.	18 - 30
No. 10	1.7 mm.	10 - 20
No. 200	75 micron	0 – 5

Note: The aggregate/chips shall be entirely dry at the time of mixing.

6.3.3 Bitumen:
Bitumen to be used shall conform to I.S. 73-1992 for paving bitumen, with 60/70 (or of specified grade) penetration and shall be from approved manufacturers.

General Contractor on demand by the Engineer, obtain and furnish a laboratory test certificate to the effect that the material conforming to the requirement of the specified grade, to the satisfaction of the Engineer-in-Charge. Bitumen (60/70 penetration or as specified) specified content by weight of the total mix, shall be used in the mixture.

6.3.4 Tack Coat:
Bitumen of the same grade as that used for premix shall be heated to a temperature of 163° C to 177° C (325° F to 350° F) in a bitumen boiler and the hot bitumen shall be applied evenly to the thoroughly cleaned and prepared road surface (as specified here-in-before) @ 7.5 kg. per 10 sq.m. or as specified leaving no part of the surface unpainted. Application shall be done by a mechanical pressure sprayer or if permitted, by perforated pouring cans. The tack coat shall be applied just before the macadam is laid. Application of tack coat shall be only slightly in advance of laying premixed chips.

6.3.5 Premixing Chips:
The bitumen shall be heated to 163° C to 177° C (325° F to 350° F) in boiler. The aggregate of the approved grading or as decided by the preliminary tests shall be dried and heated in an aggregate drier to a temperature of 149° C to 177° C (300° F to 350° F) and fed into a twin shaft peddle type mixer at a temperature not less than 149° C (about 300° F).

The bitumen, the approved aggregate and the filler shall be measured separately and accurately to the proportions in which they are to be mixed and mixed intimately till all the particles are completely coated with bitumen. The bitumen content in the mix shall not be less than 3.5 % by weight of total mix. Asphalt/bituminous mixing plant proposed to be used by the General Contractor for the preparation of Asphalt/bituminous mixing shall conform to all of the requirements of the job, which shall produce uniform mixtures of the required quality, and got approved by the Engineer-in-Charge before mixing.

6.3.6 The temperature of the premix bituminous macadam when leaving the mixer shall not be less than 130° C (about 280° F) and it shall not be less than 121° C (about 250° F) at the time of laying.

6.3.7 Bituminous macadam shall be transported to site of work in suitable tipping vehicle properly insulated and covered with canvas or other suitable materials to protect the mixture from weather conditions and to retain the heat. The road surface shall be suitably marked to ensure correct and uniform application. Width of macadam to be laid shall be slightly more (not exceeding 50 mm. on each side) than the required carriage way as per drawing. Excess on either side shall be neatly cut after full compaction to get final width of carriage way as per drawing. The premixed bituminous macadam shall be laid by a mechanical self powered spreader and compactor and finished to correct line, level, & final consolidation done by means of power roller not less than 10 tonne. Any irregularities shall be corrected during rolling.

6.3.8 Compaction
The base bituminous macadam course shall be compacted thoroughly and evenly with 10 to 12 tonne power roller immediately after it is laid. Compacted thickness shall be as specified in schedule of quantity.

6.3.9 The surface shall be checked for correct grade during and after rolling. Any irregularities shall be corrected by adding pre-coated chips or removing the surplus. The disturbed surface shall be well compacted again. If necessary, the roller wheel shall be coated with oil to prevent the coated chip from sticking to the wheels. Rolling shall be continued till no wheel marks are left on the surface.
The speed of the roller shall be sufficiently slow to prevent any pushing under the wheels.

6.4 Specifications for Asphaltic Concrete Road Surfacing

6.4.1 Nature and scope of work: Specifications under the "Asphaltic Macadam" shall apply to the "Asphaltic Concrete" also as far as cleaning existing road surfaces, mixing, weighing, transporting, laying and rolling are concerned.

The dust, dirt, debris, etc. collected from the cleaning operations shall be disposed of to an approved site and leveled to the satisfaction of the Engineer-in-Charge. The road surface should be cleaned and screened properly before laying asphaltic concrete. It may be noted that the rate to be quoted by the tenderer against the item of Asphaltic concreting shall be inclusive of preparation of surfaces, to receive the Asphaltic concrete as detailed above and no extra payment is admissible on account of the same.

6.4.2 Hot mix hot laid asphaltic concrete: Bituminous concrete shall consist of mixture of mineral aggregate, and filler, graded to fill the voids, mixed with a bituminous binder to obtain maximum stability and durability spread and compacted on a prepared base of sub-grade on conformity with the lines, grades and cross sections shown in the drawings. The aggregate shall be pre-heated to the temperature specified for the bitumen and the mixture shall be prepared and laid hot.

6.4.3 Materials:

i) Bitumen — The bitumen shall be of 60/70 penetration or such other grade as specified by the Engineer-in-Charge and shall conform to IS:73 latest edition.

ii) Filler — The filler added shall be dry and clean lime stone powder or hydrated lime having CaO content of not less than 60%.

iii) Sand — The sand shall be clean, natural, river sand, duneer pits and or quarry sand roduced in a crushing plant, as specified.

iv) Coarse — The coarse aggregate shall consist of clean trap aggregate stone of approved quality free from dust, angular but not flacky.

The grading, composition and characteristic of the asphaltic concrete mixture shall be approximately as given below:

6.4.4 Grading of Aggregate

IS Sieve No.	Percentage passing
20 mm	100
15 mm	80 - 100
10 mm	70 - 90
4.75 mm	50 - 70
2.36 mm	35 - 50
1.18 mm	26 - 38
600 micron	18 - 29
300 micron	13 - 23

150 micron	8 - 16
75 micron	4 - 10

6.4.5 Asphaltic concrete shall consists of Bitumen 7.75% plus or minus 0.25% by weight of total mix, with voids to a maximum of 2% to 4% by volume and specific gravity not less than 2.3; all properties conforming to respective IS codes, latest edition. The tenderer shall indicate the exact grading, bitumen content voids, specific gravity, Marshall Stability, etc. which they propose to adopt for the work offered by them.

6.4.6 The General Contractor shall also be responsible to see that the surface to receive Asphaltic concrete is properly consolidated so as to give uniform and adequate support to the asphalt carpet for the period of its usual life.
A thin layer of sand or stone dust should be spread over the compacted base and rolled before the asphaltic concrete carpet is laid where the base is water bound macadam, otherwise base should be swept clean.

6.4.7 Mixing:
The aggregate shall be dried and heated to the temperature specified for application of bitumen (350° F to 370° F) screened into the necessary sizes for producing the desired grading, free from dust and deposited in bathing bins. The coarse aggregates shall then be measured or weighed into the mixer at the specified temperature and in the correct proportions and thoroughly mixed dry. Approximately 2/3 the quantity of bitumen shall then be weighed into the mixer at the correct temperature. After addition the bituminous binder the mixing shall be continued till a homogeneous mix is produced. The required quantity of sand at correct temperature shall be weighed into the mixture and the remaining quantity of bitumen added.
Mixing shall be continued to produce homogeneous mix in which all the particles are uniformly coated. Finally the correct quantity of filler shall be added in a dry condition and thoroughly incorporated in the mix. As hot mix bituminous concrete must be spread, shaped and compacted while hot, it shall not be stored but used on the work immediately following the mixing operations.

6.4.8 Formwork:
Necessary formwork of a design approved by the Engineer-in-Charge shall be used to retain the asphaltic concrete in position at the sides to required lines, levels and gradients during the entire progress of work.

6.4.9 Spreading:
The asphaltic mix will be laid by a mechanical compactor and finisher, the final consolidation being by means of a power roller. Before wearing coarse mixture is laid a tack coat of 0.75 Kg of bitumen per m2 shall be applied.

6.4.10 Testing:
The General Contractor shall have a well equipped testing laboratory with a competent approved laboratory staff. Daily tests shall be made by them on the asphalt mixes produced to ensure compliance with this specification and a copy of the test results shall be submitted to the Engineer-in-Charge for record. Tests shall include water absorption, stability, filler content, grading of aggregates, bitumen content, specific gravity, void content etc. The General Contractor shall give all facilities at all times to the Engineer-in-Charge or his representative to inspect the work of testing done by them.

6.4.11 Testing of surface

The completed surface when ready for acceptance shall be thoroughly compacted, smooth, true to line, grade, camber and free from irregularities. When tested by means of a straight edge of 3.0 m long laid on the finished surface parallel with the centre line of the road, the surface shall vary in no place more than 6.0 mm from the working edge.

6.4.12 Maintenance:
It will be binding on the General Contractor to maintain the road free of cost for a period of 1 year from the date of completion of the work. The defects in the asphalt paving which the contractor may be called upon to rectify are of the following types:

I. Deformation of asphalt resulting in waves or ruts.
II. Cracking of the asphalt resulting in admission of the sub-grade and the deterioration of the asphalt adjoining the cracks provided that if such cracking results from defective foundations and General Contractor shall at their own cost carry out the necessary remedial work.
III. Unrevalling the asphalt resulting in the formation of pot holes.
IV. Polishing of the asphalt under traffic resulting in a surface which the vehicles are liable to skid.
V. Defects in area of asphalt under guarantee where they shall exceed the limits specified below be remedied immediately by the contractor.

The limiting values of defects shall be the following:

I. Deformation, 25 mm in 3.0 metres.
II. Cracks, exceeding 1.5 m length or 3.0 mm in width.
III. Unravelled patches exceeding 194 sq. cms. in area and or 13 mm in depth.
IV. Polishing to the extent greater than that of a sample to as a representative border line case by the General Contractor and the Engineer-in-Charge cut from the road, divided into two approximately equal portions and retained for reference by the Engineer-in-Charge and contractor.

6.4.13 Permitting traffic:
Traffic may be allowed on the road after a lapse of 24 to 48 hours after laying.

7.0 HOT MIXED HOT LAID BITUMINOUS CONCRETE WEARING COURSE (SEAL COAT)

7.1 Bituminous concrete shall consist of mixture of mineral aggregate, sand and filler, graded to fill the voids, mixed with bitumen binder to obtain the maximum stability and durability. It shall be spread and compacted on a prepared bituminous macadam base in conformity with lines, grades and cross section shown in the drawings. The aggregate shall be preheated to the temperature specified for the bitumen and the mixture shall be prepared and laid hot.

7.2 Coarse Aggregate:
The coarse aggregate brought by General Contractor shall be met with I.R.C. requirement, hard black trap, crushed in mechanical crushers and shall be clean, strong, tough, dense, close grained, angular but not flaky, and free from soft, decayed, weathered portion, coating of dust, dirt or other objectionable matter. Maximum size of the aggregate shall be suitable for the thickness of the seal coat (12mm./15mm. or as specified).

The aggregate grading composition and characteristics of surface (wearing course mix) shall conform to standard code of practice. The mix shall satisfy the following requirements:

Bitumen:	7.25 (+/-) 0.25% by weight of total mix.
Voids of air in total mix:	2% by weight of mix and 4% by volume.
Specific gravity	Not less than 2.3.
Marshall stability:	453.6 kg (1000 lb.) minimum
Flow :	1020.
Water absorption:	0.50%

7.3 Fine Aggregate:
The fine aggregate shall be clean, natural, river bank or pit sand or quarry sand produced in a crushing plant and satisfying the requirement of the grading of aggregate for the bituminous concrete as stated above or as determined by the preliminary tests.

7.4 Filler:
The filler shall be dry and clean lime stone powder hydrated lime having calcium oxide content of not less than 60% both passing B.S. sieve No.8. or equivalent IS sieve; It shall be free from lumps and loosely bonded aggregation. When tested by laboratory sieves, 100% shall pass through B.S. sieve No.14, 80% shall pass through B.S. sieve No.8. Fillers shall be added to the aggregate to give the above grading determined by preliminary tests.

7.5 Bitumen:
Bitumen shall be of 60/70 penetration or such other grade specified by the Engineer-in-Charge and shall conform to I.S. 73 – latest edition.

7.6 The tenderers shall indicate the exact grading, bitumen content, voids, specific gravity etc. which they propose to adopt for type to treatment offered by them.

7.7 Preparation of Base:
Dirt, dust and other foreign materials if accumulated shall be cleared off leaving the surface entirely clean. The prepared surface shall be closed to traffic and so maintained fully clean till the seal coat is applied.

7.8 Mixing and Laying Wearing Course:
Grade 60/70 (or of specified grade) bitumen shall be heated to a temperature of 163 C to 177 C (325 F to 350 F) in a boiler. The aggregate of the suitable approved grading or as decided by preliminary tests, shall be dried and heated in an aggregate drier to a temperature of 149 C to 177 C (300 F to 350 F) and fed into a twin shaft peddle type mixer at a temperature not less than 149 C (300 F).

The bitumen, the aggregate and the filler shall be measured separately and accurately to the proportions in which they are to be mixed and mixed intimately till all the particles are completely coated with bitumen. The quantities of aggregate, bitumen and the filler shall be such as to obtain the percentage of each as specified above or decided after tests.

Continues batching and mixing plant shall be used. Asphalt/bituminous mixing plant proposed to be used by the contractor for the preparation of asphalt/bituminous mixes,

shall conform to all of the requirements of the job, which shall produce uniform mixtures of the required quality.

7.9 The temperature of bituminous concrete when leaving the mixer shall not be less than 138 C (280 F) and it shall not be less than 121 C (250 F) at the time of laying.

7.10 The bituminous concrete shall be transported to the site of work in suitable tipping vehicles properly insulated and covered with canvas or other suitable materials to protect the mixture from weather conditions and to retain the heat.

7.11 The mixture shall be spread with mechanical self powered spreader. The bituminous concrete shall be laid to the specified line, curve, grade and camber. Any irregularities shall be corrected immediately before rolling is started. Before laying the mixture, the faces of the joints shall be painted with a uniform coating of hot bitumen. The bituminous concrete shall be laid to such loose depth as to give a compacted layer of specified thickness as per item in the schedule of quantities.

7.12 Compaction :
The bituminous concrete layers shall then be allowed to cool sufficiently such that it does not spread under wheel load of 10/12 tonne power roller. The compaction shall be done by the roller till no wheel mark are left on the surface and no further compaction is possible. The road shall be opened to traffic on cooling of the concrete to the atmospheric temperature or after a lapse of 24 to 40 hr. after laying.

8.0 GENERAL REQUIREMENTS FOR BITUMEN MACADAM, CONCRETE & SEAL COAT

8.1 Testing:
General Contractor shall engage a well equipped testing laboratory with a competent laboratory staff. Daily tests (not less than two specimen per day) shall be made by them on the bituminous mixture produced to ensure compliance with these specification and copy of the test results duly signed by the competent authority shall be submitted to Engineer-in-Charge for record. Tests shall include water absorption, stability, filler content etc.

8.2 The contractor shall give all facilities at all times to the Engineer-in-Charge or his representative to inspect the work or testing done by him.

8.3 Testing Surface
The completed surface when ready for acceptance shall be thoroughly compacted, smooth, true to line, grade, camber and free from irregularities when tested by means of a straight edge of 3 m long, laid on the finished surface parallel with the centre line of the road, the surface shall in no place vary more than 6mm from the working edge.

8.4 Mode of measurement:

8.4.1 Measurement for bituminous macadam including filling in pot holes and depressions shall be paid by weight measured in metric tonne used on the job (or as specified in the schedule of quantities), completed satisfactorily, measured up to second place of decimal including preparing surface, applying tack coat, mixing, transportation and compacting by roller etc. complete as specified.

8.4.2 Measurement for bituminous concrete and seal coat shall also be paid by weight as measured at site of work, irrespective of the thickness laid, in Metric tonne used on the job (or as specified in the schedule of quantities), compacted satisfactorily, measured up to second place of decimal including all the relevant items of work specified, complete.

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TECHNICAL SPECIFICATION FOR

WATER SUPPLY AND SANITARY SYSTEM

1.00 SCOPE

This specification covers the general requirements for sanitary and water supply installation work with all fittings and fixtures including ancillary works such as connections, manholes, inspection chambers etc.

The scope of work covers supply and installation of the sanitary, water supply and drainage items of works in accordance with drawings and specification.

2.00 GENERAL REQUIREMENTS

2.01 The Contractor shall furnish all skilled and unskilled labour, plant, equipment, scaffolding all materials etc. required for complete executions of the work in accordance with the drawings and as described herein and / or as directed by the Engineer.

2.02 All pipe lines, locations of fittings and fixtures etc. shall be as per the GFC drawings or as directed by the Engineer. Correctness of lines, plumb, orientation, symmetry and levels shall be strictly ensured. All items shall be fully secured against movement in both directions and must be so located as to allow easy maintenance.

2.03 All pipe lines and fittings shall be leak proof. All connections shall be such as to prevent any splashing or emission of foul odour or gases.

2.04 The installation shall also be in conformity with the bye laws and requirements of the local authority in so far as these become applicable to the installation. This specification shall take precedence over the said regulations and standards, wherever this specification calls for a higher standard of materials and/or workmanship than those required by any of the above regulations and standards. The regulations shall govern and prevail if the drawings and specifications indicate details which violate the regulations,

2.05 Contractor shall set out the drainage, soil, waste and water pipes lines and other fittings and fixtures in accordance with the GFC drawings and instructions of the Engineer. The Contractor shall be responsible for the correctness of the above and any inaccuracies are to be rectified by him at his own expense. The Contractor will be responsible for taking levels of the site before setting out and putting them on record without extra charge.

2.06 All works should conform to the description given for each item and in specification in addition to the bye-laws / requirements of the Municipal Corporation / Local Authorities within whose jurisdiction the work is required to be done.

2.07 The drawings, specifications and schedule of quantities forming part of the contract are self explanatory and are complementary to one another. They together represent scope of works / installation to be carried out. The Contractor shall provide the any other work or installation required if it is required to complete the work as a whole even if the same is not indicated in the GFC drawings, technical specifications or the schedule of quantities.

2.08 Works shall comply with local regulations and unit rates shall include all costs:

a. All sanitary installations, water supply and drainage work shall conform to the Local Municipal Bye-Laws and/or rules and regulations of Local Bodies and the work shall be inspected and passed by the various authorities having jurisdiction.

b. The work shall be carried out through a licensed plumber.

c. The rates quoted shall be for complete items as fixed in position and cover all cost of materials, labour, tools, supervision, cutting of holes, chases, etc. and also for providing fixing arrangements viz. clamps brackets, wooden blocks etc. The rate shall also include restoration to original condition of all damages to walls, floors, etc. during the process of fixing of sanitary installations, water supply and drainage to the entire satisfaction of the Engineer. All debris of plumbers' excavation, demolition etc. shall be removed without any extra charge. The plumbing work or the other building work if affected by the PHE work shall be left thoroughly cleaned to the satisfaction of the Engineer.

d. All brackets shall be painted with one coat of approved primer and two coats of enamel of approved colour. All painting work shall be carried out to the entire satisfaction of the Engineer. Additional coats of paint shall be applied to get uniform and matching finish without any extra cost if directed.

e. All pipes shall be embedded in an approved manner in chases made in walls or floors in the interior of the building if required by the Engineer. The Contractor shall make necessary holes in the walls, etc. as required and restore them to the original condition.

f. All water supply and sanitary fixtures, pipes and pipe fittings, traps, etc., which are to be embedded into the concrete or masonry work or other building work shall be placed in position and embedded or concealed at the time of casting concrete or erecting the brickwork. The locations of such fittings, alignment of pipe lines and traps etc., shall be marked suitably in case chasing or cutting of concrete, masonry, or other structural or construction work is unavoidable and the cutting, chasing or disturbing of the construction work shall proceed only after approval of the Engineer.

g. All cutting, chasing and fixing work shall be completed before commencement of any plastering, tiling or finishing work.

h. Unless otherwise specified, galvanized iron pipes and pipe fittings shall be of medium quality conforming to IS: 1239 and shall be tested if required by the Engineer.

i. The Contractor shall be responsible for the adequacy and efficiency of the entire plumbing system and if, in his opinion, he finds any serious objection to the system shown on the drawings, he shall intimate his objection or his suggestions to ensure adequacy and efficiency of the said system and notify the Engineer before proceeding with the work.

j. The works, during its progress and till final acceptance by the Engineer and handover, including raw materials delivered at site to be incorporated for use in the work by the Contractor, shall be under the care of and responsibility of the Contractor and at his risk. The Contractor at his expense shall immediately replace any loss or damage to such materials or work prior to final acceptance of the work by the Engineer.

2.09 The Contractor shall strictly follow, at all stages of work, the stipulations contained in the Indian Standard Safety Code and the provisions of the safety rules as specified in the General Conditions of the Contract for ensuring safety of men and materials.

2.10 Any approval, instructions, permission, checking, review, etc. whatsoever by the Engineer shall not relieve the Contractor of his responsibility and obligation regarding adequacy, correctness, completeness, safety, strength, workmanship etc.

3.00 CODES AND PRACTICES

3.01 All standards, specifications, acts, and codes of practice referred to herein shall be the latest editions including all applicable official amendments and revisions.

3.02 List of certain important Indian Standards, Acts and Codes applicable to this work is given below. However, the applicable standards and codes shall be as per but not limited to the list given below:

Latest editions shall always be consulted.

IS : 458 Precast concrete pipes (with and without reinforcement).
IS : 771 Glazed fire clay sanitary appliances.
IS : 772 General requirements for cast iron sanitary appliances.
IS : 775 Cast iron brackets and supports for wash basins and sinks.
IS : 778 Copper alloy gate, globe and check valves for water works purposes.
IS : 781 Cast copper alloy screw down bib taps and stop valves for water services
IS : 783 Code of practice for laying of concrete pipes.
IS : 1172 Code of basic requirements for water supply drainage and sanitation.
IS : 1200 Methods of measurement of building and civil Engineering works.
IS : 1230 Cast iron rainwater pipes and fittings.
IS : 1538 Cast iron fittings for pressure pipe for water gas and sewage.
IS : 1703 Copper alloy float valves for water supply fittings.
IS : 1726 Cast iron manhole covers and frames intended for use in drainage works.
IS : 1742 Code of practice for building drainage.
IS : 2064 Code of Practice for selection, installation and maintenance of sanitary appliances.
IS : 2065 Code of practice for water supply in building.
IS : 2470 Code of practice for installation for septic tank.
IS : 2527 Code of practice for fixing rain water gutters and down pipes for roof drainage.
IS : 2548 Plastic seats and covers for water-closet
IS : 4111 Code of practice for ancillary structures in sewerage system
IS : 4127 Code of practice for laying of glazed stoneware pipes.
IS : 4984 Specification for high density polyethylene pipes for potable water supplies, sewage and industrial effluents
IS : 4985 Specification for uPVC pipes for conveying potable Water supply. This pipe can also be used for internal Concealed waste pipe for sizes 63mm dia and down Sizes
IS : 5219 Cast copper alloy traps (Part - I)
IS : 5329 Code of practice for sanitary pipe work above ground for buildings.
IS : 5961 Specification for cast iron gratings for drainage purposes.
IS : 13592 PVC SWR GRADE Type B pipes for soil, Waste and vent pipes
IS : 13592 PVC SWR GRADE Type B pipes for soil, Waste and vent pipes
ASTM D-1784 : Rigid poly vinyl chloride (PVC) compounds
ASTM D-1785 : Poly vinyl chloride (PVC) plastic pipes, Sch 40& Sch 80
ASTM D-2466 : Socket type Poly vinyl chloride (PVC) plastic pipe fittings, Sch 40
ASTM D-2467 : Socket type Poly vinyl chloride (PVC) plastic pipe fittings, Sch 80
ASTM D-2564 : Solvent cements for plastic pipes & fittings.
ASTM D-2846: Chlorinated poly (vinyl chloride) CPVC plastic hot & cold water distribution systems.

ASTM D-F493:Solvent cements for Chlorinated poly (vinyl chloride) CPVC plastic pipe & fittings.
ASTM D-F441 Chlorinated poly (vinyl chloride) CPVC plastic pipe Sch 40& Sch 80
ASTM D-F438 Socket – Type Chlorinated polyvinyl chloride plastic pipe fittings. Schedule 40
ASTM D-F439 Socket – Type Chlorinated polyvinyl chloride plastic pipe fittings. Schedule 80.

4.00 MATERIALS

4.01 Materials shall be of the best-approved quality available in the market and unless otherwise specified they shall conform to the respective Indian Standard Specification.

Contractor shall submit samples of all materials and get them approved before placing order and the approved samples shall be deposited with the Engineer.

The nearest size in FPS units shall be provided with prior approval of the Engineer in case of non-availability of materials in metric sizes. No additional payment or any deduction will be made for such substitution.

The materials shall be tested in any approved Testing Laboratory and the Contractor shall produce the test certificate in original to the Engineer and entire charges for original as well as repeated tests shall be borne by the Contractor if directed. The Contractor shall arrange to test portions of the work at his own cost in order to prove their soundness and efficiency if directed by the Engineer. The Contractor shall pull down and redo the work at his own cost if any portion of works is found to be defective or unsound in the opinion of the Engineer even if tests have been conducted. Defective materials shall be immediately removed from the site.

It shall be obligatory for the Contractor to furnish certificate, if demanded by Engineer, from manufacturer or the material supplier that the work has been carried out by using their material and installed/fixed as per their recommendations.

4.02 Cement

Cement shall comply in every respect with the requirements of the latest publication of IS: 8112-1989. Ordinary Portland cement Grade 43 shall be used unless otherwise specified.

Cement shall be stored in weatherproof shed with raised wooden plank flooring to prevent deterioration by dampness or intrusion by foreign matter.

4.03 Sand

Sand shall be clean, free from salt, clay, loam, shells, vegetable matter and fit for use in the opinion of Engineer and shall conform to IS : 383 and IS : 2116. If directed, the sand shall be washed.

4.04 Coarse aggregate

Coarse aggregate shall conform to IS: 383.

It shall be angular, tough, and sharp and well graded stone metal from approved source. It shall be clean and free from any foreign material. The aggregate shall be washed If directed.

4.05 Bricks

Bricks shall conform to IS: 1077.

Bricks shall be with a minimum compressive strength of 40 Kg/Sq.cm.

Bricks shall be of chamber burnt best quality locally available and shall be well burnt, but not over burnt and shall be free from cracks, chips, flaws and stones. It shall not absorb water more than 20% of its own weight when dry.

4.06 Cement mortar

It shall be of proportion specified in the particular item in the Schedule of Quantities. Sand shall be measured in suitable measuring boxes and correct quantity of cement shall be added. The materials are to be mixed dry on a clean platform. Clean water is then added and mixed thoroughly. It shall be prepared in such quantity as can be readily used up. Mortar, which has partially set, shall under no circumstances be re-tempered by mixing with additional material or water.

5.00 DRAINAGE (Internal & External)

5.01 Trenches for Drains

Alignment and gradients: The pipes are to be laid to alignment gradients shown on the drawings but subject to such modifications, as shall be ordered by the Engineer from time to time to meet the requirements of the works. No deviations from the lines, depths of cutting or gradients of pipeline shown in the plans and sections shall be permitted except by the expressed direction in writing of the Engineer.

The minimum gradients of soil and drainage pipeline shall be as follows if not otherwise specified:

100 mm nominal dia	...	1 in 35
150 mm nominal dia	...	1 in 65
230 mm nominal dia	...	1 in 120
300 mm nominal dia	...	1 in 200

Water Supply Pipeline

Under no circumstances, shall drainage and soil pipes be allowed to come close to water supply pipelines.

5.02 Excavation

The trenches for the pipes shall be excavated to lines and levels as directed. The bed of the trench shall be truly and evenly dressed throughout from one change of grade to the next.

The gradient is to be set out by means of boning rods. The trench shall be refilled by means of cement concrete of proportion 1: 4: 8 at the contractor's own expense and should the required depth exceed at any point.

The bed of the trench, if in soft or made up earth, shall be well watered and rammed and the depression thus formed shall be made up with sand or other suitable materials as directed by the Engineer without any extra cost.

If rock is met with, it shall be removed to 15 cm. below the level of the pipe and the trench refilled with concrete or sand or other suitable material as directed by the Engineer without any extra cost.

The rates shall include keeping trenches dry either by bailing out or pumping water, timbering and shoring of sides of excavation if required and as directed by the Engineer.

The trench width shall be nominal diameter of the pipe plus 38 cm. (15") but it shall not be less than 53 cm. (21").

Excavated material shall be stacked sufficiently away from the edge of the trench and the side of the spoil bank shall not be allowed to become such as to endanger the stability of the excavation. Spoil may be carried away and used for filling the trench behind the work.

5.03 **Protection of Existing Services**

All pipes, water mains, cables etc. met with in the course of excavation shall be carefully protected and supported.

5.04 **Refilling:**

Refilling in trenches for pipes shall be commenced as soon as the joints are tested and approved. The refilling on the top and around the pipes shall be done with great care and in such a manner as to obtain the greatest amount of compactness and solidity possible. For this purpose the selected excavated earth shall be laid in regular layers of 15 cm. watered and each layer rammed. Utmost care shall be taken in doing this, so that no damage shall be caused to the pipeline and other permanent works.

All surplus earth shall be disposed off as directed by the Engineer.

5.05 **Concreting**

All pipes at shallow road crossings and made up ground shall be laid on a bed of 150mm thick 1:4:8 concrete (one part of cement, four parts of sand and eight parts of 40 mm and down gauge stone metal) and properly consolidated. The pipes shall be encased with 1:3:6 cement concrete using 25 mm and down gauge stone metal. Concrete shall be laid to the full width of the trench and also in haunches as per the standard drawings.

5.06 **Laying**

The pipe shall carefully be laid to the levels and gradients shown on the drawings with "socket up" the gradient.

Each separated pipe shall be individually set for line, level, plumb etc. Where lengths of sewer or drain pipes are laid in trench, properly painted sight-rails shall be fixed across the trench at a height, equal to length of the boning rod to be used, above the required invert level of the drain or sewer at the point where the sight is fixed.

5.07 **Jointing**

Jointing of laid pipes shall be so carried out immediately as to avoid any movement or strain to the joints already made. If any joint is suspected to be damaged it shall be opened out and redone.

All joints between pipes, pipes and fittings and manholes shall be gastight when above ground and watertight when underground. Method of jointing shall be as per instruction of the pipe and

fittings manufacturer and as approved by the Engineer. However, in the absence of any instruction available from the manufacturer, methods as detailed hereunder shall be used.

5.08 Spun yarn soaked in thick cement slurry shall be passed round the joint and inserted into it by means of a caulking tool. More skins of yarn shall be added and caulked tightly so as to fill more than 1/4th of the total depth of the socket. The remainder of the socket in the joint shall be carefully filled with a stiff cement mortar of 1:1 (One part of cement and one part of sand) proportion by hand. When the joint is completely filled with tightly caulked mortar, a fillet shall be formed round the joint with a trowel, forming an angle of 45° with the barrel of the pipe. The newly laid joints shall be protected until set from sun and rain and shall be covered with damp sack or other suitable materials.

5.09 **Curing**

The joints shall be cured at least for seven days.

5.10 **Testing**

All lengths and joints shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure at least 2.0M head of water at the highest point of the section under test. Any joint found leaking or sweating shall be remade and section re-tested at Contractor's own cost.

5.11 **Support and Protection to Pipelines**

All drainage and sewer pipes shall be laid with socket leading uphill. Preferably the pipes shall rest on solid and even foundations for the full length of the barrel. However, the pipe manufacturer's instructions as approved by the Engineer shall be followed in the matter of support and jointing.

Anchoring of pipes where necessary shall be achieved by suitable concrete encasing designed for the expected thrust.

5.12 **Entry into Structures**

For entry of the pipelines into any building or structures suitable conduits under the structures or sleeves shall be used. The conduits and sleeves shall be such as to allow easy repairs and replacement of the pipes. When openings or chases are required to be made in the structure for entry of pipe-lines, locations and sizes shall be marked and checked by the Engineer. After laying of the pipeline the openings and chases shall be made good.

5.13 **Ducts**

Where soil, waste and ventilating pipes, rain ware pipes are accommodated in ducts, access to cleaning eyes shall be provided. Connection to drain shall be through a gully with sealed cover to guard against increase of sewer gas, vermin or back flow.

5.14 **Traps and Ventilating Pipes**

Pipes for carrying off the waste from water closets and waste water and overflow from baths, wash basins, sinks to drains shall be trapped immediately beneath such fixtures. Traps shall have minimum water seal of 50 mm and shall be ventilated whenever such ventilation is necessary to maintain water seal of the trap.

Ventilating pipes shall be carried up vertically from the drain to a height of at least 800 mm above the outer covering of the roof of the building or as shown on drawings. All vertical ventilation, anti-siphon and similar pipe shall be covered on top with a cowl.

B. HUME PIPE FOR DRAINAGE

5.15 Pipes

Shall be reinforced and conform to relevant I. S. Specification. They shall be new and perfectly sound, free from cracks, cylindrical, straight and of specified nominal diameter. Each pipe shall have one collar.

5.16 Jointing

Socket and spigot pipes shall be joined by lead joints. The spigot shall be centered in the socket of the next pipe by tightly caulking in sufficient turns of tarred gasket or hemp yarn to have unfilled half the depth of socket. When the gasket or hemp yard has been caulked tightly, a jointing ring shall be placed round the barrel and tightened against the face of the socket to prevent airlock.

Molten lead shall then be poured in to fill the remainder of the socket and caulked with suitable tools right round the joint to make up for shrinkage of the molten metal on cooling and shall be finished 3 mm behind the socket face.

In special cases if flanged joints are accepted by the Engineer, the joints shall be made leak proof by inserting approved type of rubber or other gasket no less than 1.5 mm thick. The bolts shall be secured in stages to avoid uneven strain. Damaged gasket shall be replaced.

6.00 Manholes and Inspection Chambers

6.01 The maximum distance between manholes shall be 30 metres unless specially permitted otherwise. In addition, at every change of alignment/gradient or diameter there shall be a manhole for inspection chamber. The distance between manhole or inspection chamber and gully chamber shall not exceed 6 metres unless desired otherwise. Manhole shall be constructed so as to be watertight under test. The benching at the sides shall be carried out in such a manner as to provide no lodgement for any splashing in case of accidental flashing of the chamber. The chamber or drain at the bottom of chamber shall be plastered with 1:3 cement, sand mortar and finished smooth to the grade. The channels and drains shall be shaped and laid to provide smooth flow.

Connection to existing sewer lines shall be through a manhole.

Manholes shall be provided with standard covers, usually FRP or as desired by the Engineer. The covers shall be close fitting so as to prevent gases come out.

6.02 Size of manholes

The size specified in the Schedule of Quantities shall be internal size of the manhole.

The work shall be done strictly as per standard drawing and following specifications.

6.03 **Bed concrete**

Shall be in 1: 4: 8 cement concrete 150 mm thick for inspection chambers, 230 mm for depths up to 2.1 meters and 300 mm for greater depths in case of manhole.

6.04 **Brickwork**

Shall be with locally available best quality chamber burnt bricks in 1: 4 cement mortar or as specified.

6.05 **Plaster**

Inside of the walls shall be plastered with 12 mm. thick cement plaster 1: 3 and finished with a floating coat of neat cement.

In wet grounds, 20 mm thick plaster of the above specification shall be done on the exterior surface of the walls also and this plaster shall be waterproofed with the addition of approved waterproofing compound as per manufacturer's specification.

6.06 **Pointing**

In dry ground, pointing shall be done in 1: 2 cement mortar to the outside surface.

6.07 **Benching**

Channels and benching shall be done in cement concrete 1: 2: 4 rendered smooth with neat cement.

The following size of channels for the bench shall be adopted.

Size of drain		Depth at the centre		Depth at sides at walls	
in cm.	in inches	in cm.	in inches	in cm.	in inches
10	4	15	6	25	10
15	6	20	8	30	12
23	9	28	11	38	15
30	12	35	14	45	18
38	15	43	17	53	21
45	18	50	20	61	24

6.08 **Foot rests**

Polypropylene foot rests / steps shall be embedded in masonry, whenever the depth of the manhole / chamber is more than 1.2 metres as shown in the drawing. They shall be fixed 30 cm. apart and projecting 11 cm. from the wall.

6.09 **Manhole Covers**

Manhole covers shall be of tough homogeneous FRP of heavy/medium/light type as specified. The sizes specified are the clear internal dimensions. Cover placed on the frame shall be air tight.

7.00 **SANITARY INSTALLATION & FIXTURES:**

7.01 All fixtures and fittings shall be of approved quality and type manufactured by well-known manufacturers. All items brought to the site must bear identification mark of the type and manufacturer. Procurements shall be made well in advance and got inspected and approved immediately by the Engineer. All fixtures shall be adequately protected covering and plugging till handed over.

All fittings, gratings, fasteners, unless specified otherwise, shall be chromium plated.

All fixtures shall be fixed in a neat workman like manner true to line and as recommended by the manufacturer or shown on the drawings. Care shall be taken to fix all fixtures, brackets and accessories by proper wooden cleats, raw plugs, bolt and nuts as each fixture will warrant with the correct site of screws, nuts or bolts.

Care shall be taken in fixing all approved chromium plated fixtures and accessories so as not to leave any tool marks or damages. All such fixtures shall be tightened with fixed spanners. Use of pipe wrenches with toothed jaws shall not be allowed.

All fixtures shall be thoroughly tested after connecting up the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping, valves and waste fittings corrected to the entire satisfaction of the Engineer.

Upon completion of the work, remove all labels, stickers, plasters etc. from the fixtures and clean all fixtures with soap and water so as to present a neat and clean toilet.

7.02 **Water closet**

i) Indian type W. C. pans

The W. C. pan shall be of white vitreous china, of specified size and pattern. Pan shall be of approved quality and shall bear the mark of the firm manufacturing it.

ii) **Orissa type pans**

Shall be from an approved manufacturer and trapped as specified above.

Fixing

Pan shall be fixed securely with a cushioning bed in an approved manner taking care that the cushion is uniform and even, without having any hollows between pan and the concrete. The joint between the pan and the trap shall be made with cement mortar 1: 1 and shall be leakproof.

Each closet shall be provided with the following accessories and the rate shall be all-inclusive

a. Necessary length of 10 cm. H. C. I. pipe or lead pipe connecting the pan and plug bend. (The plug bend/tee connection to vertical stack shall be paid under appropriate item).

b. Wherever anti-syphonage pipe connections are required necessary length of lead pipe 62.5 mm. dia. shall be provided.

c. Necessary length of porcelain or lead or C.I. connecting pipe 10 cm. dia. (plug bend/tee connection to vertical stack shall be paid under appropriate item.)

Painting

All fittings and fixtures shall be painted with two coats of enamel paint over a coat of primer.

iii) **European Type W.C.**

The Closet shall be of white Vitreous China readily flushed, of "cascade model wall mounted European type with close coupled flushing cistern" and shall be of best quality manufactured by an approved firm, and fixed to the floor by approved means. It shall have 100 mm dia. porcelain 'P' or 'S' trap with effective seal.

Each closet shall be provided with the following accessories and the rate shall be all inclusive

a. **Seat**

Matching colour plastic seat of approved quality and seat cover with rubber buffers fixed to the pan with C.P. brass bar hinge.

7.03 **Cistern/ Flush valve**

Flush valve having 32/ 40mm dia inlet or dual purpose flushing tank with 3 or 6liters/ flush capacity of white vitreous china cistern of best quality manufactured by an approved firm with C.P. flush handle and C.P. overflow pipe of length as per Municipal requirement or as per Engineer's drawing with mosquito-proof bronze cap etc. complete unit including enameled or C.P. flush pipe and bend.

Necessary length of lead water inlet pipe and 12 mm dia. C.P. brass stopcock.

Necessary length of lead or C.I. connecting pipes 10 cm dia. (Plug bends / tee connection to vertical stack shall be paid under appropriate item).

Wherever anti-syphonage pipe connections are required, necessary length of lead pipe 6.25 cm. dia. shall be provided.

Painting

All fittings and fixtures shall be painted with two coats of enamel paint over a coat of primer.

7.04 **Urinals**

i) **Lipped Urinals**

Shall be magnum urinal with automatic sensor or flat back or angle urinal of specified dimensions and shall be of white Vitreous china from an approved manufacturer.

They shall be screwed to the wall with coach screws of chromium plated brass on dowel shaped wooden plugs built into the walls or fixed as per manufacturer's specification. Each basin should have an outlet with C. P brass hinged grating connected to 40 mm diameter waste pipe through a C.P. bottle trap. When a range of urinals are provided only a straight length of 40 mm diameter

Waste pipe and white glazed half round channel with tread platform finished with white glazed tiles complete as per Engineer's drawings shall be provided. All joints shall be in plumber's wiped solder joint with necessary C.P. brass sockets and thimble etc.

ii) **Stall wall type urinals**

Shall be white vitreous china of approved design and manufacturer.

They shall be fixed to the wall as per manufacturer's specification. Each urinal should have an outlet with C.P. brass hinged grating connected to 40 mm diameter waste pipe through a C.P. brass bottle trap. All joints shall be in plumber's wiped solder joint with necessary C.P. brass sockets and thimble etc.

7.05 **Flushing Cistern**

These shall be automatic/ manually operated flushing cisterns of vitreous china or as specified in the Schedule of Quantities complete with valve less siphon fittings. Cistern shall be supported on brackets of standard pattern and fixed to wooden dowel plugs embedded in the wall with C.P. brass screws.

7.06 **Angle valve**

The cistern shall be fed with 15 mm. (1/2") C. P. brass inlet tube angle valve of approved make with necessary length of lead inlet pipe complete with C. P. brass unions unless otherwise specified in the Schedule of Quantities.

The main and distribution pipefittings and clamps shall be of C. P. brass unless otherwise specified in the Schedule of Quantities. Distribution pipes shall feed the urinals with C. P. brass spreaders of approved make.

Painting

All brackets etc. shall be painted with two coats of enamel paint over a coat of primer.

7.07 **Lavatory Basin**

Wash basin

They shall be of white vitreous china of best quality manufactured by an approved firm and size as specified in the schedule of quantities. They shall be supported on a pair of CI brackets of approved design.

Fittings

Each lavatory basin shall be provided with a single cold water C.P. brass pillar tap of approved design and make, C. P. brass waste, C. P. brass chain and rubber plug, C. P. brass bottle trap of approved quality and design, with C. P. brass stop cock and water inlet pipe of standard length complete.

Waste pipe

Waste pipe beyond bottle trap shall be measured and paid separately under appropriate item.

Painting

All brackets, pipes etc. shall be painted with two coats of enamel paint over a coat of primer.

7.08 **Sinks**

They shall be of stainless steel sink with drain board of best quality and sizes as per the schedule of quantities. They shall be supported on necessary brackets.

Fittings

Each sink shall be provided with 40 mm. (1.5") C. P. brass waste of approved pattern with C. P. brass chain and 40 mm. rubber plug and 40 mm. dia. C. P. brass trap and union which shall be connected to 40 mm. diameter waste pipe.

Waste pipe beyond the trap shall be measured separately and paid under appropriate item.

Where specified, sinks shall be provided with puff pipe with a brass-perforated screw cap.

Painting

All fittings, brackets and pipes shall be painted with two coats of enamel paint over a coat of primer.

7.09 **Drain board**

Drain board of type and size as specified in the Schedule of Quantities shall be provided. These shall be fixed on strong brackets of approved design and where necessary provided with hinges. Brackets shall be painted with two coats of enamel paint over a coat of primer.

8.00 **TOILET REQUISITES**

8.01 **Mirrors**

Mirrors shall be of the best quality, specified size, approved design and make. It shall be mounted on asbestos sheet backing and shall be fixed in position by means of four C. P. brass screws and cup washers over rubber washers on wooden plugs firmly embedded in the wall. Alternative method for fixing could be by using brass clamps with C. P. brass screws. A suitable T. W. cover of approved design shall be fixed all round as directed.

8.02 **Glass shelf**

The shelf shall be of glass of approved quality and thickness with edges rounded off. The size of the shelf shall be as specified and shall rest on C. P. brass brackets which shall be fixed with C. P. brass screws to wooden plugs, firmly embedded in the wall. The shelf shall have C. P. brass guard rail all round.

8.03 **Towel rail**

Towel rail shall be of C. P. brass with two C. P. brass brackets. The size of the rail shall be as specified. The bracket shall be fixed by means of C. P. brass screws to wooden cleats firmly embedded in the wall. Where specified, anodized aluminum towel rails may be used of approved quality and design.

8.04 **Toilet paper holder**

Toilet paper holder shall be of Jaquar or equal approved make exposed type to be fixed over wall dado.

8.05 **Floor sump/ Traps**

The floor sump/ trap shall be have fabricated in PVC self-cleaning and deep water seal type with a 50 mm water seal. It shall have an outlet ranging from 75mm to 110 mm dia. With grating at top. These shall be fixed in concrete to the required level and position.

8.06 **Shower**

These shall be of CP finish swivel type as specified.

8.07 **Towel Ring, Soap Tray, Cloth Stand etc.**

These shall be of CP/ anodized aluminium as described in the schedule and as per the displayed sample. These shall be fixed by means of CP brass screws to wooden cleats, firmly embedded in the wall.

8.08 **Liquid Soap Dispenser**

It shall be round and easily revolving with removable threaded nozzle. The body, bracket for wall mounting and screws shall be chromium plated.

9.00 **WATER HEATERS**

These shall be of Venus / Racold make. The type and capacity will be as per schedule of quantities. They shall be mounted on the wall with necessary bolts of approved make. They shall have 8 mm PVC inlet pipe, 12 mm lead pipe outlet, and 15 mm non-return valve.

10.00 **Waste and Vent Pipes and Fittings**

10.01 **Laying**

The pipes shall be laid as described in the Schedule of Quantities and as shown on the Engineer's drawings.

uPVC Soil, Waste Vent and rain water pipe system:

PVC pipe of SWR grade TYPE B pipes conforming to IS 13592 shall be used for soil, waste, vent and rainwater pipe system. The fittings shall conform to relate IS and Joints will be pasted or ring seal type.

10.02 **Fixing**

The pipes and fittings shall be fixed to walls by using proper holder-bat clamps, if directed. The pipes shall be fixed perfectly vertical or in approved alignment. The spigot end shall abut the shoulder of the socket and shall leave no annular space in between. All soil and waste water pipes shall be carried up above the roof parapet wall and shall have Vent cowl.

Connection between main pipe and the branch pipes shall be made by using appropriate branches and bends invariably with access doors for cleaning.

10.03 **Testing**

All PVC soil, waste, vent and rain water pipes and fittings including joints shall be tested by smoke test as recommended by ISI and left in working order after completion. The acceptance criteria shall be as laid down therein.

10.04 **Nahani or floor traps**

The traps shall be of self-cleaning design deep seal type with a minimum seal of 5 cm. (2"). If directed, 25 mm. puff pipe shall be provided. The other specifications for these shall be the same as those for C. I. soil, waste and vent pipes and fittings. The nahani trap shall be back inlet type.

10.05 **Painting**

All exposed C. I. pipes and fittings shall be painted to match the colour of the surroundings with two coats of flat/enamel paint over a coat of approved primer. If directed, additional coats shall be given at no extra cost.

10.06 **WATER SUPPLY**

A. INTERNAL WATER SUPPLY

11.00 CPVC Pipes as per ASTM D 2846 – SDR 11 only with fittings as per ASTM F 438 for pipes up to 50 mm.

For pipes above 65 mm and above pipes shall be ASTM F 441 Schedule 80 and fittings as per ASTM F 439.

The CPVC SDR 13.5 and SDR 11 pipes shall be used for cold and hot water supply respectively.

11.01 ASTM PVC pipes and fittings:

Pipes conforming to ASTM D 1785 poly vinyl chloride (PVC) plastic pipes sch'80 and fitting conforming to ASTM D 2467 sch'80

Brass female threaded fitting should be used for connecting C.P. Bathroom fittings like Angle stopcock, health faucet bibcock, etc.,

Laying and fixing:

CUTTING:

In order to make a proper and neat joint, measure that the pipe and fitting length accurately and make a small mark. Ensure that the pipe and fittings are size compatible. You can easily cut with a wheel Type plastic pipe cutter or hacksaw blade. Cutting tubing as squarely as possible provides optimal bonding area with in a joint.

DEBURRING / BEVELING:

Burss and filings can prevent proper contact between tube and fitting during assembly and should be removed from the outside and inside of the pipe. A pocketknife or files are suitable for this purpose. A slight bevel on the end of the tubing will ease entry of the tubing into the fitting socket.

FITTING PREPARATION:

Using a clean, dry rag, wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 to 2/3 of the way into the fitting socket.

SOLVENT CEMENT APPLICATION:

Use only CPVC cement or an all – purpose cement conforming to ASTM – 493 or joint failure may result. When making a joint, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged waterways.

ASSEMBLY:

Immediately insert the tubing into the fitting socket, rotate the tube ¼ to ½ turn while inserting. This motion ensures and distribution of cement within the joint. Properly align the fittings. Hold the assembly for approximately 10 seconds, allowing the joint to set-up.

SET AND CURE TIMES:

Solvent cement set and cure times are a function of pipe size, temperature and relative humidity. Curing time is shorter for drier environments smaller sizes and higher temperatures. It requires 10 to 20 minutes for perfect joint.

12.00 **Testing**

Before any pipes are concealed or covered in false ceiling, they shall be tested to a hydrostatic pressure of 10 Kg/cm or 1.5 times maximum working pressure whichever is higher. Pressure shall be maintained for at least two hours without appreciable drop in pressure. In addition to the sectional testing of water supply pipes, the contractor shall test the entire installation to the entire, satisfaction of the Engineer.

All CPVC SDR 13.5 & SDR 11 pipes or any other pipes and fittings shall be tested in an approved manner while unloading at the site. All leaky materials, joints must be made leak proof by tightening or redoing at contractor's expenses.

13.00 **BUTTERFLY AND BALL VALVES:**

13.01 **Ball valves: -** The valve shall be brass body with specified size and shall be of approved quality.

The valves shall work easily and smoothly under all conditions and shall be watertight when closed under the working pressure as stipulated in the relevant I. S. codes.

The diameter of the water way, when the valve is fully opened shall not be less than the diameter of the pipe.

13.02 **Butterfly Valves**

Valves above 50 mm dia. shall be butter fly valves.
Butterfly valves shall conform to the following specification:

Body	:	High duty cast iron to IS 210 FG 220 and BS 1452 Gr 220
Seating	:	Molded in situ resilient lining of black nitrile rubber.

Disk : Nylon coated S.G iron to IS 1865/SG 400/12 and BS 2729 Gr.470/12.

Shaft: The shafts are made of stainless steel AISI 431. Only flanged and valves to be used with flanges drilled to BS 10 Table F. Valves shall be capable of being locked in open position. Hand wheel shall be with flow control lever unit for smooth opening and closing of the valve. Key rods with MS coated extended spindles to be provided whenever the valves are not Approachable from the ground surface.

14.00 APPURTENANCES

The other appurtenances of the pipe line are mentioned below:

14.01 **Air valves:-** These are placed at every summit in the pipe line to permit the escape of air when the main is filled, and afterwards air if any is carried into the main (they are also placed on long stretches of nearly level main).

14.02 **Scour valves: -** These are placed at the bottom of all depressions for emptying the main or letting out sediment.

14.03 **Reflux valves :-** These are fixed on the ascending parts of the main which open in the direction of flow, but automatically close if a burst occurs and the water flows back. They diminish the damage done by the escape of water at a burst.

17.00 SEWAGE DISPOSAL

Sullage and sewage produced from this complex shall be conveyed through a common inspection chambers at appropriate locations. After this, the collected sewage will be treated by providing suitable sewage treatment plant within the premises. Then the treated effluent will be stored and re-used for flushing and gardening purposes.

18.00 TESTING AND ACCEPTANCE

18.01 Inspection before Installation

All pipes, fittings and fixtures shall be inspected before delivery at the site to see whether they conform to accepted standards. The pipes shall again be inspected on site before laying by sounding to disclose cracks. All defective items shall be clearly marked and forthwith removed from the site.

18.02 Testing of Pipelines for Drainage and Sanitation

Comprehensive test of all pipe lines shall be made by simulating conditions of use. The method of actual tests shall be decided by the Engineer. All test data shall be recorded and submitted to the Engineer for review and instruction. The Engineer's discretion regarding tolerance shall be final.

General guidance for the tests are given below:

(a) **Smoke Tests**

All soil pipes, waste pipes and vent pipes and all other pipes when above ground shall be approved gastight by a smoke test connected under a pressure of 25 mm of water and maintained for 15 minutes after all trap seals have been filled with water. The smoke is produced

by burning oily waste or tar paper or similar material in the combustion chamber of a smoke machine. Chemical smokes are not satisfactory.

(b) **Water Test for pipes other than Cast Iron**

Glazed ware pipes shall be subjected to a test pressure of at least 1.5 m head of water at the highest point of the section under test. The tolerance figure of two litres per centimeter of diameter per kilometer be allowed during a period of 10 (ten) minutes. The test shall be carried out by suitably plugging the low end of the drain and the ends of connections, if any, filling the system with water. A knuckle bend shall be temporarily jointed in at the top and a sufficient length of the vertical pipe jointed to it so to provide the required test head or the top may be plugged with connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fixed suitable for observation.

Subsidence of test water may be due to one or more of the following causes:

(i) Absorption by pipes and joints

(ii) Sweating of pipes or joints

(iii) Leakage at joints or from defective pipes

(iv) Trapped air

Allowance shall be made for (i) by adding water until absorption has ceased and after which the proper tests should commence. Any leakage and the defective part of the work shall be cut out and made good.

(c) **For Straightness**

(I) By inserting at the high end of the sewer or drain a smooth ball of a diameter 13 mm less than the pipe bore. In the absence of obstruction, such as yarn or mortar projecting through the joints, the ball will roll down the invert of the pipe and emerge at the lower end; and

(ii) By means of mirror at one end of the line and lamp at the other. If the pipeline is straight, the full circle of light may be observed. The mirror will also indicate obstruction in the barrel if the pipeline is not straight.

18.03 **Testing of Water Mains after Laying**

After laying and jointing, the main shall be slowly and carefully charged with water, so that all air is expelled from the main, by providing 25 mm inlet with a stop-cock, allowed to stand full of water for a few days if time permits, and then tested under pressure. The test pressure shall be 5 kg/cm² or double the maximum working pressure, whichever is greater. The pressure shall be applied by means of a manually operated test pump, or in the case of long mains or mains of a large diameter, by a power-driven test pump provided that the pump is not left unattended. In either case, due precaution shall be taken to ensure that the required test pressure is not exceeded. Pressure gauges shall be accurate and shall be preferably have been recalibrated before the test. The pump having been stopped the test pressure shall maintain itself without measurable loss for at least five minutes. The end of the main shall be closed by fitting a

watertight expanding plug and plug shall be secured by struts to resist the end thrust of the water pressure in the mains.

18.04 **Testing of Service Pipes and Fittings**

The service pipes shall be slowly and carefully charged with water allowing all air to escape avoiding all shock or water hammer.

18.05 **Fixtures Etc.**

All fixtures and fittings shall be connected by water tight joints. No dripping shall be accepted.

18.06 **Manuals**

3 copies of manuals shall be submitted duly indexed with complete technical data sheet of each piece of equipment installed. The manuals shall be well bound and shall contain the following:

i. Table of Contents.
ii. Design data / standards.
iii. 'As built' drawings.
iv. Manufacturer's catalogues, installation and maintenance brochure.
v. Spare parts list.

19.00 **MODE OF MEASUREMENT**

1. Unless otherwise stated, all pipes shall be measured net, length as laid or fixed and measured linear over all fittings, such as bends, junctions, etc. and given in running metres. The length shall be taken along the center line of the pipes and fittings.

2. Length of fittings viz., taps, valves, traps, etc. which are paid under appropriate items shall not be re-measured under linear measurements as enumerated above.

3. Soil, waste and vent pipes shall be measured along the center line of the stack including the connecting bends/tees to W. C. Pan, Nahani trap, etc. and shall be paid as enumerated above.

4. W. C. pans, Lavatory basins, Sinks, Drain boards, Urinals, Mirrors, Glass shelf, Toilet paper holder shall be measured by number and shall include all accessories as enumerated in detailed specifications under each item.

5. Unless otherwise specified, all types of taps, valves, etc. shall be measured by number and paid separately.

6. Manholes, Inspection Chambers, Gulley traps, etc. shall be constructed according to detailed specifications, and measured by number and paid separately. The depth of manhole shall mean the vertical distance from the top of the manhole cover to the outgoing invert of the main drain channel.

7. Water meter shall include 'Y' strainer and other appurtenances required by the Local bodies and shall include Brick Masonry Chamber etc. as per detailed specification and item shall be measured by number and paid for accordingly.

ANNEXURE TO BILL OF QUANTITIES FOR THE WORKS RELATED TO WATER SUPPLY AND SANITARY ENGINEERING

BIDDERS WILL NOTE THE FOLLOWING BEFORE OFFERING THEIR RATES.

GENERAL NOTES TO CONTRACTOR:

1. All glazed Sanitarywares, Chromium plated bathroom fittings, Pipes and pipe fittings, Valves, pumps etc., shall be as specified in the bill of quantity.

2. Transportation of materials, lead, lift, for fixing in position, fixing materials like brackets / rag bolts, screw nails, wooden plugs or any other like materials for proper as well satisfactory completion, labour charges to fix in position, making holes or cutting in masonry or concrete surfaces, restoring the damaged portions using materials like river sand, cement, stone chips, steel rods, shuttering materials, curing the works, carting away the broken materials from respective site of operations, conveying by head load or any other means, to ground floor, stack neatly at appropriate places - such items of work should be included in the rates offered by Contractors, in addition to basic prices of all materials with taxes, duties & levies.

3. The Contractors should make his own arrangement to bring testing equipments, any other materials for temporary fixing/ removing, conducting tests required at their cost and should include for these in their rates against each item of work.

4. Incase of non-availability of material with specification mentioned in schedule of quantities, the Contractor shall obtain approval from Architects to use material with alternative specification. This is subject to satisfaction of Architect & client.

5. The Contractor will take care to procure samples of materials as stated in schedule of quantities. After obtaining approval from Architects & clients Contractor to arrange for required materials as per approved samples. Approved sample of materials are to be retained at site by the Contractor and can be taken off after completion of works or with approval of Architects and clients.

6. All the materials to be used on works should bear I.S.I. mark. Wherever Non I.S.I. marked products are brought in, such materials should be the best in Market & prior approval of Architect's/ Consultant's should have been obtained. It is the responsibility of the Contractors to follow the product specification.

7. Only drilling machines shall be used for making the holes in the walls and no jumper and hammer will be allowed. Wall chasing shall be done with chasing machine.

8. Quoted rate shall be inclusive of cost of hi-tech supports with anchor fasteners and all consumables like hacksaw blade, solvent cement, twine/ Teflon tape, etc.

9. Quoted rate shall be inclusive of cement concrete all around the IWC/EWC and pipe works wherever required.

10. Commercial Terms & Conditions for this part of work will be identical to what is stated for General Builders Work Contract.

11. Quantities of work involved for above project on water supply and sanitary engineering is enclosed herewith. These quantities are arrived based on consultants drawing in consultation with Project Architect & client.

12. Quantities mentioned may differ from actual. Hence it is not a lump sum contract and vendors will be paid on completed quantity of work certified measurement of work by the authorities' in-charge at site. Vendors should read and follow the technical specification followed in tender documents.

13. It is the responsibility of the vendor awarded with the work to take on the successful commissioning of the system. For this purpose changes or alterations on the work front are to be brought to the notice of the consultants/ architects/ clients for their approval. The vendor is not permitted to find any reasons for failure on performance of the system and authorities are also flexible to effect changes as well these to be within the value of the contract awarded.

14. It is necessary that shop drawing is prepared by the vendor. Approval will be provided only if the shop drawings mention ascends and descends of pipe work without damaging the structural concrete members supporting the construction. The vendors should also note that making holes wherever needed, cutting earth, refilling the trench with excavated earth are item included in their rates. Additional claim in the invoice of the vendors will not be paid under any circumstances.

15. The vendors after receiving the work order should submit catalogue, technical details, Proforma on all the materials to be used on the work. The authorities will scrutinize, inform the vendor for procurement. On completion, the vendor will submit to authorities "as built" drawings showing actual work carried out with measurements. Absence of this will attract the client to withhold payment due to the vendor.

    In addition to said above, the following points shall also be taken into account while quoting the price of each item.

Co – ordination:

- Work shall be carried out in conformity with the specifications, accompanying drawings and with the requirements of the general architectural and structural plans after approval by the Architects / Project Manager of the Employer. The Contractor shall be responsible for taking actual measurements at site and varying the work in details if required to meet the site conditions. Such deviations shall, however, be subject to the approval of the Architects / Project Manager.

- The Contractor shall also co-operate with the Employer's Project Manager / other Contractors, compare and co-ordinate plans, specifications and time schedules and so arrange his work that there will be no interference. The Contractor shall forward to the Employer copies of all correspondence and drawings so exchanged. Failure to check plans and conditions will render the Contractor responsible for bearing the costs of any subsequent change found necessary.

Bye-Laws:

- The Contractor shall comply with all bye-laws and regulations of local and other statutory authorities having jurisdiction over the works and shall be responsible for the payment of all fees and other charges and giving and receiving of all necessary notices and keeping the Employer informed of the said compliance with the bye-laws, payment made, notice issued and received.

- The Contractor shall indemnify the Employer, Architect and Project Manager against all claims in respect of patent rights, designs, trade marks or names or other protected rights in respect of any plant, machine, work or material used for or in connection with the works or temporary works and from and against all claims, demands, proceedings, damages, cost, charges and expenses whatsoever in respect thereof or in relation thereto. The Contractor shall defend all actions arising from such claims and shall himself pay all royalties, licenses fees, damages, costs and charges of all and every sort that may be legally incurred in respect thereof.

Drawings and Literature:

- Before proceeding with the work, the Contractor shall submit for approval, general layout and assembly drawing and such additional assembly and sub – assembly detail drawings as are necessary to demonstrate fully that all parts of the system to be furnished conform to the specifications.

- Within 10 days of the acceptance of the tender, the Contractor shall furnish required prints of layout, assembly and erection drawings for approval. If any modification is proposed by the architects / Project Manager, required further prints of the modified drawings shall be submitted. No modifications shall be made in a drawing after it has been approved by the Architects / Project Manager, without their prior consent. All drawings necessary for assembly, erection, maintenance, repair and operation of the equipment shall be furnished. Different parts shall be suitably numbered for identification and ordering of spare parts.

- Approval by the Architect / Project Manager of the drawings shall not relieve the Contractor of any part of his obligations to meet all the requirements of the contract or of the correctness of his drawings. The Contractor shall be responsible for and pay for all alterations of the works due to discrepancies or omission in the drawings or other particulars supplied by him, whether such drawings have been approved by the Architect / Project Manager or not

- Copies of a comprehensive manual for use by the Project Manager before and during erection and subsequent operation and maintenance of the plant shall also be furnished after approval of the contract drawings.

- The Contractor shall furnish and install in the machine room, a neatly typed set of operating instructions securely framed and glazed. The Contractor shall also provide one set of tools free of cost required for routine and special maintenance work.

Shop Drawings:

- Prior to the execution of the work, the Contractor shall check all drawings, specifications and Bill of quantities and shall within fifteen days report any error, discrepancies and / or omission discovered therein, to the Consultant and obtain appropriate orders on the same. Any adjustment made by the Contractor without prior approval of the Architect / Project Manager shall be at his own risk.

- The drawings attached to these specifications are design drawings and are general in nature and cannot be regarded as working drawings. The Contractor shall prepare his own detailed working drawings and shall get them approved by the Consultant before execution.

- Cost of all shop drawings, fabrication drawings and details to be furnished by the Contractor shall be deemed to be included in his tendered rates for the work. Approval of shop drawings shall not be construed as authorizing additional works or authorized in writing by the Architect / Project Manager.

- Space allotted for major equipment shall be taken into consideration before ordering the equipment. The Contractor should ensure that the equipment shall fit into the space provided with required clearances all round as per relevant I.S.S. and I.E. Rules

- Prior to submission of all drawings to ensure that they comply with the intent of the specifications and that they fit in with the overall building layout. Drawings found to be inaccurate or otherwise erroneous will be returned to the Contractor.

- Contractor shall submit copies each of all drawings for the approval of the Consultant. Additional copies of drawings, if required, shall be supplied by the Contractor without additional cost.

- The approval of the drawings by the Consultant shall not be construed as a complete dimensional check but will indicate only that the general method of construction and detailing is satisfactory. The Contractor shall be responsible for the dimensions and design of adequate connections, support, details and satisfactory construction of the work.

- All shop drawings shall be submitted within 15 calendar days of the award of contract, except the control drawings, which shall be submitted within 30 days.

Negligence:

- If the Contractor shall neglect to execute the work with due diligence or shall contravene the provisions of the Contract, the Employer may give notice in writing to the Contractor calling upon him to make good the neglect or contravention complained of. If the Contractor fails to comply with such notice within a reasonable period, the Employer shall have the option and get it completed at a reasonable price. The Employer shall then be entitled to retain and apply any balance sum, which may otherwise be then due on the contract, by him to the Contractor towards the payment of the cost of execution of such work as aforesaid. If the cost of

execution shall exceed the balance due to the Contractor, the Employer shall be at liberty to dispose off any of the Contractor's material or construction plant that may be at site and apply the proceeds for payment of the difference of such cost or recover the balance by due process of law.

Statutory Inspections:

- The Contractor shall be fully responsible for meeting all the statutory obligations & local inspectorates wherever applicable to the works carried out by them. The Contractor should prepare all working drawings and obtain approval of competent authorities and also have the equipment and installation inspected and got approved. All official fees will be paid by the clients directly against demand in writing from the appropriate authority and all other expenses for submission and approval of the various and relevant statutory/bodies shall be embodied in the tender prices.

Tools and Spare parts:

- All tools, tackle, scaffolding and staging required for erection and assembly of the equipment and installation covered by the Contractor shall be obtained by the Contractor himself. All other materials such as foundation bolts, nuts etc. required for the installation of the plant shall also be supplied and included in the contract.

Testing:

- The Contractor shall carry out tests on different equipment as specified in various sections in the presence of representative of clients, architects and consulting Engineer in order to enable them to determine whether the plant, equipment and installation in general comply with the specifications.

- Routine and type tests for the various items of equipment shall be performed at the Contractor's works and test certificate furnished. If required by the Project Manager, the Contractor shall permit the Employer's authorized representative to be present during any of the tests. The Contractor shall bear all the expenses thereof.

- All equipment shall be tested after carrying out necessary adjustments and balancing to establish equipment rating and all other design conditions. At least four sets of readings shall be taken for each item tested and submitted in the form shown in annexure or any other Acceptance Test forms supplied by the consultants. Instruments required for testing shall be furnished by the Contractor along with initial requirements of all consumables.

RESPONSIBILITIES OF SPECIALIZED CONTRACTORS

Contractors shall include in their contracts, provision for costs in connection with the following:

- The Provision, erection, maintenance, and removal of all their temporary office and storage accommodation.
- Full responsibility for loss or damage to their plant, tools, equipment and other property on the site.

- Water for construction purpose will be made available by the main Contractor at one point within the site premises; further distribution will have to be taken care of by the Contractor. No claim for non-supply / inadequate supply shall be entertained.
- Power for construction purpose will have to be taken care of by the FIRE PROTECTION Contractor.
- No Contractor workers shall be entitled to stay inside the site premises.
- Contractors to make their own office on space allotted by the Project Managers.

Handing Over & Taking Over:

The plant shall be handed over after satisfactory testing along with sets of documentation each consisting of:

- Detailed equipment data in the proforma approved by the Architects / Project Manager / Employer.
- Manufacturer's maintenance and operating instructions.
- Set of As – built drawings, showing plant layouts, piping, and cable route etc. both in soft format and tracing film.
- Approved Test readings.
- Certificates of approval from statutory or Local Authorities for the operation and maintenance of the installation and equipment, wherever such approval or certification is required.
- List of recommended spares.
- Certificate from the Contractors that they have cleared the site of all debris and litter caused by them during the construction.

The equipments when erected at site shall be deemed to have been taken over by the Employer, after the Contractor gets it certified in writing from the Employer/ Project Manager/ Architects that the plant has fulfilled the contract conditions.

APPROVALS / TNGST & CST

- **All statutory approvals from various authorities shall be obtained by the Contractor. Any Statutory fees to be paid to the authorities will be borne by the Employer upon intimation from respective departments.**
  Note: Scope includes preparation, submission of Application Forms and other associated works with necessary documents and General Arrangement Diagrams to relevant Statutory Bodies(CMWSSB, etc) for obtaining approval for drawing and availing Safety Certificate, approval for Energisiation, availing service connections required as per single line diagram. Quoted Rates shall be inclusive of all Liaisoning / Incidental charges with the respective departments wherever applicable and No additional charges will be given.

इंडियन बैंक Indian Bank

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TECHNICAL M
SPECIFICATION
FOR
ELECTRICAL WORKS

Scope

This Specification covers general principles to be follow for the selection of electrical equipment and accessories and their installation, testing and commissioning. The term selection of electrical equipment means the electrical equipment and accessories as well as materials. This also covers installation procedure of electrical equipment as well as materials.

The selection of electrical equipment and their installation work as well as during testing and commissioning, safety of equipment and operating personnel, ease of operation and maintenance shall have to be give the prime considerations.

The electrical installation shall be complete in all respects and any item not included in the specifications but essential for proper installation and functioning of the electrical system shall be deemed to be included in the scope of the specification whether specifically mentioned in the Technical and General specifications or not.

All electrical equipment, installation materials and accessories shall be selected from the standardized types and ratings and shall be oriented towards maximizing inter change ability and minimizing maintenance.

In the interest of standardization, the Purchaser reserves the right of selecting particular types and makes of installation materials and accessories and the supplier shall provide materials and accessories of the particular makes if so required.

- **Standards**

The equipment and accessories covered by this specification shall be designed, manufactured and tested in accordance with Indian Standards and codes of practice published by the Indian Standards Institution wherever available, in order that specific aspects under Indian Conditions are take care of.

In case where Indian Standards are not available, then equipment and accessories shall conform to the latest publications and codes of practice by any other recognized National Standards Institutions.

All electrical equipments and installations shall conform to the latest publication of Indian Standards maintenance as listed below:

S.No.	ISI Codes	Description
(1)	(2)	(3)
01.	IS:3072-1975	Code of Practice for Installation and Maintenance of Switch gear.
02.	IS:732-1989	Code of Practice for electrical wiring Installations (Systems Voltage not exceeding 650V)
03.	IS:2274-1963	Code of Practice for Electrical wiring Installation (System Voltage exceeding 650V)
04.	IS:3043-1987	Code of Practice for Earthing
05.	IS:374	Electric ceiling type fans and regulators
06.	IS:375	Aluminum Busbar

07.	IS:694:2010	Wires
08.	IS:1293	6Amps & 16Amps Switches & Sockets
09.	IS:1951	PVC Pipes
10.	IS:2551	Specifications for Danger Plates
11.	IS:4064/1978	Air Break switches
12.	IS:5077	Light Fittings
13.	IS:5216/1982	Safety in Electrical work general
14.	IS:7752/1975 PART I	Guide for PF Improvement (L.V.)
15.	IS:8623	LV Swith Gear
16.	IS:13947 PART II	Air Circuit Breaker / Fuse Switch Units / Module case Circuit Breaker.
17.	IS:13947 PART IV	Contractor / Over load Relays

All electrical equipment and installation shall also conform to the latest Indian Electricity Rules as regard Safety, earthling and other essential provisions specified therein for installation and operation of electrical plants.

Design

Site Conditions

All equipment shall be designed for operation in tropical climate for 35 Deg. C ambient as a 24 hours average with a short time of maximum of 45 Deg. C and relative humidity of 100%. Maximum temperature and maximum humidity however are not likely to occur simultaneously. The de rating of all equipment shall be done for if specifically mentioned in the Technical Specification. The equipment to be installed outdoor subject to direct incidence of sunrays shall be designed for operation at a maximum ambient temperature of 50 Deg.C and shall be weatherproof design.

Reliability and Safety

Continuity of Power supply is the first consideration and the installation shall be such as to provide facilities to simplify inspection, testing, maintenance, cleaning and general repairs at Site.

Special care shall be taking to make the enclosed equipment proof against entry of creeping reptile, which may create electrical short circuits inside the live equipment.

All ventilating and forced-draft opening shall have suitable screen protection. When screens are, provide on top of the equipment, means shall be provide to protect them from falling objects.

Voltage Drop in Cables

The total allowable voltage drop in the power circuits from the load centers to any motor or other consumers shall not exceed 5%. The distribution of this voltage drop in different parts of the System shall depend on the layout of the installation. General the voltage drop in main feeders from the load centers to the PCCs or PDBs shall not exceed 2% and in the sub-feeders from the PCC or PDB to individual equipments or other consumers shall not exceed 3%.

MCB Distribution Board

All the MCB Distribution Boards shall be fabricated out of 16 G thick sheet steel and Shall be of the totally enclosed dust proof type suitable for wall mounting

The Board shall have welded back and sides and gasketted fully hinged front door. Detachable gland plates shall be providing at the top and bottom with suitable gaskets for cable entry. All DBs will have double door only.

The enclosure shall undergo suitable pretreatment followed powder coated.

The MCB Distribution Boards shall have the following:

Incoming MCB of required rating is in an independent compartment with door interlock. The incoming terminals shall be fully shrouded.

Three phase segregated compartments, each housing MCB's connected to one phase of the power supply system. Each of the sections shall have a DP ELMCB on the incoming and SP MCB's for Lighting/Computer/power on outgoing.

In each section, a separate neutral bus and independent earth bus shall be provided.

The MCB's shall be of current limiting type.

All cable entries shall be from the bottom or top.

The busbar shall be of Copper having continuous current ratings equal to that of the incoming switch. The busbars shall be designed to withstand a fault level of not less than 31 MVA for one second.

The MCB's shall have a lockable switching lever.

The minimum electrical endurance shall be 20,000 operations.

The housing of the MCB shall be mounted self-extinguishing thermo set plastic Material.

The short circuit current shall be brought to zero within 4 to 5 milli seconds from the time they are established.

All MCBs shall have a minimum short circuit capacity of 10 KA RMS.

Un drilled gland plates shall be provided both at the top and bottom.

The degree of protection shall confirm to IP 50.

LT Cables - Lying of Cables

Method of Laying Cables

All cables lay indoor and outdoor but exposed shall be enclose in MS conduits.

Extra length of cables shall be providing wherever possible for any future contingency to the extent of 10% of the length of any section.

The cables laid fully buried in ground or partly in trench and partly in ground shall be armoured type. Cables are laid fully in rack/tray/hook or laid in GI pipes/Hume pipes, shall be also armoured type.

The installation work shall be carried out in a neat worker like manner by skilled, experienced and competent workers particularly with experience in jointing termination of aluminum / copper conductor cables.

Cables runs shall be uniformly spaced properly supported and protected in an approved manner. All bends in runs shall be well-defined and made with due consideration to avoid sharp bending and linking of the cable. The minimum bending radius of cables shall not be less than twelve times the overall diameter.

Cable installation shall be property co-coordinated at site with the routing of other services, utilities and the cable routings with a view to avoid interference with any part of the building, structure, equipment, utilities and services.

Entry of cables directly burried in ground or from underground trenches, to the buildings shall be through PVC pipe sleeves. Necessary precautions shall be taking to make entry point watertight by properly sealing the pipe sleeves with epoxy resin (rubberized compound).

All cables shall be providing with identification tags indicating the cable numbers in accordance with the cable/circuit schedule. Tags shall be fixing at both the ends of cable at joints and at 20 m. spacing for straight runs. When a cable passes through a wall, tags shall be of durable fiber of aluminum sheet with the numbers punched on them, and securely attached to the cables with non-corrosive wire. For single core cables, wire shall be non-ferrous material.

All cables shall be test for proper insulation prior to laying. The cable drums shall be transport on wheels to the place of work. The cables shall be laid out in proper direction as indicated on the drum using cable drunk stands. In case of higher size cables, the laid out cables shall run over rollers placed at close intervals and finally transferred carefully on to the trenches and racks. Care shall be taking so that links and twists or any mechanical damage does not occur in cables. Only approved cable pulling grips or other devices shall be use.

Adequate length of cables shall be pull inside the switchboards, control panels, terminal boxes etc. to permit neat termination of each core/conductor. Control cables cores entering switchboard or control panels shall be neatly bunch and strapped with PVC perforated tapes and suitable supported to keep it in position at the terminal block. All spare cores shall be neatly dressed and suitably taped at both ends.

Power cable terminations shall be carried out in such a manner to avoid strain on the terminals by providing suitable clamp near the terminals.

All power cable terminations shall be by means of crimping type cable lugs. Control cables shall be terminated by crimping or directly clamped in the terminal blocks by screws

No jointing shall normally be made at any intermediate point in through runs of cables unless the length of the run is more than the length of the standard drum supplied by cable manufacturers. In such cases when jointing is unavoidable, the same shall be made by means of standard cable jointing boxes/kits.

All cables entry openings in the equipment shall be sealed and made proof against entry of creeping reptiles.

II. Laying of Cables on Racks / Trays / Brackets / Hooks

All power cables in trenches and on structures shall be laid on racks and shall be clamped by means of single or multiple galvanized MS saddles. The saddles shall be placed at an interval of 1000 mm. in both horizontal and vertical straight runs, at each bend and turnings from horizontal

to vertical direction and vice versa. All 1100 V grade power cables shall be laid touching each other.
Multi-core control cables shall be laid touching each other on trays and wherever required may be taken in two layers.

Ladder type cable racks shall be selected from two sizes viz. 300 mm. and 600 mm. Ladder type trays shall be galvanized after fabrication.

Vertical spacing between cable racks/trays shall be 250 mm.

Power cables of different voltage grades shall be laid in separate racks / brackets / hooks. Control cables as well as signal and communication cables shall be laid in a separate trays. However, in cases where smaller size power cables (below 16 sq.mm) of fewer numbers cables provided suitable vertical barriers are installed between them. As far as possible AC and DC Power cables shall be laid in separate trays.

Order of laying of various cables in racks/trays brackets/hooks shall be such that control cables are located at the bottom-most tier and 1100 V grade cables at top tier. In case of duplicate feeders of same consumer, these shall be laid in two separate racks/brackets.

Where there is possibility of mechanical damage, cable rack / trays shall be adequate protected by sheet steel covers.

For future installation of cables, provision shall be made to keep 20% space as spare on each tray/rack/bracket.

Cable Terminations and Jointing

Termination and jointing of aluminium conductor power cables shall be by means of compression method using compression type of aluminium lugs. Copper conductor control cables shall be terminated directly into screwed type terminals provided in the equipment. Wherever control cables are to be terminated by means of terminal lugs, the same shall be tinned copper compression type.

Wiring

III. Internal Wiring (Open Fashion) for Small Power / Light Point

All wiring shall be carried out only with PVC conduits.

All light, fan sockets and any other equipment must be earthed.

Wiring shall be carried out with 650 V grade PVC FRLS insulated single core multi stranded copper conductor wires as per IS : 694.

The method of wiring shall be as recommended in IS : 732 and its several parts.

The physical and electrical continuity of the conduit system shall be maintained throughout.

No wire shall be left exposed at any location, metallic flexible pipe shall be used to cover the same.

Colour coding of wire shall be carried out as detailed below:

PHASES	RED
	YELLOW
	BLUE
NEUTRAL	BLACK
EARTH	GREEN

The minimum diameter of the conduits shall be 25mm. only.

The following sizes of PVC insulated FRLS multi stranded copper conductor wires shall generally be followed throughout:

a. From the final switch to individual outlets — 1.5 sq.mm

b. From Distribution Boards to First Switch Board and subsequent switchboards — 2.5 sq.mm

c. All 16Amps socket — 4.0 Sq.mm.

d. All 20Amps Socket — 4.0 Sq.mm

e. Earth wire throughout for Lighting (Green) — 1.5 Sq.mm.

f. Earth wire throughout for Power (Green) — 4.0 Sq.mm.

f. Adequate protection for other larger size feeders have been provided.

Bunching of Wires

Wires carrying current shall be so bunched that the outgoing and return wires are drawn into the same conduit. Wires originating from two different phases shall not run in the same conduit.

Strands of wires shall not be cut for connecting terminals. The terminals shall have sufficient cross sectional area to take all strands and shall be soldered. At all bolted terminals, brass flat washer of large area and approved steel shall be used. Brass bolts and nuts shall be used for all connections.

Only certified wiremen and cable jointers shall be employed to do jointing work. All wires and cables shall bear the manufacturer's label and shall be brought to site in original packing. For all internal wiring, PVC Insulated wires of 650Volts grade shall be carried out in loop system and no joints shall be allowed in the length of the conductors. If the use of joints/connections are unavoidable due to any reason prior permission, in writing shall be obtained from the Engineer. No wire shall be drawn into any conduit, until all work of any nature, that may cause injury to wire is completed. Care shall be taken in pulling the wires into the conduits. The conduits shall be thoroughly cleaned of moisture, dust, dirt or any obstruction by forcing compressed air through the conduits. The minimum size of PVC FRLS Insulated copper conductor wires for all sub-circuit wiring for light points shall be 1.5 Sq.mm.

All inspection boxes shall have a minimum depth of 65 mm. and shall be of circular nature (Dia 50 mm.) They shall have a cover securely fixed through screws and shall be fixed flush with the wall.

Mains and Sub-Mains Wiring

Mains and sub-mains cable or wires called for shall be of rated capacity and Approved make. Every main and sub-main wires shall be drawn into an Independent adequate size conduit. An independent earth wire of the proper Rating shall be provided for every single phase sub-main. For every 3 phase sub-Main, 2 Nos. earth wires of proper rating shall be provided along with the sub-Main. Where mains and sub-mains cables are connected to switch gear, sufficient extra length of cable shall be provided to facilitate easy continuous and Maintenance.

Load Balancing

Balancing of circuits in three phases installation shall be planned before the commencement of wiring and shall be adhered to.

Conduits must be placed inside conduit sleeves at all expansion joint crossings.

Conduit sleeves shall be provided at all beams to take point wiring conduit, so as to avoid the bend.

Circuit Wiring

Circuit wiring shall mean the length of wiring from the Distribution Board upto the tapping point for nearest first point of that circuit - viz upto the nearest first switch board measured along the run of wiring. Such wiring shall not be measured on linear basis. The cost of Circuit mains shall be included in the point wiring rate itself.

Sub-main wiring shall mean the length of wiring from one main / distribution switchgear to another main/distribution switchgear measured along the run of wiring. Such wiring shall be measured on linear basis.

Lights, 6A sockets, Ceiling fans and Exhaust fans may be wired on a common circuit. Such circuit shall have 10 points of light, ceiling and exhaust fan and socket outlets or a load of 800 watts, whichever is less. A switch board might have more than two circuits but should be of same phases.

The smallest copper conductor to be used for lighting circuits shall be 2.5 Sq.mm. and for power circuits 4 Sq.mm. Wiring shall be done in the "looping system" and neutral conductor can be looped from the ceiling fan and exhaust fan or socket outlet. Neutral conductor and earth continuity wire shall be brought to each switchboard situated in rooms and halls. These shall be terminated inside the switchboards with adequate size to accommodate one number 6Amps socket outlet and control switch in future.

Conduit Wiring

In this system of wiring, no bare or twist joints shall be made. In through run of cables, if the length of final circuits / sub main is more than the length of the standard coil, joints shall be made by means of approved mechanical connector in suitable and approved junction boxes.

The chases in the wall shall be neatly made and ample dimensions to permit the conduit to the fixed in the manner desired. In case of buildings under constructions, conduits shall be buried in the wall before plastering. These shall be grouted and covered with cement and mortar, neatly finished at the plate of the un plastered brick work and scratched for providing key to the plaster and cured. Under no circumstances finished plastered surfaces shall be allowed to be chased for the conduit work. Before taking up chasing of the wall, the routes shall be marked and got

approved by the Engineer. The horizontal chases shall be avoided as far as possible. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

All conduits after erection shall be tested for electrical continuity.

Fixing of standard bends or elbows shall be avoided as far as practical and all curves maintained by bending the conduit itself with a long radius which will permit easy drawing conductors. All thread joints of conduit shall be treated with some approved "preservation compound" to secure against rust.

Pipe runs between outlet and outlet or between outlet and equipment shall not contain more than two 90 Deg bends (180 Deg total) including those bends located immediately at the outlet or fittings. Straight run of cables in pipes shall be limited by provision of approved type of pull boxes once every 15 mts.

Insulated type end bushings shall be used where conductors enter or leave pipes.

To facilitate pulling of cables in pipes, powdered soft, stone, plastic soap or other dry inert lubricant may be used but grease or other material harmful to the cable sheathes shall not be used.

Ends of MS Pipe shall be cut square and the threads cut in the field shall have the same effective length and the same dimensions and taper as specified for factory cut threads. Ends of pipe shall be reamed to remove burrs and sharp edge after threads are cut.

All joints shall be made tight with a minimum of 5 boxes, panels, cabinet etc. by means of one lock-nut outside and one inside and shall be provided with bushing of approved insulating materials unless the pipe is directly screwed into a thread hub in the box.

In damp locations the entire pipe system, including all boxes and fittings used, shall be made water-tight and the pipe shall be so mounted on spacers so as to leave minimum of about 6mm. gap between the MS pipe and the surface over which it passes.

A minimum separation of 700mm. shall be maintained between hot pipe lines and electrical pipelines. Also where required, electrical pipe shall be properly shielded from direct heat.

The termination of MS Pipe in rotating machines subject to vibration as well as connections to equipment required to be disconnected at periodic intervals shall be made by means of flexible pipes. Flexible metallic pipes shall also be use for termination of connection to limit switches, level switches, pressure switches etc. The equipment where the direct termination of rigid pipe is inconvenient, the termination can be done by means of flexible pipe. The use of flexible pipe in outdoor location shall be avoided as far as practicable.

Flexible pipes shall be of liquid tight galvanized heavy duty interlocked type generally conform to IS : 3480-1966 with PVC Jacket extruded over the pipe. The adapter for coupling rigid MS Pipe to flexible conduit and termination to equipment shall be of either cast aluminium or galvanized sheet steel.

Suitable junction/inspection boxes according to requirements shall be provide to permit periodical inspection and to facilitate replacement of wires. However, such boxes shall be located and arranged so that they are not in-irregular postures. These locations shall also be specifically shown in the conduit layout of the shop drawings and approval shall be obtained before installation.

However, such installation and the number of such boxes shall be minimizing. The boxes shall be mounting flush with the wall or ceiling. Minimum 65mm. depth junction boxes shall be used in roof slabs and depth of boxes in other places shall be as per IS : 2667-1977. All outlets such as switches wall, sockets etc. shall be flush mounting type.

Conduit Capacity

Maximum number of PVC FRLS insulated cable conforming to IS:694 that can be drawn in one conduct shall be as follows:-

Nominal cross section area of conductor in Sq.mm.	Size of conduit									
	25mm		32mm		38mm		51mm		64mm	
	S	B	S	B	S	B	S	B	S	B
1.50	10	8	18	12	-	-	-	-	-	-
2.50	8	6	12	10	-	-	-	-	-	-
4	6	5	10	8	-	-	-	-	-	-
6	5	4	8	7	-	-	-	-	-	-
10	4	3	6	5	8	6	10	7	12	8
16	2	2	3	3	6	5	8	6	9	7
25	-	-	3	2	5	3	6	5	8	6
35	-	-	-	-	3	2	5	3	6	5
50	-	-	-	-	-	-	4	3	5	4
70	-	-	-	-	-	-	-	-	-	-

The columns headed S applies to run of conduit which have distance not exceeding 4.25mm between draw in boxes and which do not deflect from the Straight by an angle or more than 15 degrees. The columns headed `B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

Switches and Accessories

All switches shall be placed in the live conductor of the circuit and no single pole of fuse shall be inserted in the earthed neutral conductor of the circuit.

Single pole switches (other than for multiple control) carrying not more than 16Amps may be of the piano key type / moulded plat type and the switch shall be `ON' when the knob is down.

The switch box shall be made of metal on all sides, except on the front. In the cases of cast iron boxes wall thickness shall be at least 3mm. and in case of welded mild steel sheet boxes the wall thickness shall not less than 18 gauge for boxes upto a size 20 cms x 30 cm. above this size 16 gauge MS boxes shall be used. Except where otherwise stated 3mm. thick phenolic laminated sheets shall be fixed on the front with aluminium alloy/brass/cadmium plated iron screws as approved by Site Engineer. Clear depth of the box shall be minimum 60mm.

To facilitate drawing of wires in the conduit, GI Fish wire of 16 SWG shall be provided while laying recessed conduit.

Point wiring shall include all works necessary to complete wiring of a switch circuit of any length from the tapping point on the distribution circuit to the following (via the switch).

- Ceiling rose or contractor (in the case of ceiling / exhaust fan points)
- Back plate (in case of fluorescent fitting with down rods etc).
- Socket outlet (in the case of socket outlet points)
- Lamp holder (in case of wall brackets, bulkhead and similar fittings).
- All civil works like chippiding, making good the damages, drilling holes in walls etc., are to be done by the contractor only.
- The following shall be deeming to be including in the point wiring:-
- Switch
- Ceiling rose or connector as required
- Any special or suitable round block for neatly housing the connector and covering the fan hook in case of fan point.
- Bushed conduit, MS Sleeves where cables or pipes passes through wall etc.
- Earth wire from three-pin socket outlet point/fan regulator to common earth including earth dolly.
- All wood or metal blocks, boards and boxes sunk of surface type, including those required for mounting fan regulator but excluding those under the main distribution switchgear.
- All fixing accessories such as clips, rails screws, raw plugs, wooden plugs etc. as required.
- Connections to ceiling rose, connector socket outlet, lamp holder, switch and fan regulator etc.
- Looping the same switchboard interconnections between points on the same circuit.
- Providing fish wire in conduits while recessed circuiting work is undertaken.

Length per Point

The term "Length per point" in point wiring in the case of the fan and light points shall mean the distance between the switch and ceiling rose, connector or back plate, lamp holder depending upon the fitting, measured along the run of wiring irrespective of the number of wires in the run.

In the case of socket outlet points, the length shall mean the distance between the socket outlet and the tapping point of live wire on the nearest switchboard.

Measurement of Point Wiring

Points because of length per point inclusive of circuit mains shall be classifies Under:

a) Average point : Length per point not exceeding 10Mtrs.

b) Special point for Light, Fan and 5A socket outlet points : Length per point exceeding 10Mtrs

The rate for average point shall be on a per point basis.

For special points, the extra length of wiring over and above the length of Meters specified shall be measured and paid for. Rate for the same shall be given in the offer separately.

In case of points with more than on light point controlled by the same switch, they shall be measured on a set basis (i.e.) Two lights controlled by one switch shall be considered a set and so on. The distance between the first point and subsequent point shall not be more than 5mts. In

case of more than two lights controlled by one switch only the average distance between light points shall be considered.

Additional Consideration for Internal Wiring

The minimum size of pipe shall be 25mm. dia only. The wall thickness shall 2mm. only. The chases in the wall shall be neatly made and in ample dimensions to permit the conduit to be fixed in the manner desired. In case of buildings under construction, conduits shall be burried in the wall before plastering. These shall be grouted and covered with cement and mortar, neatly finished at the plane of the unplastered brick work and scratched for providing key to the plaster and
cured. Under no circumstances finished plastered surfaces shall be allowed to be chased for the conduit work. Before taking up chasing of the wall the routes shall be marked and got approved by Engineer. In case of exposed brick/rubble masonry work, special care shall be taken to fix the conduit and accessories in position along with the building work.

Earthing

Selection and Installation of System and Equipment Earthing

The method adopted for system as well as equipment earthing shall be in accordance with the code of practice for earthing IS:3043-1987 and shall also comply with the relevant clauses of Indian Electricity Rules.

For Plant building and Switch/Control room one main earthing ring shall be provided along the plant/building periphery connected to required number of earth electrodes. The earthing ring shall be taken 1500mm away from building column/wall and shall be laid directly buried in ground. Main earthing ring shall be further cross-connected and a mesh formed depending layout and location of the equipment. The cross-connections shall generally run in cable trenches, or embedded in concrete floor based on the layout. For buildings having a number of floors, separate earthing rings shall be established in each floor.

All non-current carrying metallic parts of various electrical equipment as well as cable armouring metallic conduit/GI pipe system, cable racks/trays brackets, supporting structures etc. shall be effectively earthed. Earthing of medium and high voltage equipment shall be done by means of two separate earth conductors connected either directly to earth electrodes or to an earthing ring irrespective of use of armoured cable or metallic conduit/GI pipe.

Building/technological steel structures, metallic utility pipes shall not be used as earth continuity conductor.

All earthing system shall be so designed as to ensure effective operation of protective gears in case of earth faults. The total earth resistance at any point of the earthing system for substations and main plan buildings shall not be more than one ohm. However, at other points the value shall not exceed 5 ohms.

The earth resistivity values of soil will vary in different areas of the site. For all substations and main plant buildings, number of electrodes to be provided for the earthing system shall be decided after actual measurement of soil earth resistivity at that location. However, after complete installation actual earth resistance shall be measured in all cases and, if required, additional electrodes shall be provided to achieve the values indicated above. No earth ring shall have less than two earth electrodes.

Earth copper plate shall comprise 600mm x 600mm x 6mm Copper plate at a depth of 3000mm in an earth pit chamber of 600 x 600 x 250mm .

Generally, main earthing rings and earthing leads shall be directly buried in ground. Additional earthing rings wherever provided inside plant buildings/substations and earth continuity conductors shall be taken either exposed on cable racks/trays, structures, walls, ceiling etc. or embedded in concrete depending on installation. Earth conductor directly buried be taken at a depth of 600mm. and shall be provided with one coat of bituminised paint, at all welded joints to prevent corrosion. Earthing ring wherever embedded in concrete shall be laid parallel to the column rows of buildings. Earth continuity conductor embedded in concrete shall generally follow the shortest route and wherever possible shall be taken along pipes embedded for laying of cables. Earth conductors laid on cable racks, trays etc. shall be placed in accessible location keeping adequate clearance to facilitate easy connections. Earth conductors laid along plant/equipment structure, wall, ceiling etc. shall maintain symetry with other installations and shall be uniformly spaced with cables/utility pipes running along the same route. Galvanised MS Saddles shall be used for clamping earth conductors on structures, wall ceiling etc. Flats shall be supported at intervals of 500mm. Welding shall be done wherever earth flats are to be run through rack/cable tray.

As far as possible all earth terminations and connections shall be visible for inspection. Each earthing system shall be so designed that testing of individual earth electrode is easily possible. For earth bus embedded in floor slabs, stub-ups shall be provided at convenient locations near the equipment as well as building columns for connecting earth continuity wires leading to the equipment and structures.

Alternate columns of structural buildings shall be connected to earthing ring.

Where the power to the equipment is fed flexible training cables, the same shall contain one separate earth continuity conductor having the same cross section as that of the current carrying conductor. Earth connections to equipment subjected to movement, vibrations and shocks shall be made by stranded wire having enough loop.

Connection of earthing leads to earth electrodes and terminations of flat earth continuity conductors to equipment shall be made by means of bolting. Connection of stranded earth wire to earth bus as well as to equipment shall be made through crimping type lugs and bolting. Jointing and tapping of flat earth conductor shall be done by means of welding. Termination of earthing flats to building structures, shall be done by means of welding. Termination of earthing flats to building structures, shall be done by means of welding.

Cable screens and armours shall be bonded to earthing system in accordance with IS:1255. Also, metal pipes and conduit system carrying cables shall be bonded and effectively earthed.

Earth conductors shall be kept electrically separated from the metal work of surface pipes which are carrying gases or inflammable liquids.

In explosive and hazardous locations like gas pipelines, fuel oil tanks etc. provisions shall be made for protection against static discharge by suitably connecting the equipment to an earthing system, which is segregated from the Hospital earthing system.

Conductor size adopted for earthing ring shall in no case be less than that of the earth continuity conductors connected to it. The size of earthing leads connected to earth electrodes shall not be less than that of the earthing main.

Conductors used for earthing shall be in no case have cross sectional area less than 4 sq.mm. Stranded GI wire.

All 3-phase equipments shall have duplex earthing. Whereas single-phase equipments shall have only one run.

The minimum size of galvanized GI flat/wire for earthing of various equipment shall be as follows unless otherwise specified-

- Power control centers auxiliary power distribution boards, etc. - 50 x 6 mm
- Sub Power Control Centers – 25 x 6 mm
- Power / Lighting Distribution Boards – 4.0Sq.mm PVC Insulated copper wire

Clearance and Safety

For every electrical switchboard, control panel, power control centers etc., that Require back access the space behind the equipment shall generally be 50mm. This space shall also be adequate to permit at least a 90 Deg. opening of doors or Hinged panels. In such cases where back clearances are provided, there shall be a Passage-way from either end of the equipment clear to a height of 1800mm. Where the equipment are not required to be attended from the back, if Equipment shall be placed along the wall / structure having clearances less than 200mm.

For all switch boards, control panels, power control centers, a clear space of Not less than 1200 mm. shall be providing in front of the equipment. In case, Where the equipment is, provide with draw out unit, a minimum clearance of 2,000mm shall be providing.

For all electrical equipment, minimum clearance headroom of 500mm shall be providing.

All motors located away from the feeding and control panels and for which control desk of posts are not within visible location, shall be provided with readily accessible and easily operated, locally mounted lockable type `stop' pushbuttons in the control circuits.

All electrical equipment operating on 415 V or higher voltage shall be provide with caution notice boards of approved type and shall be affix permanently in a conspicuous position. Where a group of equipment is located within a switch / control room or within a fenced area, the notice board shall be fixed at the entrance.

All moving parts of the equipment that are exposed and liable to cause hazard to the operating and maintenance personnel shall be suitably protected by metallic guards.

In front of the entire switch board rubber mats shall be provide for personnel safety.

Open type control panel or open type busbars shall not be install inside the plant building.

In accordance with the requirement of the Indian Electricity Rules, the following shall be providing

- Danger Boards and shock treatment charts in two languages viz. English and Tamil.
- 750mm wide, tested rubber mats of thickness not less than 19mm shall be provide in front of all switchboards and control panels in accordance with IS 15652:2006 IEC 61111:2009

Tests and Equipments / Installation

GENERAL

The Purchaser / Engineer shall have the right to Inspect / Witness on the equipment or any part there of at various stages of fabrication. Manufacture, sub-assembly, assembly and testing, erection and commissioning. Inspection / test shall be carried out at the supplier's works / his sub – contractor's works and at site as specified.

Inspection of equipment by the Purchaser / Engineer shall be only with a view to ensure that the equipment is fabricated / manufactured, assembled, tested, supplied and commissioned as per approved drawings and prescribed specifications.

Inspection by the Purchaser / his representative shall in no way relieve the supplier of his responsibilities as per the contract and shall be in no way binding on the purchaser / engineer.

Immediately after order placement, the Purchaser / Engineer shall in consultation with the supplier draw up a detailed inspection schedule to fix up the procedure and timing of inspection of various materials components, sub-assemblies, assemblies testing etc.

The supplier shall not despatch any materials from his works until they have been inspected and accepted by the Purchaser / Engineer by issuing a provisional acceptance certificate.

The supplier shall intimate the Purchaser / Engineer at least 2 weeks in advance before any material is ready for inspection /tests. The supplier shall list out all such material / items with their respective weights.

The supplier at his own expense provide free and safe access and all necessary facilities, equipment etc., to facilitate inspection by the Purchaser / Engineer.

Immediately after approval of drawings / documents, the supplier shall give 4 sets of all such drawings / documents to the Purchaser to enable the Purchaser / Engineer to carry out inspection of the equipment.

Purchaser / Engineer may reject the whole or any part of the equipment at any time if after inspection / testing. Purchaser / Engineer at their sole discretion determine the equipment or any part there of to be unsatisfactory or does not fulfil the terms of the contract, Purchaser's / Engineer's decision regarding rejection shall be final and binding on the supplier.

Routine and type test certificates shall be submitted for approval on completion of the tests. Number of copies required for approval and procedure of submission shall be intimated to the supplier.

On successful completion of erection / installation, each item / equipment will be thoroughly inspected by the Purchaser / Engineer for correctness and completeness of installation.

The Site tests, pre commissioning tests and commissioning tests shall be carried out in the presence of the Contractor and the Purchaser / Engineer.

The Contractor shall provide Purchaser/ Engineer with complete test report in a form approved by the Engineer / Purchaser.

Test results obtained at site shall be compared with factory test results to ensure the condition of the equipment.

TESTING

Manufacture's test certificates shall be furnished by the supplier for all bought out materials, components etc.

Wherever such test certificates are not available, the item shall be got tested by the supplier at his own expense at the government recognized laboratories mutually agreed upon.

The main equipment and components shall be carefully examined to determine their conformance with this specification with respect to material and workmanship, finish marking, dimensions, arrangement, and to assess its conformance with other requirements stated or reasonably implied and not covered by specific tests.

Complete tests shall be made in factory by the contractor to ensure that the performance and operating characteristics of the equipment are satisfactory and to determine whether or not guarantee have been met.

At the conclusion of all test procedure the equipment shall be examined for signs of wear, cracks, distortion or incipient damage of any sort and any defects shall be corrected before the equipment is shipped / commissioned.

In the event of failure of the product or any part thereof to fully meet any inspection or test requirement specified, the Contractor shall notify the Purchaser / Engineer, if he wishes to repair and / or use such product or part.

The tests to be carried at Works / Site for various items shall be as indicated against each item.

Factory inspection shall be carried for power panel of 415V supply and HT Panel

POWER DISTRIBUTION BOARDS / LIGHTING DISTRIBUTION BOARDS

Routine tests as per applicable standards shall be carried out at Contractors' works. The minimum tests at works and at site shall be as follows:-

A. AT WORKS

a) Power frequency high voltage withstand test.

b) Insulation Resistance Test.

c) Dimensional tests

d) Operational Tests

e) Tests to prove interchangeability of similar parts

B. AT SITE

a) Power frequency high voltage withstand test.

b) Insulation Resistance Test.

c) Operational Tests

d) Tests to prove interchangeability of similar parts.

TESTING AND COMMISSIONING OF POWER DISTRIBUTION EQUIPMENTS.

In addition to the checks and tests specified earlier or later the following shall be applicable for all Power Distribution equipments.

After installation but before any power supply in connected, the contractor shall make a complete mechanical and electrical check of the system. These shall include, but not restricted to the following:-

MECHANICAL CHECKS

Visually inspect all equipment / items for defects if any, and check equipment numbers against approved drawings to ensure that equipment has been correctly located and proper installation is done.

Check, name plate details and wiring diagrams indicated on the equipments viz switch boards, disconnecting switches load break switches, PDBs, etc., for conformity with the data given in approved drawings.

Check that all moving parts, drive motors, linkages in the disconnecting switches, breakers are properly lubricated by approved / recommend type of lubricant.

Check for mounting of all separately supplied accessories against approved GA Drawings for equipment viz. Breaker, disconnecting switch, busduct, Rising Main etc.

ELECTRICAL CHECKS

VISUAL / MECHANICAL

a) Check for the phase sequence from Transformer, LT Busduct and LT Switch Board.

b) Check for proper bus joint and connections for tightness

c) Check all power cable connection for tightness and proper support.

d) Check drive motors turn freely by hand.

e) Check padlocking of all operating cabinets.

f) Check proper gasketing of outdoor, installed equipment, operating cabinets etc. Busduct end terminations, inspection openings, joints between standard erections, Switchboards, PDBs, DBs.

VISUAL / ELECTRICAL

a) Check all plug in contacts for alignment and grip for HT and LT Breakers.
b) Clean moving and fixed contacts of LT Breakers, Contactors, and Switch Fuse Unit with CRC 2 – 26.
c) Check the rating of Power and Control Fuse against approved drawings. Fuses shall be undamaged and fit for service.

d) Check for voltage rating of auxiliary equipment viz. Closing and tripping coils of breakers, auxiliary supply of all protection and auxiliary relays, spring charging / power drive motors against approved drawings.
e) Insulation resistance tests as IS 2259 1963

TESTS FOR INTERNAL WIRING

AT SITE

Insulation Resistance Tests at

a) Individual circuits
b) Individual MCB and FUSE DISTRIBUTION BOARDS
c) Each Panel Boards, Sub – Panel Boards
d) Main Incoming ACBs

NOTE:

All tests shall be carried out with final appliances / equipments connected and disconnected and with 1000 V Megger.

Conditions of Contract

The quoted rates shall be inclusive of all Liaisoning / Incidental charges with the respective departments wherever applicable and No additional charges will be given. Scope includes preparation, submission of Application Forms and other associated works with necessary documents and working drawings to CEIG / CEA / TANGEDCO / TNERC / MNRE & TEDA for obtaining approval for drawing and getting Safety Certificate, approval for Energisiation, availing service connections as per Single Line Diagram

The existing walls shall be cut to conceal the conduits.

After installation of concealed conduits, repair patchwork and repainting of all damaged surfaces to mach existing finish shall be carried out

Repainting of all walls and ceilings to restore finish surfaces, where the electrical work has occurred shall be done.

The complete ratings of each equipment, the main service panel, branch circuit panels, quantity and sizes of conductors shall be included in the relevant as built drawings.

Separate as built lighting and power layouts shall be provided.

Floor plans shall be drawn in 1: 100 scale and the details of main electrical room etc. shall be provided 1: 50 scale.

All metallic housings, panel boards, junction boxes, pull boxes, receptacles, Lighting outlets, switches, metal conduits and other non – current carrying Metallic bodies shall be bonded with equipment grounding conductors.

It shall be ensured that the ground resistance is less than 05 Ohms.

After installation, the ground resistance of the installed grounding shall be tested and ensured that it is 05 Ohm or less.

All neutral conductors are isolated from the ground down stream from the Main Service Panel

It shall be ensured no other conductor shall have white or grey and green Color insulation other than the neutral and ground respectively as indicated above.

It shall be ensured that the installation contractor obtains the necessary construction permits from the city or local authorities as required

All drawings, specifications, Bill of Materials, Bill of Quantities, cost estimate and other information shall be provided only in English Language which is only acceptable.

All Manufacturer / Type and ratings of main distribution panels are included in the one line diagram

TECHNICAL SPECIFICATIONS FOR ON GRID SOLAR PANEL SYSTEM

Solar PV Modules

The cell of the modules shall be polycrystalline. The capacity shall be considered as **320 Wp** per module. The PV modules shall qualify IEC-61215 or IS-14286 and IEC-61730. The proposed PV modules have test certificates issued from accredited test laboratories of MNRE (Ministry of new and renewable energy). Test certificates issued by IEC accredited laboratories are also acceptable. The proposed PV modules shall be manufactured in India.

Each PV module used in this project must use an RF (Radio frequency) identification tag. The information must be mentioned in the RFID tag used in each module as per guide lines of MNRE which must be inside the laminate and able to withstand harsh environment condition.

If higher capacity Solar Power Panel (> 320Wp) is used, the quantity of solar panels should be such that the total power output (10 kWp, 15 kWp, 20 kWp & 30 kWp) is maintained.

Technical specification of the PV Module shall include but not limited to the following:

Sl. No	Item	Description
1.0	Certification	i) IEC 61215 or IS 14286 ii) IEC 61730
1.1	Test certificate issuing authority.	NABL/ IEC Accredited Testing Laboratories or MNRE accredited test centers (preferably the latest).
2.0	PV Cell	
2.1	Type	poly crystalline
2.2	Size	156mm x 156mm
3.0	PV Module	
3.1	Rating at STC	320Wp, 72 cells (without any negative tolerance)
3.2	Efficiency	Minimum 16%
3.3	Fill factor	Minimum 70%
3.4	Withstanding voltage	1000V DC
3.5	Glass	Toughened
3.5.1	Thickness	3.2 mm (minimum)

3.5.2	Type	High transmission, low iron, tampered & textured
3.6	PV Module Junction Box	
3.6.1	Protection level	IP 65 or above
3.7	Bypass Diode	
3.7.1	System Voltage (Vsys)	1000 V dc
3.7.2	Number	3 numbers
3.8	Module Frame	
3.8.1	Type	Anodized aluminum frame

3.0 PV Array

Specification of the PV Array shall include but not limited to the following:

Sl. No	Item	Description
1.0	Nominal Capacity	10kWp, 15 kWp, 20 kWp & 30 kWp.
2.0	PV Module interconnection connector	MC-4
3.0	PV Module interconnection cable and array cable	PV 1-F standard / NEC standard "USE-2 or RHW-2" type (double insulated)
4.0	PV array String Voltage	Compatible with the MPPT Channel of the inverter
5.0	Number of Parallel String against	02 Nos (Maximum)

4.0 Array Structure

i) PV Array shall be installed at the Roof top of the Indian Bank, Branches / buildings at the respective Locations given in the tender.

ii) PV Array structures shall be of GI with combination of either of I, C, L or T sections MS flat as per structure design requirement. The structure should be capable of withstanding a wind load of 180 km/hr after installation (Structural design document to be submitted by the contractor)

iii) Weight of the Metallic part of PV Array structure excluding nuts and bolt must be minimum same as the Weight of the total PV Module.

iv) Structural shall be corrosion resistant and electrolyticaly compatible with the materials used in the module frame, its fasteners, nuts and bolts.

v) The array structure shall be made of hot dip galvanized MS structure of minimum galvanizing thickness 120 micron (Test certificate to be submitted by the contractor from standard testing laboratory to prove the thickness of galvanization)

vi) Structures shall be supplied complete with all members to be compatible for allowing easy installation.

vii) The module mounting structure shall have to be designed and fabricated with optimum tilting angle considering the site conditions.

viii) The s structure shall be designed for simple mechanical a n d electrical installation. It shall support Solar Photo Voltaic modules at a given orientation, absorb and transfer the mechanical loads to the ground.

ix) All fasteners for supporting conduits, nut & bolts shall be made with stainless steel of grade SS314 except foundation bolts and the nuts and bolts to be used for connection of earth strip with module mounting structure which will be of MS (GI Coated).

x) Supporting structures including module Mounting structure shall have to be adequately protected against all climatic condition. The array structure shall support SPV modules at a given orientation and absorb and transfer the mechanical loads to the columns properly.

xi) The structures shall be designed for simple mechanical and electrical installation. There shall be no requirement of welding or complex machinery at the installation site. Required civil work or support platform is absolutely essential to install the structures, detailed engineering drawings and instructions for civil and other works shall got approved from the competent authority before carried out at the site.

xii) The Specification of the GI sections, flats must be as per IS 808

xiii) The supplier shall specify installation details of the PV modules and the support structures with appropriate diagrams and drawings.

5.0 PV Array Junction Box (AJB)

Array Junction Box (AJB) shall have to be used for termination of string prior connecting array with each inverter. The desired specification of the PV Array Junction Box and accessories shall include but not limited to the following:

Sl No	Item Description	Desired Data
1.0	Enclosure	
1.1	Degree of Protection	IP65 with UV Protected
1.2	Material	Polycarbonate.
1.3	Withstanding voltage	1000V DC
1.4	Withstanding Temperature	100 ^{0}C
1.5	Accessories mounting arrangement	DIN Rail
1.6	Number of Strings entry	As may be required
2.0	Cable Entry and Exit	
2.1	Position	Bottom at cable entry and exit
2.2	Cable Entry and Exit connector type	MC 4 Connector (PV Array String cable)
2.3	Cable gland	Earthing cable entry
3.0	Surge Protecting Device (SPD)	
3.1	Type	DC
3.2	Approved Make	ABB / OBO bettrman / Legrand
3.3	Protection class	Type B+C
3.4	Number of set	As may be required as per string Design
3.5	System Voltage	Matched with System Voltage 1000 V DC
4.0	Fuse with fuse holder	
4.1	Position	Positive and negative terminal for each series string
4.2	Type	Glass fuse, for PV Use only

4.3	Rating	Current: Minimum **1.25** times the rated short circuit current of the string Voltage: Minimum **1000 V DC**

6.0 Grid Connected Inverter

The inverters shall be of string inverter. The proposed 10kWp shall be connected solar PV power plant shall be connected with grid. As such, the inverters shall be compatible to operate with existing utility supply. The PV system shall comprise of **10 KVA (or higher) Solar Invertor**

Specification of inverter shall include but not limited to the following:

Sl. No.	Operating Parameter	Desired specification
1.0	Type	Grid connected String Inverter
2.0	Usage	Specially used for PV system
3.0	**Standards**	
3.1	Efficiency Measurement	IEC 61683/ Equivalent BIS Std.
3.2	Environmental testing	IEC 60068-2 (1,2,14,30) / Equivalent BIS Std.
3.3	Interfacing with utility grid	IEC 61727
3.4	Islanding Prevention Measurement	IEC 62116
3.5	Type Test certificate issuing authority **(for item no 3.1 , 3.2,3.3 and 3.4)**	NABL/ IEC Accredited Testing Laboratories or MNRE approved test centers.
4.0	**Input (DC)**	
4.1	PV array connectivity capacity	10,15,20,30 kWp (minimum)
4.2	MPPT Voltage range	Compatible with the array voltage
4.3	Number of MPPT Channel	2 no (Minimum)
5.0	**Output (AC)**	
5.1	Nominal AC Power output	10 ,15,20,30 kVA or as per site condition of approved capacity
5.2	Number of Grid Ph	3Ø
5.3	Adjustable AC voltage range	Programmable as per grid condition 360V-
5.4	Frequency range	47-53 Hz
5.5	AC wave form	Sine wave
5.6	THD	Less than 3%
5.7	Switching	High frequency transformer / transformer less
6.0	General Electrical data	
6.1	Efficiency (Maximum)	95 %
6.2	Sleep mode consumption	Less than 5 W
7.0	**Protection**	
7.1	DC Side	1. Reverse-polarity protection 2. Reverse current to PV array protection, over voltage, Under voltage protection

7.2	AC side	1. DC inject protection to grid less than1% 2. Over voltage and Under voltage 3. Over current 4. Over and under grid frequency protection, 5. Anti Islanding protection
7.3	Isolation Switch	1. PV array Isolation switch (DC)
7.4	Ground fault detection device (RCD) which can detect changes in ground current. Rating shall be as suitable	To be provided for transformer less inverter.
8.0	Display	
8.1	Display type	If any
8.2	Display parameter	
8.2.1	DC	Voltage Current Power
8.2.2	On grid connected mode	Line status Grid voltage Grid frequency Export Power Cumulative Export Energy
9.0	Interface (Communication protocol)	Suitable port must be provided in the inverter for i) On site upgrade of Software, ii) On site dumping data from the memory, iii) Web based remote monitoring system
10.0	Web monitoring	Matched with the monitoring and data logging system
11.0	Mechanical Data	
11.1	Protection Class	IP 65 or higher
11.2	Operating ambient temperature	0^0 C to 60^0C
11.3	Cooling	Natural / forced cooling

7.0 Web enable on line data logger and Remote Monitoring Unit:

Web enable data logging system may be an integrated part of the inverter or a separate unit. The data logging system includes **MPPT wise PV array monitoring** system also. The data Logger should have the provision of recording **the data of solar insolation (the amount of solar radiation reaching in a given area), PV cell temperature and ambient temperature and associated electrical parameters** at different stages to study performance of system as well as to study status of the system at a particular instant. The data logger should have required transducer to monitor and record the required system data. **The data logger should be provided with an insolation sensor and a module temperature sensor, ambient temperature sensor matched with the system**.

The data logger shall have reliable battery backup and data storage capacity (minimum two days data) to record all sorts of data simultaneously round the clock. Web based Remote Monitoring system must be compatible with data logger.

The Web based monitoring system should have the provision of graphical representation of the data shall include but not limited to the following:

7.a – Web based monitoring system:

Sl. No.	Operating Parameter	Desired specification
1.0	Input data	PV Power PV Energy
2.0	Meteorological data	Insolation Module Temperature Ambient Temperature
3.0	Output data	
3.1	Inverter	Export Power Export energy

All data shall be recorded chronologically date wise. The data file should be MS Excel/XML/PDF/or any readable form compatible and should have the facility of easy download.

8.0 ACDB Panel

Output of the Inverter shall be terminated in ACDB Panel (indoor wall mounting type) through 32/63/100/125 Amps 415V 4 pole MCCB at the incoming side (Inverter side). The outgoing side (Grid side) shall be connected to the spare feeder available in the Main MV panel at the basement through 32/63/100/125 Amps 415V 4 pole MCCB. The set of AC surge suppressor (Surge protection Device) shall be connected at the outgoing bus.

9.0 Energy Meter: (As per TNERC Order No: 03 dated 25/03/2019)

Two nos of Energy Meters to be installed. One is for measuring solar power generation and the other is to measure import and export of energy. The First Meter, Solar Generation Meter shall be placed after the invertor at the ground floor of the premises to facilitate easy access for meter reading. The Second meter shall be bi-directional meter which will replace the existing meter at the branch and used for commercial settlement of energy imported and exported. The First and second meter will have to be installed at the same location where existing meter for recording consumption of energy is installed.

The cost of new/additional meters provided for the net feed-in scheme and the installation and testing charges shall be borne by the Bank (Invoice of M/s TANGEDCO to be submitted in this regard). For Procurement of Meters the distribution licensee (M/s TANGEDCO) shall procure, test and install the meters. However Liasoning with M/s TANGEDCO for procurement and installation of Energy Meters at the site to be done by the contractor only (as per Price Bid (SlNo:13)).

If M/s TANGEDCO or M/s TNERC hosts the lists of manufacturers of energy meters in their website, the contractor shall procure the energy meter from the market (in the same Technical Specification and rate prescribed by M/s TANGEDCO) (Purchase Bill of the Energy Meter in the rate prescribed by M/s TANGEDCO to be submitted to the Bank). The Positioning, sealing, testing, commissioning of energy meters will be guided by the same provisions as applicable to consumer meters in the Central Electricity Authority's metering regulations. The Contractor is wholly responsible for liaisoning with M/s TANGEDCO during the calibration, testing & commissioning of energy meters procured by them as per the Technical Specifications. The liaisoning rates shall be quoted in the Price Bid (Sl No:13).

10.0 Cables & Wirings:

The Specification of wiring material of PV Power plant shall include but not limited to the following:

Sl No	Item	Description
A	DC Cable	
1.1	Conductor	Tinned annealed stranded flexible copper according to IEC 60228
1.2	Standard	PV-1F / 2 PfG 1169/08.2007 / VDE Standard
1.3	Make	LAPP/Top Solar/Nexans/ Schneider
B	AC Cable	
2.1	Rated Voltage	1.1Kv
2.2	Construction	
2.2.1	Type	Armored or unarmored as per
2.2.2	Conductor	Stranded flexible copper
2.2.3	Insulation	PVC
2.2.5	Standard	IS : 1554 -1
2.3	Make	Polycab/KEI/Finolex/Havells/RR cable or equivalent
C	PVC Conduit tees, bends etc (Hard & flexible)	
3.0	Standard	ASTM D 1785 u PVC
3.1	Ambient Temperature	0 ^{O}C to 50 ^{O}C
3.2	Type	UV stabilized , temperatures, Shock proof
3.3	Make	Oriplast /Supreme or equivalent
D	GI Pipe	
2.0	Make	TATA- B class

Notes:

(i) All the Array Junction Boxes shall be located at the rear side of the solar array.

(ii) The equipment / structure of the equipment fixed on the array structure then suitable insulation must be provided between Array structure and the equipment and equipment structure.

(iii) The minimum clearance of the lower edge of the equipments from the developed ground level shall be maintained as standard practice.

11.0 System, Equipment, Array structure

i. Array Structure must be earthed with GI Strip

ii. The complete earthing system shall be electrically connected to provide return to earth from all equipment independent of mechanical connection.

iii. The equipment grounding wire shall be connected to one grounding electrode per PV power plant.

iv. Test point shall be provided for each earth pit.

v. An earth bus and a test point shall be provided inside the room / location where we are installing the inverter and combiner panel.

vi. Earthing system design should be as per the standard practices and conforming IS-3043.

vii. The earth electrode shall be as per relevant standard

viii. The Code of Practice Earthing shall be IS 3043:1987

ix. Necessary provision shall be made for bolted isolating joints of each earthing pit for periodic checking of earth resistance.

x. Minimum four (04) numbers of earth pits. Earthing Pit Cover Needs to be provided. The Resistance value of the each Earth pit should be submitted.

xi. Earth Grid must be made by inter connection of earth pit through GI Strip. The size of the GI earth strip must be minimum **25 x 3 mm**. The thickness of the galvanization should not be less than 610gr/M2.

12.0 Lightning Protection

Lightning protection shall be installed to protect the building and the solar panels / modules from lightning as per relevant IS Standard. Design shall be submitted for approval before installation

13.0 Signage:

Safety Signage: Safety Signage must be provided mentioning the level and type of voltage and symbols as per IE Rule at different position as may be required.

The Solar PV System Caution Stickers shall be fixed in the following locations.

(a) On the Main LT Panel were the solar power is terminated.
(b) Near PV Modules / Junction Box / Combiner panel / Inverter / Soar Generation Meter.
(c) And signage at locations as per the requirement of CEA/TANGEDCO

The above stickers shall be non-corrosive caution label with the following text:

WARNING – DUAL POWER SOURCE EB & SOLAR

The size of the caution label shall be min of 105mm (width) x 20mm (height) with white letters on a red background.

14.0 Provision for Module Cleaning

Module Cleaning: Necessary arrangement and equipment is to be provided to facilitate easy cleaning of the PV Modules

15.0 Fire Buckets and Fire Bucket holding stand

Fire Bucket of minimum quantity eight (08) numbers and Fire Bucket Stand of minimum quantity two (02) shall be provided at Array field. Each fire Bucket holding stand (Triangular type) shall have the arrangement to hold four (04) numbers of fire buckets. The Fire Bucket stand must be as per IS 2546. The stand shall be installed at the rare side of the PV Array. The minimum technical specification is a follows:

Bis Specification	IS 2546
Fire Bucket Capacity	10 Litres
Fire Bucket Body Material	Galvanized Mild Steel Sheet
Body Thickness	1 mm

16.0 Spares, Tools and Measuring Instruments:

The minimum number and different type of spares, tools and measuring instruments must be supplied under this project within the contract value. Also any special tools, spares, measuring instruments if required as may be shall be provided by the contractor within the contract value.

17.0 Operation and Maintenance (O&M)

i. Cleaning of solar modules with soft water, wet and dry mops: Monthly once (Yearly 12 Times). The Solar Panels to be cleaned monthly once as per the instructions of Banks Engineer. (The signed (Bank /Contractor) service report should be submitted monthly to Banks Engineer).
ii. DC String / Array and AC Inverter monitoring: Continuous and computerized.
iii. AC Energy monitoring: Continuous and computerized.
iv. Visual Inspection of the plant: As and when required.
v. Functional Checks of Protection Components and Switchgear:
vi. Inverter, transformer, data acquisition, energy meters and power evacuation checks: Monthly once.
vii. Support structure and terrace water-proofing checks:
viii. O & M log sheet shall be provided and maintained: Continuous and computerized.
ix. The repair/replacement work shall be completed within 72 hours from the time of identification / reporting of the fault.
x. A Monthly performance report of the plant inclusive of energy generation data shall be provided.

18.0 Warranties and Guarantees

Warranties and Guarantees

1	Solar Modules	10 years free replacement guarantee against material defect or craftsmanship
2	Solar Modules	90% power output for 10 years and 80% power output for 25 years
3	Inverter	Workmanship/product replacement - 5 years, service - 25 years
4	PV Array Installation	Structural -25 years
5	Balance of System / Plant – Parts and workmanship	Parts and Workmanship – 10years, service – 25 years
6	Power Evacuation and Metering Equipment	Workmanship / product replacement – 10 years, service- 25 years

19.0 Standards

Standards	
IEC 60364-7-712 - Electrical Installations of Buildings	Requirements for Solar PV power supply systems
IEC 61727 or similar	Utility Interface Standard for PV power plants > 10 kW
IEC 62103, 62109 and 62040 (UL 1741)	Safety of Static Inverters - Mechanical and Electrical safety aspects
IEC 62116	Testing procedure of Islanding Prevention Methods for Utility-Interactive PV Inverters
PV Modules	IEC 61730 - Safety qualification testing, IEC 61701 - Operation in corrosive atmosphere
IEC 61215	Crystalline Silicon PV Modules qualification
String/Array junction boxes	IP65, Protection Class II, IEC 60439-1, 3
DC/AC distribution boxes	Rated for IP54
Static Watt Hour Meter (AC)	IS 13779-1999
Central Inverter	Rated for IP54
Surge Protection Devices	Type 2, DC 1000V rated
PV Module/string/string combiner box interconnects	MC4 compatible. DC 1000V rated
All DC and AC cables, conduits, cable trays, hardware	Relevant IS
Earthing System	Relevant IS
PV Array support structure	Relevant IS
Lightning Protection	Relevant IS

GUARANTEED TECHNICAL PARTICULARS (GTP)

(to be completely filled and submitted along with technical bid)

PV MODULE (GTP)

Sl. No	Item	Specification (AS PER	AS OFFERED
1	Certification	i) IEC 61215 or IS 14286	
		ii) IEC 61730	
1.1	Test certificate issuing authority.	NABL/ IEC Accredited Testing Laboratories or MNRE accredited test centers (preferably the latest).	
2	PV Cell		
2.1	Type	poly crystalline	
2.2	Size	156mm x 156mm	
3	PV Module		
3.1	Rating at STC	320Wp, 72 cells (without any negative tolerance)	
3.2	Efficiency	Minimum14%	
3.3	Fill factor	Minimum 70%	
3.4	Withstanding voltage	1000V DC	
3.5	Glass	Toughened	
3.5.1	Thickness	3.2 mm (minimum)	
3.5.2	Type	High transmission, low iron, tampered & textured glass with anti reflective coating.	
3.6	PV Module Junction		
3.6.1	Protection level	IP 65 or above	
3.7	Bypass Diode		
3.7.1	System Voltage (Vsys)	1000 V dc	
3.7.2	Number	3 numbers	
3.8	Module Frame		
3.8.1	Type	Anodized aluminum frame	
4	**PV Module : MAKE offered**		

PV ARRAY (GTP)

For Solar Power Plant:

Sl. No	Item	Specification (AS PER TENDER)	AS OFFERED
1	Nominal Capacity	10 kWp	
2	PV Module interconnection connector	MC-4	
3	PV Module interconnection cable and array cable	PV 1-F standard /NEC standard "USE-2 or RHW-2" type (double insulated)	

4	PV array String Voltage	Compatible with the MPPT Channel of the	
5	Number of Parallel String against each MPPT Channel	02 Nos	

PV ARRAY JUNCTION BOX (GTP)

Sl No	Item Description	Specification (AS PER TENDER)	AS OFFERED
1	Enclosure		
1.1	Degree of Protection	IP65 with UV Protected	
1.2	Material	Polycarbonate.	
1.3	Withstanding voltage	1000V DC	
1.4	Withstanding Temperature	100 0C	
1.5	Accessories mounting	DIN Rail	
1.6	Number of Strings entry	As may be required	
1.7	Approved Make	Hensel/Spelsberg/ABB/Cooper busman	
2	Cable Entry and Exit		
2.1	Position	Bottom at cable entry and exit	
2.2	Cable Entry and Exit connector type	MC 4 Connector (PV Array String cable)	
2.3	Cable gland	Earthing cable entry	
3	Surge Protecting Device		
3.1	Type	DC	
3.2	Approved Make	OBO Betterman / ABB/ Legrand	
3.3	Protection class	Type B+C	
3.4	Number of set	As may be required as per string Design	
3.5	System Voltage	Matched with System Voltage 1000 V DC	
4	Fuse with fuse holder		
4.1	Position	Positive and negative terminal for each series string	
4.2	Type	Glass fuse, for PV Use only	
4.3	Rating	Current: Minimum **1.25** times the rated short circuit current of the string Voltage: Minimum 1000 V DC	

GRID CONNECTED INVERTER (GTP)

A) INVERTOR:

Sl. No	Operating Parameter	Specification (AS PER	AS OFFERED
1	Type	Grid connected String	
2	Usage	Specially used for PV	
3	Standards		
3.1	Efficiency Measurement	IEC 61683/ Equivalent BIS	

3.2	Environmental testing	IEC 60068-2 (1,2,14,30) / Equivalent BIS Std.	
3.3	Interfacing with utility grid	IEC 61727	
3.4	Islanding Prevention	IEC 62116	
3.5	Type Test certificate issuing authority (for item no 3.1 , 3.2,3.3 and 3.4)	NABL/ IEC Accredited Testing Laboratories or MNRE approved test	
4	**Input (DC)**		
4.1	PV array connectivity capacity	12 kWp (Min)	
4.2	MPPT Voltage range	Compatible with the array	
4.3	Number of MPPT	2 nos	
5	**Output (AC)**		
5.1	Nominal AC Power output	As per kWp at site	
5.2	Number of Grid Ph	3Ø	
5.3	Adjustable AC voltage range	Programmable as per grid condition 360V- 455V	
5.4	Frequency range	47-53 Hz	
5.5	AC wave form	Sine wave	
5.6	THD	Less than 3%	
5.7	Switching	High frequency transformer / transformer	
6	General Electrical data		
6.1	Efficiency (Maximum)	95%	
6.2	Sleep mode consumption	Less than 5 W	
7	**Protection**		
7.1	DC Side	1. Reverse-polarity	
		2. Reverse current to PV array protection, over voltage, Under voltage protection	
		3. Over current	
7.2	AC side	1. DC inject protection to grid less than1%	
		2. Over voltage and Under voltage	
		3. Over current	
		4. Over and under grid frequency protection,	
		5. Anti Islanding protection	
7.3	Isolation Switch	1. PV array Isolation	
7.4	Ground fault detection device (RCD) which can detect changes in ground current. Rating shall be as suitable for inverter	To be provided for transformer less inverter.	
8	Display		
8.1	Display type	-	
8.2	Display parameter		

8.2.1	DC	Voltage Current Power	
8.2.2	On grid connected mode	Line status	
		Grid voltage	
		Grid frequency	
		Export Power	
		Cumulative Export Energy	
9	Interface (Communication protocol)	Suitable port must be provided in the inverter	
		for	
		i) On site upgrade of Software,	
		ii) On site dumping data from the memory,	
		iii) Web based remote monitoring system	
10	Web monitoring	Matched with the monitoring and data	
11	Mechanical Data		
11.1	Protection Class	IP 65 or higher	
11.2	Operating ambient	0 0 C to 600C	
11.3	Cooling	Natural / forced cooling	
12	**MAKE offered**		

WEB BASED REMOTE MONITORING SYSTEM (GTP)

Sl. No	Operating Parameter	Specification (AS PER TENDER)	AS OFFERED
1	Input data	PV Power	
		PV Energy	
2	Meteorological data	Insolation	
		Module Temperature	
		Ambient Temperature	
3	Output data		
3.1	Inverter	Export Power	
		Export energy	

CABLES & WIRINGS (GTP)

Sl. No	Description	Specification (AS PER TENDER)	AS OFFERED
A	DC Cable		
1.1	Conductor	Tinned annealed stranded flexible copper according to IEC 60228 class 5	
1.2	Standard	PV-1F / 2 PfG 1169/08.2007 / VDE Standard E PV 01:2008-02 /Equivalent	
1.3	Make	LAPP/Top Solar/Nexans/ Schneider	

B	AC Cable		
2.1	Rated Voltage	1.1kV	
2.2	Construction		
2.2.1	Type	Armored or unarmored as per requirement	
2.2.2	Conductor	Stranded flexible copper	
2.2.3	Insulation	PVC	
2.2.5	Standard	IS : 1554 -1	
2.3	Make	RR Cable/ Polycab/LAPP/ Havell's or equivalent	
C	PVC Conduit tees, bends etc (Hard & flexible)		
3	Standard	ASTM D 1785 u PVC	
3.1	Ambient Temperature	0 0C to 50 0C	
3.2	Type	UV stabilized , temperatures, Shock proof chemical resistant	
3.3	Make	Oriplast /Supreme or equivalent	
D	GI Pipe		
2	Make		

ADDITIONAL SPECIAL TERMS AND CONDITION

1.0 Field Proven Inverter

The proposed string inverter must be field proven in Indian atmosphere. The string inverter of the proposed manufacturer must be used in any project in India and in operation on or before 31st December 2015. Also there must be a good maintenance setup of the proposed inverter manufacturer with having sufficient numbers of qualified service engineers (Degree / Diploma engineers) and well equipped set up with instruments, tools and tackles at Tamil Nadu or Vellore city. The maintenance setup of the proposed inverter manufacturer may be inspected by authority, if required.

2.0 Equipment and Material

Equipment and material shall comply with description, rating, type and size as detailed in this specification. Equipment and materials furnished shall be complete and operative in all respect. All accessories, which are necessary for safe and satisfactory installation and operation of the equipment, shall be furnished. All parts shall be made accurately to standard gauges so as to facilitate replacement and repair. All corresponding parts of similar equipment shall be interchangeable. Contractor shall carefully check the available space and the environmental conditions for installation of all equipments available at site and shall design the system accordingly.

3.0 Mode of Execution

The PV power plant shall be procured as a complete package. The entire work shall have to be executed on **turnkey basis.**

4.0 Materials and Workmanship

Qualified, experienced people should be deployed to install the **PV Power Plant**. All materials shall be of the best quality and workmanship capable of satisfactory operation under the operating and prevailing climatic conditions of respective. Unless otherwise specified, they shall conform in all respect to the latest edition of the relevant code and standards.. The project must be supervised by a qualified Civil Structural Engineer/ Engineering firm and Electrical /Electronics Engineer so that the work shall be as per drawing and related IS/IEC Code. The work shall be performed confirming safety precaution of all level of worker execute the project. The name and the qualification of the project engineers must be submitted to authority after placement of order. **The qualification of the supervising engineers must be minimum diploma or degreed in respective stream.**

5.0 Testing and Inspection

- Material Inspection will be carried out after submission of all test reports /certificates and after completion of the manufacturing work, against formal intimation from the contractor. The contractor shall, give notice of any material being ready for testing and the authority Bank / Engineer-In-charge/ bank, if desired, shall attend at the contractor's premises and may proceed with the routine tests. The material shall have to be dispatched at site after inspection and clearance from the purchaser. The inspection setup and instruments must be provided by the contractor within the contract value. The necessary charges for Site Testing, Transportation, accommodation and any other expenses shall be borne by the Contractor only.

Factory Testing:

- **A Factory Test Report (FTR) shall be supplied with the unit after all tests. The FTR shall include detailed description of all parameters tested qualified and warranted. The report must contain measurement of phase currents, efficiencies, harmonic content and power factor, also should include all other necessary tests/simulation required. Tests may be performed at 25, 30, 75 and 100 percent of the rated nominal power.**

Site Testing:

a. The PCU shall be tested to demonstrate operation of its control system and the ability to be automatically synchronized and connected in parallel with a utility service.

b. Operation of all controls, protective and instrumentation circuits shall be demonstrated by direct test if feasible or by simulation operation conditions for all parameters that cannot be directly tested.

c. Special attention shall be given to demonstration of utility service interface protection circuits and functions, including calibration and functional trip tests of faults and isolation protection equipment.

d. Operation of start up, disconnect and shutdown controls shall also be tested and demonstrate. Stable operation of the PCU and response to control signals shall also be tested and demonstrated.

6.0 Commissioning

After the erection and testing of the equipment/works as per above, commissioning of the plant and works shall be carried out and here the term "Commissioning" shall mean the activities of functional testing of the complete system after erection and testing, including tuning or adjustment of the equipment for optimum performance and demonstrating to the Purchaser that the equipment performance meets the requirements of the specifications.

7.0 Comprehensive Warrantee and Maintenance

The contractor must ensure that the goods supplied under the contract are new, unused and of most recent or current models and incorporate all recent improvements in design and materials unless provided otherwise in the contract.

The warranty period **the complete PV Systems** will be **60 (sixty)** calendar months from the date of completion of Defects liability period of **one year** from date of commissioning of plant. The contractor shall remain liable to replace any defective parts that may develop in the plant of his own manufacture or that of his sub-contractors under the conditions provided **for** by the contract under proper use, and arising solely from faulty design, materials or workmanship, provided always that such defective parts as are not, repairable at site and are not essential in the meantime to the maintenance in commercial use of the plant are promptly returned to the contractor's works at the expense of the contractor unless otherwise arranged.

The maintenance includes Routine, Preventive, Breakdown & Capital Maintenance the details are as follows but not limited:

Routine, Preventive, Breakdown & Capital Maintenance:

8.0 Routine and preventive maintenance:

Routine and preventive maintenance shall include cleaning of PV Module on regular basis , checks and maintenance activities such as tightening of all electrical connections ,daily, weekly, fortnightly, monthly, quarterly, half yearly, and yearly basis which are required to be carried out on all the components of the power plant to minimize breakdowns and to ensure smooth and trouble free running of the power plant. The supplier shall be responsible to carry out routine and preventive maintenance and replacement of each and every component / equipment of the power plant and he shall provide all labour, material, consumables etc. for routine and preventive maintenance at his own cost.

9.0 Breakdown maintenance:

Breakdown maintenance shall mean the maintenance activity including repairs and replacement of any component or equipment of the power plant which is not covered by routine and preventive maintenance and which is required to be carried out as a result of sudden failure/breakdown of that particular component or equipment while the plant is running. The supplier shall be responsible to carry out breakdown maintenance of each and every component of the power plant and he shall provide the required manpower, materials, consumables,

components or equipment etc. for breakdown maintenance at his own cost irrespective of the reasons of the breakdown/failure

10.Capital maintenance:

Capital Maintenance shall mean the major overhaul of any component or equipment of the power plant which is not covered by routine, preventive and breakdown maintenance which may become necessary on account of excessive wear & tear, aging, which needs repair/replacement. The capital maintenance of power plant and all civil structures shall normally be planned to be carried out on an annual basis. For this purpose a joint inspection by the supplier and purchaser shall be carried out of all the major components of the power plant, about two months in advance of the annual maintenance period, in order to ascertain as to which components of the power plant require capital maintenance. In this regard the decision of the purchaser will be final and binding. However, if the condition of any plant and component warrants its capital maintenance at any other time, a joint inspection of the purchaser and supplier shall be carried out immediately on occurrence of such situation and capital maintenance shall be carried out by arranging the shutdown of the plant/part of the plant, if required, in consultation with concerned authorities. The decision of the purchaser shall be final and binding. Capital maintenance also includes replacement of defective lights fans under the project supplied by the contractor. The capital maintenance includes painting, of mechanical structure, civil structure.

The contractor shall under take necessary maintenance/troubleshooting work of the Solar PV Power Systems. Down time shall not be more than 72 working hours from time of occurrence. Adequate measures should be taken for prevention of wear and tear of the machines. Solar PV Power System is to be designed to operate with a minimum of maintenance.

The scope of Support Service provides preventive maintenance as & when necessary within the contract period and break down maintenance in the event of malfunctions, which prevent the operation of the power system or part of it within the stipulated time period & free replacement of spares required for maintenance. Party will provide the A list of Spare parts & measuring instruments are The contractor will submit warrantee certificates of the work & spare parts and materials at the time of submission of completion report. *If any defect is found within the warrantee period, contractor will be liable to repair or replace the same at his own cost and risk, within three (72 hours) days from the date of complaint lodged by the authority or by the user themselves.*

11.0 End Users Training

The Contractor shall arrange for training at site for the end users / employer. The duration of training shall be minimum **five days**. The contractor shall provide training materials at least seven days before commencement of training programme. **The training shall be the part of contract and no extra cost shall be provided for organizing the training programme**.

12.0 Handing Over

The work shall be taken over by authority upon successful completion of all tasks to be performed at site(s) on equipment supplied, installed, erected, commissioned AND RUN SUCCESSFULLY FOR CONSECUTIVE **30 DAYS** AT A STRETCH by the contractor in

accordance with provision of this order. During handing over complete project work, the contractor shall submit the followings for considering final payment.

i. All As-Built Drawings &design
ii. Detailed Engineering Document with detailed specification, schematic drawing, and test results, manuals for all deliverable major items, Operation, Maintenance & Safety Instruction Manual and other information about the project
iii. Certificate issued by the structural & civil engineer/firm having engineer with minimum LBS/ESE/EBA License for structural design of PV Array.
iv. Bill of Materials
v. Inventory of spares at project site
vi. Completion certificate as per prescribed format provided by authority

13.0 CEA / CEIG Inspection

The contractor shall submit all the necessary drawings, SLD etc to CEA / Govt Authorities and arrange for inspection of the installation and obtain their certification. **Rectifications if any pointed out by CEA/CEIG/TEDA/Govt. Authorities in the installed equipments / details shall be carried out by the contractor without any extra claim.**

14.0 Operation & Maintenance (O&M)

The bidder shall be responsible for operation and maintenance of the Roof top Solar PV system for a period of 05 years (in addition to DLP of 1 year).

During this period, the bidder has to **clean the solar panels monthly once** and submit a report to Bank. Care should be taken such that the solar panels are maintained neat and tidy always such that optimum Power Generation is maintained.

15. Metering and Grid Connectivity

Metering and grid connectivity of the roof top solar PV system under this scheme would be the responsibility of the bidder in accordance with the prevailing guidelines of the concerned Distribution Company / TANGEDCO / TNERC / CEA (if available by the time of implementation). Bank could facilitate connectivity; however the entire responsibility lies with bidder only i.e obtaining clearance / liaisoning etc.

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इंडियन बैंक Indian Bank

इलाहाबाद ALLAHABAD

TECHNICAL SPECIFICATION FOR

FIRE FIGHTING SYSTEM

INTENT OF SPECIFICATION

This specification is intended to cover design, residual, engineering, manufacture, test and inspection at works, delivery to site properly packed for transportation, erection, testing, commissioning, performance demonstration at site and handing over to purchaser of Fire Protection System as indicated in the schedule of Requirement and scope of work and as required for reliable and effective fire protection of this building.

A.01.01 This specification also includes complete earthwork, i.e. excavation and back filling for the entire buried piping for hydrant and water spray system.

A.01.02 The specification also includes the supply of erection and commissioning of spares as specified and additional recommended spares for three (3) years trouble free operation of the plant and special tools and tackles.

A.01.03. This specification also makes it obligatory for the contractor for arranging and obtaining necessary clearance / approval from all statutory authorities.

A.01.04. It is not the intent to completely specify all the details of design and construction herein. Never the less the equipment and installation shall confirm to high standard of engineering, design, and workmanship in all respect and shall be capable of performing continuous satisfactory operation and acceptable to the purchaser as well as to the various statutory authorities. In case of any violation of the above contract, the purchaser reserves the right to change / reject / modify the equipment / system during detail engineering.

A.01.05. Wherever material or article is specified or described by the name of particular brand, manufacturer or vendor, the specific item mentioned shall be understood as established type function and quality desired. Other manufacturer's product will be considered provided sufficient information is furnished to allow the purchaser to determine that the product proposed is equivalent to those brand.

A.01.06. The entire system shall be designed and engineered by the Bidder based on the guidelines furnished in the specification, various codes / standards. Bidder's experience and also good engineering practice. Items and quantities, which have been furnished in this specification, are tentative and indicative only. During quoting, the Bidder shall vet the above Bill of Material and may furnish additional items necessary for satisfactory operation of the system.

A.01.07 Supplies and services to be covered under this tender specification and the conditions thereof are detailed in the subsequent sections of the specifications. In case of conflict among various sections, subsections, documents, drawings the same shall be referred to purchaser whose decision shall be final and binding to the Bidder. In all cases, the best advantages will go to the purchaser.

BUILDING DETAILS AND DESIGN CONSIDERATION

I. SYSTEM SPECIFICATION & WRITEUP

CONCEPT

Providing fire suppression system in a building is an attempt to extinguish the fire while it is still small, or to limit its growth in order to prevent it from becoming large and spreading to other parts of the building. Water is the most common and convenient fire-extinguishing agent. However, the most suitable extinguishing system whether water, powder or gas will be dependent on the nature of the combustible materials.

The Fire Hydrant system is the most effective, efficient and ultimate means of extinguishing very large fires, which can prove to be devastating. The main advantage of Fighting Fires with Fire Hydrant System is its accessibility and penetration capability, since fires can be fought from a very large distance and to very high reach ability. Many a time the water from the Hydrants through appropriate nozzle may also be used as shield (Water shield) in protecting the Fire Fighter against fire and smoke when evacuating persons in a room engulfed by fire.

The Hydrant network is pressurized with water at a definite pressure and is maintained in readiness for any eventuality. Once the hydrant valve is manually opened during fire, the fall in pressure in the pipe line is sensed by the pressure switches activating the pumps, thereby ensuring continuous supply of water and pressure at the outlets (Hydrant Points).

YARD HYDRANTS

For fighting fires from out side the building at strategic locations on perimeter of the building there are yard (external) hydrants have been proposed for every 30 m of periphery of the building. The yard hydrants are provided with hose cabinet in which 2 x 15Mts. fire hoses, branch pipe and nozzle are stored.

AUTOMATIC SPRINKLER SYSTEM

Automatic sprinkler system is considered to be the most effective and economical way to apply water from fixed systems. It is designed to act upon a fire at a pre-determined temperature by measure of water spray. It could either extinguish the fire or control its spread. The extinguishing mechanism of sprinkler water spray includes combustible materials to prevent further fire spread and displacement of combustible vapour and oxygen by steam. The sensitivity of a sprinkler glass bulb varies and is identified by different color.

Sprinklers have been designed for ceiling level with Sprinkler riser, piping network, Sprinkler control valve, Floor control valves etc. All sprinklers are 68 deg. Temperature rating and pendant-recessed type also upright and sidewall through type sprinkler shall be envisaged wherever required as per site. The Sprinklers are designed to cover 9 to 12 Sq. m each and design density of water is 5 LPM / Sq. m for assumed area of 360 Sq.m. The sprinkler system and hydrant

system are fed by common pump. The sprinkler mains at each zone consisting with Flow switch which will transfer audio / visual indications to Fire alarm panel in case of water flow in the pipes.

Sl. No	Description	As per NBC
1	Type of Occupancy	Business Building
2	General Classification	Group E
3	Type of Building	Office & Residence
4	Systems to be provided	Yard hydrants, Internal Hydrants, Sprinklers & Fire extinguishers
5	Interval of Yard Hydrant and Hydrant pressure	Every 30 Mtr interval and 3.5 Bar at the remotest point.
6	Fire water pump house & tanks	Shall be accommodated at Basement
7	Pump capacity for both Hydrant and Sprinkler system	**At Below Ground Level:** 1No. Main pump of 97Cu.M at 70 MWC. 1No. Jockey Pump of 10.8Cu.M at 70 MWC. 1No. Common Standby pump of 97Cu.M at 70 MWC. **At Terrace Level:** 1No. Terrace Pump of 27Cu.M at 35 MWC
8	Fire water tank capacity	Ground level. 50 cum. Terrace Tank 5 cum.
9	Power supply.	Main Electric pump – 420V 3Ph –1no. Jockey Pump – 420 V, 3Ph – 1no. (Star delta starter mechanism)

II DESIGN PHILOSOPHY

Fire Protection System mainly envisages providing protection to this Business/residential buildings.

Brief system description indicative of the nature of various systems is provided below.

1.0 TYPE OF SYSTEMS

Following are the various Fire Protection Systems proposed for protection:

Fire Hydrant System (Internal & External)

Automatic Sprinkler System at Office Floor

Fire Extinguisher

2.0 GENERAL REQUIREMENTS:

Sl.No (1)	Description (2)	Residential Building (A-3)		Business Building (E)	
		Upto 15m in height (3)	> 15m in height & upto 35.0M (4)	Above 10m but not exceeding 15m in height (5)	> 15m in height& upto 24.0M (6)
1.	Fire Extinguisher	Required	Required	Required	Required
2.	Fire Aid Hose Reel	Required	Required	Required	Required
3.	Wet Riser	Not Required	Not Required	Required	Required
4.	Down Comer	Not Required	Required	Not Required	Not Required
5.	Yard Hydrant	Not Required	Not Required	Not Required	Required
6.	Automatic Sprinkler System	Not Required	Not Required	Not Required	Required
7.	Manually operated electronic fire alarm systems	Not Required	Required	Required	Required
8.	Automatic detection & alarm system	Not Required	Not Required	Required	Required
9.	Under Ground Water Storage Sump	Not Required	Not Required	50,000 litres	1,00,000 litres
10.	Overhead water tank	5,000 litres	25,000 litres	5,000 litres	10,000 litres
11.	Pump Room at Ground Level	Not Required	Not Required	1 No. Electric & Diesel Pump of capacity 1620 lpm & one diesel pump of capacity 180lpm.	1 No. Electric & Diesel Pump of capacity 2280 lpm & one diesel pump of capacity 180lpm.
12.	Pump at terrace level	450 lpm @ 3.5kg/sq.cm	900 lpm @ 3.5kg/sq.cm	450 lpm @ 3.5kg/sq.cm	Not Required

Note:
Being this building is involved in business activities, we suggest you to follow the requirements in Column No. 5.

3.0 HYDRANT SYSTEM PHILOSOPHY

The hydrant system has been designed to cater to the single fire demand at a time. The pumping philosophy shall be as follows:

Fire pumps shall be installed in firewater pump room. Pumps shall have positive suction having common header.

The hydrant & sprinkler system header shall be fed by one jockey pump (JP) of 10.8 Cu.M /Hr. (180 LPM) capacity and one electrically operated main pump set of 97 Cu.M/Hr (1620 LPM). There shall be one diesel engine driven standby pump of same capacity.

Stopping of the jockey pump sets shall occur automatically either due to restoration of system pressure sensed by pressure switches or due to the operation of interlocking circuits provided within the local control panel by which main fire pumps comes into operation.

Stopping of main pump sets shall only be done manually by operation of the respective push buttons on local control panels.

External hydrants called courtyard hydrant shall be spaced at intervals of 30 Mtr. (maximum) around the periphery of the main building. Courtyard hydrants shall be provided with hose box & two hoses of 15 m length, nozzle & branch pipes. The underground pipe will be of MS medium grade, coated and wrapped as per relevant IS specification.

4.0 SPRINKLER SYSTEM PHILOSOPHY:

A Sprinkler system has two functions to perform, i.e. to detect a fire and then provide an adequate distribution of water to control or extinguish it. The suction of the pump-sets are connected to a tank of 50,000Ltrs capacity (common tank to Hydrant and Sprinkler system). The delivery of these pump-sets are connected to a common manifold and further connected the risers and a network of piping will be kept under pressure and whenever Sprinkler bulb breaks, Water sprinkled immediately and the reduction of pressure automatically sensed thereby switching ON the Pump.

The pump-sets can be either switched ON automatically or manually depending upon the selector switch in the MCC / Auto start panel.

Flow switches will be installed in all the risers of sprinklers and these flow switches are connected to a fire alarm panel. This Fire Alarm panel will give indication whenever the sprinkler operates indicating the exact floor / area.

Sprinkler Data

Coverage of Sprinklers

Sprinkler rating	:	68 & 79 Deg.C
Sprinkler point design	:	16 / 18 sprinklers.

Sprinkler system shall be tapped off from pumps considered for hydrant/Sprinkler system.

5. FIRE EXTINGUISHERS

5.1 Portable Fire extinguishers of various types will be located in the following areas:

Pump Room

Office Floor

Residential Floor

5.2 Type of Fire Extinguishers

ABC type dry chemical powder

Carbon dioxide

Mechanical Foam

APPLICABLE CODES & STANDARDS

Unless specifically mentioned otherwise, all the applicable Codes and Standards published by the Bureau of Indian Standards and their subsequent revision shall govern in respect of design, workmanship, quality and properties of materials and method of testing; standards listed below shall be applicable, in particular: NBC Part IV-Fire Protection System, 2005 and TAC Fire Protection Manual / 1998 (Guidelines only)

IS-1239	:	Specification for MS / GI Pipes
IS-778/780/2906 supply.	:	Specifications for Gun Metal gate, globe, and check Valves for water
IS-800	:	Specifications for Structural steel
IS-3589	:	Specifications for ERW black pipes for water, gas and sewage for pipes above 150 NB.
IS-814 structural	:	Specifications for covered electrodes for metal are welding of steel.
IS-4927	:	Specifications for Canvas Hose Pipes.
IS-1641	:	Specifications for C.I.screwed fittings.
IS-903	:	Specifications for Branch pipes (Long Pattern)
IS-3844 Multistoried	:	Code of practice for installation of internal Fire Hydrant in Building.
IS-5290	:	Specifications for hydrant landing valves.
IS-903	:	Specifications for coupling double male double Female instantaneous pattern for fire fighting.
IS-2217 public buildings.	:	Recommendation for providing first aid fire fighting arrangement in
IS-1879	:	Malleable iron fittings (Parts I to X)
IS-1200	:	Method of measuring of building & civil

Engineering Works (water supply, plumbing drain & sanitary fittings)

IS-1538	:	Specifications for cast iron fittings for pressure Pipes for water, gas and sewage
IS-4853 butt	:	Recommended practice for radiographic inspection of fusion welded Joints in steel pipes.
IS-636	:	Synthetic, jacketed hose pipes.
IS-1520	:	Electrically operated multistage / multi outlet pump.
IS-2198	:	Control Panels.
IS-2159	:	Hot dip galvanising of iron and steel
IS-5	:	Specification for painting

IV. EQUIPMENT SPECIFICATION

D.00.00 **I. WET RISER CUM DOWN COMER / SPRINKLER SYSTEM**

D.01.00 **FIRE PUMPSETS**

D.01.01 The pumps shall be of horizontal end suction, top discharge centrifugal pump. The speed of motor driven pump shall be 2900 RPM and the Engine driven pump shall be 1800 to 2100 RPM.

D.01.02 Pump shall preferably be designed to have the best efficiency at the specified duty point. The pump shall be suitable for continuous operation at any point within the "Range of Operation" i.e. 0% to 150% of rated capacity.

D.01.03 The pump shall be driven by drive unit directly coupled. A heavy duty coupling along with coupling guard shall be provided between the pump and drive unit.

D.01.04 The pump shall be capable of furnishing not less than 150% of rated capacity at a head of not less than 65% of the rated head.

D.01.05 The shut-off head shall not exceed 120% of rated head.

D.01.06 The drive unit power rating shall be the maximum of the following requirements.

i. 15% margin over the pump shaft input power at the rated duty point.
ii. 5% margin over the pump shaft input power required to drive the pump at 150% of its rated discharge

D.01.07 The pump set shall be of securely mounted on a robust base frame and shall be free from vibration at all variations of load.

D.01.08 The pump shall also be linked to re-circulation pipeline required for minimum flow through the pump during its operation without any discharge through headers.

D.01.09 The pump shall be provided with a nameplate indicating delivery head, capacity and RPM.

D.01.10. The material of construction of pump shall be as under:

i. Casing	:	Cast Iron, IS:210, Gr 25
ii. Impeller	:	Bronze IS: 318, Gr LTB1
iii. Wearing Rings	:	Bronze
iv. Shaft Sleeve	:	S/S Type AISI 410
v. Stuffing Box	:	FG 260 (Gr.25)
vi. Gland	:	FG 260 (Gr. 25)
vii. Gland packing	:	Graphited Asbestos rope
viii. Shaft	:	Stainless Steel AISI 410
ix. Base frame	:	Fabricated M.S

D.02.00 **JOCKEY PUMPSETS**

D.02.01 The pump shall be horizontal end suction top discharge centrifugal pump.

D.02.02 The pump shall be single / multistage.

D.02.03 The pump base frame shall be fabricated out of MS channels

D.02.04 The base frame shall accommodate both the pump and the motor.

D.02.05 The pump shall be suitable for automatic operation

D.02.06 Jockey pump drive motor shall be suitable for frequent start / stop operations as required by the system.

D.02.07 The pump shall be provided with a name plate indicating delivery head, capacity and RPM.

D.02.08 The material of construction of pump shall be as under:

i. Casing	:	Cast Iron, IS:210, Gr 20
ii. Impeller	:	Cast Iron
iii. Base frame	:	Fabricated M.S

Bidder shall confirm the adequacy of space requirement for pumps and associated piping as indicated in the tender drawings

D.03.00. **MOTORS**

D.03.01. The motors for the wet riser & jockey pumps shall be of general purpose, constant speed, and sized for the maximum output at an ambient temperature of 40 Deg C.

D.03.02. The motor for electrical driven pump sets shall be of TEFC type.

D.03.03. The motors shall be wound of class 'F' insulation.

D.03.04. The motors shall be rated for continuous duty. They shall also be suitable for long period of inactivity.

D.03.05. The operating speed for the Electrical pump / Jockey pump motor shall be of 2900 RPM.

D.03.06. The motors shall be suitable for electric supply of 415V, 3 phases, 50 Hz and shall run continuously at rated input over the entire range of voltage and frequency variations as under:

RANGE OF VARIATION

i. Voltage	:	10%
ii. Frequency	:	5%
iii. Combined voltage frequency	:	10% (Absolute sum)

D.03.07. Motors shall be designed for direct on line starting.

D.03.08. Motors shall be effectively grounded and shall be provided with two separate and distract grounding pads, each complete with tapped hole galvanized bolt and washer for connection to station ground conductors

D.03.09 Motors shall confirm to IS: 325

D.04.00 **CONTROL PANEL FOR THE MOTOR DRIVEN STANDBY PUMPSET AND JOCKEY PUMPSET.**

D.04.01. The starting switchgear for the motor driven pump set shall be suitable for star delta/direct on line starting.

D.04.02. The control circuit for the electrical driven firefighting pump set shall be designed for automatic operation i.e., whenever the pressure reduces in the system, the pumps shall automatically starts. The stopping of the pumps is 'Manual'.

D.04.03. The control circuit for the Jockey pump set shall be designed that whenever pressure reduces the pump shall start automatically and when pressure reaches rated system pressure then it should automatically switched OFF.

D.04.04. Auto/Manual switch shall be provided for both the electrical driven firefighting pump set & Jockey pump set so that the pump sets can be started/stopped manually also.

D.04.05. The panel shall be provided with the Voltmeter and ammeter with indicating `R' `Y' `B' Lamps.

D.04.06. The control panel shall be of welded construction, fabricated from sheet metal having 2.03 (14 SWG) thickness and shall be dust and varnish proof.

D.04.07. The Panel shall be completely factory wired absolutely ready in all respect for installation at site and incoming power cables to be laid by main electrical contractor for which un drilled bottom gland plate shall be provided. The internal wirings of the panel shall be carried out with 650 V grade stranded copper wire of size rated for the current in the corresponding circuit. The minimum size of the wire shall not be less than 1.5 Sq.mm stranded copper. The wiring termination shall be done using ferrules having indelible at the termination to reduce the possibility of short circuit between various wires. The contractor shall be solely responsible for proper functioning of the equipment supplied. The internal control wiring shall be done with FRLS cable.

D.04.08. Neoprene or equivalent rubber gaskets shall be provided at all openings.

D.04.09. All the components used in the Panel shall be of reputed makes.

D.04.10. Nameplate shall be provided at the Panel.

D.04.11. MCCBs shall be provided for the panels. All the protection circuits shall be removed. The panels shall have 2 Nos. of incoming MCCBs with mechanical inter-locking facility.

D.04.12. 2 (two) numbers earthing connection shall be provided for the panel. The earthing of the panel shall be done as per the rules and regulations.

D.04.13 Adequate number of potential free contacts shall be provided for connecting to the BAS system.

D.05.00 **DIESEL ENGINE**

D.05.01 The engine shall be of the compression ignition mechanical direct injection type, capable of being started without the use of wicks, cartridges, heater plugs or ether, at an engine room temperature of 7 Deg. C. And shall accept full load within 15 seconds from the receipt of the signal to start.

D.05.02. The engine shall be naturally aspirated, supercharged or turbo charged and either air or water-cooled. In the case of charge air-cooling by means of a belt-driven fan or of a belt driven auxiliary
Water pump there shall be multiple belts such that should half the belts break, the remaining belts would be capable of driving the fan or pump.

D.05.03. The engine shall be provided with an adjustable governor to control the engine speed within 10% of its rated speed under any condition of load upto the full load rating. The governor shall be set to maintain rated pump speed at maximum pump load.

D.05.04. Engines, after correction for altitude and ambient temperature shall have bare engine horsepower rating equivalent to the higher of the following two values.

a. 20% in excess of the maximum brake horsepower require driving the pump at its duty point.

b. The brake horsepower required to drive the pump at 150% of its rated discharge.

D.05.05. The coupling between the engine and the pump shall allow each unit to be removed without disturbing the other.

D.05.06. **STARTING MECHANISM**

Provision shall be made for two separate methods of engine starting viz.,

a. Automatic starting by means of a battery powered electric starter motor incorporating the axial displacement type of pinion, having automatic repeat start facilities initiated by a fall in pressure in the water supply pipe to the sprinkler and/or hydrant installation. The battery capacity shall be adequate for ten consecutive starts without recharging with a cold engine under full compression.

b. Manual starting by
i. Crank handle, if engine size permits.
or

iii. Electric starter motor.

D.05.07. **BATTERY CHARGING**

The means of charging the batteries shall be by a 2-type trickle and boost charger with manual selection switch and the batteries shall be charged in position.

D.05.08. **COOLING SYSTEM**

The cooling system shall be of heat exchange type.

D.05.09. **FUEL SYSTEM**

Engine shall be provided with a fuel oil tank fitted with a level indicator and having adequate capacity to hold sufficient fuel oil for minimum two (2) hours of full load run.

The fuel oil tank shall be constructed of welded steel. The tank shall be above the inlet of fuel injection pump of the diesel engine to ensure adequate pressure at suction of injection pump.

The fuel oil tank shall be provided with a sludge and sediment trap. So that the same is not carried to the injection pump. Adequately sized inspection and cleaning hole shall be provided to felicitate maintenance.

Pipeline carrying fuel oil shall be independent for each engine and gradually sloped from the tank to the injection pump. Any valve in this line shall be placed adjacent to the tank and kept locked in open position.

Pipe joints shall be welded only and shall not be soldered. No plastic pipes shall be used.

The design of complete fuel oil system shall be free of air pocket in any part of the pipe work, fuel pump, sprayers / injectors, filter system, etc., Use of screwed plugs shall be permitted where air relief is essential with approval of Architect/Employer.

D.05.10. **AIR FILTERATION**

The air intake shall be fitted with a filter of adequate to prevent foreign matter entering the engine.

D.05.11. **EXHAUST SYSTEM**

The exhaust shall be fitted with a suitable silencer to keep the total backpressure within the engine maker's recommendation. The exhaust system shall also be free from any condensate flowing into the engine.

D.05.12. **ENGINE SHUT-DOWN MECHANISM**

This shall be of manual operation to bring the engine to starting position after use.

D.05.13. **ACCESSORIES**

The engine shall be mounted on a frame of fabricated steel construction. Adequate access shall be provided to the big end and main bearings, camshaft and governor drives water jacket, etc.

Indicator cocks shall be mounted directly on the cylinder head and located in such a manner as to permit preparation of the indicator cards without removing the valve operating gear covers.

D.05.14. **TOOLS**

A standard tools kit shall be provided with the engine and kept at handy place all times.

D.05.15. **SPARE PARTS**

The following spare parts shall be supplied with the engine and kept at handy places.

a. Two sets of fuel filters, elements and seals.
b. Two sets of lubricating oil filters elements and seals.
c. Two sets of belts (where used).
d. One complete set of engine joints, gaskets and hoses.
e. Two injector nozzles.
f. One complete set of piston rings for each cylinder.
g. One inlet valve and one exhaust valve.

D.06.00. **AUTO START CONTROL PANEL FOR DIESEL ENGINE**

D.06.01. The Auto-start control panel shall have the following:

i. Auto/Manual selector switch for pump set.
ii. Manual start/stop push button.
iii. Indicating lamps showing power is on and run/stop.
iv. Voltmeter/Ammeter in battery charging circuit.

D.06.02. The control panel shall be of welded construction, fabricated from sheet metal having 2.03 (14 SWG) thickness and confirm to IP 54 construction.

D.06.03. Neoprene or equivalent rubber gaskets shall be provided at all openings.

D.06.04. The Auto Start panel shall have both trickle & Boost charger to charge the batteries.

D.06.05. The Panel should be designed and compatible with the make of the diesel engine offered.

D.06.06. Nameplate of approved design shall be furnished for panel and for each instrument or device mounted on the panel.

D.06.07. The panel shall have provision of cable entry at the Top plate.

D.06.08. 2 (two) numbers opposite earthing connection shall be provided for the panel. The earthing of the panel shall be done as per the rules and regulations.

D.07.00. **PIPES AND FITTINGS**

D.07.01. The use of Pipes in the execution shall be as follows:

BURIED PIPES & ABOVEGROUND PIPES (WET RISER CUM DOWN COMER SYSTEM)

The pipes shall be of Mild Steel ERW Pipes as per IS: 1239 Part-I, medium grade up to 150 NB and below or IS: 3589 for pipes of sizes 200 mm and above with IS mark in both the cases.

D.07.02. Minimum thickness of steel pipes IS: 3589 shall be as follows:

Pipe Size NB (mm)	200	250	300	350	400
Minimum wall thickness (mm)	6.35	6.35	6.35	6.35	6.35

D.07.03. All fittings to be used in connection with steel pipelines shall be as per IS: 1239, Part-II, `Mild Steel tubular and other wrought steel pipe fittings. All Fittings shall be of heavy quality. Fittings with sizes above 150 mm shall be fabricated from pipes conforming to IS: 3589 or steel plates having thickness not less than those specified in the IS: 3589. Minimum three pieces meter bends shall be used.

BURIED PIPES & ABOVEGROUND PIPES (SPRINKLER SYSTEM)

The pipes shall be of Mild Steel ERW Pipes as per IS:1239 Part-I, heavy grade up to 150 NB and below or IS:3589 for pipes of sizes 200 mm and above with IS mark in both the cases.

D.07.04. Minimum thickness of steel pipes IS: 3589 shall be as follows:

Pipe Size NB (mm)	200	250	300	350	400
Minimum wall thickness (mm)	6.35	6.35	6.35	6.35	6.35

D.07.05. All fittings to be used for sprinkler system upto 50mm shall be of forged steel fitting socket weld able type ANSI B16.11 and fittings above 50 mm shall be of heavy grade MS.

D.07.06. Welded construction shall be adopted for steel pipelines unless specified otherwise.

D.07.07. Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipelines movements as necessary. All guides, anchors, braces, dampers, expansion joint and structural steel to be attached to the building/structure/trenches etc., shall be provided. Type of hangers and components for all piping shall be selected by Contractor and approval obtained from the Purchaser/Architect before commencement of the work.

D.07.08. All piping system shall be capable of withstanding the maximum pressure arising from any condition of testing (as stipulated) and operation, including water hammer effects.

D.08.00. **COATING AND WRAPPING:**

Steel pipelines to be laid underground buried in the soil shall be protected against corrosion by means of coating & wrapping as per IS: 10221.

D.08.01. The above coating and wrapping shall be carried out in systematic manner such that uniform thickness of coating is obtained as per IS specification.

D.08.02. Buried pipelines shall be laid in general with top of pipe 1(one) meter below the ground level. Where soil conditions are not satisfactory, masonry or equivalent supports shall be provided at regular intervals.

D.09.00. **VALVES**

D.09.01. **SLUICE VALVES**

i. Gate / Sluice valve shall be as per IS:14846 (PN 1.6)

ii. The sluice valves shall be provided with hand wheel, position indicator and locking facility.

iii. Sluice valves shall be provided with back seating bush to facilitate gland renewal during full open condition.

iv. Sluice Valves shall be with IS mark.

D.09.02. **NON-RETURN VALVES**

The Non-Return Valve shall be of CI body swing check & waffer type.

D.10.00 **BUTTERFLY VALVES**

Butterfly valves shall be slim seal type with an integrally moulded elastomer body liner. The valve shall be designed to outperform loose liners, the elastomer line is moulded directly in the body bore and vulcanized in – situ, making it last the entire life of the valve. The slim seal is available in different combinations of body, liner and disc material to suit a wide of line fluids, a size range of 50 to 600mm and a pressure rating upto PN 1.6.

D.11.00. **HYDRANT COMPONENTS**

D.11.01. **HYDRANT VALVE**

a. Hydrant valve shall be of single headed/double headed with 75 mm NB flanged inlet, 63 mm female inst. oblique outlet as per IS: 5290

b. The material of construction shall be as follows:

i. Body	:	Gunmetal.
ii. Trim	:	Leaded tin bronze as per IS:318, Grade-2.
iii. Hand Wheel	:	Cast Iron FG 200 as per IS:210.
iv. Washer, Gasket	:	Rubber as per IS:638.

v. Quick coupling connection:		Leaded tin bronze as per IS:318.Grade-2.
vi. Spring	:	Phosphor Bronze as per IS:7608.
vii. Male Blank cap.	:	Leaded tin bronze as per IS: 318.Grade-2.
viii. Chain	:	G.I.

D.11.02. **BRANCH PIPE:**

Branch pipe shall be of gunmetal short, 63 mm male instantaneous inlet, made threaded outlet, 20 mm bore nozzle with IS: 903.

D.11.03. **HOSES**

The hoses shall be 63 NB with heavy quality gunmetal coupling confirming to IS: 903 with ISI mark. Hoses shall be RRL type with IS: 636 type 'A', 100% polyester, resistance to fungus formation. Hoses shall be externally coated with red synthetic elastomeric compound, which provides resistance to moisture meldew fungus and protection against heat and abrasion. Hoses shall be of 15 M / 7.5 M long and each hose shall be provided with a male and female coupling, gunmetal, 63 mm (2 1/2") size, heavy quality bearing conforming to IS:903 with IS mark.

D.11.04. **HOSE REEL**

i. Hose reel shall be of type 'A' wall mount type, swinging complete with 19 mm bore, high pressure braided rubber hose 30 M. long, 6 mm bore shut off nozzle and 25 mm dia inlet valve, confirming to IS: 884.

ii. The material of construction for various components shall be as per IS: 884.

D.11.05. **HOSE BOXES**

Hose box for yard hydrants shall be fabricated from fibreglass sheet materials with glass panel, lock & key. The size of the hose box shall be 750 mm x 600 mm x 250 mm and capable of accommodating 2 Nos. of 15 Mtr. Hoses and 1 No. branch pipe. The hose box shall be provided with double door with glasses, lock, 2 keys and a break glass, recess for keys. The colour of the hose box shall be red.

D.11.06 **HOSE FRONT DOOR**

In each floor, in each riser, tapping will be taken and in this tapping, a hydrant valve and hose reel is connected and required hoses and the branch pipe will be kept. The entire arrangement will be inside the duct. For covering the duct, a door shall be provided with anodized aluminium frames and glass panel.

D.11.07 **FIRE BRIGADE CONNECTION**

The fire brigade inlet connection shall be of Two-way type incorporating non-return valves on the external hydrant ring main and also shall be provided for the fire-fighting sump. The two ways fire brigade inlet connection shall be accommodated in a glass fronted MS box made of 18 gauge MS sheet. The inside portion of the box shall be painted with one coat of zinc rich primer and two coats of white enamel paint. The outside shall be painted with one coat of zinc rich primer and two coats of red enamel paint. The box shall be also provided with lock and key. Fire Brigade connection shall confirm to IS: 5131.

D.11.08. All the hydrant components i.e. hydrant valve, Hoses with coupling, branch pipe shall have ISI approval.

D.11.09 **FLOW SWITCH**

Flow switches will be mounted in a horizontal section of pipe where there is a straight horizontal line of at least 10 pipe diameter on upstream side and 5 pipe diameter on down stream side of the flow switch. Flow switch shall accommodate a micro switch with at least 1 NO and 1 NC contacts and the same shall be actuated by metallic bellows sealed pivoted paddle. The instrument shall be weather proof with IP52 when the cover and suitable cable gland are properly fixed. The flow switch shall be suitable for mounted on 150/100mm-dia pipeline. The flow switches shall be provided for sprinkler system.

D.11.10 **SPRINKLER HEADS**

The sprinkler heads shall be rated for 68 deg.C. Pendent type Sprinkler. Sprinkler shall be provided with escutcheon plate and sprinkler shall have approval of FM / UL.

D.11.11 **ORIFICE PLATES**

Orifice Plates shall be provided wherever required on wet riser system to limit the pressure to 5 Kg. per Sq.Cm.

D.11.12 **Cables**

All cables specified in the Schedule of Quantities shall have Outer sheath with Fire retardant low smoke (FRLS) PVC compound to reduce the Fire hazard. The FRLS outer sheath material shall meet the following requirements:

a. Oxygen Index - 29 when tested at 27 + 2°C as per ASTM – D – 2863 - 77

b. Temperature Index - Minimum 250°C at Oxygen Index 21 – as per NES 715.

c. Flammability - As per IEC – 332 – 1. It shall also pass Flammability Test as per Class F3 of Swedish Standard SS – 424 - 1475.

d. Smoke Density - Smoke density rating shall not be More than 60%. When tested as per ASTM – D – 2843 – 77 (1988).

e. Acid gas generation - Less than 20% by weight as per IEC – 754 – 1.

The sheath shall be resistant to water, UV radiation, fungus, termite and rodent attacks. The colour of the outer sheath shall be black.

II. 10.11.13 **EARTHING**

This specification covers the supply, installation testing and commissioning of earthing system.

1. STANDARDS (Indian Standards)

IS 3043	:	Code of Practice for earthing
Safe Earthing	:	As per IS – 3043
Electricity Rules	:	National Electric code
Earthing for Lightning Protection	:	As per IS - 2309.

2. GENERAL REQUIREMENTS

The plant shall be provided with complete earthing system comprising earth electrodes in conjunction with earth grid.

3. DETAILS OF EARTHING SYSTEM

Unless otherwise specified main earthing shall not be less than 50 x 6 mm Cu. Flat wherever buried.

The minimum size of earthing conductor of various equipment shall be as follows:

a.	2500 kVA Transformer Neutral	-	50x6mm cu flat
b.	Transformer body & HT Panel body	-	50 x 6 mm Cu Flat
c.	Main Earth Bus	-	50 x 6 mm Cu Flat
d.	PCC/LT Switch boards body	-	50 x 6 mm Cu Flat
e.	Distribution Panels	-	25 x 3 mm Cu Flat
f.	Interconnections Earth pit to Earth pit	-	50 x 6 mm Cu. Flat

4. EARTH ELECTRODE

Earth electrodes shall be erected 1.5 Mts away from the building edge and minimum spacing between the electrodes shall be maintained as per IS: 3043.

5. EARTHING LAYOUT

Earthing conductors in outdoor areas shall be buried atleast 600mm below finished grade level unless stated otherwise.

Wherever earthing conductors cross cable trenches, underground service ducts, pipes, tunnels, etc. it shall be laid minimum 300 mm below and shall be re-routed in case it fouls with equipment structure foundations.

Tap-connections from the earthing grid to the equipment/structure to be earthed shall be terminated on earthing terminals of the equipment/structure, if the equipment is available at the time of laying the grid, otherwise, "earth riser" shall be provided near the equipment foundation/ pedestal for future connections to the equipment earthing terminals.

Earthing conductors along their run on cable trench ladder columns, beams, walls, etc. shall be supported by suitable clearing at intervals of 750 mm. Earthing conductors along cable trenches shall be cleared to the wall nearer to the equipment. Cable trays and supports shall be connected to the earth mat at every 10 meters interval. Wherever it passes through walls, floors, etc. GI sleeves shall be provided for the passage of the conductor.

Earthing conductor around the building shall be buried in earth at a minimum distance of 1500 mm from the outer boundary of the building.

6. EQUIPMENT EARTHING

All electrical power items shall be earthed by two separate and distinct earth connections from main earth bus.

Earthing pads shall be provided by the supplier of the apparatus/equipment at accessible position. The connection between earthing pads and the earthing grid shall be made by short and direct earthing lead free from links and splices.

Electrical continuity shall be ensured by bonding the different sections of hand-rails and metallic stairs.

Metallic pipes, and cable tray sections for cable installation shall be bonded to ensure electrical continuity and connected to earthing conductors at regular interval. Apart from intermediate connections, beginning points shall also be connected to earthing system.

Metallic conduits shall not be used as earth continuity conductor. Wherever earthing conductor crosses or runs along metallic structures such as gas, water, steam, conduits, pipes etc. and steel reinforcement in concrete, it shall be bonded to the same.

Cable end boxes, glands, etc. shall be connected to the earthing conductor running along with the supply cable which, in turn, shall be connected to earthing grid conductor at minimum two points.

The metallic screens of the single core cable, shall be connected to earth at one end only.

7. JOINTING

Earthing connections with equipment earthing pads shall be bolted type. Contact surface shall be free from scale, paint enamel, grease, rust or dirt. Two bolts shall be provided for making each connection. Bolted connections, after being checked and tested shall be taped with PVC tape.
Resistance of the joint shall not be more than the resistance of the equivalent length of the conductor.

8. GENERAL

Excavation and refilling of earth necessary for laying of underground earth bus and earth pipes shall be the responsibility of the Contractor.

All earth electrodes shall be tested for earth resistance by means of standard earth resistance tester.

Earthing resistance of the main bus shall be measured after connecting all the electrodes to the bus and the resistance shall not exceed one (1) ohm.

III. 10.11.14 INSTALLATION

1.0 GENERAL

The electrical installation shall be complete in all respects and any item not included in the specification but essential for proper installation and functioning of the electrical system shall deemed to be included in the scope of the specification whether specifically mentioned or not.

The system under the scope of work shall conform to the latest codes and standards as amended in the respective technical specification and schedule of works. Nothing in the specification shall be construed to relieved the successful tenderers from the responsibilities where specifically mentioned in the tender or not.

The following standards as amended shall also to be covered.

Installation

All electrical works shall comply with following standards:

IS – 10028 – Code of Practice for installation of transformers.
IS – 732 – Code of Practice for electrical wiring installation.
IS – 5216 – Guide for safety procedures & practices in electrical work.
IS – 10118 – Code of practice for section, installation and maintenance of LT Switch, switch gears & control gears. Workmanship shall be highest standard and quality.

Equipments

All equipments shall be installed strictly in accordance with manufacturers instructions / drawings.
All LT panels shall be erected on suitable base frame.
Distribution boards shall be erected on wall such that height of top of board will be at 1800 mm.

Switch boards / MCC's shall be erected with a front clearance of not less than 1000 mm and a clearance of not less than 750 mm at the rear clearance of there are cable entries or with a rear clearance of less than 200 mm in case there are no cable entries or attachments at the rear.

Cables

Cable shall be taken on trays fixed on ceiling / wall.
Cable tray shall be of Galvanised iron with welded runs.
All cable shall be provided with punched aluminium identification tags at both ends.

Earthings

Earthing shall be as per IS 3043.
All electrical power items shall be earthed by two separate and distinct earth connections from main earth bus.
General grounding shall be done to achieve earth resistance of less than 1 Ohms.

Special grounding shall be done to achieve earth resistance of less than 5 Ohms.
Earth electrodes shall be erected 1500 mm away from the building edge and minimum spacing between the electrodes shall be 3000 mm.
Earth electrodes – 38-mm dia 3 m long Cu.plate earthing. The size of copper plate earthing shall be 600 x 600 x 3mm.
Size of earth
Main earth bus : 50 x 6 mm Cu.Flat

Type of Wiring

Service building electrical rooms: Concealed wiring using PVC conduit
AHU & Staircase areas, Basement : Concealed wiring using PVC conduit
Office areas, Ground floor, lift shaft: Open conduit wiring using MS conduit above false ceiling & concealed wiring below false ceiling.

IV. 2.0 CABLING

No cable shall be laid along side a water main. Spacing equal to the diameter of the cable shall be maintained between adjacent power cables.

Selection of cable drums for each run shall be so planned as to minimise straight through joints. In each cable run, extra length shall be kept at a suitable point to enable one straight through joint to be made, should the cable develop a fault at a later date.

All due care shall be taken during unreeling, laying and termination of cable, to avoid damage due to twist, kink and sharp bends, etc. Wherever cables pass through floor or through wall openings, it shall be taken through GI. pipe sleeves. The open ends of the sleeves shall be sealed by cold setting Fire Proof sealing compound after cables are pulled through them to prevent spread of fire entry of vermin and ingress of water.

While laying cable, cable rollers shall be used at an interval of 2.0 Mts. The cables shall be pushed over the rollers by a gang of people positioned between rollers. The cable shall not be pulled from the end without intermediate pushing arrangement. The bending radius shall not be less than that specified by the manufacturer.

Each cable shall be provided with an identification tags at entrance and exit from any equipment. The tag shall be of aluminium, with the number punched on it and securely attached to the cable by not less than two turns of GI wire.

Single core cables shall be laid in trefoil formation and clamped with trefoil clamps at every 600mm intervals.

All multi core cables shall be secured to the cable tray by clamps at every 600mm intervals.

Cables from overhead cable trays to the equipment shall be taken in prefabricated cable tray with cover/GI Pipe sleeves.

2.1 Direct In Ground

Power and control cables laid directly in ground shall be laid generally conforming to the requirements of code of practice IS:1255. Generally cables shall be taken at a depth of 750mm from finished ground level and shall be provided at least 150mm sand cushioning both at top and bottom and brick protection.

Control cables shall be laid touching each other without any horizontal spacing. However the distance of the control cable from the nearest power cables shall be 150mm. Power and control cables shall be laid separately in groups.

Wherever power or control cables crosses fire hydrant or any other pipelines of earth flat the cable shall be taken 300mm below the pipeline.

After laying of cables, the trench shall be back filled with good excavated soil and well rammed in successive layer not less than 300 mm depth. The width of the trench shall be in accordance with the number of cables to be laid and in no case shall be less than 300 mm.

Cast Iron cable route markers (Cast Iron) shall be provided at every 100M intervals and at bends.

2.2 Laid On Cable Tray

The cables inside the plant buildings shall be taken on trays fixed on the ceiling.
Cable trays shall be of prefabricated GI (2.0mm thick) with necessary accessories like Tees/Bends etc. and shall be supplied along with fasteners.
Cable trays shall be hot dip galvanised as per IS: 2629.

The top tray shall be provided with cover if required.

Galvanised angle supports for trays shall be welded to insert plates. The support shall be spaced at 1500 mm centres.

Cables inside the premises shall be taken on cable trays running on ceiling.

Vertical spacing between cable racks/trays shall be minimum 300 mm. Different voltage grade cables shall be laid in separate trays when trays are arranged in tiers.

Contractor shall include in their scope of supply all Insert plates, Anchor fasteners, etc. required for the laying of cable trays. Fastening on walls/RCC columns shall be by Anchor Fasteners only.

2.3 Cable Termination

Termination and jointing of XLPE (FRLS) /PVC armoured cables shall be by means of compression method using double compression type glands and compression type lugs. Control cables are to be terminated by means of terminal lugs, the same shall be of tinned copper compression type.

Cable tails shall be sufficiently long to run all cores to the farther most terminal and then back to the appropriate point of connection.

3.0 EARTHING

The overall earth resistance of the system shall not be greater than one (1) ohm.

All panels, Distribution boards shall be provided with two (2) independent earth connections of adequate capacity to discharge the max. earth fault current.

The size of Earth bus and earth electrode shall be as per specification and as per schedule.

Minimum spacing between earth electrodes shall be provided as per IS:3043.

Water stops shall be provided wherever earthing conductor enters the building from outside, below grade level.

4.0 INSPECTION

After completion of erection/installation, each piece of equipment shall be thoroughly inspected in the presence of Contractor for correctness and completion of erection and operation.

5.0 STATUTORY REQUIREMENTS / APPROVAL FROM STATUTORY AUTHORITIES

Work for electrical installation shall be carried out in accordance with this specification and complying with the relevant statutory requirements and national standards. It shall be the responsibility of the contractor to obtain approvals of Electrical authorities and satisfy them regarding the compliance with relevant regulations for this scope of work.

The work should be carried out only under the supervision of licensed supervisors. The licenses possessed by the Contractor's supervisor shall be made available to the Client for scrutiny before commencement.

D.12.00. INSTRUMENTATION

D.12.01. PRESSURE GAUGE

i. Pressure gauge sensing elements shall be of continuous `C' bourdon type.
ii. Gauges shall be of 150/100 mm diameter dial stored enamel black finish case.
iii. Normal process pressure shall be gauged within 70% of full scale reading of the scale range.
iv. Accuracy shall be within 1.0 % of full scale range.
v. Gauges shall have internal and external stop pegs for cover range protection of 125% of maximum range and zero point respectively.
vi. All gauges shall have bottom connection for local mounting.

D.12.02. PRESSURE SWITCH

Pressure switches shall be used to control the operation of the main fire pump and the jockey pump. The pressure switches shall be of bellows type with required differential as per the system (Schematic offered and the range shall be adjustable and suitable for the operation of the pumps).

D.12.03 VALVE CHAMBER

The internal dimensions of the valve chamber shall be 1m x 1m x 1.2 m depth. Adequate PCC's shall be provided and then valve chamber shall be constructed with brickwork of 9

inches thick. The cover slab shall be of RCC with CI cover of heavy duty. Adequate rungs shall be provided for getting down into the valve chamber.

D.13.00. **PORTABLE FIRE EXTINGUISHER**

D.13.01. Portable Extinguishers of the following types shall be installed.

1. Co2 type
2. ABC Powder type
3. Foam type

D.13.02. **Co2 TYPE**

a. The Co2 Extinguisher shall be ISI mark, with initial charge with high-pressure cylinder, complete with wheel type valve, internal discharge tube, with high-pressure discharge hose with horn and suspension brackets. The extinguisher shall have ISI mark of 2878 and capacity shall be 4.5 Kgs.

b. The Co2 Extinguisher of 22.5 kg. Capacity shall have ISI mark 2878 and necessary wheel valve, discharge hose and shall be mounted on lightweight rubber tyre wheels.

D.13.03. **FOAM TYPE (MECHANICAL TYPE)**

a. The foam extinguishers of 9 Ltrs. Shall be with solution of 6% concentration with Co2 gas cartridge for making and exploring the foam compound with discharge hose and nozzle, upright type with IS:10204.

b. The 50 Ltr. Foam extinguishers shall be with IS: 5507 complete with gunmetal cap, discharge hose, initial charge mounted on trolly.

D.13.04 **ABC POWDER TYPE**

The ABC Powder Type shall be with IS: 13849. The Extinguishers shall be stored pressure dry powder, 5 Kg. capacity complete with initial charging of ABC type powder pressurized with dry nitrogen, fitted with squeeze type valve assembly, pressure gauge, discharge nozzle and mounting bracket.

E.00.00. **ERECTION, TESTING AND COMMISSIONING**

E.01.00. PIPING

E.01.01. GENERAL

a. For Steel pipelines, welded construction shall be adopted unless specified otherwise

b. Hangers and supports shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipelines movements as necessary. Approval to the type of hangers and components for all piping selected by contractor shall be obtained from the Employer/Architect before commencement of work.

c. All piping system shall be capable of withstanding the maximum pressure arising from any condition of testing (as stipulated) and operation, including water hammer effects.

d. While erecting field run pipes, the contractor shall check the accessibility of valves, instrument tapping points, and maintain minimum head room requirement and other necessary clearance from the adjoining work areas.

e. Modification of pre-fabricated pipes, if any, shall have to be carried out by the contractor at no extra charge to the Purchase/Employer.

f. All pipelines shall be given proper slope towards the drain point.

g. External and internal attachment to piping shall be designed so as not to cause flattening of pipes of excessive localized stresses.

h. All pipelines shall be identified by means of colour bands and direction arrows in consultation with the Architect.

E.01.02. END PREPARATION

a. For steel pipes, end preparation for butt welding shall be done by machining / flame cutting.

b. Socket weld end preparation shall be sewing/machining.

c. For tees, laterals, mitre bends and other irregular details cutting templates shall be used for accuracy.

E.01.03. PIPE JOINTS

a. In general, pipes having sizes 50 mm and over shall be joined by butt welding, pipes having 40 mm size of less shall be joined by socket weld able fittings.

b. Flanged joints shall be used for connection to vessels, equipment, flanged valves and also on straight lengths of pipeline at strategic points to facilitate erection and subsequent maintenance work.

E.01.04. OVER GROUND PIPING

Piping to be laid over ground shall be supported on supports. Support details shall have to be approved by the Employer/Architect.

E.01.05. PAINTING

Above ground pipes shall be coated with one coat of zinc rich primer and 2 (two) coats of synthetic enamel of `Fire Red' colour. The pipeline surfaces shall be manually cleaned of rust / millscales by wire brush, carborandum tips etc., Use of Whipping hammer, emery paper shall be done to clean pitted areas.

E.01.06. WELDING

a. Before welding, the ends shall be cleaned by wire brushing, filing or grinding. Each weld-run shall be cleaned of slag before the next run is welded.

b. Welding at any joint shall be completed uninterrupted. If this cannot be followed for some reason, the weld shall be insulated for slow and uniform cooling.

c. Welding shall be done by manual oxy-acetylene or manual shielded metal arc process.

d. As far as possible welding shall be carried out in flat position. If not possible, welding shall be done in a position as close to flat position as possible.

e. The root of butt joints shall be such as to achieve full penetration with the complete fusion or root edges. The weld projection shall not exceed 3 mm inside the pipe.

f. On completion of each run crater, weld irregularities, slag etc., shall be removed by grinding or chipping.

g. During the process of welding, all movements, shocks, vibration or stresses shall be carefully avoided in order to prevent weld cracks.

E.02.00. TEST AT SITE

E.02.01. PIPING

After the entire pipeline is erected, the pipeline shall be subjected to a hydrostatic test at 1.5 times the working pressure for a period of 2 (Two) hours. The test should be made in the presence of and to the satisfaction of the Employer's / Consultant's representative. Defects noticed in the test should be repaired or if necessary defective work should be replaced with new work. Tests shall be repeated until work is done satisfactorily. 10% of the total welding joints shall be tested for 'Radiographic' and the test results / films shall be submitted for approval. Any defects under welding have to be rectified by the Contractor free of cost.

E.02.02. WET RISER SYSTEM

After erection at site, the complete system shall be subjected to tests to show satisfactory performance in line with the requirements of specification and as per instruction of Employer/Consultant. The following tests shall be under taken in particular.

a. Automatic starting of all fire pumps by operating the test valves.
b. Operation of yard hydrant/internal hydrants and testing of sequential starting of all the fire pumps.
c. Testing of the complete system / equipment.

E.02.03. SPRINKLER SYSTEM

After erection, sprinkler system shall be tested to show the satisfactory performance in line with the requirement of the specification and as per instruction of the employer / consultant. However, the following tests shall be undertaken in particular.

a. Automatic starting of sprinkler pumps by actuating the sprinkler head in anyone of the zones as specified by the consultant / employer.

b. Automatic starting of all fire pumps without breaking the sprinkler bulb by operating test valves in the pump house.

c. Complete sequence of sprinkler annunciation panel shall be activated for the system requirement.

E.03.00. MANUALS

3 copies of manuals shall be submitted duly indexed with complete technical data sheet of each piece of equipment installed. The manuals shall be well bound and shall contain the following:

i. Table of Contents.

ii. Design data/standards.

iii. 'As built' drawings.

iv. Manufacturer's catalogues, installation and maintenance brochure.

v. Spare parts list.

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TECHNICAL SPECIFICATION FOR ELEVATOR

STANDARDS

STANDARDS COMPLAINCE: All work shall be performed in accordance with the latest edition of EN81/IS 14665 - Safety rules for construction and installation of electric Elevators, including published supplements; and such local codes as may be applicable.	
INDIAN STANDARD	
IS 14665 : Part 1 : 2000	Electric Traction lifts - Part 1 : Guidelines for Outline Dimensions of Passenger, Goods, Service and Hospital lifts
IS 14665 : Part 2 : Sec 1 and 2 : 2000	Electric Traction lifts - Part 2 : Code of Practice for Installation, Operation and Maintenance - Section 1 : Passenger and Goods lifts - Section 2 : Service lifts
IS 14665 : Part 3 : Sec 1 and 2 : 2000	Electric Traction lifts - Part 3 : Safety Rules - Section 1 : Passenger and Goods lifts - Section 2 : Service lifts
IS 14665 : Part 4 : Sec 1 to 9 : 2001	Electric Traction lifts - Part 4 : components - Section 1 : s Buffers - Section 2 : Guide Rails and Guide Shoes - Section 3 : Car-frame, Car, Counterweight and Suspension ? Section 4 : Safety Gears and Governors ? Section 5
IS 14665 : Part 5 : 1999	Electric Traction lifts - Specification - Part 5 : Inspection Manual
IS 15785: 2007	Installation and maintenance of lifts without conventional machine rooms - Code of Practice
IS 15330:2003	Installation and maintenance of lifts for handicapped persons - Code of Practice
NBC 2016	PART 8 SECTION 5 : Installation of Lifts & Escalators
EUROPEAN STANDARD	
EN 81	EUROPEAN STANDARDS FOR ELECTRIC TEACTION LIFTS
EN 115	EUROPEAN STANDARDS FOR ESCALATORS & TRAVALATORS
CIBSE GUIDE D: 2010	TRANSPORTATION SYSTEMS IN BUILDINGS
LOCAL STANDARD	
Local Lift Rules	

ON SITE TESTING SHALL BE CARRIED OUT INLINE WITH THE RECOMMENDATIONS OF ABOVE STANDARDS AND SHALL BE DULY APPROVED BY THIRD PARTY INDEPENDENT INSPECTORS APPOINTED BY US.

ELEVATOR SPECIFICATION

SL NO	SPECIFICATION	PASSENGER LIFT
1.00	BASIC DETAILS	
1.01	EQUIPMENT NOMENCLATURE	P1
1.02	EQUIPMENT TYPE	MACHINE ROOM TYPE
1.03	ZONE	No Zone
1.04	NO. OF UNITS	1 NO.
1.05 A	CONTROL SYSTEM	SIMPLEX
1.05 B	GROUPING	SIMPLEX ELEVATOR
1.05 C	GROUPED WITH	NOT GROUPED
1.06	CAPACITY NOT LESS THAN	544 KG X 8 PAX
1.07	SPEED NOT LESS THAN	1 MPS
1.08	NO OF STOPS / OPENINGS	06 / 06
1.09	SERVICE FLOORS	G,L1,L2,L3,L4,L5
1.10	NON SERVICE FLOOR	Nil
1.11	EMERGENCY EXIT FLOORS	Nil
1.12	FRONT OPENING FLOORS	G,L1,L2,L3,L4,L5
1.13	REVERSE OPENING FLOORS	Nil
1.14	TRAVEL(M) (APPROXIMATE)	15.3 M
1.15	HOISTWAY SIZE AVAILABLE AS PERARCH.DRW (Tolerance +0 MM/-50 MM (SHAFT TOLERANCE IS INDICATIVE AND FOR PLANNING PURPOSE ONLY)	1750 MM +0/-50 WIDE X 1750 MM +0/-50 DEEP
1.16	MACHINE LOCATION	ABOVE HOIST WAY IN SEPARATE MACHINE ROOM
1.17	CONTROL	ATTENDENT
1.18	PIT DEPTH REQUIRED	1800 MM
1.19	COUNTER WEIGHT SAFETY ON ACCOUNT OF HANGING PIT	NOT APPLICABLE
1.20	OVERHEAD REQUIRED	4115 MM
1.21	POWER REQUIREMENT	3 PHASE - 415 VOLTS, 50 HERTZ, 4 WIRE 1 PHASE - 220 VOLT, 50 HERTZ
1.22	COMBINED VOLTAGE AND FREQUENCY VARIATION	+/-10
1.23	CAR TYPE	WIDE
1.24	CLEAR CABIN INTERNAL SIZE	1300 MM WIDE X 1100 MM DEEP
1.25	CLEAR CABIN INTERNAL HEIGHT BELOW FALSE CEILING	2300 MM
1.26	MINMUM ACCEPTABLE CAR AREA	1.31 SQM ~ 1.45 SQM

	IN SQ.M		
1.27	CAR DOOR WIDTH	800 MM	
1.28	CAR DOOR HEIGHT	2100 MM	
1.29	LANDING DOOR WIDTH		800 MM
1.30	LANDING DOOR HEIGHT		2100 MM
1.31	NON STANDARD ENTRANCE HEIGHT FLOORS		Nil
1.32	STRUCTURAL ENTRANCE WIDTH X HEIGHT		1000 MM WIDE X 2200 MM DEEP
1.33	FLOORING WEIGHT ALLOWANCE		100 KG
2.00	CABIN DETAILS & FINISHES:		
2.01	CAR ENCLOSURE - REAR PANEL		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.02	CAR ENCLOSURE - LEFT SIDE PANEL		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.03	CAR ENCLOSURE - RIGHT SIDE PANEL		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.04	CAR ENCLOSURE - FRONT RETURN PANEL		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.05	CAR ENTRANCE		AUTOMATIC POWER OPERATED
2.06	CAR DOOR TYPE		2 PANEL CENTER OPENING
2.07	CAR DOOR FINISH		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.08	VISION PANEL		NOT REQUIRED
2.09	CABIN WEIGHT ALLOWANCE		NOT APPLICABLE
2.10	LANDING DOOR TYPE		2 PANEL CENTER OPENING
2.11	LANDING DOOR FINISH IN GROUND FLOOR		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.12	LANDING DOOR FINISH IN ALL OTHER FLOORS		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.13	VISION PANEL		NOT REQUIRED
2.14	ENTRANCE JAMB TYPE		NARROW - 50MM
2.15	LANDING ENTRANCE FRAME FINISH IN GROUND FLOOR		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.16	LANDING ENTRANCE FRAME FINISH IS OTHER FLOORS		STAINLESS STEEL HAIRLINE FINISH IN 304 GRADE
2.17	DOOR OPERATOR		ACVVVF DOOR OPERATOR
2.18	CAR & LANDING SILL		EXTRUDED HARD ALUMINIUM
2.19	FIRE RATING FOR LANDING DOORS		60 MIN FIRE RESISTENT RATING
2.20	DOOR PROTECTION		INFRA RED SCREEN OF MINIMUM 75 BEAMS. THE LOWEST BEAM SHOULD BE AT 25 MM ABOVE THE FLOOR LEVEL AND THE HIGHEST BEAM SHOULD BE AT 1823 MM.
2.21	FLOORING		25 MM RECESS - FLOORING BY OTHERS
2.22	BUMPER RAIL - SS FLAT BAR MOUNTED 330 MM TO CENTRE OFRAIL FROM CAB FLOOR.		NOT REQUIRED
3.00	EQUIPMENT SPECIFICATION :		
3.01	PRIME MOVER		GEARLESS PERMANENT MAGNET

		SYNCHRONOUS MOTOR
3.02	ROPING TYPE	02:01
3.03	DRIVE MOTOR CONTROLLER - CUBICLE RATING IP 22	MICRO PROCESSOR BASED ACVVVF
3.04	TYPE OF HOIST MOTOR	**PM MOTOR**
3.05	BRAKE SYSTEM	**ELECTRO MECHANICAL BRAKE**
3.06	TYPE OF GROUP OPERATION	**SIMPLEX**
3.07	DOOR MOTOR TYPE & CONTROL	**ACVVVF**
3.08	COUNTER WEIGHTS	**CAST IRON BLOCKS**
3.09	POSITION OF COUNTER WEIGHTS	**REAR CWT**
3.10	CAR RAILS /CWT RAILS	**MACHINED T SECTIONS**
3.11	TYPE OF CAR GUIDE	**SLIDING TYPE GUIDE SHOE**
3.12	TYPE OF COUNTER WEIGHT GUIDE	**SLIDING TYPE GUIDE SHOE**
3.13	LOAD COMPENSATION (if required)	**ENCAPSULATED CHAIN WITH GUIDE IN THE PIT**
4.00	SAFETY FEATURES:	
4.01	CAR SAFETY	**GRADUAL**
4.02	LANDING DOOR LOCK	**ELECTRO MECHANICAL**
4.03	EMERGENCY BRAKE RELEASE	**REQUIRED**
4.04	OVER SPEED PROTECTION	**BI DIRECTIONAL OVER SPEED GOVERNOR**
4.05	SAFETY BUFFERS IN PIT	**OIL BUFFER /SPRING BUFFER**
4.06	PROVISION FOR EMERGENCY OPENING OF LANDING DOOR AT EACH FLOOR	**REQUIRED**
5.00	INDICATORS ,SIGNAL FEATURES & OPERATING DEVICES	
5.01	CAR	
5.02 A	NO. OF CAR OPERATING PANELS	**ONE ON THE FRONT RETURN PANEL**
5.02 B	PRIMARY COP	**THE MAIN COP SHALL CONSIST OF FLOOR BUTTONS , INTERCOM, ALARM, DOOR OPEN & DOOR CLOSE BUTTONS ALONG WITH A SERVICE CABINET . THE INDICATOR SHALL BE MOUNTED ON THE TOP PORTION OF THE PANEL. THE COP SHALL BE FULL HEIGHT**
5.02 C	AUXILLARY COP	**NA**
5.02 D	TYPE OF CAR OPERATING PANEL	**WITH FACE PLATE**
5.02 E	FINISH OF FACE PLATE (COP)	**STAINLESS STEEL HAIRLINE FINISH**
5.02 F	THICKNESS OF FACE PLATE (COP)	**3 MM**
5.02 G	BUTTON TYPE	**MICRO MOTION CLICK TYPE VANDAL PROOF WITH BRAILLE MARKINGS**
5.02 H	CABIN CAR ILLUMINATION	**ATTRACTIVE DOWN LIGHTS - MINIMUM 50LUX AT FLOOR LEVEL AND ON CONTROL DEVICES.**
5.02 I	LIGHTING FIXTURES	**COLD WHITE OR WARM WHITE COLOUR LED BASED LIGHTS WITH BUILT IN TRANSFORMERS (3 PIECES 1 W LUXEON LED) IN ALUMINIUM CASING WITH A BEAM ANGLE OF 30 DEGREES**
5.02 J	FALSE CEILING	**MANUFACTURER SHOULD PROVIDE MINIMUM 5 OPTIONS FOR SELECTION**
5.02 K	ATTENDANT OPERATION WITH KEY SWITCH	**REQUIRED**
5.02 L	FAN CONTROL	**REQUIRED**
5.02 M	PRESS & SPEAK THREE WAY, BUILT IN INTERCOM	**REQUIRED**

	(INCLUDING WIRING UPTO BUILDING CONTROL ROOM)	
5.02 N	CAPACITY PLATE	REQUIRED
5.02 O	EMERGENCY DISPLAY ENGRAVED IN STAINLESS STEEL PLATE OF 3 MM THICK	REQUIRED
5.02 P	CAB VENTILATION a) CROSS FLOW FAN -2 NOS NOT MORE THAN 0.33 W PER CUBIC FEET PER MIN AT MAXIMUM SPEED) b) NATURAL VENTILATION THERE SHALL BE A MINIMUM AIR HANDLING CAPACITY TO PROVIDE ONE AIR CHANGE PER MINUTE BASED ON THE NET INSIDE CAR VOLUME.	REQUIRED
5.02 Q	NO SMOKING SIGNAGE	REQUIRED
5.02 R	DISPLAY UNIT IN EACH CAR WITH 50 MM HIGH NUMERALS, ON THE COP	DOT MATRIX /16 SEGMENT DIGITAL
5.02 S	HANDRAIL	REQUIRED ROUND TYPE ON THREE SIDES
5.03	HALL POSITION INDICATION IN ALL FLOORS	DOT MATRIX /16 SEGMENT DIGITAL
5.04	HALL POSITION INDICATION IN MAIN LOBBY FLOOR	DOT MATRIX /16 SEGMENT DIGITAL
5.05	NUMBER OF HALL BUTTON RISERS IN EACH FLOOR	ONE RISER PER FLOOR
5.06	HALL CALL BUTTONS TYPE AT ALL FLOORS	VANDAL PROOF BUTTONS IN STAINLESS STEEL FINISH WITH BRAILLE MARKINGS
5.07	FULL WIDTH HALF HEIGHT CLEAR MIRROR	REQUIRED ON REAR SIDE
5.08	CAR TOP BARRICADE MIN 700 MM TO 1100 MM AS PER CODE	REQUIRED
5.09	EMERGENCY LIGHT WITH 30 MINUTES BACK AND Ni-Cd BATTERIES ILLUMINATING 3 W LED LAMPS	REQUIRED
5.10	TRAVELLING CABLE - FLAT TYPE WITH MINIMU 10% SPARE CORES, FRLS, HALOGEN FREE WITH INBUILT `CAT 6E / FIBER OPTIC / CO- AXIAL CABLE FOR CAMERA, VOICE AND DATA (REQUIREMENT OF CAT 6E / FIBER OPTIC / CO-AXIAL WILL BE SELECTED BY THE CLIENT BASED ON THE END SYSTEM)	REQUIRED
5.11	LIFT IDENTIFICATION (STYLE & TYPE AS PER CLIENTS CHOICE)	NOT REQUIRED
5.12	CABIN VENTILATION AT SKIRT LEVEL .	REQUIRED
5.13	CABIN TOE GUARD - PAINTED GI SHEET FOR 1 MM THICK	REQUIRED
5.14	FULL HEIGHT LANDING FASCIA - PAINTED GI SHEET FOR 1 MM THICK	REQUIRED
5.15	CROSS FLOW BLOWER .	REQUIRED
5.16	EMERGENCY ALARM CAN BE OPERATED BY PRESSING A BUTTON IN THE CAR. POWER SUPPLY IS OBTAINED FROM Ni-Cd BATTERIES.	REQUIRED
6.00	OPERATING FEATURES	
6.01	Full collective operation Registered car and hall calls are answered in the order in which the landings are reached.The direction of travel is established by the first registered car command or hall call.	REQUIRED
6.02	Advanced Door Opening To improve performance time, the doors will begin opening as the car approaches a landing.	REQUIRED
6.03	Fireman operation During a fire when the fireman `s switch is activated the car call	

	of all cars and all calls are cancelled and the cars immediately returns to a pre determined floor. The designated fire lift then responds only to car calls which facilitates fire fighting and rescue operations.	FIRE LIFT
6.04	Firemens emergency Return Upon activation of the fireman`s switch or a key switch or the buildings smoke/fire sensors, all calls are cancelled, all cars return to a specified evacuation floor and the doors then open for the safe exit of the passengers. The activation of the Smoke/ fire alarm in any other floor shall bring the elevator to the Ground floor and the activation of Smoke/ Fire alarm in the ground floor shall bring all the elevators to another predetermined floor.	REQUIRED
6.05	Safe landing operation If a car has stopped between floors due to some equipment malfunction, the controller checks the car and if its considered safe to move the car, the car will move to the nearest floor at a lower speed and the doors will open.	REQUIRED
6.06	Next landing operation If the Elevator do not open fully at destination floor, the doors close the car automatically moves to the next or nearest floor where the doors will open.	REQUIRED
6.07	No Correction Mode After power failure and ARD operation when the power supply is resumed, Elevator should continue to attend Car / Hall Calls without going to terminal floor for re setting the floor position reference.	REQUIRED
6.08	Top of Car Inspection The inspection operation switch and its push buttons and an emergency stopping device shall be placed on the car roof that they are readily accessible.	REQUIRED
6.09	Hand operation In the event the elevator is stuck in between floors, a brake release device should be provided to open the brakes and allow the car to move in a controlled manner and bring it to level.	REQUIRED
6.10	Emergency Brake release and manual Rescue operation In the event the elevator is stuck in between floors, a brake release device should be provided to open the brakes and allow the car to move in a controlled manner and bring it to level.	REQUIRED
6.11	Motor Overheat Protection Self protection mode will be achieved if the temperature of the motor exceeds the preset value due to the heat made by motor itself or the high temperature in the environment. The car stops at the nearest floor, once the temperature falls down to normal, the car will recover.	REQUIRED
6.12	Overload holding stop with indicator If the load exceeds the rated load, the sound signal will be given out by Speaker and `OVERLOAD` will be displayed, the car door will not close, the elevator will not start. The overload condition is removed when the weight of the car falls below the rated load.	REQUIRED
6.13	Over load Bypass When a car is loaded to a predetermined percentage of capacity, weight sensing devices are activated, causing the car to bypass further hall calls.	REQUIRED
6.14	Door Hold Button Pressure on the Door Hold Button in the car operating panel opens the door, reverses the door and keeps the door open for a specified adjustable door hold time.	NOT REQUIRED
6.15	Door open/close button light Door open/close button will be	

	highlighted if the buttons are pressed.	REQUIRED
6.16	Separate Hall & Car call door times The time that an elevator door remains open after a stop defers between hall & carcalls. Generally more time is needed for a car to respond to hall calls.	REQUIRED
6.17	Reopen with Hall Call Button operation Closing doors can be opened by pressing the hall button corresponding to the travel direction of the car.	REQUIRED
6.18	Door Load Detector When excessive door load has been detected while opening or closing, the doors immediately move in the reverse direction.	REQUIRED
6.19	Repeated door -close Should an obstacle prevent the doors closing, the doors will repeatedly open and close until the object is removed.	REQUIRED
6.20	Door Nudging If the doors are prevented from closing for a fixed period of time a buzzer sounds and the doors begin to close at slow speed.	REQUIRED
6.21	Door time protection close If the car door does not close completely within an adjustable time after the door close command, the elevator will enter the mode: Remove itself from group operation, i.e. Extinguish hall or car direction lanterns. Hall calls will be assigned to other elevators in the group. open its doors and sound the buzzer in the car- operating panel. attempt to close the doors again after three unsuccessfull retries, the car will be shut down with its doors open and deenergized. Pending car calls will be cleared.	NOT REQUIRED
6.22	Automatic door speed control The system monitors the actual door load conditions at each floor and automatically adjust the door speed and torque accordingly.	REQUIRED
6.23	Door sensor self diagnosis operation Failure of non-contact door sensors is checked automatically, and if a problem is diagnised, the door close timing is delayed and the closing speed is reduced to maintain elevator service and ensure passenger safety.	REQUIRED
6.24	Car arrival chime On each floor , a bell ring will be given out when the car stops approaches at the destination floor.	REQUIRED
6.25	Voice Guidance System Information on elevator service such as current floor or service direction will be heard by the passengers inside the car. The system will alo make announcements on the emergency operations	REQUIRED
6.26	Car call erase Before the car starts the registration of a car or operation can be cancelled by double click of this button. After the car starts the registration cancelling will not be allowed.	REQUIRED
6.27	False call cancelling If the number of registered car calls does not correspond to the car load, all calls are cancelled to avoid unnecessary stops.	REQUIRED
6.28	Car Travel Time Evaluation Cars are allocated to hall calls by considering the number of car calls that will reduce passenger waiting time in each hall and the travel time of each car.	NOT REQUIRED
6.29	Automatic Hall call registration If one car cannot carry all waiting passengers because it is full, another car will automatically be assigned for the remaining passengers.	REQUIRED
6.30	Main Floor Parking	

	An available car always parks on the main floor with the doors open to reduce the passenger waiting time.	REQUIRED
6.31	Immediate Prediction When a passenger has registered a hall call, the best car to respond to that call is immediately selected. The corresponding hall lantern lights up and chime sounds once to indicate which lift doors will open.	NOT REQUIRED
6.32	Continuity of service A car experiencing trouble is automatically withdrawn from group operation to maintain an overall group performance.	NOT REQUIRED
6.33	Car Fan/Light shutoff- Automatic If there are no calls for a specified period the car ventilation fan/lighting will automatically be turned off to conserve energy.	REQUIRED
6.34	Terminal floor protection When the lift arrives at the terminal floor, and the speed exceeds the imaginary speed line calculated from control system, the car would be forced to decelerate and stop at the terminal floor.	REQUIRED
6.35	Regenerative Drive For energy conservation, power generated by a traction machine can be harnesed using regenerative drives and converted to electrical power to be used by other electrical systems in the building.	NOT REQUIRED
6.36	CCTV Cable An additional FIBER OPTIC / Co- Axial / CAT-6E cable to be used for close circuit television monitoring. This system enables the security personnel to monitor the movement inside the elevator. this will be effective in preventing criminal and mischievous acts inside the elevator. CCTV System including external wiring will be by others.(Type of cable will depend on the end user requirement)	REQUIRED
6.37	Group indicator panel / Supervisory Panel A panel installed inside the engineering room or anyother location inside the building helps to monitor each elevator status and operation status and operations using indicators. Scope includes wiring upto Chief Engineer`s room.	NOT REQUIRED
6.38	Energy saving operation (No. of Cars) To save energy, the number of service cars is automatically reduced to some extent but not so much that it adversely affects passenger waiting time.	NOT REQUIRED
6.39	Emergency Exit On car top An emergency trap door in the car roof to permit the rescue and evacuation of passengers. The exit should measure at least 0.50 M x 0.70 M	NOT REQUIRED
6.40	Automatic Rescue Device This device is used for rescue operation in case of power shut down, it is powered by a rechargable battery when a sudden power cut happens, a sound signal will comfort the trapped passengers, then the car will move towards to the near floor, keep the door open, meanwhile trapped passengers can get out of the car.	REQUIRED
6.41	Energy saving operation (Allocation control) When a call is registered, the system controls car assignment considering near - future traveling distance of all elevators to conserve the energy.	NOT REQUIRED
6.42	Potential Free Contacts All elevators are to be provided with a dry-contact interface. Customer can use it to monitor the elevator status and the signal to be indicated are : a. Emergency stop switch in the cabin or any other elevator safety activated signal. b. Operation of alarm bell signal. c. Firemen`s emergency operation signal.	NOT REQUIRED

	d. Car position status. e. Indications of faulty conditions. f. Indications of equipment operation. g. Run / Stop status	
6.43	ACCESS CONTROL Necessary dry contacts shall be provided for interphase with access control system. The elevator vendor shall terminate these potential free contacts in the pit of every elevator. There shall be a over rider provided in the service cabinet of the specific elevator. Integration with access barriers shall also be possible.	**NOT REQUIRED**
6.44	EMERGENCY BATTERY OPERATED POWER SUPPLY FOR ALL LIFTS A invertor based battery operated emergency power supply source should be provided on top of the cabin and connected to the emergency alarm, emergency light, fan and intercom. The required backup is for additional 1 hour beyond the default half a hour provided for individual items	**REQUIRED**
6.45	HIGH-DEFINITION LCD DISPLAY UNIT THAT HAS THE FOLLOWING FUNCTIONS : a. Floor and travel directions of lift b. User / time based messages c. Lift status messages d. Date / time e. Time based pictures/videos f. Floor directory messages g. MPEG 1 and MPEG 4 play back h. Portrait view i. Remote configuration THE MINIMUM VIEWING AREA SHOULD BE 228 MM W X 304 MM H.CONTRAST RATIO OF 400:1 OPERATING ON 12 V DC THIS CAN BE USED AS A MEANS OF PROVIDING IN-HOUSE INFORMATION OR AS A MEANS OF PUBLIC RELATIONS THE COP TO INDICATE, SERVING FLOORS	**NOT REQUIRED**
6.46	Flashing Hall lanterns A Hall lantern which corresponds to a cars service direction Flashes to indicate that a car will soon arrive.	**NOT REQUIRED**
6.47	Bank Separation operation Hall buttons and the cars called by each button Can be divided into several groups for independent group control operation to serve special needs or different floors.	**NOT REQUIRED**
6.48	Back-up operation for group control An operation by car controllers, which automatically starts to maintain elevator operation in the event that a micro processor or transmission line in the group controller has failed.	**NOT REQUIRED**
6.49	VIP OPERATION A specified car is withdrawn from group control operation for vip service operation. When activated , the car responds only to the existing car calls, moves to the specified floor and parks there with the doors open. the car then responds only to the car calls.	**NOT REQUIRED**
6.50	OPERATION FOR EMERGENCY : The car upon the activation of exclusive button on the car operating panel the elevator transports , the bed/medical equipment etc. exclusively to a preprogrammed emergency	**NOT REQUIRED**

	floor without responding to other calls.	
6.51	RETURN Upon activation of primary and/or secondary wave seismic sensors, all cars stop at the nearest floor, and park there with the doors open to facilitate the safe evacuation of passengers.	NOT REQUIRED
6.52	FLOOD EMERGENCY RETURN: Upon activation of flood sensors, all cars stop at the nearest floor, and park there with the doors open to facilitate the safe evacuation of passengers.	NOT REQUIRED
6.53	ELEVATOR MONITORING SYSTEM: Each elevator status can be monitored and controlled using an advanced web based technology which provided an interphase through personal computers. It should be possible to turn on /off the elevators and change the service floors using this system. Scope includes wiring upto Chief Engineer`s room and all hardware including PC (common for whole project)	NOT REQUIRED

TECHNICAL DATASHEET ELEVATOR

SL NO	SPECIFICATION	PROPOSED Construction of G+1 floors Indian Bank, Institutional Building at Thirupapuliyar Village, Cuddalore - Remarks	PAPL COMMENTS
1	MOTOR KW RATING		
2	STARTING CURRENT - AMPS		
3	RUNNING CURRENT - AMPS		
4	KVA RATING		
5	HEAT EMISSION IN MACHINE ROOM - KCAL		
6	NOISE LEVEL IN CABIN - DB		
7	NUMBER OF MAIN ROPES - NOS.		
8	SIZE OF MAIN ROPES - MM		
9	SIZE OF GOVERNOR ROPE - MM		
10	BUFFER TYPE		
11	SAFETY SYSTEM		
12	COUNTER WEIGHT MATERIAL - AS PER TENDER		
13	DECORATION WEIGHT CONSIDERED FOR FLOORING - KG		
14	MACHINE ROOM AIRCONDITIONING		
15	CABIN HEIGHT UNDER FALSE CEILING FROM TOP OF FLOORING - MM		
16	CABIN HEIGHT UNDER ROOF FROM TOP OF FLOORING - MM		
17	CAR TOP CONTROLS		

18	FALL PROTECTION ON CAR TOP AND HEIGHT AS PER TENDER REQUIREMENT		PLEASE PROVIDE THE POWER DETAILS FOR CLIENT REQUIREMENT
19	PROVISION FOR ACCESS CONTROL SYSTEMBOTH IN CAR AND IN THE LANDING AS PER TENDER REQUIREMENT		
20	ALL THREE PHASE EQUIPMENTS SHOULD BE DOUBLE EARTHED. THREE PHASE POWER EARTHING SHOULD BE CONNECTED SEPARATELY WITH INDEPENDENT BOLT AS PER INDIAN CODE REGULATIONS. EARTHINGS CAN BE EITHERIN COPPER OR IN GI TO MEET THE REQUIREMENT.		
21	EMERGENCY STOP SWITCH IN PIT AT TWO LOCATION		
22	PIT LADDER UP TO HEIGHT OF 1300MM FROM LAST LANDING		
23	COUNTER WEIGHT SCREEN GUARD IN THREE LOCATION - PIT , OVER HEAD ANDAT THE POINT WHERE THE CAR AND COUNTER WEIGHT CROSS EACHOTHER.		

SITEWORKS

SL NO	SPECIFICATION	REQUIREMENT	PROPOSED Construction of G+1 floors Indian Bank, Institutional Building at Thirupapuliyar Village, Cuddalore - Remarks	PAPL COMMENTS
1.00	MINOR BUILDERS WORK	BY ELEVATOR VENDOR		
1.01	SAFETY BARRICADES DURING ERECTION	BY ELEVATOR VENDOR		
1.02	STEEL ITEMS - M/C. BEAMS, SILL ANGLES, BUFFER SUPPORT CHANNELS, CAR & CWT BRACKETS,FASCIAS, TOE GUARD, SEPARATOR BEAMS ETC.	BY ELEVATOR VENDOR		
1.03	SCAFFOLDING	BY ELEVATOR VENDOR		
1.04	PIT LADDER	BY ELEVATOR VENDOR		

1.05	STORE ROOM - ENCLOSURE, SAFTY AND SECURITY BY (ONLYSPACE WILL BE PROVIDED BY OWNER)	BY ELEVATOR VENDOR		
1.06	LIFT LICENSE	BY ELEVATOR VENDOR		
1.07	UP TIME GUARANTEE	99%		
1.08	RESPONSE TIME FOR ATTENDINGTHE BREAK DOWN FROM THE TIME INTIMATION IS MADE	1 HOUR		
1.09	RESPONSE TIME FOR RECTIFICATION FROM THE TIMEOF ATTENDING TO THE CALL	2 HOURS		

TEST CERTIFICATE

SL NO	SPECIFICATION	Remarks
	TEST CERTIFICATES	
1	GOVERNOR	
2	MACHINE	
3	BUFFER	
4	CONTROLLER	
5	AUTOMATIC RESCUE DEVICE	
	TYPE TEST CERTIFICATES	
1	DOORS	
2	TRAVELING CABLE	
3	HOISTWAY WIRING	
4	MAIN ROPE	
5	GOVERNOR ROPE	
6	CAR RAIL	
7	COUNTER WEIGHT RAILS	
	ON SITE TESTS	
1	LOAD TEST	
2	OVER SPEED GOVERNOR	
3	BUFFER COMPRESSION TESTS	
4	PMT READINGS	

APPROVALS ELEVATOR

SL NO	SPECIFICATION	PROPOSED Construction of G+1 floors Indian Bank, Institutional Building at Thirupapuliyar Village, Cuddalore -Remarks
	CAR FINISHES	

1	CABIN	
2	CEILING	
3	COP & BUTTONS	
4	CAR DISPLAY	
5	FLOORING	
6	CAR DOOR	
	LANDING FINISHES	
1	DOORS	
2	LANDING DISPLAY / DCS PANEL	
3	HALL CALL BUTTON	
4	HALL LANTERN	
	DRAWING APPROVAL	
1	SHAFT PLAN	
2	SECTION	
3	ENTRANCE VIEW	
4	MACHINE ROOM LAYOUT	
5	OTHER COMPONENTS SUCH AS BEAM GROUTING, HOISTING HOOK / BEAM, ELECTRICAL LINE DIAGRAM ETC..	

INNOVATIONS

SL NO	SPECIFICATION	PROPOSED Construction of G+1 floors Indian Bank, Institutional Building at Thirupapuliyar Village, Cuddalore -Remarks
1	IS REGENERATIVE DRIVE PAR OF YOU?RE YOUR SPECIFICATION	
2	MANUAL RELEASE LEVER FOR RESCUE PROVIDED IN CONTROL PANEL IN TOP LANDING IN MACHINE ROOMLESS ELEVATORS	
3	SAFETY SWITCH IS PROVIDED FOR THE MANUAL CRANKING WHEEL IN THE MACHINE ROOM - WHEN THE CRANKING WHEEL IS REMOVED FROM ITS POSITION FOR ANY RESCUE PROCESS A SAFETYSWITCH AUTOMATICALLY CUTS OFF POWER TO THE ELEVATORS	
4	ALL GEARLESS MACHINES HAVE EMBEDDED PM MAGNETS & NOT GLUED	
5	DC DOOR MOTOR IS PROVIDED	
6	ELEVATORS ARE IOT READY	
7	CAR TOP EMERGENCY IS PROVIDED	

APPROVED PARTS

MOTOR /MACHINE	OTIS , KONE ,SCHINDLER ,CROMPTON , SIEMENS, KINETIC

इंडियन बैंक INDIAN BANK CUDDALORE BRANCH OFFICE

DRIVE	OTIS , KONE ,YASHIKAWA ,HITACHI ,TOSHIBA , MITUSBISHI ,FUJI , SCHINDLER
DOORS	OTIS , KONE ,SCHINDLER ,WITTUR , FERMATOR
RAILS	MONTEFERO ,SIEMATIC
ROPES	USHAMARTIN
SS PANELS	TATASTEEL , JSW & SAIL
BATTERY	EXIDE ,AMARON ,FUJI ,AMCO

ADDITIONAL FEATURES

SL NO	SPECIFICATION	PROPOSED Construction of G+1 floors Indian Bank, Institutional Building at Thirupapuliyar Village, Cuddalore -Remarks
1	BIGGER CAPACITY PROVIDED THAN THE TENDER SPEC.	
2	HIGHER SPEED PROVIDED THAN THE TENDER SPEED.	
3	BETTER DISPLAYS PROVIDED THAN THE TENDER SPECIFICATION.	
4	ADDITIONAL WARRANTY PROVIDED THAN THE TENDER SPECIFICATIONS.	

इंडियन बैंक Indian Bank

इलाहाबाद ALLAHABAD

LIST OF APPROVED MAKES OF MATERIALS

List of Material of
Approved Makes / Brands

The contractor shall quote for the best of the materials specified below with ISI mark wherever applicable. The contractor shall obtain prior approval from the Bank / Architect before placing order for the specific materials agencies. In case of non availability of any of the approved/specified materials/agency during the execution of the work, the Bank /Architect may approve suitable equivalent brand/agency and his decision shall be final and binding on the contractor and the price variations If any shall be adjusted accordingly.		
LIST OF CIVIL WORK MATERIALS		
1	Grey Cement (43 or 53 Grade)	UltraTech / A.C.C / Ramco / Coramandel
2	White Cement	Birla White / J.K.white
3	Putty	Birla White Putty / JK Wall putty
4	Steel (Thermo Mechanically Treated Steel) High strength deformed bars	TATA / SAIL / JSW
5	Clay Bricks	Table moulded clay bricks of crushing strength not less than 35 kg / sq cm approved by Engineer / Architect.
6	200MM AND 100 MM THICK SOLID CONCRETE BLOCK WORKS	Good quality locally available material approved by Engineer / Architect
7	Teakwood Panel Main Frame and Shutter	Ghana teak wood 2nd Quality
8	Bank internal ,Dormitory and toilet doorframe Teak wood	Ghana teak wood 2nd Quality
9	Bank internal ,Dormitory and toilet doorframe water proof flush door with lamination two site	Century / Anchor / Archid / Green
10	Main Door heavy duty SS Ball BearingButt Hinges ,Brass Mortise Locks & Latches, SS Tower bolt, Handle & Stopper.	Hardware – Godrej / Ebco / Hettich / Hebba
11	Bank internal, Bedroom and Toilet heavyduty SS Ball Bearing Butt Higes, Brass Mortice Locks, Cylindrical Lock & Latches, Tower Bolt with Handle.	Hardware – Godrej / Ebco / Hettich / Hebba
12	UPVC frame for windows, Ventilator, glazing	Fenesta / Kommerling, with Saint Gobin glass
13	Water proofing material / compound.	Pidilite / Sika / DR. Fixit / Cico

14	ceiling paint material Premium emulsion paint With primer	Asian paint-Classic emulsion / Nippon / Dulux paint / Berger
15	Internal wall paint Premium emulsion with primer	Asian paint-Classic emulsion / Nippon / Dulux paint / Berger
16	External paint (ACE) emulsion paint With primer	Asian Ultima Range / Nippon / Dulux / Berger
17	window Grill of synthetic enamel paint with corrosion protection (zinc chroming)	Asian paint / Nerolac paint / Dulux / Berger
18	Melamine Polish	Asian paint / MRF / Nerolac / Dulux / Berger
19	External Texture paint Finish(frontelevation)	Asian Paints Apex ULTIMA allura range / Axo noble Dulux, DuluxWeather Shiled Textured Finishes
20	ACP CLADDING (In Front/Side Elevation)	Alucobond / Eurobond
21	Vitrified tiles	RAK / NITCO / Johnson / Khajaria
22	Granite (Bank 1st Floor & Staircase Area, and Lift Wall Gladding with	Good quality available material approved by Engineer / Architect
23	Decorative Concrete Parking Tile 38 mm	Basant Beton / Eurocon
24	Iterlocking Paver Block	Basant Beton / Eurocon
25	MS Rolling Shutter & Grills	Good quality locally available material.

WATER SUPPLY AND DRAINAGE

LIST OF APPROVED BRAND / MAKE / MANUFACTURE

PORCELAIN WARES	:	PARRYWARE / ROCA / HINDWARE / KOHLER
U.P.V.C. PIPES	:	ASTRAL / ASHIRWAD / SUPREME / FINOLEX
P.V.C. FITTINGS	:	ASTRAL / ASHIRWAD / SUPREME / FINOLEX
C.P.FITTINGS / TOILET ACCESSORIES	:	JAQUAR / SCHELL
BALL VALVES	:	RB / ZOLOTO / LEHRY / LEADER
CPVC PIPES	:	ASTRAL / ASHIRWAD / SUPREME / FINOLEX
GATE VALVES	:	LEADER / ZOLOTO / LEHRY / RB
FLUSHING CISTERN (CONCEALED)	:	GEBERIT
MIRROR	:	PARRYWARE / MODIGUARD / ASAHI
BUTTERFLY VALVES	:	LEADER / ZOLOTO / LEHRY
PUMPS	:	GRUNDFOS / ITT / KIRLOSKAR
Y STRAINER	:	ZOLOTO / LEHRY / TECHNO
PRV	:	RB / HAWK / LEHRY
WATER METER	:	TOSHNIWAL / EUREKHA
CHECK VALVE / NON-RETURN VALVE	:	LEADER / ZOLOTO / LEHRY
FRP MANHOLE COVER	:	HP STRONG DRAIN
PRESSURE GAUGE	:	H-GURU, WIKA
LEVEL INDICATOR	:	LEHRY
PVC ENCAPSULATED FOOTREST.	:	TCS / EQUAL APPROVED MAKE
R.C.C. PIPES	:	MAHALAKSHMI SPUN PIPES / INDIAN HUME PIPE WITH ISI
STORAGE HEATERS	:	RACOLD / VENUS

BRACKET SUPPORTS	:	LOCALLY FABRICATED
CONNECTION PIPE-PVC	:	USING ASTRAL / ASHIRWAD / SUPREME / FINOLEX
PVC FITTINGS (MOULDED)	:	USING ASTRAL / ASHIRWAD / SUPREME / FINOLEX

LIST OF APPROVD MAKES - FIRE SUPRESSION SYSTEM

I. WET RISER CUM DOWN COMER / SPRINKLER SYSTEM

1.	Pumps		Kirloskar / Mather & Platt / Greaves
2.	Motor		ABB / Siemens
3.	Diesel Engine		Kirloskar / Greaves Cotton
4.	Motor Control Panel / Diesel Auto Start Panel		Creative switch gear/ Bright Engineering / Excel / Lotus controls / Chennai control system / Hallmark controls & security systems
5.	Pipes		Jindal /Tata / Zenith
6.	Butterfly fly & Ball Valve		Keystone / Audco / Lehry / leader / Zoloto
7.	Sluice Valve		Kalpana / Sarkar / Kirloskar
8.	Expansion Joints		Cori / Kanwal
9.	Hydrant Valve & Branch Pipe		Newage / Sukan / Winco / Shah Bhogilal
10.	Fire Brigade Inlets		Newage / Shah Bhogilal
11.	RRL Hoses		Newage / Chataria / Shah bhogilal
12.	Hose Box		Newage / Eversafe / Eqv.
13.	Pressure Gauge		H.Guru / Wika
14.	Pressure Switch		Indfos / Switzer
15.	Cables		Polycab / CCI / Universal / Finolex
16.	Alarm Valve, Sprinklers		HD / Tyco / Viking
17.	Flow Switches		System Sensor / Switzer / Emerson / Endress+ Hauser
18.	Paint		Asian Paint / Shalimar / Berger
19.	Pipe Fittings		VS / BM / Equivalent
20.	Supports		Hitech / Sarathi
21.	Nuts & Bolts		Precision / Unbrako / Equivalent
22.	Extinguishers		Minimax / Safex / Cease fire / Usha fire
23.	Non return valve		Audco / Keystone / Lehry / Normex
24.	Coating and Wrapping		IWL pypkote

25.	Air release valve		Newage / Zoloto / Lehry
26.	Strainer		Procedeyne / Zoloto/ Advance/ Fluid line
27.	Flexible Hose		HD Fire / Viking / Tyco

LIST OF APPROVED MAKES - ELECTRICAL SYSTEM

Sl.No	Description		Approved Makes
1	Cutouts	..	Sethco
2	Moulded Case Circuit breakers - Rate Service Voltage -690Volts, TPN switches / Switch Fuse units / Fuse Switches and HRC fuses	..	Siemens / Schneider / ABB / Legrand
3	Miniature Circuit Breaker Distribution Boards	..	Legrand / Hager / Schneider / Siemens
4	Miniature Circuit Breakers / Isolators / Residual Current Circuit Breaker or Residual Current Circuitwith Overload breakers / Contactors		Legrand / Hager / Schneider / Siemens
5	Indicator	..	Teknic / Vaishnov
6	Indicating Meters and Mesasuring Digital Meters	..	Conserve, Secure, Rishab, Elecon
7	Current transformers		AE / Kappa
8	Selector switches		Kaycee / L&T / ABB
9	Indicating lamps	..	Teknic with LED lamps
10	Power, Control cables	..	RR Kable / Polycab / Seichem / KEI
11	Terminations	..	Jainsons / Dowells
12	PVC Insulated Copper Conductor Wires	..	Finolex / RR Kable / Polycab
13	Cables and Wires for DC Power	..	LAPP / Top Solar / Nexans / Schneider
14	PVC Conduits with Accessories	..	Avon Plast / Essorke / EMJay
15	MS Conduits with Accessories	..	Gupta / Bharat
16	Switches / Sockets / Electronic Regulator and RJ 11 Telephone and Co Oxial Television Outlets	..	Anchor Roma / Legrand Mylinc / Schneider Livia / Crabtree
17	IP54 Plug & Socket with MCB / Rotary Switch	..	Legrand / Clipsal
18	Industrial Plug & Socket with MCB / Rotary Switch	..	Legrand / Clipsal
19	Telephone cables - Unarmoured	..	Delton / Lapp Kabel
20	TV Cable	..	Finolex / Comscope
21	Ceiling Fan	..	Usha / Grompton / Bajaj
22	Exhaust Fan	..	Almonard / Ebm Nadi / Rexello

23	Light Fixtures	..	Philips / Wipro / Osram
24	Fire Extinguisher	..	Alert / Tyco / Minimax / Newage / Ceasefire
25	Power Capacitors	..	Schneider / Siemens
26	Diesel Generator Set	..	Cummins / Kirloskar Green
27	Panel Board / AC DB	..	Local fabrication with test certificate from CPRI
28	Surge Protection Devices	..	OBO Bettermann / Legrand / Schneider
29	Lightning Protection System	..	OBO Bettermann
30	Cable Tray	..	OBO Bettermann
31	Fasteners	..	Hilti / Fisher
32	RMU	..	Siemens / CGL / Schneider
33	Solar PV Cells	..	Vikram Solar / Warre / Emmvee / HHV / Tata / Adani / REC / Sun Power / Panasonic / Trina Solar / Bosch / Q Cells
34	Solar Inverter	..	Delta / ABB / Schneider / Refusol / Kaco / SMA .
35	External duty Weather Proof Junction Boxes with terminals and glands	..	Hensel / Spelsberg / ABB / Cooper busman
36	PV Module interconnecting Connector	..	Tyco / Cooper busman / MC
37	Ethernet switch	..	Amp / Dax / Cisco / Logitec
38	Cat-6 cable	..	Amp / Avaya / Beldon / Krone Communication / Molex / Dax / Cisco
39	Data logging System	..	Delta / ABB / Schneider / Kaco Monitoring / SMA / Energy Recommerce / Refusol / Energy Tracking Iic
40	Paints	..	ICI / Asian / Berger / Kansai Nerolac

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