INDIAN BANK

Corporate Office, No. 254 – 260, Avvai Shanmugam Salai,
Royapettah, Chennai – 600014

e-TENDER

FOR

PROPOSED CONSTRUCTION OF BRANCH CUM RESIDENTIAL BUILDING (Stilt + 5 Floors) @ NO. 2, New DOOR No. 261, OLD DOOR No. 32/B, VELACHERY MAIN ROAD, VELACHERY, CHENNAI – 600042.

VOLUME- IV

TECHNICAL SPECIFICATIONS

Tender ID: IB/VEL/CONTR/001/2024-25

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इंडियन बैंक Indian Bank
इलाहाबाद ALLAHABAD
Chennai-14.
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TECHNICAL SPECIFICATIONS

GENERAL

PREAMBLE

1.0 GENERAL

These Specifications cover the items of work in structural parts coming under preview of this document. All work shall be carried out in conformation with this. These specifications are not intended to cover the minute details. All codes, standard and good construction practice shall be referred to this specification be the latest thereof.

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

2.0 REFERENCE TO THE STANDARD CODES OF PRACTICE:

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

2.2 In case of discrepancy between standards, codes of practice, tentative specifications, and specifications referred to, the specifications of Indian Standard Codes of practice shall govern.

3.0 SUPREMACY OF TENDER

In case of contradiction between/among two or more clauses given separately in two or more different documents, conditions of acceptance clause will be in following preference:

General Conditions of contract. Shall prevail over Drawings

Drawings shall prevail over BOQ

BOQ shall prevail over shall prevail over technical specification

4.0 DIMENSIONS

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

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

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

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WATERPROOFING

1.0 INDIAN STANDARDS:

IS : 702 – 1988 Specifications for Industrial bitumen

IS : 1322 – 1993 Bitumen Felts for Waterproofing and Damp Proofing 3 IS : 3384 – 1986 Specifications for Bitumen primer for use in waterproofing and damp-proofing (first Revision)

The above mentioned IS Codes of Practice have been given for general guidance. However, these IS Codes will be adopted only for those particular items in the contract where the detailed technical specifications are not laid down in the Tender Documents.

All waterproofing work shall be carried out by the main contractor through a specialized Waterproofing agency as specified in the tender. The work shall be carried out strictly in accordance with the instructions of the manufacturer of the waterproofing materials used in waterproofing treatment and the contractor shall be responsible for the proper production of record of ingredients used and the performance of the waterproofing work done.

The entire work shall be covered by a performance guarantee for waterproofing for the period mentioned in the description of item.

The Contractor shall promptly attend to any leakage or dampness see or communicated during the period and satisfy the Dept. that the same has been rectified; if required, by conducting a test by storing 75 mm water over the roof for 10 days. If the Contractor fails to carry out the waterproofing rectification, the dept. will, after giving 10 days notice to the Contractor, get the work carried out by another agency at the Contractor's risk and cost.

2.0 WATERPROOFING PERFORMANCE TEST:

After completion of waterproofing treatment, it shall be tested for waterproofing by storing water for 10 days, to the following depths:

75 mm over exposed horizontal surface. Upto brim in case of water tanks, lift pits

Bone dry surfaces of all underground structures shall have to be demonstrated by the contractor.

The rate for the waterproofing work to be carried out under the contract shall include all labours , materials, tools, plants, equipments, transport and all the operations required for carrying out and completing the work, whether spelt out in detail or not, but including removing all loose materials, loose scales, mortar droppings and oil, grease etc. and removing all debris / rubbish outside AI premises, curing where required and testing to the satisfaction of the EIC.

3.0 WATER PROOFING WITH BITUMEN FELT:

Waterproofing treatment shall be four course or six course as described.

1.1 MATERIALS:

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The self finished felt shall be approved brand and manufacture of types 3, Graded, Hessian base felt conforming to IS :1322 -1970.

WEIGHTS:

The total weight of the finished bitumen felt in dry condition with mica dusting powder in the manufactured bitumen felts shall not be less than 22.3 kgs per 10 sqm SAMPLING:

All rolls from the same batch manufactured in one consignment shall constitute a lot.

The number of rolls to be taken from a lot shall depend upon the size of the lot as follows:

NOTE 1: All the rolls taken as per Col.2 shall be inspected for width, length and visible external defects.

These rolls shall be taken at random from the lot. From each of the rolls, one piece 3m long and full width of the felt shall be cut out for preparing test specimens. First 2 m of the roll shall not be selected for this purpose. The length of felt selected shall be free from abnormal defects and shall be truly representative of the whole consignment. In case the material has stuck together no heat shall be applied to separate the layer, but the whole roll shall be sent for testing.

NO OF ROLLS PERMISSIBLE NO. ROLLS	NO. OF ROLLS IN THE LOT	TO BE SELECTED OF DEFECTIVE
Up to 100	0	0
101 to 150	0	0
151 to 300	1	0
301 to 500	2	1
501 to 1000	3	2
1001 to 3000	5	3
3001 & Above	8	5

3.2 CRITERIA FOR CONFORMITY:

The lot shall be considered to be in conformity with the requirements of the standard, if: The number of rolls found defective with respect to width, length and visible external defects, does not exceed the corresponding number given in Col.3 of Sampling.

3.3 BONDING MATERIALS:

This shall be blown type bitumen conforming to IS : 702 – 1988 and IS grade 85/25 of approved quality.

1st Course Kg/sq.m

3rd Course Kg/sq.m

5th Course Kg/sq.m

1 Four Course Treatment 1.45 1.45'—

2 Six Course Treatment 1.45 1.20 1.45

3.4 STONE GRIT AND PEA-SIZED GRAVEL:

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Stone Grit shall be 6m and down size. Pea sized gravel shall be hard, round and free from dust, dirt, etc. Grit and gravel shall not be spread over vertical or sloping faces of flashing and at drain mouths. At these places, the surfaces should be painted with two coats of bituminous solution. Stone grit or pea sized gravel for final course of four or six course treatment shall be 0.06 cu.m. per sq.m.

PREPARATION OF SURFACES: The surfaces to be treated shall have a minimum slope of 1:120. This grading shall be carried out with cement concrete or cement plaster with coarse sand as ordered, to the average thickness required and finished smooth. Grading work shall be paid for separately.

The junction between roof and vertical faces of parapet walls, chimneys, etc. shall be cased by running triangular fillets 7.5 cm x 7.5 cm size in cement concrete. At drain mouths, fillets shall be cut back and rounded for all owing for waterproofing treatment. Cement Concrete in fillet shall be 1:2:4 {1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm (nominal size)}.

Where the parapet height is 450 mm or less, the waterproofing treatment shall be carried out over the top of the parapet wall to its full thickness.

For carrying over and tucking in the waterproofing felts into parapet wall of height

more than 450 mm, chimney stack etc. a horizontal groove of 65 mm deep, 75 mm wide, with it slower edge at minimum 150 mm above the graded roof surface shall be cut out nearly and finished smooth inside with cement mortar (1:4).

The triangular fillet 75 mm x 75 mm and the cutting & finishing of the groove shall not be measured or paid for extra. No deduction will be made, however, if the groove has already been provided in an existing building.

Where expansion joints are provided, the construction of dwarf walls and RCC slab, etc., covering the dwarf walls shall be carried out by the same agency and shall be paid separately.

The graded roof surface, concrete fillets, and faces of walls shall be thoroughly cleaned with wire brushes and all scales, mortar droppings, etc. removed. Any cracks in the roof shall be cut into "V" section and filled up flush with cement mortar 1:4 or blown up type petroleum bitumen 82/25 grade. Cleaning of surface or treating the cracks shall not be paid for separately.

4.0 PAINTING OF ROOF SLAB WITH HOT BITUMEN:

4.1 The surface to be painted should be absolutely dry sand shall be cleaned with wire brushes. All scales, mortar droppings, loose materials shall be removed.

4.2 PAINTING WITH BITUMEN:

Surface prepared shall be painted uniformly with bitumen of approved quality of 80/100 etc. after heating it to the required temperature. The cost of bitumen shall be continued at least 15 cms along vertical surface along roof slab and up to drip course in case of parapet wall.

Immediately after painting, dry clean sharp and coarse sand shall be evenly spread at 60 dm3 per 10 sqm of surface to be treated.

4.3 PRIMING COAT:

If directed the priming coat of bitumen shall be applied to the cleaned slab. This shall be paid for separately.

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4.4 LAYING:

Blown type petroleum bitumen of IS grade 85/25 shall be heated to 180° C and conveyed to the roof in buckets or pouring can in weighed quantities. The roof surface shall be cleaned dry. Laying shall be commenced at the lowest level and worked up to crest. Each length of the felt laid, shall be rolled half its length.

Hot bitumen shall be poured on the roof across the full width of the rolled felt and the felt rolled out and pressed down. When the first half of felt has been bonded, the other half is rolled up and then unrolled and pressed on the hot bitumen the same way.

Subsequent strips shall be laid similarly with end laps of 10cm and side laps of 7.5 cm.

All over laps shall be firmly bonded with hot bitumen.

The third layer of bitumen in the four course treatment shall be carried out in a similar manner after flashing has been completed, followed by the final course of gravel or grit as specified in above .

4.5 SIX COURSE TREATMENT:

In six course treatment, the third and fourth layers of bitumen and self finished felt shall be laid in manner described above. The laps in fourth layer shall be staggered from those in second layer. The fifth layer of bitumen shall be carried after the flashing is done, followed by the final course of gravel or grit as specified in Waterproofing treatment shall be carried over the drain outlets and 10 cms into drain pipes or outlets.

The flashing shall consist of the same four or six course treatment except that the final course of stone grit or pea sized gravel shall be replaced by an application of additional coat of bitumen on the vertical and sloping faces of the flashing.

The upper edge of the flashing felt shall be well tucked into the flashing grooves in the parapet etc. to a depth of minimum 65 mm. The flashing treatment shall be held in place in grooves with wood edges at intervals and grooves filled up with cement mortar (1:4) and the surface finished smooth with the wall. After curing, when dry, the exposed plaster joints of grooves shall be painted with bitumen and the vertical and sloping surface of the flashing shall be painted with two coats of bitumen.

5.0 FLAT BRICK TERRACOTA TILE WATERPROOFING TREATMENT:

The work is to be carried out on the brick bat lime concrete laid on terrace, measured and paid for separately.

The flat tiles shall be machine pressed flat earthen ware tiles, quality and make approved by EIC. The tiles shall be 20 mm thick and of the sizes as approved by EIC.

The tiles shall be laid on 12 mm thick cement mortar (1:3) with neat cement slurry. The joints of 3 mm thickness approx. shall be properly pointed in neat cement slurry. The whole surface shall be properly watered and cured. The tiles shall be carried at an angle of 45 ° at the joints with vertical walls. Where the treatment consists of two layers, the second layer shall be laid similar to the first with joins in the two layers properly staggered. The terrace shall be tested for waterproofing by keeping 75 mm standing water on completed work for ten days. The soffit of the slab should not show any dampness or leakage.

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6.0 CHINA MOSAIC WORK:(if required)

China Mosaic work shall be prepared from broken pieces of while glazed tiles or mixture of white and colour glazed tiles. No piece shall be more than 40 mm and smaller than 10 mm in any direction.

LAYING:

15 mm thick screed consisting of 1 part cement : 4 part sand shall be laid on top of roof slab. Before the screed is about to set, a floating coat, 3mm thick of cement mortar (1 cement : 4 fine sand) shall be laid on the screed. Whilst the floating coat is green, the broken pieces of glazed tiles, thoroughly soaked in water, shall be set flat, as closely as possible. The surface shall then be rolled lightly with a wooden roller to ensure proper setting of the pieces in the floating coat and also squeezing of the mortar into joints.

The surface shall be cleaned with sawdust and kept wet for a minimum of 10 days and thoroughly cleaned on completion. Junctions with the wall shall be curved to 75 mm radium and top edge of curving carried at least 50 mm up the abutting wall. The top edge shall be finished in neat horizontal line and tucked in a groove in the wall 65 mm deep. Bell mouth around rain water pipe inlets etc. wherever required for effective drainage, shall be formed in China Mosaic finish. The surface shall be even and uniform on completion.

7.0 TREATMENT TO CRACKS:

The work shall be carried out by cutting out cracks to V section, minimum 6 mm wide on top, cleaning out with wire brush, filling with cement and sand slurry (1:1) with approved waterproofing compound mixed with cement by weight as specified by the manufacturer and curing as required.

8.0 SHALLOW SUMP FOR RAIN WATER OUTLET:

Shallow sump near rain water outlet shall be constructed before parapet is built and shall be of size specified with cement concrete 1:2:4 mix.

A PVC sheet 1 m x 1 m x 400 microns shall be laid and cement concrete of minimum thickness of 3 cms laid over it with its top surface lower than the level of adjoining roof surface by not less than 20 mm. The concrete shall be of size more than 45 cm x 45 cm to allow for waterproof terracing, to overlap its through edges by min 7.5 cm and shall be sloping towards the outlet. The concrete shall be rendered with 12 mm thick cement plaster 1:3 while cement concrete is still green.

9.0 WATERPROOF TREATMENT WITH ACRYLIC BASED CHEMICAL OR CEMENT BASED WATRPROOF AGENT:

9.1 Preparation of Surface:

The roof surface shall be cleaned with wire brushes and gunny cloth. All scales, mortar falling, loose material etc. shall be removed to base slab surfaces. All cracks shall be made in to "V" grooves 25 mm wide at top and 12 to 20 mm deep and cleaned.

9.2 Laying:

The entire work shall be carried out as per instructions of the manufacturer of the approved waterproofing agent.

A layer of neat cement slurry mixed with waterproof agent shall be laid in convenient lengths and widths. Bricks on edge or broken brick pieces shall be laid in cement

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mortar1:4 (1 cement : 4 sand) with waterproof agent. The brick pieces / brick on edge shall be wetted thoroughly before use. Cement Mortar 1:4 shall be filled in the joints and a little above. Waterproofing agent of approved make shall be added at 1% weight of cement in case of acrylic based chemical waterproofing agent in slurry and mortar and properly mixed width cement specified by the Manufacturer before mixing the same with sand.

The brick on edge or brick bat work as above shall be laid to proper levels and slopes as required, directed and / or as shown on drawings. Minimum 25 mm thick joint less water proofing layers of cement mortar 1:4 (1 cement : 4 sand) with waterproof agent, shall be laid over the brick bat work and finished smooth with a layer of neat cement slurry mixed with waterproof agent. If directed, string marks showing 300 mm x 300 mm square shall be marked properly. The slope of the finished terrace shall not be less than 1 in 50, unless a flatter slope is expressly permitted by the EIC in writing. The roof surfaces shall slope from all sides towards the rain-water outlets.

The treatment shall be properly rounded at junction of walls, etc. and carried out above 300 mm above the level of waterproofing treatment. The edge of the treatment along parapet shall be tucked into a groove 65 mm deep into the parapet. The treatment shall be continued near rain water outlet etc. The entire treatment shall be properly cured for a period of 2 weeks by ponding method. Normally the proportion of acrylic based chemicals is one percent by weight of OP Cement and for other waterproofing compound 2% by weight of cement. The Contractor shall give complete details of waterproofing treatment proposed by him, including the waterproof compound he proposes to use. These details shall include roof fill materials, waterproofing compound, minimum & maximum thickness of slurry, joints thickness, mortar on top of total treatment.

The Contractor shall ensure that sufficient slope for effective drainage is provided within the average thickness of waterproofing treatment proposed by the Contractor. In case the average thickness has to exceed that specified, the fact shall be specifically brought to the notice of the EIC.

The entire work shall be covered by a guarantee for waterproofing for a period of 10 years as specified in 2.0 above.

10.0 BRICK BAT CONCRETE:

10.1 The work shall be carried out in correct line, level and slope. This shall be carried out When the thickness of cement based waterproofing treatment exceeds the specified thickness or Elsewhere in bathrooms, toilets, etc. to fill up the voids.

11.0 WATERPROOF CEMENT PLASTER:

11.1 The work shall be carried out in correct line and level in CM 1:4 (1 cement:4 sand) minimum 15 mm thick as backing coat with approved waterproofing compound, mixed with cement by weight as specified by manufacturer and finished with 6 mm thick uniform grained sand faced plaster coat including curing with 10 years performance guarantee for terrace parapet or external walls or concrete surfaces.

12.0 INJECTION / PRESSURE GROUTING WATERPROOF TREATMENT:

12.1 Surface Preparation:

The surface to be treated shall be cleaned of all scales, loose materials, and wire brushed clean. All cracks apparent and construction joints shall be made in to V grooves 25 mm at top and above 20 mm deep and treated with cement slurry 1:1 (1 cement : 1 sand) with approved waterproof compound mixed with cement by weight as specified by the manufacturer of the compound.

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Holes of about 25 mm dia. to receive funnel or pipe nozzles and 25 to 40 mm deep shall be chiseled at about 1.5 m or less centre to centre as required, in the entire floor and walls to be treated. Nozzles shall then be fixed in these holes and grooves.

After the nozzles are set for minimum 24 hours, neat cement slurry mixed with waterproofing compound by weight of cement, as specified by the manufacturer of the compound, shall be injected through these nozzles, by low pressure, gravity for the slurry to run through the minutest cracks and pores in the entire structure. The process shall be continued till the surface to be treated is bond dry and shall not show any dampness at all.

The nozzles shall then be removed and the holes properly filled up.

13.0 BOX TYPE WATERPROOF TREATMENT WITH STONE SLABS:

13.1 The treatment shall be minimum 75 mm in thickness and shall be carried out entirely as per specialized waterproofing agency's manufacturer's specifications & shall be generally as follows:

13.2 For Bottom of Basement Slabs Etc.

The treatment shall be carried out before laying the raft slab, basement slab, lift pit slab, etc. This shall be laid on 1:3:6 bedding course. The bedding course shall be measured and paid for separately.

A 25 mm thick layer of cement mortar 1:4 (1cement: 4 fine sand) with waterproofing compound mixed with cement by weight as specified by manufacturer shall be evenly laid as backing course. Rough stone slabs of Shahabad Tiles minimum 20 mm thick shall be laid firmly over this with gaps of about 15 mm to 20 mm in between and properly set. The joints thus left are raked out to full depth and cement slurry admixed with waterproofing compound is grouted in these joints. A protective layer of 25 mm thick in CM 1:4 (1cement: 4 fine sand) with waterproofing compound as above is laid over this, with stone chips embedded at random. The total thickness of waterproofing treatment shall be 75 mm. The treatment shall be extended 150 mm beyond the external face of the raft or walls, and shall be properly cured at every stage and after curing is ready to receive the raft and other slabs.

13.3 For Vertical Walls Or Basement Etc.

The surface to be waterproofed shall be properly hacked and roughened. Rough stone slabs about 20 mm thick shall be placed vertically in position with the help of cement paste applied to the internal face of vertical joints leaving a gap of about 20 mm between the external face of RCC wall and internal face of rough stone. The stones are held side by side leaving hardly any gap between the edges. In order to fix the bottom most layer of stones, a groove about 25 mm deep shall be made in the bottom and the stones fixed in it to ensure water tightness at the junction of the walls and the raft.

Maximum 2 or 3 horizontal layers of rough stones are laid at a time. A coat of rough cement plaster 1:4 (1 cement : 4 sand) with water proofing compound is applied to the external face of rough stone. After the plaster layer is set, the gap between wall and stone layer is filled with a grout made up of cement slurry with water proofing compound as per Manufacturer's specifications. The treatment shall be continued up to 300 mm above the final made up ground level.

The proportion of acrylic based waterproofing, chemicals shall be 1% by weight of cement and 2% in case of cement based waterproofing compound. Continuous pumping and bailing out water shall be ensured till RCC raft is laid and till the treatment to walls is completed. The back filling should not contain stones, boulders

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and such other material which will cause damage to waterproofing treatment. The internal treatment to walls shall be similar for walls and slabs and shall be laid after the raft slab or lift pit slab is laid. This shall be carried out if ordered by the EIC.

The internal treatment shall be finished smooth. The whole work shall be properly cured at every stage.

13.4 Performance Guarantee:

The Contractor shall give 10 years performance guarantee for the waterproofing work carried out by them.

14 .0 WATERPROOFING TREATMENT TO BASE OF WATER STORAGE TANKS, ETC.

Surface preparation is as per 6.0 with double layer of cement based waterproofing treatment

A layer of 25 mm thick cement mortar 1:3 (1 cement : 3 fine sand) shall be then laid with approved waterproofing compound in the proportion as per Manufacturer's specifications, nominal 25 mm size stone aggregates or gravel shall be embedded at random about half depth into the layer, while still green. After this is properly cured, a second layer 25 mm thick cement mortar 1:3 layer with waterproof compound, as above, is laid and finished smooth with neat cement also with waterproofing compound. The whole treatment shall be properly cured.

The entire treatment shall be covered with performance guarantee of 10 years.

14.1 Waterproof Patent Stone for Tank Bottom, Etc.

The patent stone in cement concrete 1:2:4 and 4 mm thick, finished smooth shall be carried out as per the specifications of the item in relevant section, except that the waterproofing compound, by weight, shall be mixed with cement as specified by the manufacturer.

Waterproof cement plaster for interior of water tank. The thickness of plaster shall be min. 20 mm. The specifications shall be same as per plaster finish smooth under relevant section. The work shall cover preparation of surface, waterproofing compound etc.

14.2 Cement Based Waterproofing To Toilet / Bathroom Slabs Etc.

The surface shall be cleaned of all loose scales, mortar, fallings, etc. by wire brushing and gunny cloth. All cracks shall be cut into V form, cleaned and filled in with cement mortar 1:1 slurry with approved waterproofing compound at 2% by weight of cement. A 20mm thick layer of cement mortar 1:3 shall then be laid and gravel or stone aggregate of 12 m nominal size of fairly uniform size hand set in it while the cement mortar is still green with hand pressure. A final layer of 25 mm thick cement mortar 1:3 shall then be laid over it, compacted with trowels, finished smooth. In all cement based waterproofing compound, as specified by the specialized waterproofing agency shall be mixed. The whole work shall be cured properly for 10 days. The joints with walls shall be rounded 150 mm above the waterproofing treatment level. This treatment is used in bathrooms, equipment floor, office buildings, etc.

The waterproofing treatment shall carry performance guarantee of 10 years.

14.3 Expansion Joints - Polysulphide Joints:

The top 12 mm thick and 20 mm deep strip in the horizontal and vertical expansion joints in slabs, beams, columns, walls, etc. shall be filled properly with patented poly sulphide compound as per manufacturer's instructions.

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For expansion joints, the joint filled shall be packed firmly to close all gaps or voids.

14.4 Application:

The resin shall be thoroughly mixed with the curing agent and shall be either directly poured or applied with special gun to fill up the joint. The joints are finished flush with the surface.

The expansion joints exposed inside the building at any floor level shall be covered with thin aluminium flat (20 gauge) or asbestos cement strip of min. available thickness or wooden beading etc. as directed by EIC. The width of such covering shall be sufficient to cover the entire joint and allowance for fixing nails / screws. The fixing of such strip shall be at one only to allow for the movement at the joint. Alternatively, the strip can be fixed from both sides but the holes on one side to be oval shape to allow unrestricted movement of structural member and to avoid shearing of the flat. Aluminium angles of suitable size, may also be provided, if the joint is at the corner, but shall be fixed on one side only.

14.5 Grading Roof:

The specification shall be for 1:2:4 cement concrete as covered under relevant section. The concrete shall be laid in level or grade as directed. The measurements shall be in cubic metres.

14.6 Cement Watta:

This is provided at the junction of horizontal and vertical surfaces to prevent entry of water. The surface, about 250 mm to 350 mm wide on both surfaces, shall be cleaned of all grease, oil, etc. The cement watta is triangular in cross section of each side averaging to 250 mm to 350 mm in cement mortar 1:3 (1 cement : 3 sand) finished neat with floating coat of neat cement, cured etc. Approved waterproofing compound shall be mixed with cement as directed by manufacturer by weight all complete as directed by Engineer-in-Charge.

ALTERNATIVE : ISOTHANE - EMB / ISOTHANE – EMA (or approved proven equivalent)

ISOTHANE EMB shall be a very high solid coating so designed to give a high build film with high elasticity, good U.V.stability and high strength. It should adhere permanently into a flexible seamless membrane and maintain high roof integrity on any substrate i.e the hypar shell.

ISOTHANE EMA elastomeric membrane shall be a liquid applied coating based on Urethane Prepolymers which cure by reaction with atmospheric moisture to give a continuous film which is rubbery and elastic. It shall contain leafing aluminium which gives it ultra violet resistance.

ISOTHANE EMA shall cure permanently into flexible seamless membrane, by virtue of its chemical reactivity in the wet state, and shall have a good adhesion to a wide range of substrates. Isothane-EMA should not embrittle with age, exposure to ultra violet radiation or weathering.

APPLICATION SPECIFICATION

All loose materials from roof surface shall be removed by brushing. One coat of Isothane P Primer shall be applied.

Two coats of Isothane - EMB/EMA with suitable interval between two coats shall be applied to achieve a dry film thickness of 1 mm.

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PRECAUTION BEFORE APPLICATION / INSPECTION

1. Thoroughly clean the roof surface by brushing (all debris, chippings, moss, etc., must be removed).
2. Inspect total roof area for defect, pay particular attention to:

a) Roof gradient

b) Upstands

c) Expansion joints

d) Dran/gully outlets

e) Roof edges

f) Roof finish

3. Any major cracks or defects noticed on the roof should be individually assessed, but the general treatment is to rake out to a firm base and fill with a non-setting mastic or ISOTHANE-EM. It is generally necessary to re-inforce these areas with scrim.
4. Allow surface to dry thoroughly and any moisture contained in the structure to evaporate.
5. Fill cracks and voids with mastic sealant:

NOTE

a) In the case of two coat application, the first coat should be touch dry in 12-48 hours and the second coat should be applied within 24 hours to ensure good adhesion.

b) Where application extends over more than a working day, an overlap of 150 mm should be done.

c) It is not normally necessary to re-inforce total roof area, but in case of high movement or regular foot traffic this is recommended. Regularly used walkways are also marked out and reinforced with scrim.

d) ISOTHANE - EM can be used for balconies and decks not subject to heavy foot traffic. In such cases at least 1.5 mm coating thickness should be applied and a reinforcing scrim embedded into the first coat is recommended. In order to improve foothold, fine dry aggregate or silica sand should be sprinkled over the last application before it fully cures.

TYPICAL PROPERTIES

S.No.	ISOTHANE - EMA	ISOTHANE - EMB
1. Specific Gravity	1.18	1.20
2. Solid % min	95	92
3. Abel closed cup flush point Deg.C	56	69
4. Application limit Deg.C	0.70	0.70
5. Approx. Dry time		

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(20 C.50% RH)	12.20 hours touch dry - 7 days full cure.	12.20 hours touch dry - 7 days full cure.
6. Elongation %	500	500
7. Tensile Strength	300	400
8. U/V Resistance	Excellent	Excellent
9. Storage stability (Temperature climate)	9 months	9 months

WATER PROOFING ON FLOORS AND WALLS OF SUNKEN AREAS

Preparation of Surface:

This shall be as described for Roof Water Proofing.

Horizontal Surface

Cement slurry admixed with acrylic based chemical @ 0.5 kg/50 kg of cement shall be spread smoothly over the R.C.C roof which has been cleaned and prepared prior to laying the slurry . A 20 mm thick mortar 1:4 (1 cement : 4 coarse sand) admixed with acrylic based chemical as recommended by the manufacturer shall be spread over the bed prepared with cement slury. A layer of graded stone aggregate shall be embedded at random. After cleaning for about 2 days, another layer of cement shall be spread evenly followed by a 20mm thick mortar 1:4 (1 cement : 4 coarse sand) admixed with acrylic based chemical which is finished smooth and corners rounded off.

Vertical Surface

These shall be 20 mm thickness in two coats. The under coat shall be 10 mm thick 1:4 (1 cement : 4 coarse sand) admixed with acrylic water proofing chemical @ 1 kg per 50 kg of cement and shall be applied on the prepared vertical surface. The top surface shall be brought to a true surface with wooden straight edge. The surface shall be finished smooth. The junction of vertical plastered surface and floor surface shall be rounded of suitable with the same materials as stated hereinbefore.

Curing

The finished surface shall be cured with flooding of water for a period of two weeks before filling sunken areas with concrete.

Precautions

While filling the areas with concrete it is to be ensured that the floor and the walls surface treated with water proofing treatment does not get damaged.

Water proofing of basements, lift pit base and sides and other similar locations shall be done as specified in the schedule and generally comprise of.

A. HORIZONTAL SURFACE:

The prepared surface of P.C.C leveling course shall be treated with three layers of waterproofing course of 20mm thick each, each layer preceded by a spread of proprietary material cement mix slurry for effective bonding of the layer.

The waterproofing course shall be of proprietary material mix cement mortar 1:3 (1 cement : 3 coarse sand) the proportion of mix of cement and proprietary material

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being as specified by the manufacturer and in no case it shall be less than 1% by weight of cement.

The bottom two layers of waterproofing course shall be provided with embedment of stone aggregate 12mm down by hand pack at random, the time gap between these two layers being not less than 24 hours.

The third and top layer shall be laid after curing for at least two days and top finished smooth, making the total thickness of the treatment to 60 mm.

An additional impervious layer over the waterproofing layers laid shall be formed by injecting, proprietary material cement mix grout, through a net work of nozzles of 25 mm dia M.S pipe of adequate length placed in position, at specified locations (1 to 1.5 m apart) before casting R.C.C base slab (Raft) by securing to the reinforcement of raft in such a manner that they remain in position and free from getting choked during slab casting, not earlier than 7 days of casting, by filling all voids/crevices in the concrete of the raft. The protruding part of the grouting nozzles shall be cut and the space filled with cement sand mortar (1:2) and finished smooth.

All operations of the treatment shall be as per manufacturer's directions.

VERTICAL SURFACE

The waterproofing treatment shall be done after the removal of shuttering of vertical walls cast.

The prepared external surface shall be applied with proprietary material cement mix slurry. Then waterproofing plaster shall be done in two layers of 12mm thick each with proprietary cement mix mortar of 1:4 (1 mix : 4 coarse sand).

The cavities and the minutest of cracks in the concrete of the wall is then filled by injecting proprietary material cement mix grout under pressure through nozzles prefixed in a grid pattern on the other side wall surface by cutting holes about 50mm in diameter and 25mm to 40mm deep at 1.0 to 1.5 m apart and grouting nozzles fixed in these holes with cement paste which will be allowed to set for at least 24 hours before actual grouting under pressure. The nozzles are to be removed only after the grout is set. The gaps formed on removal of nozzles shall then be filled with cement sand mortar 1:2 and finished smooth. The position of the nozzles shall cover all construction joints and a continuous groove chiseled out along the joint at the junction of the floor and walls.

All the operations shall be as per manufacturer's specification and directions.

The mix of the proprietary material and cement shall be as per manufacturer's specification and in no case it shall be less than 1% by weight of cement.

The rate for the above treatment shall include drying and cleaning surface free of dust etc.

LIFT PIT

Waterproofing to lift pit, side walls, floor slab, column projected outside and around the pile cap using standard approved chemicals in box method of water proofing prior to construction below the raft and after construction of the RCC bottom and side walls of lift on the outside including necessary materials technique and labour required for effective and water tight sealing of the entire basement structure all as per IS 6494 and to the following specifications.

At the raft level / bottom of the lift well.

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(a) 60mm thick standard box type (injection water proofing treatment shall be provided for all horizontal surface.

(b) At the junction of pile and raft, you shall leave four nozzles, two of which will be grouted after your horizontal surfaces treatment is completed and the balance two grout pipes shall be left in place and grouted after raft concreting is completed.

(c) Grouting nozzles should be left at 1.5 mtr centres in both direction, 2" deep into the raft slab and side walls for grouting after construction.

RAFT / RETAINING WALL

After the excavation the P.C.C for proper bonding with subsequent waterproofing treatment.

Waterproofing course of 20mm thick Chem-seal or approved equivalent cement mortar 1:4 in laid over the slurry, Stone aggregate 12mm down is embedded in it by handpack at random.

Not earlier than 24 hours after above operation chem-seal cement slurry is spread on the mortar and one more layer of 20mm thick Chem-seal or approved equivalent cement mortar 1:4 is laid, Stone aggregate 12mm down is embedded in it by handpack at random. After curing at least for 2 days Chem-seal or approved equivalent cement slurry is spread to enable bonding and final layer of 20mm thick chem.-seal cement mortar 1:4 is laid and finished smooth.

Polysulphide epoxy coating should be given.

The total thickness of the above treatment is about 60mm.

After the reinforcement of raft is placed in position grouting nozzles of adequate length are fixed at the specified locations (1 to 1.5m apart). These nozzles are of 25mm diameter M.S. pipes. The nozzles are placed in such a manner that they remain free from getting choked. The tip of these nozzles protrudes above the raft concrete to allow grouting hose to be connected to them for grouting.

Not earlier than 7 days after the concreting has been done, Chem-seal cement grout or approved equivalent is injected through these network of nozzles. This will help to form an additional impervious layer over the waterproofing layers laid at the bottom by filling all voids/crevices in the concrete of the raft.

The protruding part of the grouting nozzles is cut and the space filled with cement sand mortar (1:2) and finished smooth. After the vertical walls have been cast and shuttering removed, the waterproofing treatment is done as follows.

The external surface is prepared and Chem-seal or approved equivalent cement, slurry is applied and then waterproofing plaster with Chem-seal or approved equivalent cement mortar (1:4) applied in two layers of 12mm each.

Polysulphide epoxy coating will be given.

Holes about 50 mm in diameter and 25 to 40 mm deep are made on the wall surface about 1.00 to 1.5 m apart in a grid pattern, Grouting nozzles are fixed in these holes with cement paste. These nozzles are allowed to set for at least 24 hours. The positioning of the holes is such as to cover all construction joints. The joint at the junction of the floor and walls is chiseled to make a continuous groove and nozzles fixed in this groove.

Chem-seal or approved equivalent cement grout is injected through the above nozzles under pressure so as to fill in the minutest of cracks and cavities in the concrete.

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After the grout is set, the nozzles are removed and the space filled with cement sand mortar (1:2) and finished smooth.

EXTERNAL IMPREGNATION (BOX) TREATMENT:

FLOOR RAFT: Actual area over which the treatment is laid i.e. total area of raft/floor plus the projections of treatment beyond edge of raft / floor shall be measured and charged accordingly.

WALLS: The external surfaces of the walls actually provided with the treatment shall be measured and charged for.

E. In case of pile Foundations, the treatment shall be laid below pile caps and also to the vertical walls of each pile cap and the same shall be measured and charged for. No deductions shall be made for the piles as grouting shall be done to take care of piles.

GUARANTEE for the watertight performance of the structure for a minimum period of 10 years from the date of completion shall be given in the prescribed form given below. This guarantee shall be in legal paper in an acceptable form. The guarantee shall be enforceable either by the Architects or by clients. If, during the guarantee period, water leaks are noticed in the structure from the portions treated by you, the same shall be rectified when called upon immediately, all at no extra cost to the entire satisfaction of the Architect/Employer.

MODE OF MEASUREMENTS

A. TERRACE

It shall be over all plan area between the walls. The Vatta (Gola) shall be measured separately in Running Meter and as a separate item. Usually the Vatta (Gola) shall be of 300 mm height from the finished surface.

B. TOILET BLOCKS

FLOOR: Area of the Toilet Blocks shall be measured by length x breadth between walls.

VERTICAL SIDES

The actual area treated by us above the finished floor level shall be measured by length x height.

BRICK MASONRY

BRICK MASONRY

1.0 DESCRIPTION

This work shall consist of construction of structures with bricks jointed together by cement mortar in accordance with the details shown on drawings or as approved by the Engineer.

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2.0 MATERIALS

All materials to be used in the work shall conform to the requirements laid down in chapter Materials under Civil

3.0 PERSONNEL

Only trained personnel shall be employed for construction and supervision.

4.0 CEMENT MORTAR

Cement and sand shall be mixed in specified proportions given in the drawings. Cement shall be proportioned by weight, taking the unit weight of cement as 1.44 tone per cubic metre. Sand shall be pro-portioned by volume taking into account due allowance for bulking. All mortar shall be mixed with a minimum quantity of water to produce desired workability consistent with maximum density of mortar. The mix shall be clean and free from injurious type of soil/acid/alkali/ organic matter or deleterious substances.

The mixing shall preferably be done in a mechanical mixer operated manually or by power. Hand mixing can be resorted to as long as uniform density of the mix and its strength are assured subject to prior approval of the Engineer. Where permitted, specific permission is to be given by the Engineer. Hand mixing operation shall be carried out on a clean water-tight platform, where cement and sand shall be first mixed dry in the required proportion by being turned over and over, backwards and forwards several times till the mixture is of uniform colour. Thereafter, minimum quantity of water shall be added to bring the mortar to the consistency of a stiff paste. The mortar shall be mixed for at least two minutes after addition of water.

Mortar shall be mixed only in such quantity as required for immediate use. The mix which has developed initial set shall not be used. Initial set of mortar with ordinary Portland Cement shall normally be considered to have taken place in 30 minutes after mixing.

In case the mortar has stiffened during initial setting time because of evaporation of water, the same can be re-tempered by adding water as frequently as needed to restore the requisite consistency, but this re-tempering shall not be permitted after 30 minutes. Mortar unused for more than 30 minutes shall be rejected and removed from site of work.

5.0 SOAKING OF BRICKS

All bricks shall be thoroughly soaked in a tank filled with water for a minimum period of one hour prior to being laid. Soaked bricks shall be removed from the tank sufficiently in advance so that they are skin dry at the time of actual laying. Such soaked bricks shall be stacked on a clean place where they are not contaminated with dirt, earth, etc.

6.0 JOINTS

The thickness of joints shall not exceed 10mm. All joints on exposed faces shall be tooled to give concave finish.

7.0 LAYING

All brickwork shall be laid in an English bond, even and true to line, in accordance with the drawing or as directed by the Engineer, plumb and level and all joints accurately kept. Half and cut bricks shall not be used, except when necessary to complete the bond. Closer in such cases shall be cut to the required size and used near the ends of the walls. The bricks used at the face and also at all angles forming

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the junction of any two walls shall be selected whole bricks of uniform size, with true and rectangular faces.

All bricks shall be laid with frogs up on a full bed of mortar except in the case of tile bricks. Each brick shall be properly bedded and set in position by slightly pressing while laying, so that the mortar gets into all their surface pores to ensure proper adhesion. All head and side joints shall be completely filled by applying sufficient mortar to brick already placed and on brick to be placed. All joints shall be properly flushed and packed with mortar so that no hollow spaces are left. No bats or cut bricks shall be used except to obtain dimensions of the different courses for specified bonds or wherever a desired shape so requires.

The brick work shall be built in uniform layers, and for this purpose wooden straight edge with graduations indicating thickness of each course including joint shall be used. Corners and other advanced work shall be raked back. Brickwork shall be done true to plumb or in specified batter. All courses shall be laid truly horizontal and vertical joints shall be truly vertical. Vertical joints in alternate courses shall come directly one over the other. During construction, no part of work shall rise more than one metre above the general construction level, to avoid unequal settlement and improper jointing. Where this is not possible in the opinion of the Engineer, the works shall be raked back according to the bond (and not toothed) at an angle not steeper than 45 degrees with prior approval of the Engineer. Toothing may also be permitted where future extension is contemplated. Before laying bricks in foundation, the foundation slab shall be thoroughly hacked, swept clean and wetted. A layer of mortar not less than 12 mm thick shall be spread on the surface of the foundation slab and the first course of bricks shall be laid.

8.0 JOINTING OLD AND NEW WORK

Where fresh masonry is to join with masonry that is partially/entirely set, the exposed jointing surface of the set masonry shall be cleaned, roughened and wetted, so as to effect the best possible bond with the new work. All loose bricks and mortar or other material shall be removed.

In, the case of vertical or inclined joints, it shall be further ensured that proper bond between the old and new masonry is obtained by interlocking the bricks. Any portion of the brickwork that has been completed shall remain undisturbed until thoroughly set.

In case of sharp corners specially in skew bridges, a flat cutback of 100 mm shall be provided so as to have proper and bonded laying of bricks.

9.0 CURING

Green work shall be protected from rain by suitable covering and shall be kept constantly moist on all faces for a minimum period of seven days. Brick work carried out during the day shall be suitably marked indicating the date on which the work is done so as to keep a watch on the curing period. The top of the masonry work shall be left flooded with water at the close of the day. Watering may be done carefully so as not to disturb or wash out the green mortar.

During hot weather, all finished or partly completed work shall be covered or wetted in such a manner as will prevent rapid drying of the brickwork.

During the period of curing of brick work, it shall be suitably protected from all damages. At the close of day's work or for other period of cessation, watering and curing shall have to be maintained.

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Should the mortar perish i.e. become dry, white or powdery through neglect of curing, work shall be pulled down and rebuilt as directed by the Engineer. If any stains appear during watering, the same shall be removed from the face.

10.0 SCAFFOLDING

The scaffolding shall be sound, strong and safe to withstand all loads likely to come upon it. The holes which provide resting space for horizontal members shall not be left in masonry under one metre in width or immediately near the skew backs of arches. The holes left in the masonry work for supporting the scaffolding shall be filled and made good. Scaffolding shall be got approved by the Engineer. However, the Contractor shall be responsible for its safety.

11.0 EQUIPMENT

All tools and equipment used for mixing, transporting and laying of mortar and bricks shall be clean and free from set mortar, dirt or other injurious foreign substances.

12.0 FINISHING OF SURFACES

12.1 General

All brickwork shall be finished in a workmanlike manner with the thickness of joints, manner of striking or tooling as described in these above specifications.

The surfaces can be finished by "jointing" or "pointing" or by "plastering" as given in the drawings.

For a surface which is to be subsequently plastered or pointed, the joints shall be squarely raked out to a depth of 15 mm. while the mortar is still green. The raked joints shall be well brushed to remove dust and loose particles and the surface shall be thoroughly washed with water, cleaned and wetted.

The mortar for finishing shall be prepared as approved.

12.2 Jointing

In jointing, the face of the mortar shall be worked out while still green to give a finished surface flush with the face of the brick work. The faces of brick work shall be cleaned to remove any splashes of mortar during the course of raising the brick work.

12.3 Pointing

Pointing shall be carried out using mortar not leaner than 1:3 by volume of cement and sand or as shown on the drawing. The mortar shall be -filled and pressed into the raked joints before giving the required finish. The pointing shall be ruled type for which it shall, while still green, be ruled along the centre with half round tools of such width as may be specified by the Engineer. The super flush mortar shall then be taken off from the edges of the lines and the surface of the masonry shall be cleaned of all mortar. The work shall conform to IS:2212.

12.4 Plastering

Plastering shall be done where shown on the drawing.

Plastering shall be started from top and worked down. All putlog holes shall be properly filled in advance of the plastering while the scaffolding is being taken down. Wooden screeds 75 mm wide and of the thickness of the plaster shall be fixed

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vertically 2.5 to 4 metres apart, to act as gauges and guides in applying the plaster. The mortar shall be laid on the wall between the screeds using the plaster's float and pressing the mortar so that the raked joints are properly filled. The plaster shall then be finished off with a wooden straight edge reaching across the screeds. The straight edge shall be worked on the screeds with a small upward and sideways motion 50 mm to 75 mm at a time. Finally, the surface shall be finished off with a plasterer's wooden float. Metal floats shall not be used.

When recommencing the plastering beyond the work suspended earlier, the edges of the old plaster shall be scrapped, cleaned and wetted before plaster is applied to the adjacent areas. No portion of the surface shall be left unfinished for patching up at a later period.

The plaster shall be finished true to plumb surface and to the proper degree of smoothness as directed by the Engineer.

The average thickness of plaster shall not be less than the specified thickness. The minimum thickness over any portion of the surface shall not be less than the specified thickness by more than 3 mm.

Any cracks which appear in the surface and all portions which sound hollow when tapped, or are found to be soft or otherwise defective, shall be cut in rectangular shape and re-done as directed by the Engineer.

12.5 Curing of Finishes

Curing shall be commenced as soon as the mortar used for finishing has hardened sufficiently not to be damaged during curing. It shall be kept wet for a period of at least 7 days. During this period, it shall be suitably protected from all damages.

12.6 Scaffolding for Finishes

Stage scaffolding shall be provided for the work. This shall be independent of the structure.

13.0 ARCHITECTURAL COPING FOR WING/RETURN / PARAPET WALL

This work shall consist of providing an Architectural coping for wing / return / parapet walls.

The material used shall be cement mortar 1:3 or as shown on the drawings prepared in accordance as approved.

The cement mortar shall be laid evenly to an average thickness of 15 mm to the full width of the top of the wall and in continuation a band of 15 mm thickness and 150 mm depth shall be made out of the mortar along the top outer face of the walls.

14.0 ACCEPTANCE OF WORK

All work shall be true to the lines and levels as indicated on the drawing or as directed by the Engineer, subject to tolerances as indicated in these specifications.

Mortar cubes shall be tested in accordance with IS:2250 for compressive strength, consistency of mortar and its water retentivity. The frequency of testing shall be one sample for every 2 cubic metres of mortar, subject to a minimum 3 samples for a day's work.

In case of plaster finish, the minimum surface thickness shall not be less than the specified thickness by more than 3mm.

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AUTOCLAVED CELLULAR CONCRETE BLOCK MASONRY

SPECIFICATION FOR CONCRETE BLOCK MASONRY

1.0 SCOPE

These specifications cover the use of Autoclaved Cellular Concrete Block Masonry for the structural / non structural purposes.

2.0 GENERAL

The provision of the latest Indian Standards listed below form part of these specifications:

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

IS 269	Specification for ordinary and low heat portland cement
IS 383	Specification for coarse and fine aggregates from natural sources for concrete.
IS 455	Specification for portland slag cement
IS 456	Code of Practice for plain and reinforced concrete.
IS: 1200	Measurement for Building works
IS: 1725	Specifications for solid cement blocks used in general building construction.
IS: 1905	Code of practice for structural safety of buildings Masonry walls.
IS:2116	Sand for masonry mortars.
IS:2185 (Part 1)	Specification for concrete masonry units: Hollow and solid concrete blocks.
IS 2185 (Part 3)	Specifications for Autoclaved Cellular concrete Blocks.
IS:2250	Code of practice for preparation and use of masonry mortar.
IS 2572	Code of practice for construction of hollow concrete block masonry.
IS 2645	Specification for integral waterproofing compound.
IS:3115	Specification for lime based blocks.
IS:3414	Code of practice for design and installation of joints in buildings.
IS:3466	Specification for masonry cement.
IS:3952	Specification for burnt clay hollow blocks for walls and partitions.
IS 3809	Fire resistance Test for Structure.
IS:4098	Specification for lime-pozzolana mixture
IS:4441	Code of practice for use of silicate type chemical resistant mortars.
IS:4442	Code of practice for use of sulphur type chemical resistant mortars.
IS 6041	Construction of Autoclaved Cellular Concrete Block Masonry.
IS 6441(Part 1to 8)	Methods of test for autoclaved cellular concrete products. (Determination of unit weight or bulk density & moisture content).

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IS 8112	Specification for 43 Grade ordinary Portland cement
IS 9103	Specification for admixtures for concrete.

3.0 MATERIAL

3.1 Cement: Ordinary Portland cement complying with IS 269 shall be used unless specified.

3.2 Aggregates: Aggregates shall conform to IS 383. Grading shall be as indicated in IS 383. Fineness modules of the combined aggregates shall be between 3.6 and 4.

3.3 Water: Water conforming to IS 456 and as approved by the EIC shall be used.

3.4 Admixtures: Additives or admixtures may be added to the cement or concrete mix conforming to the IS specifications. Admixtures shall be chloride free and melamine polymer based. Other additives or admixtures not being governed by Indian Standards shall be tested and checked that the same are not detrimental to durability. However any addition shall only be after approval of the EIC.

4.0 MANUFACTURE:

4.1 Autoclaved Cellular Concrete blocks may be hollow (open or closed cavity) or solid and shall be referred to by its nominal dimension. The term nominal dimension includes the thickness of the mortar joint. All specifications of solid concrete blocks including specifications for actual dimensions, tolerances, sizes, shapes and webs, grades of blocks etc. shall conform to IS : 2185.

4.2 Concreting: Concrete mix used for blocks shall be pre-designed to give a minimum crushing strength of 30 Kg/Cm2. Concrete shall be mixed in the mechanical mixer. Blocks shall be moulded, laid and compacted with automatic machines table vibrator. Care shall be taken to see that the mix mould is properly filled up. Block shall be protected until they are sufficiently hardened to permit handling without damage.

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

4.4 Physical requirements: All blocks shall be sound and free of cracks or other defects. For exposed construction face or faces shall be free of chips or other imperfections, and the overall dimensions of the blocks shall be in accordance to tolerance as specified. Minimum compressive strength shall be 30 Kg/Cm2 or as specified in the Schedule of Quantity, maximum permissible water absorption shall not exceed the limit specified in I.S. : 2185, dimensional variations shall conform to I.S. 2185.

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

4.6 Sampling: A sample of 20 blocks shall be taken from every consignment of 5000 blocks or part thereof of the same size and same batch of manufacture. From these samples, the blocks shall be taken at random for conducting the test. The blocks shall be taken at regular intervals during the course of work, preferably while being loaded or unloaded. In case samples are to be taken from the stacks, blocks shall be taken at random from across the top of the stacks, the sides accessible and from the interior of the stacks.

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

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

4.9 Blocks shall be approved if requirements of conditions mentioned in 11.2 to 11.5 of IS 2185 (Part I) (as given below) are satisfied. The number of blocks with dimensions outside the tolerance limit and / or with visual defects, among those inspected shall not be more than two. For Block density and compressive strength, the mean value determined shall be greater than or equal to the minimum limit specified in Table 2 of IS 2185 (Part I).

For drying shrinkage and moisture movement, all the test specimens shall satisfy the requirements of the test. If one or more specimens fail to satisfy the requirements, the remaining 3 blocks shall be subjected to these tests. All blocks shall satisfy the requirements. Drying shrinkage shall not exceed 0.1 percent.

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

5.0 PRECAUTIONS:

5.1 ACC blocks should be stacked in dry, well ventilated areas on a level ground. Block should be placed on edges (in direction of 240mm height) not on flat. Different stacks should be maintained for different sizes of blocks.

5.2 Damp-proof course should be provided beneath the ACC block masonry.

5.3 Unsupported height of ACC block masonry should not exceed 18 times the thickness of wall and length 20 times the thickness of wall.

6.0 WORKMANSHIP:

6.1 In total dry climate top and sides may be slightly moistened to avoid absorption of water from mortar. Joints shall not be bigger than 10mm and will be perfectly horizontal and vertical. Joints shall be raked 10mm deep while mortar is wet.

6.3 Cut blocks shall not be used. Special solid / hollow pre-cast blocks at site shall be cast well in advance to be used as spacers and to adjust breaking of vertical joints.

6.4 Cracks in block masonry are due to shrinkage or expansion of blocks or due to settlement, thermal expansion or changes in moisture content in the structural members enclosing the block walls.

The following measures are recommended to prevent formation of cracks.

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

b) Expansion joints shall be provided in walls exceeding 4.8 m in length.

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

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d) R.C.C. band (Patli) 100 mm thick and width equal to block masonry and having 10mm dia. two bars with 6 mm dia links @ 200 mm c/c shall be provided at every 1000mm interval in the block masonry. The gap between the topmost layer of block and the soffit of the beam shall be packed by lightly hammering flat pieces of approved stone / tiles and then the gaps will be covered by weld mesh before closing them by cement plaster. The weld mesh will be extended at least 150 mm on the R.C.C. beam and 150 mm on block masonry and nailed to them with strong nails.

e) All block walls abutting concrete columns or walls shall be bonded to the same with approved 6mm dia 250 mm long galvanized M.S. dowels or approved G.I. butterfly ties left from the concrete columns while casting, at every alternate course of block.

7.0 SCAFFOLDING

Scaffolding shall be erected with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with. The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Block work shall be carried out with double scaffolding only. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

Raking out of joints. Preparation of the tops and sides.

Forming and preparing expansion, contraction or construction joints as detailed above or specified in the BOQ or drawings.

Making holes, openings, outlets, etc. embedding pipes, ends of beams, joints, slabs, trusses, sills, etc. whatever required during construction and neatly finishing the exposed surfaces and opening as per instructions of the EIC.

Curing and protection as specified.

PLASTERING & POINTING

1.0 SCOPE

These specifications cover the use of plastering for brick, block masonry and RCC work, pointing for brick, block and stone masonry work.

2.0 APPLICABLE INDIAN STANDARDS

The provision of the latest revisions of the following IS codes shall form a part of this specification to the extent they are relevant.

IS: 269	Specification for ordinary rapid hardening and low heat Portland cement
IS – 383	Specification for coarse and fine aggregate

IS: 712	Building Limes
IS: 1200 (Part XII)	Method of measurement of building and Civil Engg. Works - Plastering & Pointing
IS: 1542	Specification for sand for plaster
IS: 1630	Mason's Tools for Plaster work and pointing work.
IS: 1661	Code of practice for application of cement lime plaster finishes
IS 2645	Specification for integral waterproofing compound.
IS: 10067	Material Constants for Building Works

Other IS Codes, not specifically mentioned here, but pertaining to plastering work, form part of these specifications.

3.0 GENERAL

3.1 Cement Mortar

Cement mortar shall have the proportion of cement to sand as specified and shall comply with relevant clauses of concrete specifications.

3.2 Scaffolding

Scaffolding independent of masonry / RCC work i.e. double scaffolding shall be erected having two sets of vertical supports with steel sections or pipes of adequate strength so as to be safe for construction operations. The contractor shall take all measures to ensure the safety of the work and working people. Any instructions of the Engineer in this respect shall also be complied with.

The contractor shall be entirely responsible for any damage to properly or injury to persons resulting from ill erected scaffolding, defective ladders and materials or otherwise arising out of his default in this respect. Proper scaffolding shall be provided to allow easy approach to every part of the work. Overhead work shall not be allowed. Making holes of any kind for the purpose of supporting the scaffolding shall not be permitted.

3.3 Tools and Accessories

Tools and accessories used in plaster work shall conform to IS: 1630. All tools shall be cleaned by scrapping and washing at the end of each day's work or after use. Metal tools shall be cleaned after each operation. All tools shall be examined to see that they are thoroughly cleaned before plastering is begun.

3.4 Programme of work in relation to plastering

The programme of other building operations before, during and after plastering shall be according to the instructions contained in clause 9 of IS: 1661.

3.5 General Precaution in plastering

All general precautions as specified in IS.. 1661, Clause 9, shall be taken and preparation of the background shall be done as laid down in IS: 1661, Clause 13.

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Care shall be taken to see that other parts of the work or adjacent works are not damaged while plastering.

3.6 Preparatory work

All joints in the face work that is to be plastered shall be raked out to depth equal to not less than the width of the joints or as directed by the Engineer. The raking shall be done taking care not to allow by chipping of masonry. In new work the raking out shall be done when the mortar in the joints is still green. Efflorescence if any shall be removed by brushing and scrapping. Smooth surfaces of concrete, old plaster, etc. must be suitably roughened to provide necessary bond for the plaster. All dirt, soot, oil paint or any other material that might interfere with satisfactory bond shall be removed. In the case of stone masonry, scrubbing on the walls to receive the plaster shall not be more than 12 mm. The surface to be plastered shall be cleaned and scrubbed with fresh water and kept wet for 6 hours prior to plastering. It shall be kept damp during the progress of the work. The plastering shall not be commenced unless the preparatory work is passed in writing by the Engineer.

3.7 Chicken wire Mesh at Junction

All junctions of Masonry wall with R.C. structure e.g. column, beam, etc. which are to be plastered, shall be reinforced by fixing strips of approved G.I. Chicken wire mesh of minimum 300mm wide centrally over the length of junction. G.I. Chicken wire mesh of required width shall also be fixed over chasing for conduits, pipes, etc. on masonry walls before plastering is commenced. The mesh shall be nailed rigidly to the structure / masonry with G.I. nails of suitable type at approx. 400mm centers. The finished mesh shall be straight, rigid and laid without sagging. The payment shall be made for the area covered by wire mesh in Sq. mtrs including overlaps.

3.8 Gauges

Patches of plaster 15cm x 15cm shall be put on about 3 m apart as gauges to ensure even plastering in one plane.

3.9 Workmanship Plastering:

In all plaster work the mortar shall be firmly applied with somewhat more than the required thickness and well pressed into the joints and on the surface and rubbed and levelled with a flat wooden rule to give required thickness. Long straight edges shall be freely used to give perfectly plane and even surface. All corners must be finished to their true angles or rounded as directed by the Engineer. The surface shall be finished to plane or curved surface as shown on the plan or directed by the Engineer, and shall present a neat appearance. The mortar shall adhere to the masonry surface intimately when set and there should be no hollow sound when struck. Cement plastering should be done in squares or strips as directed. Plastering shall be done from top downward.

First or Backing Coat: The first coat of the specified thickness shall be applied as described above. The subsequent coat shall be applied after this coat has been allowed to sufficiently set but not dried depending upon weather conditions. The surface shall not be allowed to dry during this period and shall be kept wet.

3.10 Plastering to Ceiling

Ceiling plaster shall be 6to 12 mm thick in 1:3 cement sand mortar (1 cement : 3 sand).

Projecting burrs of mortar formed due to the gaps at joints in shuttering shall be removed. The surface shall be scrubbed clean with wire brushes. In addition concrete

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surface shall be poke marked with a pointed tool at spacing of not more than 50 mm centres, the pokes being made not less than 3 mm deep, to ensure a proper key for the plaster. The mortar shall be washed off and surface cleaned of all oil, grease etc., and well wetted before the plaster is applied.

4.0 PLASTERING IN TWO COATS

4.1 Base Coat

The base coat plaster shall be of cement mortar 1:4. Waterproofing compound of approved make shall be added according to the manufacturer's' instructions to make the mortar waterproof.

The plaster with this mortar shall be laid as specified above with a thickness of not more than 15 mm for brick work and concrete surfaces. Keys shall be formed on the surface by thoroughly combing it with wavy horizontal lines about 12 mm apart and about 3 mm deep when the mortar is still plastic. The base coat shall be sufficiently cured not allow to dried.

4.2 Final Coat / Finishing Coat

A reasonable time (not more than 48 hours) shall be allowed after the application of the base coat for thorough drying before the application of the second coat. After soaking base coat thoroughly with water the mortar for second coat shall be applied .

The cement mortar for sand faced plaster shall have washed Kharasalis or similar type of approved sand with slightly larger proportion of coarse material. The proportion of cement to sand shall be 1:4. The approved quality of waterproofing compound shall be added as specified by manufacturer and approved by Engineer – In- Charge in external surface plastering. The water is added gradually to make the mixture homogeneous. The thickness of finishing coat shall not exceed 10mm. After application, the surface should be finished with a wooden flat, lined with cork and tapped gently to retain a coarse surface texture. When the finishing coat has hardened, the surface shall be kept moist continuously for 14 days.

The item includes providing rigid P. V. C. pipes of length aprox. 9" and fixing the same at interval of not more than 60cm c/c at the junctions of beam bottom and brick / block masonry work, prior backing coat plaster from outside.

Cement grout shall be poured through the pipes by attaching flexible PVC pipes with minimum head of 3000 mm till the entire gap under the beam is filled up with grout and set. The rigid PVC pipes should be removed the next day of grouting and cavities shall be immediately plugged with 1:3 cement mortar mixed with required water proofing compound.

5.0 POINTING

5.1 General

When the type of pointing is not mentioned in the item, sunk pointing is described below shall be carried out.

5.2 Raking Out Joints

Where the joints have not been raked out when the mortar is green, the joint shall be chipped (without damaging the masonry) to such a depth that the minimum depth of new mortar measured from either the sunk surface of the finished surface of the

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finished pointing or from the edge of the brick shall not be less than 12 mm, thoroughly cleaned off all loose particles with a stiff brush and thoroughly wetted.

5.3 Pointing

The mortar shall be pressed into the raked out joints with a pointing trowel. The mortar shall not spread over the corners, edges or the surface of the masonry. With a pointing tool, the mortar shall be neatly pressed back to about 3 mm or as directed. The vertical 'joints shall be pressed back similarly to match the horizontal joints. The surface of masonry shall be cleaned of all mortar.

6.0 CURING

Curing shall be started after 24 hours after finishing the plaster. The plaster shall be kept wet for a period of seven days. During this period it shall be suitably protected from all damages as directed by the Engineer-in-Charge. The dates on which the plastering is done shall be legibly marked on the various sections plastered so that curing for the specified period thereafter can be monitored.

Construction Safety

IS:3696 Safety Code For Scaffolds And Ladders. (Part I& II)

Measurement

IS:1200 Method Of Measurement Of Building Works.

IS:3385 Code Of Practice For Measurement Of Civil Engineering Works.

In the event that state, city or other governmental bodies have requirements more stringent than those set forth in this Specification, such requirement shall be considered part of this Specification and shall supersede this Specification where applicable.

6.1 General

The quality of materials and method and control of manufacture and transportation of all concrete work irrespective of mix, whether reinforced or otherwise, shall conform to the applicable portions of this Specification.

Engineer shall have the right to inspect the source(s) of material(s), the layout and operation of procurement and storage of materials, the concrete batching and mixing equipment, and the quality control system. Such an inspection shall be arranged and Engineer's approval obtained, prior to starting of concrete work.

6.2 Materials

All materials shall conform to the requirements laid in relevant Indian Standard Specification related to them.

6.3 Admixtures:

Admixtures may be used in concrete only with the approval of Engineer based upon evidence that, with the passage of time, neither the compressive strength nor its durability will reduce. Calcium chloride shall not be used for accelerating set of the cement for any concrete containing reinforcement, or embedded steel parts. When calcium chloride is permitted to be used, such as in mass-concrete works, it shall be dissolved in water and added to the mixing water in an amount not to exceed 1½ percent of the weight of the cement in each batch of concrete. When admixtures are

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used, the designed concrete mix shall be corrected accordingly. Admixtures shall be used as per manufacturer's instructions and in the manner and with the control specified by Engineer.

6.4 Water proofing agent

Where specified and approved by Engineer, water proofing agent confirming to IS:2645, shall be added in quantities specified by Engineer.

6.5 Tests

All materials shall satisfy the relevant Indian Standards. It is the Contractor's obligation to carry out the tests at his cost at Laboratories approved by the Engineer and produce the necessary certificates in proof of the compliance of the material with the specification.

- Tests on cement shall include:
- Fineness test
- Test for normal consistency
- Test for setting time
- Test for soundness
- Test for tensile strength
- Test for compressive strength
- Test for heat of hydration (by experiment and by calculations) in accordance with IS:269.
- Tests on sand shall include :
- Sieve test
- Test for organic impurities
- Decantation test for determining clay and silt content
- Specific gravity test
- Test for unit weight and bulkage factor
- Test for sieve analysis and fineness modulus.
- Tests on coarse aggregate shall include
- Sieve analysis
- Specific gravity and unit weight of dry, loose and rodded aggregate
- Soundness and alkali aggregate reactivity
- Petrographic examination
- Deleterious materials and organic impurities
- Test for aggregate crushing value.

The Engineer, if he so desires, may order further tests to be carried out on cement, sand, coarse aggregate, water in accordance with the relevant Indian Standards.

Any or all these tests would normally be ordered to be carried out if Engineer feels the materials are not in accordance with the Specifications or if the specified concrete

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strengths are not obtained and shall be performed by Contractor at an approved test laboratory.

6.6 Standard Finish for Exposed Concrete

Exposed concrete shall mean any concrete, other than floors or slabs, exposed to view upon completion of the job.

Unless otherwise specified on the Drawings, the standard finish for exposed concrete shall be a smooth finish.

A smooth finish shall be obtained with the use of lined or plywood forms having smooth and even surfaces and edges. Panels and form linings shall be of uniform size and be as large as practicable and installed with closed joints. Upon removal of forms the joint marks shall be smoothened off and all blemishes, projections, etc. removed leaving the surfaces reasonably smooth and unmarred.

6.7 Integral Cement concrete Finish

When specified on the Drawings an integral cement concrete finish of specified thickness for floors and slabs shall be applied either monolithic or bonded, as specified on the Drawings, as per IS: 2571. The surface shall be compacted and then floated with a wood float or power floating machine. The surface shall be tested with a straight edge and any high and low spots eliminated. Floating or trowelling of the finish shall be permitted only after all surface water has evaporated. Dry cement or a mixture of dry cement and sand shall not be sprinkled directly on the surface of the cement finish to absorb moisture or to stiffen the mix.

6.8 Rubbed Finish

A rubbed finish shall be provided only on exposed concrete surfaces as specified on the Drawings. Upon removal of forms, all fins and other projections on the surfaces shall be carefully removed, offsets leveled and voids and / or damaged sections immediately saturated with water and repaired by filling with a concrete or mortar of the same composition as was used in the surface. The surfaces shall then be thoroughly wetted and rubbed with carborundum or other abrasive. Cement mortar may be used in the rubbing, but the finished surfaces shall not be brush coated with either cement or grout after rubbing. The finished surfaces shall present a uniform and smooth appearance.

6.9 Protection

All concrete shall be protected against damage until final acceptance by Engineer / Owner.

Preparation of concrete surfaces

The preparation of concrete surfaces upon which additional concrete is to be placed later, shall preferably be done by scarifying and cleaning while the concrete is between its initial and final set. This method shall be used wherever practicable and shall consist of cutting the surface with picks and stiff brooms and by use of an approved combination of air and water jet as directed by Engineer. Great care shall be taken in performing this work to avoid removal of too much mortar and the weakening of the surface by loosening of aggregate.

When it is not practicable to follow the above method, it will be necessary to employ air tools to remove laitance and roughen the surface.

The final required result shall be a pitted surface from which all dirt, unsound concrete, laitance and glazed mortar have been removed.

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6.10 Bonding Treatment (Mortar)

After rock or concrete surfaces upon which new concrete is to be placed have been scarified, cleaned and wetted as specified herein, they shall receive a bonding treatment, immediately before placement of the concrete.

The bonding medium shall be a coat of cement-sand mortar. The mortar shall have the same cement-sand proportions as the concrete which shall be placed on it. The water-cement ratio shall be determined by placing conditions and as approved by Engineer.

Bonding mortar shall be placed in sufficient quantity to completely cover the surface about 10 mm thick for rock surface and about 5 mm thick for concrete surfaces. It shall be brushed or broomed over the surface and worked thoroughly into all cracks, crevices and depressions. Accumulations or puddles of mortar shall not be allowed to settle in depressions and shall be brushed out to a satisfactory degree, as determined by Engineer.

Mortar shall be placed at such a rate that it can be brushed over the surface just in advance of placement of concrete. Only as much area shall be covered with mortar as can be covered with concrete before initial set in the mortar takes place. The amount of mortar that will be permitted to be placed at any one time, on the area which it is to cover, shall be in accordance with Engineer's directions.

Cleaning and bonding formed construction joints

Vertical construction joints shall be cleaned as specified above or by other methods approved by Engineer. In placing concrete against formed construction joints, the surface of the joints, where accessible, shall be coated thoroughly with the specified bed-joint bonding mortar immediately before they are covered with concrete or by scrubbing with wire brooms dipped into the fresh concrete. Where it is impracticable to apply such a mortar coating, special precautions shall be taken to ensure that the new concrete is brought into intimate contact with the surface of the joint by careful puddling and spading with aid of vibrators and suitable tools.

6.11 Expansion and contraction joints

Provision shall be made for expansion and contraction in concrete by use of special type joints at locations shown on the Drawing. Contraction joint surfaces shall be treated as per the Specifications on the Drawings or as directed by Engineer.

6.12 Preparation of Mortars and Its Grade

Grade of Masonry Mortar

The grade of masonry mortar will be defined by its compressive strength in N/mm2 at the age of 28 days as determined by the standard procedure detailed in IS:2250-1981.

For proportioning the ingredients by volume, the conversion of weight into volume shall be made on the following basis:

Dry hydrated lime	700 kg/cum
Burnt Clay Pozzolana	860 kg/cum
Lime Pozzolana mixture	770 kg/cum
Coarse Sand (dry)	1280 kg/cum
Fine sand (dry)	1600 kg/cum

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fly Ash 590 kg/cum

Cement Mortar: This shall be prepared by mixing cement and sand with or without the addition of Pozzolana as specified.

Proportioning: Cement bag weighting 50 kg shall be taken as 0.035 cubic metre. Other ingredients in specified proportion shall be measured using boxes of size 40 X 35 X 25 cm. Sand shall be measured on the basis of its dry volume.

Mixing: The mixing of mortar shall be done in mechanical mixers operated manually or by power as decide by Engineer. The Engineer may, however, permit hand mixing at his discretion taking into account the nature, magnitude and location of the work and practicability of the use of mechanical mixers or where item involving small quantities are to be done or if in his opinion the used of mechanical mixer is not to be used, the Contractor shall take permission of the Engineer in writing before the commencement of the work.

Mechanical Mixing: Cement and sand in the specified proportions shall be mixed dry thoroughly in a mixer. Water shall then be added gradually and wet mixing continued for at least three minutes. Only the required quantity of water shall be added which will produce mortar of workable consistency but not stiff paste. Only the quantity of mortar, which can be used within 30 minutes of its mixing shall be prepared at a time. Mixer shall be cleaned with water each time before suspending the work.

Hand Mixing: The measured quantity of sand shall be leveled on a clean masonry platform and cement bags emptied on top. The cement and sand shall be thoroughly mixed dry by being turned over and over, backwards and forwards, several times till the mixture is of a uniform colour. The quantity of dry mix which can be used within 30 minutes shall then be mixed in a masonry trough with just sufficient quantity of water to bring the mortar to a stiff plaster of necessary working consistency.

Precautions: Mortar shall be used as soon as possible after mixing and before it begins to set, and in any case within half hour, after the water is added to the dry mixture.

Exposed Aggregate Plaster

The base plaster of cement mortar of specified mix and thickness is to be done with surface true to plumb and floated hard. Necessary grooves of 20 mm x 15 mm shall be provided as shown in the drawing or as directed, in the base plaster. The plastered surface shall be properly ranked, cement paste shall be applied on a limited area at a time so that it would not become hard before granite chips are applied. The granite chips to be used shall be 6mm gauge of hard approved variety screened, washed and dried properly and shall be applied by means of floats or trowels, dashing them against the still fresh cement paste already applied. where uniform texture is not obtained chips shall be stuck suitably by hand. care should be taken that application of cement paste shall be done uninterruptedly within one panel so that joints and patches are avoided. precautionary steps should be taken to protect the surface already done during the process of finishing adjoining areas so that the areas completed shall not get stained.

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1.0 SCOPE:

This specification covers Preparation of fabrication drawings, Providing all materials, fabricating, transporting, erection in position to proper lines and levels, fixing, steelwork for various structures and painting / other protection of steelwork for structures including fixtures, fittings, temporary works and supports, and ancillaries. The steelwork may have to be fabricated out of steel shapes, plates, hollow sections, pipes, cast steel, forgings etc and may involve any or combination of two or more of these in sizes, quantity and quality as specified in the drawings or as directed by the Engineer. The steelwork may consist of all types such as columns, beams, trusses, wall beams, girders, brackets, base-plates, floorings, anchors, stairs bracings or of any other kind as shown in the drawings or as required by the Engineer. Painting would involve cleaning by sand blasting to appropriate degree and specifications as given and painting with various combinations of primary and intermediate and final coats of specified thickness.

The Contractor shall furnish all the materials, skilled staff and labour, transportation, equipment, tools, tackles, temporary work and all other things that may be required for carrying out the work described above as per drawings, specifications and the instructions of the Engineer.

CODES AND STANDARDS:

Codes and standards applicable are given in the list below, which however shall not limit the applicable standards or codes or directions of the Engineer.

Table – Codes of Practice and Standards

Specification	Description
IS: 800	Code of practice for general construction in steel
IS: 808	Dimensions of hot rolled steel beam, column channel and angle sections
IS: 813	Scheme of symbols for welding
IS: 814	Covered electrodes for manual metal arc welding of Carbon and carbon-manganese steel
IS: 816	Code of practice for use of metal arc welding in general mild steel construction
IS: 817	Code of practice for training and testing of metal arc welders
IS: 818	Code of Practice for safety and health requirements in electric and gas welding and cutting operations
IS: 822	Code of procedure for inspection of welds
IS: 823	Code of procedure for manual metal arc welding of mild steel
IS: 1030	Carbon Steel castings for general engineering purposes
IS: 1161	Steel tubes for structural purposes
IS: 1181	Qualifying tests for metal arc welders
IS: 1182	Recommended practice for radiographic examination of fusion welded butt joints in steel plates

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IS: 1363 (1&2)	Hexagon head bolts and nuts of product grade C
IS: 1364 (1-5)	Hexagon head bolts and nuts of product grade A and B
IS: 1367 (1-20)	Technical supply conditions for threaded steel fasteners
IS: 1387	General requirements for the supply of metallurgical materials
IS: 1477 (1 & 2)	Code of Practice for painting ferrous metals in buildings
IS: 1599	Method for bent test
IS: 1608	Mechanical testing of metals – tensile testing
IS: 1730	Steel plates, sheets and strips and flats for general engineering purposes – dimensions
IS: 1852	Rolling and cutting tolerances for hot rolled steel products
IS: 2004	Carbon Steel forgings for general engineering purposes
IS: 2016	Plain washers
IS: 2062	Steel for general structural purposes – (supersedes IS: 226)
IS: 2595	Code or practice for radiographic testing
IS: 3502	Steel chequered plates
IS: 3613	Acceptance test for wire flux combination for submerged arc welding
IS: 3640	Hexagon fit bolts
IS: 3658	Code of practice for liquid penetrant flaw detection
IS: 3664	Code of practice for ultrasonic pulse echo testing by contact and immersion methods
IS: 3696	Safety codes for scaffolds and ladders
IS: 3757	High strength structural bolts
IS: 4353	Submerged arc welding of mild steel and low alloy steels – recommendations
IS: 4923	Hollow steel sections for structural use
IS: 5334	Code of practice for magnetic particle flaw detection of welds
IS: 5372	Taper washers for channel
IS: 5624	Foundation bolts
IS: 6610	Heavy washers for steel structures
IS: 6639	Hexagon bolts for steel structures
IS: 7205	Safety code for erection of structural steelwork
IS: 7215	Tolerances for fabrication of steel structures
IS: 7293	Safety code for working with construction machinery

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IS: 9595	Metal arc welding of carbon and carbon manganese steels – recommendations
IS: 12843	Tolerances for erection of steel structures
SP: 34	Handbook of concrete reinforcement and detailing

2.0 INSPECTION

It is presumed that the site has been inspected and all site conditions noted that might affect the selection of erection method, plant requirements and such details. The method and units of transportation of structures from fabrication yards to site would also depend on the location of fabrication yards, the dimensions and grades of the connecting roads and the approach to the erection location. It is necessary that during the work the existing structures (where there are some) are not damaged or affected anyway by the present work.

3.0 STRUCTURAL STEEL

3.1 General

3.1.1 General requirements relating to the supply of material shall conform to the specifications of IS: 1387, for the purpose of which the supplier shall be the Contractor and the purchaser shall be the Engineer.

3.1.2 Finished rolled material shall be free from cracks, flaws, injurious seams, laps, blisters, ragged and imperfect edges and other defects. It shall have a smooth and uniform finish, and shall be straightened in the mill before shipment. They shall also be free from loose mill scale, rust, pits or other defects affecting its strength and durability.

The acceptance of any material on inspection at the mill i.e. rolling mills, foundry or fabricating plant where material for the work is manufactured, shall not be a bar to its subsequent rejection, if found defective.

3.1.3 In general, steelwork connections shall be by bolting and welding. Mild steel or high tensile bolts shall be used as indicated in the drawings.

4.0 OTHER MATERIALS

4.1 All materials shall conform to Special requirements as given below:

4.2 Mild steel for bolts and nuts shall conform to IS: 2062 but have a minimum tensile strength of 44 kg/sq. mm. and minimum percentage elongation of 14. High tensile steel for bolts and nuts shall conform to IS: 8500 but with a minimum tensile strength of 58 kg/sq. mm.

4.3 For cast steel, the yield stress shall be determined and shall not be less than 50 percent of the minimum tensile strength.

4.4 Plain washers shall be of steel. Tapered or other specially shaped washers shall be of steel, or malleable cast iron.

4.5 Parallel barrel drifts shall have a tensile strength not less than 55 kg/sq. mm, with elongation of not less than 20 percent measured on a gauge length of 4 So (So = cross sectional area).

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4.6 Materials for castings and forgings, fasteners and welding consumables shall be as under:

i) Castings and Forgings: Steel castings and forgings shall comply with the requirements of the following Indian Standards, as appropriate:

IS: 1030 Carbon Steel Castings for General Engineering purposes

IS: 1875 Carbon Steel Billets, blooms, slabs, bars for forgings

IS: 2004 Carbon Steel Forgings for General Engineer purposes

IS: 2644 High Tensile Steel Casings

IS: 4367 Alloy & tool steel forgings for general industrial use

5.0 STEEL PROTECTION SYSTEM

Generally all steelwork shall be sand / shot blasted to SA – 2-1/2 (SIS 055900) and given the following coats of paint.

One coat of zinc anode epoxy primer (or equivalent of similar properties) with a minimum dry film thickness of 75 microns per coat

An intermediate coat of epilux 950 super high build coating (or equivalent of similar properties) with a dry film thickness of 200 microns

Two coats of acrylic polyurethane enamel minimum dry film thickness of 30/35 microns per coat

Unless otherwise specified, paints shall conform to the relevant IS specifications. The paints that have been tested as per specifications only shall be used. Where there are no specifications, manufacturer's recommendation shall be followed.

6.0 FABRICATION

6.1 General

All work shall be in accordance with the drawings approved and released by the Engineer for construction, as per these specifications and as instructed by the Engineer. Care should be exercised by the Contractor to ensure that all parts of an assembly are so well fabricated to fit accurately together. All members shall carry a mark number and an item number and, if required, serial no.

Unless specifically required under the contract, corresponding parts for identical units need not be interchangeable, but the parts shall be match marked.

Templates and other appliances used for ensuring the accuracy of the work shall be of mild steel. All measurements for fabrication shall be made by means of accurate steel tapes or other devices properly calibrated.

All structural steel members and parts shall have straight edges and blunt surfaces. If necessary they shall be straightened or flattened by pressure unless they are required to be of curvilinear forms. They shall also be free from twist. Pressure applied for straightening or flattening shall be such that would not injure the materials. Hammering shall not be permitted. Adjacent surface or edges shall be in close contact or at uniform distance throughout.

The contractor shall submit his program of work to the Engineer for his approval at least 15 days before commencement of fabrication. This program shall include the proposed system of identification and erection marks together with complete details of fabrication and welding procedures.

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The Contractor shall prepare shop drawings for fabricating the components of steelwork and obtain approval of the Engineer a week before the start of work on the components. Complete information regarding the location, type, size and extent of all welds shall be clearly shown on the shop drawings. The drawings shall distinguish between shop and field welds.

6.2 Preparation of Edges and Ends

All structural steel parts, where required, shall be sheared, cropped, sawn or flame cut and ground accurately to the required dimension and shape.

End/edge planning and cutting shall be done by any one of the following prescribed methods or left as rolled:

Shearing, cropping, sawing, machining, machine flame cutting.

Hand flame cutting with subsequent grinding to a smooth edge.

Sheared edges of plate not more than 16mm thick with subsequent grinding to smooth profile, which are of secondary use such as stiffeners and gussets.

If the ends of stiffeners are required to be fitted, they shall be ground, so that the maximum gap over 60% of the contact area does not exceed 0.25 mm.

Where the flame cutting or shearing is used, at least one of the following requirements shall be satisfied.

The cut edge is not subject to applied stress.

The edge is incorporated in weld.

The hardness of cut edge does not exceed 350 HV 30.

The material is removed from the edge to the extent of 2 mm or minimum necessary, so that the hardness is less than 350 HV 30.

Edge is suitably heat treated by approved method to the satisfaction of the Engineer and shown that crack had not developed by dye penetrant or magnetic particle test.

Thickness of plate is less than 40 mm for machine flame cutting for materials conforming to IS: 2062. The requirement of hardness below 350 HV 30 of flame cut edges should be specified by the Engineer.

Where machining for edge preparation in butt joint is specified, the end shall be machined after the members have been fabricated. Outside edges of plate and section, which are prone to corrosion shall be smoothed by grinding or filing. In the case of high tensile steel at least 6 mm of the material from the flame cut edge shall be removed by machining. Longitudinal edges of all plate and cover plates in plate girders and built-up members shall be ground to correct dimensions except in the following cases:

Covers to single flange plates may be left un-machined.

Machine flame cutting instead of machining is acceptable for edges of single plates, 25 mm or less thick, in tension.

Edges of single shaped plates over 25 mm thick may be machine flame cut and the end surface ground.

Edges of plates or flats of the same nominal width in tiers may be left un-machined, if so authorised by the Engineer.

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All edges of splice and gusset plates may be sheared and ground. The ends of plates and sections forming the main components of plate girders or of built-up members may be machine flame cut, sawn or hand flame cut and ground. Where ends of stiffeners are required to be fitted, they shall be machined, machine flame cut, swan, sheared and ground, or hand flame cut and ground. The ends of lacing bar shall be rounded unless otherwise required. Other edges and ends of mild steel parts may be sheared and any burrs at edges shall be removed.

6.3 Preparation of Holes

6.3.1 Drilling and Punching: Holes for black bolts, high strength bolts and counter sunk bolts (excluding close tolerance and turn fitted bolts) shall be either punched or drilled. The diameter of holes shall be 1.5 mm larger for bolts less than 25 m. dia and 2.0 mm for more than or equal to 25 mm.

All the holes shall be drilled except for secondary members such as, floor plate, handrails etc. Members which do not carry the main load can be punched subject to the thickness of member not exceeding 12 mm for material conforming to IS: 226.

Holes through one thickness of material or when any of the thickness exceeds 20 mm for steel conforming to IS: 2062 or 16 mm for conforming to IS: 8500, shall either be sub-drilled or sub-punched to a diameter of 3 mm less than the required size and then reamed to the required size. The reaming of material more than one thickness shall be done after assembly.

Where several plates or sections form a compound member, they shall where practicable, be firmly connected together by clamps or tacking bolts, and the holes be drilled through the group in one operation. Alternatively, and in the case of repetition work, the plates and sections may be drilled separately from templates that shall be checked periodically. All burrs shall be removed.

Shop erection / assembly shall be done wherever so required by the engineer.

6.3.2 Where block drilling is done, care shall be taken to check that the holes are not out of position or are dimensionally correct

6.3.3 Size of Holes: The sizes of holes in millimeters are given in table 1 below:

Table-1: Diameter of holes for bolts

Nominal dia of Bolts (mm)	Dia of Holes (mm)
12	13.5
14	15.5
16	17.5
18	19.5
20	21.5
24	25.5
27	29.0
30	31.0
31	33.0

Close tolerance bolts and barrel bolts: Holes for close tolerance and turn fitted bolts. The diameter of the holes shall be equal to the nominal diameter of the bolt shank minus 0.15 mm to 0.0 mm. The member to be connected with close tolerance or turn fitted bolts shall be firmly held together by service bolts or clamped and drilled

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through all thickness in one operation and subsequently reamed to required size within specified limit of accuracy as specified in IS: 919 tolerance grade H8.The holes not drilled through all thickness at one operation shall be drilled to smaller size and reamed after assembly.

Holes for high strength friction grip bolts: All holes shall be drilled after removal of burrs. Where the number of plies in the grip does not exceed three, the diameters of holes shall be 1.6 mm larger than those of bolts and for more than three plies in grip, the diameter of hole in outer plies shall be as above and dia of holes in inner plies shall not be less than 1.6 mm and not more than 3.2 mm larger than those in bolts, unless otherwise specified by the Engineer.

6.3.4 Removal of Burrs: The work shall be taken apart after drilling and all burs left by drilling and the sharp edges of all rivet holes completely removed.

7.0 BOLTS, NUTS AND WASHERS:

7.1 Black bolts (black all over): Black bolts are forged bolts in which the shanks, heads and nuts do not receive any further treatment except cutting of screw threads. They shall be true to shape and size and shall have the standard dimensions as shown on the drawings.

7.2 Close tolerance bolts: Close tolerance bolts shall be faced under the head and turned on the shank.

7.3 Turned barrel bolts: The diameter of the screwed portion of turned barrel bolts shall be 1.5 mm smaller than the diameter of the barrel unless otherwise specified by the Engineer. The diameter of the bolts as given on the drawing shall be the nominal diameter of the barrel. The length of the barrel shall be such that it bears fully on all the parts connected. The threaded portion of each bolt shall project through the nut by at least one thread. Faces of heads and nuts bearing on steel work shall be machined.

7.4 Washers:

In all cases where the full bearing area of the bolt is to be developed, the bolt shall be provided with a steel washer under the nut of sufficient thickness of the parts bolted together and to prevent the nut when screwed up, from bearing of the bolt.

For close tolerance or turned barrel bolts, steel washers whose faces give a true bearing shall be provided under the nut. The washer shall have a whole diameter not less than 1.5 mm larger than the barrel and a thickness of not less than 6 mm so that the nut when screwed up will not bear on the shoulder of the bolt.

Taper washers with correct angle of taper shall be provided under all heads and nuts bearing on beveled surfaces. Spring washers may be used under nuts to prevent slackening of the nuts when excessive vibrations occur. Where the heads or nuts bear on timber, square washers having a length of each side not less than three times the diameter of bolts or round washers having a diameter of 3½ times the diameter of bolts and with a thickness not less than one quarter of diameter shall be provided.

7.5 Studs

Ordinary studs may be used for holding parts together, the holes in one of the parts being tapped to take the thread of the stud. Counter-sunk studs may be used for making the connections where the surfaces are required to be cleared of all obstruction, such as protruding heads of bolts, studs may also be welded on the steel work in the positions required.

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7.6 Service bolts:

Service bolts shall have the same clearance as black bolts and where it is required that there should be no movement prior to final riveting, sufficient drifts or close tolerance bolts shall be used to locate the work.

7.7 Tightening bolts:

Bolted connection joints with black bolts and high strength bolts shall be inspected for compliance of Code requirements.

The Engineer shall observe the installation and tightening of bolts to ensure that correct tightening procedure is used and shall determine that all bolts are tightened. Regardless of tightening method used, tightening of bolts in a joint should commence at the most rigidly fixed or stiffest point and progress towards the free edges, both in initial and in final tightening. The tightness of bolts in connection shall be checked by inspection wrench, which can be torque wrench, power wrench or calibrated wrench.

Tightness of 10% bolts, but not less than two bolts, selected at random in each connection shall be checked by applying inspection torque. If no nut or bolt head is turned by this application, connection can be accepted as properly tightened, but if any nut or head has turned all bolts shall be checked and, if necessary, re-tightened.

7.8 Drifts-

The barrel shall be drawn or machined to the required diameter for a length of not less than one diameter over the combined thickness of the metal through which the drifts have to pass. The diameter of the parallel barrel shall be equal to the nominal diameter of the hole subject to a tolerance of +0 mm and –0.125 mm. Both ends of the drift for a length equal to 1½ times the diameter of the parallel portion of the bar shall be turned down with a taper to a diameter at the end equal to one-half that of parallel portion.

7.9 Pins and pin holes

7.9.1 Pins: The pins shall be parallel throughout and shall have a smooth surface free from flaws. They shall be of sufficient length to ensure that all parts connected thereby shall have a full bearing on them. Where the ends are threaded, they shall be turned to a smaller diameter at the ends for the thread and shall be provided with a pilot nut, where necessary, to protect the thread when being drawn to place. Where the ends are not threaded suitable cotter arrangements shall be made to prevent pin from working loose. Pins more than 175 mm in length or diameter shall be forged and annealed.

Pinholes: Pinholes shall be bored true to gauge, smooth, straight at right angles to the axis of the member and parallel with each other, unless otherwise required. The tolerance in the length of tension members from outside to outside of pinholes and of compression members from inside to inside of pinholes shall be as specified in the drawings. In built up members, the boring shall be done after the members have been riveted or welded. Where specified proper brass / gunmetal bushes shall be provided in the pinholes. The specified diameter of the pinhole shall be its minimum diameter. The resulting clearance between the pin and the hole shall be not less than 0.5 mm and not more than 1.0 mm or otherwise as specified in the drawings.

8.0 SHOP ERECTION AND MATCH MARKING

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Sub-sections of the steelwork, if so required by the Engineer, shall be temporarily erected in the fabrication shop before dispatch to site, for the Engineer's inspection. The quality of fabrication, and the alignment and fit of all connections would be checked. For this purpose a sufficient number of parallel drifts and service bolts that tightly screw up, shall be employed. All parts shall fit accurately and be in accordance with drawings and specifications. After the Engineer's approval, any sub-size holes left shall be reamed to size and materials match marked and dispatched to site. The Engineer shall be the sole authority to decide the extent of shop erection required

After the work has been approved by the Engineer and before it is dismantled, each part shall be carefully marked for erection with distinguished marks and stamped with durable markings. Drawings showing these markings correctly shall be supplied to the Engineer.

Unloading, handling and storage of steel work as per these specifications shall be the responsibility of the Contractor. The cost of repairs or rejected material, its removal and the cost of transporting replacement material to the site shall be borne by the Contractor.

9.0 WELDING

All welding shall be done with prior approval of the Engineer and the workmanship shall conform to the specifications of IS: 823 or other relevant Indian Standards as appropriate.

When material thickness is 20 mm or more, special precaution like preheating shall be taken as laid down in IS: 823. Surfaces and edges to be welded shall be welded smooth, uniform and free from fins, tears, cracks and other discontinuities. Surfaces shall also be free from loose or thick scale, slug rust, moisture, oil and other foreign materials. Surfaces within 50 mm of any weld location shall be free from any paint or other material that may prevent proper welding or cause objectionable fumes during welding.

The general welding procedures including particulars of the preparation of fusion faces for metal arc welding shall be carried out in accordance with IS: 9595.

The welding procedures for shop and site welds including edge preparation of fusion faces shall be submitted in writing in accordance with Clause 22 of IS: 9595 for the approval of the Engineer before commencing fabrication and shall also be as per details shown on the drawings. Any deviation from above has to be approved by the Engineer. Preparation of edges shall, wherever practicable done by machine methods.

Machine flame cut edges shall be substantially as smooth and regular as those produced by edge planning and shall be left free of slag. The Engineer shall permit manual flame cutting only where machine cutting is not practicable.

Electrodes to be used for metal arc welding shall comply with relevant IS specifications. Test shall be carried forward as per IS: 8613 to find out suitable wire flux combination for welded joint.

Assembly of parts for welding shall be in accordance with provisions of IS: 9595.

The welded temporary attachments should be avoided as far as possible, otherwise the method of making any temporary attachments shall be removed by cutting, and chipping and surface shall be finished smooth by grinding to the satisfaction of the Engineer.

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Welding shall not be done when the air temperature is less than 10 degrees Celsius. Welding shall not be done when the surfaces are moist, during periods of strong winds or snowy weather unless the work and the welding operators are adequately protected.

For welding of any particular type of joint, welders shall qualify to the satisfaction of the Engineer in accordance with appropriate welders qualification tests as prescribed in any of the Indian Standards IS: 817, IS: 1393, IS: 7307(PART I), IS: 7310(PART I) and IS: 7318(PART I) as relevant.

In assembling and joining parts of a structure or of built up members, the procedure and sequence of welding shall be such as to avoid distortion and minimise shrinkage stress.

All requirements regarding pre heating of parent material and inter pass temperature shall be in accordance with provision of IS: 9595

Peening of weld shall be carried out wherever specified by the Engineer:

If specified peening may be employed to be effective on each weld layer except first.

The peening shall be carried out after weld has cooled out by light blows from a power hammer using a round nose tool. Care shall be taken to prevent scaling or flaking of weld and base metal from over peening.

Where the Engineer has specified the butt welds are to be ground flush, the loss of parent metal shall not be greater than that allowed for minor surface defects. The end of butt joints shall be welded so as to provide full throat thickness. This may be done by use of extension pieces, cross runs or other means approved by the Engineer. Extension pieces shall be removed after the joint has cooled and the ends of the welds shall be finished smooth and flush with the faces of the abutting parts.

The joints and welds listed below are prohibited type, which do not perform well under cyclic loading.

i) Butt joints not fully welded throughout their cross section

ii) Groove welds made from one side only without any backing grip

iii) Intermittent groove welds

iv) Bevel grooves and J grooves in butt joints for other than horizontal position

v) Plug and slot welds

The run on and run off plate extension shall be used providing full throat thickness at the end of butt-welded joints. These plates shall comply with the following requirements.

One pair of run on and one pair of run off plates prepared from same thickness and profile as the parent metal shall be attached to start and finish of all butt welds preferably by clamps. When run on and run off plates shall be removed by flame cutting, it should be cut at more than 3 mm from parent metal and remaining metal shall be removed by grinding or by any other method approved by the Engineer.

10.0 TOLERANCES:

The tolerances in fabrications shall be governed by IS: 7215. Tolerances in dimensions of components of fabricated structural steel work shall be specified on the drawings and shall be subject to the approval of the Engineer before fabrication. Unless specified all parts of an assembly shall fit together accurately within

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tolerances specified in Table –2. A machine bearing surface, where specified by the Engineer, shall be machined with a deviation of 0.25mm for surfaces that can be inscribed within a square of side 0.5 m.

TABLE -2 FABRICATION TOLERANCES

SNO	DESCRIPTION OF WORK / ITEM	TOLERANCE
	INDIVIDUAL COMPONENTS	
1	LENGTH	
	a) Member with both ends finished for contact bearing	± 1mm
	b) individual components of members with end plate connection	+ 0 mm,-2 mm
	c) Other members i) up to and including 12 m	± 2 mm
	Other members ii) over 12 m	± 3.5 mm
2	WIDTH	
	a) width of built-up girders	± 3 mm
	b) Deviation in the width of members required to be inserted in other members	+ 0 mm - 3 mm
3	DEPTH	
	Deviation in the depth of the solid web and open web girder	+3 mm, -2 mm
4	STRAIGHTNESS	
	a) Deviation from straightness of columns (L – length of member)	L/3000 with max of 15 mm
	i) in elevation	+5 mm,- 0 mm
	ii) in plan	L/1000 with max. of 10 mm
5	Deviation of centre line of web from centre line of flanges in built up members at contact surfaces	3mm
6	Deviation from flatness of plate of webs of built members in a length equal to depth of member (d- depth of member)	0.005 d with max of 2 mm
7	Tilt of flange of plate girders (b – width of the member)	
	i) At splices and stiffeners, at supports, at the top flanges of plate girders and at bearings	0.005 b with a max of 2 mm
	ii) at other places	0.015 b with a max of 4 mm
8	Deviation from square ness of the flange to web of columns and box girders (L is nominal length of the diagonal)	L/1000
9	Deviation from squareness of fixed base plate (not machined) to axis of column. This dimension shall be measured parallel to the longitudinal axis of the column at points where the outer surfaces of the column sections make contact with the base plate (D- the distance from the column axis to the point under consideration on the base plate)	D/500
10	Deviation from square ness of machined ends to axes of columns (D- same as in 9 above)	D/1000

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SNO	DESCRIPTION OF WORK / ITEM	TOLERANCE
11	Deviation from square ness of machined ends to axes of beams of girder (D- same as in 9 above)	D/1000
12	Ends of member abutting at joints through cleats or end plates, permissible deviation from the square ness of ends	1/600 of depth of member subject to a max of 1.5 mm

11.0 PACKING AND TRANSPORT

All projecting plates and bars and all ends of members at joints shall be stiffened, all straight bars and plates shall be bundled, all screwed ends and machined surfaces shall be suitably packed and all bolts, nuts, washers and small loose parts shall be packed separately in cases, so as to prevent damage or distortion. Care shall be taken during loading and unloading so that no material sustains damage and materials are not mixed up.

The materials shall be carefully transported and unloaded at site of erection, exercising great care not to damage the materials in any manner. They shall be stored as per erection marks and sizes with small materials being stored in sheds to prevent loss or mixing up.

12.0 ERECTION

12.1 General

The provisions of this item shall apply of erection of steelwork in the various structures either in the roof or elsewhere. The contractor shall transport the fabricated steel to the erection site. This should be done without damaging the steelwork in any manner. Even so the steelwork shall be subject to the Engineer's inspection and minor rectification if needed shall be carried out as directed by the Engineer.

The steelwork shall be erected in position to lines and levels as shown in the drawings with or without enabling works. It will be welded or bolted in final position all as shown in the drawings. The contractor shall take all safety precautions to prevent any damage to the work or any accident. After erection and necessary welding / bolting is approved by the Engineer, the Contractor shall touch up the shop paints as necessary and shall apply the required coats of paint as shown in the drawings. After approval of painting, further work on the structure such as sheeting etc shall be carried and do all the work required to complete the construction included in the contract in accordance with the drawings and the specification and to the entire satisfaction of the Engineer.

12.2 Organization and Equipment

The contractor shall submit a complete erection scheme for the approval of the Engineer showing the equipment that he would be a method and procedure of erection, compatible with details of fabrication. As time is of the very essence, the means to achieve fast and accurate work shall be employed. The approval of the Engineer shall not relieve the contractor of his responsibility for the safety of his method or equipment or from carrying out the work fully in accordance with the drawings of the specifications.

A detailed scheme must be prepared showing stage-wise activities, with complete drawings and phase-wise working instructions. This should be based on detailed stage-wise calculation and take into account specifications and capacity of erection machinery, tools, tackles to be used and temporary working loads as per Code

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provisions. Temporary work where used shall be supported by design and calculations.

The scheme should be based on site conditions, erection machinery employed, available working space, length and weight of members to be handled. The accent of the scheme shall be safe working and avoidance of any risk of accident.

The scheme should indicate precisely the type of temporary fasteners to be used as also the minimum percentage of permanent fasteners to be fitted during the stage erection. The working drawings should give clearly the temporary, fixtures, clamps, spacer supports, etc.

Unless otherwise provided in the contract, the contractor shall supply and erect all necessary false work and staging and shall supply all labour, tools, erection plant and other materials necessary to carry out the work complete in all aspects.

The contractor shall supply all types, bolts, nuts, washers, etc. required to complete erection at site with allowance for wastage, etc., of 10% of the net number of field bolts, washers required, or a minimum of five number of each item.

Service bolts and nuts, ordinary plate washers and drifts for use in the erection of works shall be supplied at 25% of the number of the permanent bolts in the work.

Prior to actual commencement of erection all equipment, machinery, tools, tackles, ropes, etc. need to be tested to ensure their safe and efficient working. Frequent visual inspection is essential in vulnerable areas to detect displacements, distress etc.

For welded structure, welders' qualifications and skill are to be checked as per standard norms. Safety requirements should conform to IS: 7205, IS: 7273 and IS: 7269 as applicable. Safety shall be the paramount consideration in erection work.

Erection work should start with complete resources mobilized as per latest approved drawings and after a thorough survey of foundations and other related structural work. The structure should be divided into erectable modules as per the scheme.

This should be pre-assembled in a suitable yard/platform and its matching with members of the adjacent module checked by trial assembly before erection.

The structure shall be set out to the required lines and levels. The steelwork should be erected, adjusted and completed in the required position to the specified line and level s with sufficient drifts and bolts. Packing materials are to be available to maintain this condition. Organised "Quality Surveillance" checks need to be exercised frequently.

During the progress of work, the Contractor shall have a competent Engineer and a skilled Foreman in charge of the work, who shall be adequately experienced in steel erection and acceptable to the Engineer.

12.3 Handling and storing Materials

Suitable area for storage of structures and components shall be located near the site of work. The access road should be free from water logging during the working period and the storage area should be on leveled and firm ground.

The store should be provided with adequate handling equipments e.g. road mobile crane, gantries, derricks, chain pulley blocks, winch of capacity as required. Stacking area should be planned and have racks, stands sleeper, access tracks, etc., and properly lighted.

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Storage should be planned to suit work sequence and avoid damage or distortion. Rusted, bent or damaged steel shall be rejected. Methods of storage and handling steel, whether fabricated or not shall be subject to the approval of Engineer and should be accessible to handling equipment.

Small fitting hand tools are to be kept in containers in covered stores.

All materials, consumables, including raw steel or fabricated material shall be stored specification-wise and size-wise above the ground upon platforms, skids or other supports. It shall be kept free from dirt and other foreign matter and shall be protected as far as possible from corrosion and distortion. The electrodes shall be stored specification-wise and shall be kept in dry warm condition in properly designed racks. The bolts, nuts, washers and other fasteners shall be stored on racks above the ground with protective oil coating in gunny bags and suitably marked. It is essential to ensure that bolts of different strengths / sizes are not mixed up. The paint shall be stored under cover in airtight containers.

IS: 7293 and IS: 7969 dealing with handling of materials and equipments for safe working should be followed. Safety nuts and bolts as directed are to be used while working. The Contractor shall be held responsible for loss or damage to any material paid for by the Department while in his care or for any damage to such material resulting from his work.

12.4 Straightening Bent Material

The straightening of plates, angles and other shapes shall be done with prior approval of the Engineer by methods not likely to produce fracture or any injury. The metal shall not be heated unless permitted by the Engineer for special cases, when the heating shall not be to a temperature higher than that producing a dark "cherry red" colour, followed by as slow cooling as possible.

Following the straightening of a bend or buckle the surface shall be carefully investigated for evidence of fracture. Sharp kinks and bends may be the cause for rejection of material.

12.5 Assembling Steel

The parts shall be accurately assembled as shown on the drawings and match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged. Hammering which will injure or distort the members shall not be done. Bearing surface or surfaces to be in permanent contact shall be cleaned, given a coat of contact paint before the members are assembled. All joint surface for bolted connections including bolts, nuts, washers shall be free from scale, dirt, burrs, other foreign materials and defects that would prevent solid seating of parts. The slope of surface of bolted parts in contact with bolt head and nut shall not exceed 1 in 20, plane normal to bolt axis, otherwise suitable tapered washer shall be used.

All fasteners shall have a washer under nut or bolt head whichever is turned in tightening. Any connection to be bolted shall be secured in close contact with service bolts or before the connections are finally bolted. Joints shall normally be made by filling not less than 50 percent of holes with service bolts and barrel drifts in the ratio 4:1. The service bolts are to be fully tightened up as soon as the joint is assembled.

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Connections to be made by close tolerance or barrel bolts shall be completed as soon as practicable after assembly.

Any Connection to be site welded shall be securely held in position by approved methods to ensure accurate alignment, camber and elevation before welding is commenced. The field welding, bolted and pin connection shall conform to the Code requirements. The correction of minor misfits involving harmless amounts of reaming, cutting and chipping will be considered a legitimate part of erection. However, any error in the shop fabrication or deformation resulting from handling and transportation which prevents proper assembling and fitting up of parts by moderate use of drifts or by a moderate amount of reaming and slight chipping or cutting shall be reported immediately to the Engineer and his approval of the method of correction obtained. The correction shall be made in the presence of the Engineer.

Erection tolerance: The unloaded steel structure, as erected shall satisfy the criteria specified in the following table within specified tolerance limits. Each criterion given in the table shall be considered as a separate requirement, to be satisfied independently of any other tolerance criterion.

The erection tolerances specified in the table apply to the following reference points:

- For a column, the actual centre point of the column at each floor level and at the base, excluding any base-plate or cap-plate. The level of the base plate on pedestal shall be so as to avoid contact with the soil and corrosion environment. For a beam the actual centre point of the top surface at each end of the beam, excluding any end plate.

Permissible tolerances after erection

Criterion	Permitted deviation
Deviation of distance between adjacent columns	5 mm
Inclination of a column in a multi-storey building between adjacent floor levels	0.002 h where h is the storey height
Deviation of location of a column in a multi-storey building at any floor level from a vertical line through the intended location of the column base	.0035 hb / n 0.5 where hb is the total height from the base to the floor level concerned and n is the number of storeys from the base to the floor level concerned
Inclination of a column in a single storey building, (not supporting a crane gantry) other than a portal frame	0.0035 h c where h c is the height of the column
Inclination of the column of a portal frame (not supporting a crane gantry)	Mean 0.002 h c Individual 0.010 h c Where h c is the height of the column

A tension member shall not deviate from its correct position relative to the members to which it is connected by more than 3 mm along any setting axis.

Setting Column bases and grouting: Column bases shall be set so that the column load is uniformly transmitted to the foundation with column centre line aligned with

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the foundation as shown in the drawings. The location and layout of anchor bolts are to be correctly set to ensure that the structures are erected as shown in the drawings.

The Contractor shall be responsible for the correct alignment and leveling of all steelwork at site to ensure that the columns are plumb. Before erection of columns on foundations, the top surface of the base concrete shall be thoroughly cleaned with wire brushes and by chipping to remove all laitance and loose material. The Contractor shall be responsible to provide all packing and shim plates that may be required for the proper erection and bedding of the columns with base plates. No steel structure shall be erected on the foundation unless the foundation has been certified fit for erection of steel, by the Engineer. Adequate number of air releases and inspection holes shall be provided in the base plate.

After the column is erected and alignment is checked and accepted, the column with base shall be held firmly in position by shims and pickings. The space between the column base and the base concrete shall be grouted with non-shrink grout.

The grout shall be of the type Sika grout 214 / Conb extra GP 2 / Shrinkomp 40 or equivalent. The substrate surface must be free of contaminants and all dirt and dust blown clean. The surface shall be thoroughly cleaned with water and all free water removed after cleaning. A containing formwork or other arrangement shall be made to hold the grout without leaks.

The (grout) powder shall be mixed with recommended quantity of water and stirred till a grout of smooth consistency is obtained. It shall be poured as soon as possible in order that the expanding properties are fully availed of. Where a thicker section is encountered, 10 mm chips may be added to the grout. This may slightly affect the flow properties of the grout and additional powder may be needed to restore the same. Bolt holes shall be filled in first and then the gap between the column base and base concrete grouted. It is essential that the grout flow is continuous. For larger grouts suitable pumps shall be employed. The air must escape and shall not be trapped inside. Grouting shall not be done in extreme hot or cold weather.

13.0 FIELD INSPECTION:

13.1 General

All materials, equipment and work of erection shall be subject to the inspection of the Engineer who shall be provided with all facilities including labour and tools required at all reasonable times. Any work found defective is liable to be rejected.

No protective treatment shall be applied to the work until the appropriate inspection and testing has been carried out. The stage inspection shall be carried out for all operations so as to ensure the correctness of fabrication and good quality. Girder dimensions and camber shall not be finally checked until all welding and heating operations are completed and the member has cooled to a uniform temperature.

14.0 TESTING OF MATERIALS:

Structural steel shall be tested for mechanical and chemical properties as per various IS codes as may be applicable and shall conform to requirements specified in IS: 226, IS: 2062, IS: 11587,IS: 1977, IS: 8500 and IS: 961, etc.

Bolts, nuts, washers, welding consumables, steel forging, casting and stainless steel be tested for mechanical and chemical properties in the appropriate IS Code. Measurements for the plate and rolled sections shall be taken at not less than 15 मम from edge.

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Lamination tests for plates shall be carried out by ultra-sonic testing or any other specified methods. Steel work shall be inspected for surface defects and exposed edge laminations during fabrication and cleaning. Significant edge laminations found shall be reported to the Engineer for his decision.

Chipping, grinding, machining or ultrasonic testing shall be used to determine depth of imperfection.

14.1 Bolted connections:

Bolts and bolted connection joints with high strength bolts shall be inspected and tested according to IS: 4000.

The firmness of joint shall be checked by 0.2 mm filler gauge, which shall not go inside under the bolt head by more than 3 mm. The alignment of plates at all bolted splice joints and welded butt joints shall be checked for compliance with Code requirements.

Testing of flame cut and sheared edges is to be done, where the hardness criteria given in the code are adopted. Hardness testing shall be carried out on six specimens.

14.2 Welding and welding consumables:

Welding procedure, welded connection and testing shall be in compliance with Code requirements.

All facilities necessary for stage inspection during welding and on completion shall be provided to the Engineer or their inspecting Authority by manufacturer.

Adequate means of identification either by identification mark or other record shall be provided to enable each weld to be traced to the welder(s) by whom it was carried out.

All metal arc welding shall be in compliance with IS: 9595 provisions.

The method of inspection shall be in accordance with IS: 822 and extent of inspection and testing shall be in accordance with the relevant standards or in the absence of such a standard, as agreed with the Engineer.

Procedure tests -The Destructive and Non-Destructive test of weld shall be carried out according to IS: 7307 (Part I).

14.3 Non-Destructive Testing of Welds

One or more of the following methods may be applied for inspection or testing of weld:

Visual Inspection: All welds shall be visually inspected, which should cover all defects of weld such as size, porosity, crack in the weld or in the HAZ (Heat Affected Zone) etc. Suitable magnifying glass may be used for visual inspection. A weld shall be acceptable by visual inspection if it shows that:

The weld has no cracks.

Through fusion exists between weld and base metal and between adjacent layers of weld metal.

Weld profiles are in accordance with requisite clauses of IS: 9595 or as agreed with the Engineer.

The weld shall be of full cross section, except for the ends of intermittent fillet welds outside their effective length.

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When weld is transverse to the primary stress, undercut shall not be more than 0.8 mm deep when the weld is parallel to the primary stress in the part that is undercut.

The fillet weld in any single continuous weld shall be permitted to under run the nominal fillet weld size specified by 1.6 mm without correction provided that undersize portion of the weld does not exceed 10 percent of the length of the weld. On the web-to-flange welds on girders, no under run is permitted at the ends for a length equal to twice the width of the flange.

The piping porosity in fillet welds shall not exceed one in each 100 mm of weld length and the maximum diameter shall not exceed 2.4 mm, except for fillet welds connecting stiffeners to web where the sum of diameters of piping porosity shall not exceed 9.5 mm in any 25 mm length of weld and shall not exceed 19 mm in any 300 mm length of weld.

The full penetration groove weld in butt joints transverse to the direction of computed tensile stress shall have no piping porosity. For all other groove welds, the piping porosity shall not exceed one in 100 mm of length and the maximum diameter shall not exceed 2.4 mm.

Magnetic Particle and Radiographic Inspection:

Welds that are subject to radiographic or magnetic particle testing in addition to visual inspection shall have no crack.

Magnetic particle test shall be carried out for detection of crack and other discontinuity in the weld according to IS: 5334.

Radiographic test shall be carried out for detection of internal flaws in the weld such as crack, piping porosity inclusion, lack of fusion, incomplete penetration, etc. This test may be carried out as per IS: 1182 and IS: 4853.

Acceptance Criteria:

The weld shall be unacceptable if radiographic or magnetic particle testing shows any of the type of discontinuities indicated in the code.

Ultrasonic Inspection:

The Ultrasonic testing in addition to visual inspection shall be carried out for detection of internal flaws in the weld such as cracks, ping porosity inclusion, lack of fusion, incomplete penetration, etc. Acceptance criteria shall be as per IS: 4260 or any other relevant IS Specification and as agreed to by the Engineer.

Liquid Penetration Inspection:

The liquid penetrant test shall be carried out for detection of surface defect in the weld, as per IS: 3658, in addition to visual inspection.

The non-destructive testing of following welds be carried out using one of the method or methods described at (ii), (iii) and (iv) above, as may be agreed to by the Engineer.

All transverse butt welds in tension flange.

10 percent of the length of longitudinal and transverse butt welds in tension flanges.

5 percent of the length of longitudinal and transverse butt welds in compression flanges.

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All transverse butt welds in webs adjacent to tension flanges as specified by the Engineer.

The particular length of welds in webs to be tested shall be agreed with the Engineer, in case of (b) or (c).

Where specified by the Engineer, bearing stiffeners or bearing diaphragms adjacent to welds, plates in box girder construction adjacent to plates at cruciform welds, plates in box girder construction adjacent to corner welds or other details shall be ultrasonically tested after fabrication.

Any lamination, lamellar tearing or other defect found shall be recorded and reported to Engineer for his decision.

14.4 Testing of welding for Cast Steel: The testing of weld for cast steel shall be carried out as may be agreed to by the Engineer.

14.5 Stud Shear Connectors (where applicable)

Stud shear connectors shall be subjected to the following tests:

The fixing of studs after being welded in position shall be tested by striking the side of the head of the stud with a 2 kg hammer to the satisfaction of the Engineer.

The selected stud head stroked with 6 kg hammer shall be capable of lateral displacement of approximately 0.25 the height of the stud from its original position. The stud weld shall not show any sign of crack or lack of fusion.

The studs whose welds have failed the tests given in (a) and (b) shall be replaced.

14.6 Inspection requirement:

The fabricated member/component made out of rolled and built-up section shall be checked for compliance of the tolerances given in Table-2. Inspection of member/components for compliance with tolerances, and the check for deviations shall be made over the full length.

During checking, the inspection requirement shall be placed in such a manner that local surface irregularities do not influence the results.

For plate, out-of-plane deviation shall be checked at right angle to the surface over the full area of plate.

The relative cross frame deviation shall be checked over the middle third of length of the girder or frame between each pair of webs and for cantilever at the end of member.

The web of rolled beam or channel section shall be checked for out-of-plane deviation in longitudinal direction equal to the depth of the section.

During inspection, the component/member shall not have any load or external restraint.

14.7 Inspection Stages:

The inspection to be carried out for compliance of tolerances shall include but not be limited to the following stages:

For completed parts, component/members on completion of fabrication and before any subsequent operation such as surface preparation, painting, transportation, and erection.

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For webs of plate and box girder, longitudinal compression flange stiffeners in box girders and orthotropic decks and all web stiffeners at site joints, on completion of site joint.

For girders and frames, cantilevers and other parts in which deviations have apparently increased on completion of site assembly.

Where, on checking member/component for the deviations in respect of out-of-plane or out-of-straightness at right angles to the plate surface, and any other instances, exceed tolerance, the maximum deviation shall be measured any recorded. The recorded measurements shall be submitted to the Engineer who will determine whether the component/member may be accepted without rectification, with rectification or rejected.

15.0 PAINTING

15.1 General Scope

Unless otherwise specified, all steelwork shall be given approved primer and top coats of painting. The work shall include sand / grit blasting of steel to Swedish specification 2-1/2 and other preparation of metal surfaces as required, providing and applying the paint in the specified number of coats and thickness (with repair / touching of the shop / first coat / other coats as necessary) including supply of all materials, equipment, tools and tackles, scaffolding, labour, supervision, thickness testing instruments, all testing, materials and all and other work to complete the painting as per specifications and to the satisfaction of the Engineer.

15.2 Quality of paint

Only the paints which have been tested for the following qualities as per the specification given in the relevant IS codes should be used:

- Weight test (weight per 10 litre of paint thoroughly mixed)
- Drying time
- Flexibility and adhesion
- Consistency
- Dry thickness and rate of consumption

Unless otherwise specified all painting and protective coating work shall be done in accordance with IS: 1477 (Part 1)

15.3 Preparation of Steelwork

The steelwork shall be thoroughly cleaned and all grease, oil and all other surface contaminants shall be removed by application of solvents, wire brushing and other tools. The steelwork shall be grit / sand blasted to degree defined as 2-1/2 as per Swedish Standard SI S 05 5900 with a surface profile not exceeding 65 microns. It must be ensured that the steel is clean and free of all contaminants. The longevity of the coating and protection will depend on the extent to which the steel is clean. All dust is removed and the steelwork.

The steel after grit / sand blast cleaning is very susceptible to atmospheric action and as such within as short a time as possible (not more than 15 to 20 mins) the first coat of primer shall be applied.

15.4 Paint preparation and application procedure

The primer shall be an inorganic Zinc silicate solvent based paint normally of the two pack self curing type. The liquid part is thoroughly stirred to uniform consistency and

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then the solid part (zinc dust) shall be added with constant mechanical stirring till the powder is thoroughly dispersed. The mixture is strained through a 80 mesh sieve and allowed to mature for 20 minutes with stirring. It is then applied by airless spraying with a pump ratio of 30 : 1, a tip size of 0.40 mm and a pressure of 120 kg / sq.cm The wet film thickness shall be not less than 125 microns and the dry film thickness 75 microns. One coat of primer shall be applied with a DFT of not less than 75 microns.

The intermediate coat shall be of a super high-build epoxy coating with a composition of catalysed epoxy resin suitably pigmented. This is in two packs. The separate packs are stirred properly and mixed in the recommended ratio. The mixture shall be applied to the clean primer surface by airless spray (pump ration 45:1) with a fluid tip of about 0.55 mm and air supply of 100 psi. The pot life of the mixture is an hour. At approximately 4.25 sq.m per litre, a 200 micron DFT should be available.

The topcoats shall be two coats of an acrylic polyurethane enamel for a high gloss coating to provide protection against the atmosphere at site.. The steelwork which has already been primed with one coat and given an intermediate coat shall be carefully cleaned of adhering contaminant without damaging the coats.

The top coat paint also comes in two packs, base is stirred thoroughly and the catalyst is added in the ration of four parts of base to one part of catalyst. The mixture is stirred to uniform consistency and after a maturing period of 30 minutes, the top coats shall be applied by air less spray with pump ratio of 30:1, a tip between 0.40 and 0.45 mm at a tip pressure of 140 kg / esq. There shall be two topcoats each of DFT of 30 microns.

The prime and top coats shall be compatible with each other.

The surface of the steelwork shall be clean dry before the application of any paint.

The painting equipment shall be kept scrupulously clean and for this purpose, a thinner shall be used for cleaning the equipment before and after use.

It must be ensured that all paints are fresh and whenever the contents of two pack paints are mixed the paint must be used up before the time recommended by the manufacturers.

The colour of the topcoats shall be selected by the Engineer. Two slightly different shades may be chosen to ensure that two topcoats are given without missing out any area of the steel work.

15.5 Curing: The painted materials shall not be handled till it is dry. The painted components shall be allowed to air-dry for at least 24 hours after which it should be gradually subjected to working temperature range.

15.6 Ambient conditions and painting: Painting work shall not be done if the ambient temperature is below 10 0 C or if it is above 50 0 C, nor shall it be done if the relative humidity is above 90 %. No painting work shall be done during rain or misty or foggy conditions. As far as possible coated surface shall not be exposed to rain or forest before they are dry.

15.7 Other requirements

The coatings shall be applied to all surfaces excluding inner surfaces of fully sealed hollow sections. Surfaces that would be inaccessible for cleaning and painting after fabrication shall be painted as specified before being assembled.

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All bolts, nuts, washers etc. are to be thoroughly cleaned and dipped into boiling linseed oil conforming to IS: 77.

All machined surfaces are to be well coated with a mixture of white lead conforming to IS: 234 and Mutton Tallow conforming IS: 887.

The work shall be done inside a properly covered area by workmen who are properly attired and protected for the work.

All fabricated steel shall be painted in the shops after inspection and acceptance with at least one priming coat, unless the exposed surfaces are subsequently to be cleaned at site or are metal coated. No primer shall be applied to galvanised surfaces.

Field contact surfaces and surfaces to be in contact with cement shall be painted with primer only. No paint shall be applied within 50 mm of designed location of field welds.

WOOD WORK & JOINERY INCLUDING DOORS & WINDOWS

1.0 SCOPE

The specifications refer to wood work in general including carpentry and joinery work in the building.

2.0 GENERAL

The provision of the latest revisions of the following I.S. codes shall form a part of these specifications.

IS 205	Specifications for non-ferrous metal butt hinges.
IS 287	Recommendation for maximum permissible moisture content of timber used for different purpose.
IS 303	Specification for plywood for general purpose.
IS 362	Specification for parliamentary hinges
IS 419	Specification for putty for the use on window frames
IS 883	Code of practice for design of structural timber in building.
IS 1003	Specification for Timber panelled and glazed shutters Part II - Window and ventilator shutters.
IS1200	Method of measurement of building and Civil Part XXI Engineering Works – Wood Work and Joinery.
IS:1341	Specification for steel butt hinges
IS:1658	Specification for Fibre Hard Boards
IS: 1761	Specification for transparent sheet glass for glazing and framing purposes.
IS: 3087	Specification for wood particle boards (medium density for structural timber in building)

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Other I.S. codes not specifically mentioned here, but pertaining to wood work and joinery form part of these specifications.

3.0 MATERIALS

3.1 Sawn Timber

Teak wood of good quality and class as specified in the item shall be used. The timber shall be of high quality and well seasoned. It shall have uniform colour free from defects such as cracks, dead knots, shakes, sapwood etc. No individual hard and wound knot shall be more than 6 sq.cm in size and the aggregate area of such knots shall not be more than 1% of the area of the piece. The timber shall be close grained having not less than 2 growth rings per cm. width in cross section.

The maximum permissible percentage of moisture content for well seasoned timber used in building work shall be as specified in the IS : 287.

3.2 Glazing materials - Glass Panels:

Unless otherwise specified, glass panes used in glazed or panelled and glazed shutters, shall be of good quality glass of thickness not less than 4 mm for panes upto 0.1 sq.m in area not less than 5 mm for glass panes of area larger than 0.1 sq.m with a tolerance of 0.2 mm in both cases. The glass shall be free from flaws such as specks, bubbles, smoke waves, air holes, etc. and shall conform to the relevant IS : 1761.

Unless otherwise specified, glass panes used in shutters of bath room and lavatories shall be frosted and of thickness as mentioned above and shall be free from any flaws.

Where so specified, special quality glass such as plate glass, pin heads glass, wired glass, float glass etc. shall be used. They shall conform to relevant IS standards as regards quality. Putty for glazing in wooden frames of doors and windows. Putty shall be prepared by mixing one part of white lead with three parts of finely powdered chalk and then adding boiled linseed oil and mixing the whole thing into a homogeneous stiff paste. It shall be free from impurities like dust, grit, etc. and shall conform to IS : 419.

3.3 Fittings

The item of wood work of joinery generally includes fittings such as hinges and screws for fixing of door shutters and is explicitly so mentioned in the item.

Hinges - Hinges shall be of iron, brass, aluminium or any other material as specified. They shall present a neat appearance and shall operate smoothly. All hinges shall be of steel and their riveted heads shall be well formed and smooth. Hinges shall be of the type specified and shall conform to the relevant Indian Standard Specifications.

4.0 WORKMANSHIP

4.1 Wood Work, Wrought, Framed and Fixed

General

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The work shall be carried out as per detailed drawings and/or as directed by the Engineer-in-charge. The wooden members of the frame shall be planed smooth and accurate to the full dimensions. Rebates, rounding, mouldings, etc. as shown in the drawing shall be done before the members are joined into frames. Where wood work is not exposed to view as in the case of frames for false ceiling, however, no planing is required to be done unless specified expressly as rough timber work.

Note: The work wrought shall mean 'planed'.

Jointing in timber frames must be made carefully and accurately. They shall be strong, neat and shall fit without edging or filling. The joints shall be pinned with hard wood or bamboo pins of 10 to 15 - dia after the members of the frame are pressed together in a suitable vice-mechanism

The door and window frame shall have rebate to house the shutters and the depth of such rebate shall be 1.25 cm.

Wood work shall be painted, oiled, polished or otherwise treated as specified. All portions of timber abutting against masonry or concrete portion of building shall be coated with boiling coal tar or other type of approved wood preservatives primer, before placing them in final position.

Before any surface treatment is applied in the wood work shall be got approved by the Engineer-in-Charge

Fixing in Position:

The frames shall be fixed only after acceptance by the Engineer-in-Charge. In case of door frames without sills, the vertical members shall be buried in floor for the full thickness of the floor and the door frame shall be temporarily braced at the sill level so as to prevent warping or distortion of frame during construction.

All Carpenter's work shall be accurately set out and framed together and securely fixed in the best possible manner and with properly made joints. All joints must fit accurately without wedging or filling. All nails screws, plugs, pins etc. shall be provided as necessary and as directed and approved. After the woodwork has been erected, if any undue shrinkage or bad workmanship is discovered, the Contractor shall forthwith amend the same without any extra charge.

All expose woodwork in country teak shall be painted with one coat of primer and two coats of paint of type; make and shade as indicated and approved. All woodwork coming in contact or embedded in masonry work shall be treated with two coats of solignum or coal tar as directed by the Engineer prior to installation.

4.2 Panelled, Glazed or Panelled and Glazed Shutters:

General: The work shall be carried out as per detailed drawing. The wooden members shall be planed smooth and accurate. They shall be cut to the exact shape and sizes without patching or plugging of any kind. Mouldings, rebates, rounding, etc. shall be done, as shown in the drawing, before the pieces are assembled into the shutter.

Joinery work: The thickness of the styles and rails shall be as specified in the item of work. The minimum thickness of panels shall normally be 15 mm where the clear width of panel is not more than 300 mm and 20 mm where the clear width of the panel is more than 300 mm. However, where the Engineer-in-Charge so considers, lesser thickness upto 12 mm and 15 mm respectively may be allowed by him instead of 15 mm and 20 mm specified above. Solid wood panel for door and window shutters shall be made out of one or more strips of timber planks of not less than 125

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mm width. it is preferable to use strips of not more than 200 mm width to reduce chances of warping, splitting or other defects. The timber strips shall be joined together with continuous tongued and grooved joints, glued together and reinforced with metal dowels. The grooving of the solid panel shall normally run along the longer dimensions of the panel unless otherwise directed. The corners and edges of panels shall be finished as shown in the drawing and these shall be feather tongued into styles and rails. Sash bars shall have mitres joints with the styles.

Styles and rails of shutters shall be made out of single piece. Lock and intermediate rails exceeding 200 mm in width if permitted by the Engineer-in-charge may be made out of one or more pieces of timber but the width of each piece shall not be less than 125 mm. Where more than one piece of timber is used, they shall be joined with a continuous tongued and grooved joint glued together and reinforced with metal dowels (rust proof) at regular intervals of 20 cm or pinned with not less than three 40 mm rust proof pins of the lost head type.

The tenons shall pass clear through styles. The styles and rails shall have a 12 mm groove to receive the panel.

In case the double shutters the rebate at the closing junction of the two shutters shall be of depth not less than 2 cm.

Shutters shall not be painted or otherwise treated before these are passed by the Engineer-in-Charge and fixed in position.

4.3 Glazing: The glazing work shall be done in accordance with the specification given separately elsewhere.

4.4 Hold Fasts: Hold fasts used for fixing doors and window frames shall be made of 40 x 3 mm flat iron and 40 cm long. It shall have two holes on one end for fixing to frame with long screws, and at the other end, the flat iron shall be split and bent at right angles in the opposite direction. The hold fast shall be tightly fixed to the frame by means of bolts, the bolt hole in frame being plugged suitably and finished neat. The hold fast shall be embedded into masonry by concrete block of 200 x 250 x 400 mm size.

5.0 FLUSH DOOR SHUTTERS

5.1 General:

The door shall be of flush type solid core with single or double shutter as the case may be.

5.2 Shutters

The shutters shall be decorative or non-decorative type of the exterior or interior grade as described in the item and as shown in the drawings. It shall conform to the relevant specifications for the type and grade given in I.S. 2202/1983, Specifications for Wooden Flush door shutters (solid core type). The face panel shall be of BWP grade ply conforming to IS-2191 (Part-I).

The finished thickness shall be as mentioned in the item. Face veneers used shall be of the pattern and colour approved by the Engineer. Solid teakwood lipping of thickness not less than 12mm shall be provided on all edges. The lipping shall be fixed using adhesive as specified and shall be factory pressed. Nothing extra shall be payable on this account.

All necessary rebates, recesses, holes etc., if any, for fixtures or otherwise shall also be provided and the visible surface finished with teak veneering to match.

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The solid core shall be of wood laminate prepared from battens of well-seasoned and good quality wood, having straight grains. Battens shall be properly glued and machine pressed together.

Edges of the core shall be lipped with good quality teakwood battens of minimum 25mm depth and 35mm width glued and machine pressed along with the core and shall stand 72 hours boiling water test for de-lamination and strength. The flush doors shall be truly plain, well finished and shall be free from detects like warping etc.

Only phenol formaldehyde resin glue shall be used for door manufacture and a certificate to this effect from manufacturers shall be furnished.

5.3 Inspection:

The Contractor shall give intimation to the Engineer-in-Charge who shall arrange for the visual inspection of the samples at the factory premises, accompanied by the Contractor. The samples inspected by the EIC or his representative shall be signed as a mark of identification. These inspected samples of each type will be delivered by Contractor at site.

The final approval of the door and window shutters is subject to testing.

Flush doors shall be tested as per IS-4020.

The cost of sample, packaging, sealing and transportation of samples to the laboratory, shall be borne by the Contractor. Testing charges shall be reimbursed to Contractor, provided that the shutters fulfill the requirement of relevant specification. If the shutters fail to fulfill the requirements, testing charges shall be borne by the Contractor.

5.4 Fixtures and Fastenings

These shall be as shown in a table on the drawings or as indicated in the specifications. Where it is not specified they shall be of oxidised brass and shall be of good workmanship. All fixtures and fastenings shall be sound and strong. They shall be sectional and of the best quality. The size, shape, design and finish shall be as shown on drawings and approved by the Engineer.

Unless otherwise specified each leaf shall be hung with three brass parliamentary hinges for back flap with brass screws. Each door shall be furnished with aldrop and latch, brass flush bolts, etc. The fixtures shall comply with the relevant Indian Standards. Samples of all fixtures and fastening shall be got approved by the Engineer and deposited in his office for reference.

All the fixtures shall be fixed to the joinery in a secure and efficient manner. Metal sockets shall be provided to all bolts where the shoots enter, stone, concrete, etc.

FLOORING, SKIRTING, DADO OR CLADDINGWORKS

1.0 SCOPE

These Specifications covers flooring, skirting, dado or cladding works using different types of stone/ slabs/ tiles as detailed hereunder:

2.0 GENERAL

The provision of the latest revisions of the following IS Codes shall form a part of this specification to the extent they are relevant.

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IS: 269		Specification for ordinary, rapid hardening and low beat Portland cement.
IS: 383		Specification for coarse and fine aggregate from natural sources for concrete
IS: 657		Specification for material for use in the manufacturer of magnesium oxychloride flooring compositions.
IS: 1130		Specification for marble (Blocks, slabs & Tiles).
IS: 1200	Part XI	Method of measurements for Building and Civil Engg. Works, paving, floor finishes, dado & skirting.
IS: 1237		Specification for cement concrete flooring tiles.
IS: 1443		Code of practice for laying and finishing of cement concrete flooring tiles.
IS. 2541		Code of practice for use of lime concrete' in buildings.
IS: 2571		Code of practice for laying in situ cement concrete flooring
IS: 4082		Recommendation on stacking and storage of construction materials at site.
IS: 4457		Specification for Ceramic unglazed vitreous acid resistant tile.
IS: 8042		Specification for white port land cement
IS 8112		Specification for high strength ordinary portland cement
IS: 10067		Material Constants in Building Work
IS: 13711		Ceramic Tiles : Sampling & basis of acceptance
IS: 13712		Ceramic Tiles : Definitions, classifications, characteristics and making
IS: 13753		Dust Pressed ceramic tiles with water absorption of E > 10% (Group - B III)
IS: 13754		Dust Pressed ceramic tiles with water absorption of 6% < E < 10% (Group - B IIb)
IS: 13755		Dust Pressed ceramic tiles with water absorption of 3% < E < 10% (Group - B IIa)
IS: 13756		Dust Pressed ceramic tiles with water absorption of E < 3% (Group - B I)

Other I.S Codes not specifically mentioned here, but pertaining to Floor Finishes form part of these specifications.

3.0 MATERIAL

3.1 Cement, sand, aggregate, water shall conform to the specifications for Cement concrete of this volume. Stone shall be hard, sound, durable and free from defects like cavities, cracks, sand-holes, flaws, injurious veins, patches of loose or soft materials and weathered portions etc.

4.0 SUB-BASE

4.1 Sub-base for all flooring shall be prepared and kept ready for further applications. All items shall be defined and detailed on the drawing.

Preparation of sub-base may be carried out by excavation or back filling in plinth. Back filling shall be with the selected earth in layer of 150mm to 200mm maximum and adequately watered and well-compacted to achieve at least 90% compaction at optimum moisture content.

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

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4.2 Dry Brick Flooring

4.2.1 Spreading Sand:- After the plinth has been prepared as detailed above, 225mm of sand shall be spread, evenly over the surface and well watered and the wet sand brought to a true under surface formation.

4.2.2 Laying bricks:- Over the sand, thoroughly well burnt bricks of uniform shape shall be laid on edge breaking bonds in straight lines. After laying each two or three lines of bricks, they shall be cramped together as tightly as possible. When the last line of bricks has been cramped into position no movement of the bricks should be possible and if any such exists, the flooring must be removed and railed.

4.2.3 Blinding the surface:- After the bricks are satisfactory laid, sand will be spread over the surface so as to fill all joints. This sand will be well watered and more sand and water added as necessary and until all joints are filled flush and solid.

4.2.4 Pointing:- The joints shall thereafter be raked out to a depth of half an inch and level pointed with cement mortar.

4.2.5 Curing:- The complete work shall be kept covered with wet straw for ten days after pointing.

4.3 Rubble soling

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

Soling shall be watered and again packed with sand or stone dust to fill interstices created by watering. Then it shall be rolled by power driven roller of 10MT capacity wherever possible or with vibratory compactor. Filling sand or stone dust, watering and compaction shall continue till full compactness is achieved to the satisfaction of the Engineer-in-Charge.

4.4 Base floor

This shall be regular reinforced concrete floor or plain cement concrete floor as specified. All specifications of concreting shall be the same as per Plain & Reinforced Concrete section of this volume.

5.0 CEMENT CONCRETE FLOORING

5.1 Materials

Cement concrete: The cement concrete shall generally conform to specifications for ordinary concrete. The coarse aggregates shall be carefully selected, sufficiently tough and hard stone pieces broken in a manner that will provide particles of approximately cubical shape affording good interlocking. The maximum size of coarse aggregate shall be 12 mm. The fine aggregate shall consist of properly graded particles. The proportion of mix shall not be of the grade below M15 {1: 2: 4 (1 cement: 2 coarse sand: 4 stone aggregate)}. The least amount of mixing water that will produce a workable mix and will allow finishing without excessive trowelling shall be used. Generally a water cement ratio of 0.5 should suffice.

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5.2 Workmanship:

The sub-grade in all cases shall be formed to proper levels and slopes, well compacted and cured. The top surface shall be kept slightly rough.

The surface of the sub-grade shall be cleaned off all loose materials and moistened immediately before laying the concrete floor. The concrete flooring shall be laid in alternate bays not exceeding 6.25 sq.m (about 64 sf.ft) each. The edge of each panel into which the floor is divided should be supported by aluminium dividing strips of adequate size to prevent sticking. Their depth shall be the same as that proposed for the finished floor as mentioned in the item. At least 48 hours shall elapse before the concreting in the adjacent bays is commenced.

The concrete shall be laid immediately after mixing. While being placed the concrete shall be vigorously sliced and spaded with suitable tools to prevent formation of voids or honey comb pockets. The concrete shall be brought to the specified levels by means of a heavy straight edge resting on the side forms and drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with small lateral shifts. While concreting the adjacent bays care shall be taken to ensure that the edges of previously laid bays are not broken by careless or hard tamping.

Immediately after laying the concrete, the surface shall be inspected for high or low spots and any needed correction made up by adding or removing the concrete. After striking off the surfaces to the required grade concrete shall be compacted with a wooden float. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given to complete the ramming.

The floating shall be followed by steel trowelling after the concrete has hardened sufficiently to prevent excess of fine material from working to the surface, The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix. After the concrete has been thoroughly rammed and has dried sufficiently to allow rendering to be worked up, surface shall be rendered with a thin coat of 1:1 cement mortar with fine sand and uniformly floated. If so directed by the Engineer-in-Charge, approved mineral colour pigment conforming to appendix-B of IS 657 shall be added to the cement mortar to give the required colour and shade to the flooring. When the cement mortar rendering is sufficiently stiff, lines shall be marked on it with strings or by any other device to give the appearance of tiles 30 x 30 cm or of any other size laid diagonally or square as directed by the Engineer-in-Charge. The junctions of floor and walls shall be rounded off if so directed, without any extra payment.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge. Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

Finishing: When the rendering is somewhat stiff, neat cement may be sprinkled on sparingly through a paper pot on the surface and rubbed lightly to give smooth polished ordinary cement coloured surface. If coloured flooring is required by the Engineer-in-Charge the approved coloured cement shall be used. Surface shall be protected from direct sun when it is green.

Curing: Curing shall start on the next day after finishing and shall be continued for 14 days. Curing shall not be commenced until the top layer has hardened. Covering with

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empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

6.0 GLAZED / ANTISKID CERAMIC / VITRIFIED TILES IN FLOORING

6.1 Material:

The tiles including specials shall be of the approved make and quality and shall conform to BIS Specifications in all respects. Glazed tiles / Ceramic tiles shall conform to IS : 13711-1993, IS : 13712-1993, IS : 13753-1993, IS : 13754-1993, IS : 13755-1993, and IS : 13756-1993. Samples of tiles shall be got approved by the Engineer-in-Charge, who will keep them in his office for verification as to whether the material brought for use conform to the approved samples.

The tiles shall be square or rectangular of size as specified in the item description or as directed by the Engineer-in-charge. The thickness of the tiles shall be as specified. The length of all four sides shall be measured correct to 0.1mm and average length breadth shall not vary more than ± 0.8mm from specified dimension. The variation of individual dimension from average value of length / breadth shall not exceed ± 0.5mm. Tolerance in thickness shall be ± 0.4mm.Cement Mortar 1:4 to be used along with White Cement of approved quality and make.

6.2 Workmanship

6.2.1 Mortar Bedding

The amount of water added while preparing mortar shall be the minimum necessary to give sufficient plasticity for laying. Care shall be taken in the preparation of mortar to ensure that there are no hard lumps that would interfere with even bedding of the tiles. Before spreading the mortar bed, the base shall be cleaned of all dirt, scum or laitance and loose materials and then well wetted without forming any pools of water on the surface. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens to proper level or slope. The thickness of the bedding shall not be less than 12 mm (about ½") or more than 20 mm (about ¾") in any one place. The tiles shall be laid on bedding mortar when it is still plastic but has become sufficiently stiff to offer a fairly firm cushion for the tiles.

6.2.2 Fixing Tiles

The tiles before laying shall be soaked in water for at least 2 hours. Tiles, which are fixed in the floor adjoining the wall, shall be so arranged that the surface of the round edge tiles shall correspond to the skirting or dado. Neat cement grout of honey like consistency shall be spread over the bedding mortar just to cover so many areas as can be tiled within half an hour. The edges of the tiles shall be smeared with neat white cement slurry and fixed in this grout one after the other, each tile being well pressed and gently tapped with a wooden mallet till it is properly bedded and in level with the adjoining tiles. There shall be no hollows in bed or joints. The joints shall be kept as close as possible and in straight lines. The joints between the tiles shall not exceed 1.5 mm (about 1/ 1 6") wide. The joints shall be grouted with a slurry of white cement. When hairline joints are specified the same shall be followed. After fixing the tiles finally in an even plane, the flooring laid shall be kept moist and allowed to mature undisturbed for 10 days to allow the bedding and flooring to set properly.

6.2.3 Cleaning

After the tiles have been laid in a room or the day's fixing work is completed, the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. Once the floor has set, the floor shall be carefully washed clean and dried.

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When dry, the floor shall be covered with oil free dry saw dust which shall be removed only after completion of the construction work and just before the floor is occupied.

7.0 GLAZED/CERAMIC TILES IN DADO/ SKIRTING

7.1 Materials

The tiles including specials shall be of the approved make and quality and shall conform to BIS standards in all respects. Samples of tiles shall be got approved by the Engineer-in-Charge. Materials brought for use shall conform to the approved samples.

7.2 Workmanship

7.2.1 Plastering

Cement plaster of about 15 mm thickness shall be applied to the part of the wall where dado or skirting is to be fixed. The proportion of mortar shall be as mentioned in the item.

7.2.2 Fixing of Tiles

Dado or skirting work shall be done only after fixing tiles on the floor is completed. The tiles shall be soaked in water for at least 2 hours before being used for skirting or dado work. Tiles shall be fixed when the cushioning mortar is still plastic and before it gets very stiff. The back of tiles shall be covered with a thin layer of neat cement paste and the tile shall then be pressed in the mortar and gently tapped against the wall with a wooden mallet. The fixing shall be done from the bottom of wall upwards without any hollows in the bed or joints. Each tile shall be fixed as close as possible to the one adjoining. The tiles shall be joined with white cement and matching coloured pigment slurry. Any difference in the thickness of tiles shall be evened out in cushioning mortar so that all tile faces are in one vertical plane. The joints between the tiles shall not exceed 1.5 mm in width and they shall be uniform. After fixing the dado, they shall be kept continuously wet for 14 days.

7.2.3 Cleaning

After the tiles have been fixed the surplus cement grout that may have come out of the joints shall be cleaned off before it sets. After the complete curing, the dado or skirting work shall be washed thoroughly clean.

8.0 CUDDAPAH / KOTA STONE FLOORING (local available sand stone for flooring)

8.1 Cuddapah / Kota Stone Slabs

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

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

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8.2 Dressing

Every slab shall be cut to the required size and shape and fine chisel dressed on the sides to the full depth so that a straight edge laid along the side of the stone shall be

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in full contact with it. The sides (edges) shall be table rubbed with coarse sand or machine rubbed before paving. All angles and edges of the slabs shall be true, square and free from chippings and the surface shall be true and plane.

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

8.3 Laying

Base concrete or the RCC slab on which the slabs are to be laid shall be cleaned, wetted and mopped. The bedding for the slabs shall be with cement mortar 1:6 (1 cement: 6 coarse sand) or with lime mortar (1 lime putty: 1 surkhi: 1 coarse sand) as given in the description of the item.

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

The slabs shall be laid in the following manner:-

Mortar of the specified mix shall be spread under the area of each slab, roughly to the average thickness specified in the item. The slab shall be washed clean before laying. It shall be laid on top, pressed, tapped with wooden mallet and brought to level with the adjoining slabs. It shall be lifted and laid aside. The top surface of the mortar shall then be corrected by adding fresh mortar at hollows. The mortar is allowed to harden a bit and cement slurry of honey like consistency shall be spread over the same at the rate of 4.4 kg. of cement per sqm. The edges of the slab already paved shall be buttered with grey or white cement with or without admixture of pigment to match the shade of the stone slabs as given in the description of the item.

The slab to be paved shall then be lowered gently back in position and tapped with wooden mallet till it is properly bedded in level with and close to the adjoining slabs with as fine a joint as possible. Subsequent slabs shall be laid in the same manner. After each slab has been laid, surplus cement on the surface of the slabs shall be cleaned off. The flooring shall be cured for a minimum period of seven days. The surface of the flooring as laid shall be true to levels, and, slopes as instructed by the Engineer-in-Charge.

8.4 Curing, Polishing and Finishing:

The day after the tiles are laid all joints shall be cleaned of the grey cement grout with a wire brush or trowel to a depth of 5 mm and all dust and loose mortar removed and cleaned. Joints shall then be grouted with grey or white cement mixed with our without pigment to match the shape of the topping of the wearing layer of the tiles.

The floor shall then be kept wet for a minimum period of 7 days. The surface shall thereafter be grinded evenly with machine fitted with medium grade grit block (No.80). Water shall be used profusely during grinding. After grinding the surface shall be thoroughly washed to remove all grinding mud, cleaned and mopped. It shall then be covered with a thin coat of grey or white cement, mixed with or without pigment to match the colour of the topping of the wearing surface in order to fill any pin hole that appear. The surface shall be again cured. The second grinding shall then be carried out with machine fitted with fine grade grit block (No.120).

The final grinding with machine fitted with the finest grade grit blocks (No.320) shall be carried out the day after the second grinding described in the preceding Para or before handing over the floor, as ordered by the Engineer-in-Charge.

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For small areas or where circumstances so require, hand polishing may be permitted in lieu of machine polishing after laying. For hand polishing following carborundum stones, shall be used:

First Grinding : Medium grade (No.80)

Final Grinding : Fine grade (No.120)

In all other respects, the process shall be similar as for machine polishing.

After the final polish, oxalic acid shall be dusted over the surface at the rate of 33 gm per square metre sprinkled with water and rubbed hard with a 'namdah' block (pad of woolen rags).

The following day the floor shall be wiped with a moist rag and dried with a soft cloth and finished clean.

If any tile is disturbed or damaged, it shall be refitted or replaced, properly jointed and polished. The finished floor shall not sound hollow when tapped with a wooden mallet.

9.0 CUDDAPAH / KOTA STONE IN RISERS OF STEPS, SKIRTING AND DADO

9.1 Kota Stone Slabs and Dressing shall be as specified above, for clause 8.0 for Kota Stone flooring, except that the thickness of the slabs which shall be as specified in the description of the item. The slabs may be of uniform size, as specified.

9.2 Preparation of surface shall be as specified above in clause 8.0 for Kota Stone flooring.

9.3 Laying shall be as specified above in clause 8.0 for Kota Stone flooring for flooring, except that the joints of the slabs shall be set in grey cement mixed with pigment to match the shade of the slabs and the backing coat shall be 15mm thick cement mortar 1: 4 (1 cement : 4 Coarse sand).

9.4 Curing, Polishing and Finishing shall be as specified above in clause 8.0 for Kota Stone flooring.

10.0 MARBLE / GRANITE STONE SLAB FLOORING

10.1 General

The item refers to provision of flooring of Indian Marble / Granite stone slabs of approved colour / pattern and shall conform to the specification as given below :-

10.2 Materials

10.2.1 Stone Slabs

The stone slab specified in the item shall be got approved by the Engineer . At its thinnest part, no stone shall be thinner than the specified thickness. The stone slab shall be hard, sound, durable, resistant to wear, rectangular in shape or square if directed by the Engineer and of the specified width. The stone slab shall be of the type mentioned in the item and of the colour and quality approved by the Engineer. Slabs shall be hard, dense, uniform and homogenous in texture. They shall have even crystalline grain, and free from defects and cracks. The surface shall be machine polished to an even and perfectly plane surface and edges machine cut true and square. The rear face shall be rough enough to provide a key for the mortar. Uniformity of size shall generally be maintained for the stone slab used in any room. The stone shall be without any soft veins; cracks of floors and shall have a uniform colour. The edges shall be quite straight. The stone in slabs in external and internal

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wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used. Samples of stone slabs to be used shall be got approved by the Engineer and the slabs to be used shall conform to the approved sample.

The dimensions of the slab shall be as specified in the item.

10.2.2 Bedding

Cement mortar for the bedding shall be of the proportions as specified in the item. The proportions will be by volume on the basis of 50 Kg. bag of cement. The mortar may be hand mixed or machine mixed.

In hand mixed mortar, cement and sand in the specified proportions shall be thoroughly mixed dry on a clean impervious platform by turning over at least 3 times or more till a homogeneous mixture of uniform colour is obtained. Fresh & clean water shall be added gradually and thoroughly mixed to form a stiff plastic mass of uniform colour so that each particle of sand shall be completely covered with a film of wet cement. The mortar so prepared shall be used within 30 minutes of adding water. Only such quantity of mortar shall be prepared as can be used within 30 minutes. The mortar remaining unused after that period or mortar which has partially hardened or is otherwise damaged shall not be re-tempered or remixed. It shall be destroyed or thrown away.

10.3 Construction

10.3.1 Bedding

The base of cement concrete shall be laid and compacted to a reasonably true plain surface and to the required slopes and below the level of the finished floor to the extent of the thickness of the slabs and mortar bedding. Cement concrete bedding if provided shall be paid under a separate item. Cement mortar for bedding may be mixed manually or by a mechanical mixer. The amount of water added shall be the minimum necessary to give just sufficient plasticity for laying and satisfactory bedding. Care shall be taken in preparing the mortar to ensure that there are no hard lumps that would interfere with the even bedding of the stones. Before spreading the mortar, the sub-floor or base shall be cleaned of all dirt, scum or laitance and of loose material and then well wetted without forming any pools of water on the surface. In case of R.C.C. floors, the top shall be left a little rough. All points of level for the finished paving surface shall be marked out. The mortar shall then be evenly and smoothly spread over the base by the use of screed battens only over so much area as will be covered with slabs within half and hour. The thickness of the mortar bedding shall not be less than 12mm, not more than 25mm. The required slope shall be given to the bed.

10.3.2 Fixing stone slab

Before laying, the stone slabs shall be thoroughly wetted with clean water. Neat cement grout of honey like consistency shall be spread on the mortar bed over as much area as could be covered with the slabs within half an hour. The specified type of stone slabs shall be laid on the neat cement float and shall be evenly and firmly bedded to the required level and slope in the mortar bed. Each stone slab shall be gently tapped with a wooden mallet till it is firmly and properly bedded. There shall be no hollows left. If there is a hollow sound on gentle tapping of the slabs, such

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slabs shall be removed and reset properly. The Mason shall make the joints of uniform thickness and in straight lines. The joints shall be filled solidly with pigmented grout for their full depth. The stone slabs shall be laid so as to give continuous parallel long joints with cross joints at right angles to them. The edges of the adjoining slabs shall be in one plane. Where the slabs cover open edges, of floor or window sills the edges shall be neatly rounded off. This shall be included in the rate.

When diamond pattern paving is provided in the item, the slabs shall be square and laid to the diamond pattern with triangular shaped slabs to make up the edges. In plain pattern stones on each course shall break joints with those in the next. The pattern joints etc. shall be as per drawings or as directed by Engineer-In-Charge, to the entire satisfaction of Engineer –In- Charge.

10.3.4 Curing

The flooring shall be kept well wetted with damp sand or water for fourteen days. It shall be kept undisturbed for at least seven days.

10.3.5 Cleaning

All flooring shall be thoroughly cleaned and handed over clean and free from any mortar stains etc.

All labour, materials and equipment, cleaning the sub-base, laying mortar bed and cement grout, fixing stone slabs specified above and making up the joints.

Any cutting and waste if required.

Pointing when included in the item.

Cleaning the floor from all stains, etc.

Polishing wherever required.

11.0 MARBLE / GRANITE STONE IN RISERS OF STEPS AND SKIRTING

11.1 Marble Stone Slabs and Dressing of Slabs shall be as specified above in clause 10.0 of Marble / Granite Stone Slab Flooring except that the thickness of slabs shall be as specified in the item description. A tolerance of + 3mm shall be allowed, unless otherwise specified in the description of the item.

11.2 Preparation of Surface

It shall be as specified above in clause 10.0 of Marble / Granite Stone Slab Flooring except where necessary the wall surface shall be cut uniformly to the requisite depth so that the skirting face shall have the projection from the finished face of wall as shown in drawings or as required by the Engineer-in-Charge.

11.3 The risers of steps and skirting shall be in grey or white cement admixed with or without pigment to match the shade of the stone, as specified in the description of the item, with the line of the slab at such a distance from the wall that the average width of the gap shall be 12mm and at no place the width shall be less than 10mm. The skirting or riser face shall be checked for plane and plumb and corrected. The joints shall thus be left to harden then the rear of the skirting or riser slab shall be packed with cement mortar 1:3 (1 cement: 3 coarse sand) or other mix as specified in the description of the item. The fixing hooks shall be removed after the mortar filling the gap has acquired sufficient strength.

The joints shall be as fine as possible. The top line of skirting and risers shall be truly horizontal and joints truly vertical, except where otherwise indicated.The risers and

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

11.4 Curing, Polishing and Finishing

The face shall be kept cured with water for at least seven days.

The face and top of skirting shall be polished. The stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used.

12.0 MARBLE / GRANITE STONE SLAB CLADDING

Marble / Granite tiles and slabs shall be mirror polished, eggshell polished, flame finished or given any other surface treatment as specified. All exposed edges shall be similarly treated.The Marble / Granite stone in slabs in external and internal wall veneer work shall be mirror polished where required, in the factory with silicon carbide abrasive starting from no. "00" up to no. 5 and then using buff/lead strip rolls with tin oxide for final mirror polish. For flooring and counter top the final tin oxide polish shall not be used Machine polishing and sizing shall be done with only water as lubricant. Sawing also shall be preferably done with water as lubricant but as a special case, oil or kerosene may be permitted subject to the oil or kerosene being thoroughly dried in ovens. Tiles / slabs with stains or patches due to the use of oil or otherwise shall be rejected. Any tiles / slabs showing patches or stains after installation shall also be rejected and replaced.

Tiles shall be transported to site well-packed in boxes. Slabs will be individually packed in cardboard paper. Tiles / slabs shall not be waxed or touched up with dyes / colours.

The entire supply for each type of marble / granite, unless specifically permitted by the Architect/ EIC, shall be procured from one location in one quarry to keep variations to the minimum. The Contractor shall segregate and sort the tiles / slabs according to colour, texture and size to keep variations in the same in any one floor, wall or isolated area to the minimum. The Contractor shall, before fixing the marble / granite on floors or walls, lay whole areas of marble / granite loose on ground to select and match the marble / granite. Any tiles / slabs with a variation not acceptable to Architect / PMC/ EICof shall not be used, and if used shall be removed and replaced.

Tight tolerances shall be checked and maintained throughout. Maximum variations shall be as follows:-

Sides	±	0.5 mm
Thickness	±	0.5 mm slabs
	±	0.3 mm tiles
Angularity	±	0.2 %
	±	2 mm

Linear items such as treads, skirting, sills etc. shall be of uniform thickness throughout. All visible edges shall be machine polished unless otherwise specified.

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Marble / granite shall be laid or fixed to the highest standard by highly trained masons to the entire approval of Architect / PMC/EIC. Any tiles / slabs broken, stained or damaged shall be removed / replaced.

External wall cladding shall be fixed with approved stainless steel 316 grade serrated cramps and dowels. Marble / granite slabs for external cladding shall be minimum 30mm thick. The Contractor shall prepare shop drawings and get them approved by the Architect before proceeding with any work.

The Contractor shall put a mock-up of typical and non-typical panels and get it approved well before he commences fixing on site.

The Contractor shall coordinate his site activities with other contractors working on site through PMC/ EIC and shall take particular care, in coordination with the PMC/ EIC , in ensuring that his methods of fixing do not damage or endanger the building structure, finishes and services in any way.

The Contractor shall get his system of anchorage approved by the Architect/ EIC of . No reinforcement bar in concrete shall be cut through during drilling or anchorage.

The anchorage in solid concrete blockwork shall be specially designed taking into consideration the actual compactness and crushing strength of the blocks. 2 nos. pullout tests in blockwork shall be carried out prior to commencing work to prove the strength of anchorage with ample margin of safety.

Prior to commencing work, the Contractor shall obtain approval of the Architect for material and workmanship after submitting the following details:-

a. 3 representative samples for each type of marble / granite specified.
b. Physical characteristics:- Dimensional tolerances, water absorption (polished or unpolished as applicable) by weight, compression strength, Mohs hardness, unit weight.
c. Source of supply and availability in full quantity and uniformity of colour, tone and texture.
d. Company profiles of suppliers and labour sub contractor if any.
e. Procedure for fixing and samples of fixtures such as cramps, pins, dowels etc.

If required the Contractor shall arrange visits to the quarries and to the works carried out by the proposed Sub Contractor.

Marble / Granite stone slab / tiles delivered on Site, including wastage and breakage, polishing, chamfering, rounding, grooves, drip moulds and other linear works as per drawings and specifications.

Stainless steel cramps, pins and dowels as per approved shop drawings and as specified.

Backing mortar and pigmented cement grout where specified.

Labour in transporting materials on site, fixing, carefully cutting, hand polishing, and touching up where required etc.

Protecting Marble / Granite stone slab / tiles during construction until virtual completion of works.

Temporary supports, templates, straight edges etc.

Alignment and leveling in coordination with EIC / PMC and Main Contractor.

Joints with plastered and other surfaces.

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Cleaning on completion.

Scaffolding and safety precautions.

Submissions of Samples.

Mock-up (total area approx. 15 sqm.)

Working to specified tolerances

Shop drawings

Pull out tests – 2 nos. – On anchors in blockwork.

Provisions for adequate anchorage.

13.0 INTERLOCKING BLOCK PAVEMENTS

13.1 Scope

Scope of work consisting of manufacturing of concrete paver blocks of required size, shape and colour, as per the specification given below and providing and fixing of interlocking paver blocks.

13.2 Dimension and Tolerances:

Concrete interlocking paver blocks shall be made in size and shall be as specified in the tender documents.

Maximum variation in dimension of interlocking paver block shall not be more than 2mm.

13.3 Materials

13.3.1 Water

The water used in the manufacture of concrete masonry units shall be free from matter harmful to concrete or reinforcement, or matter likely to cause efflorescence in the units and shall conform to the requirement of IS 456-1978 (Third Revision).

13.3.2 Additives or admixtures

Additives or admixtures may be added as admixtures to the concrete mix. Additives or admixtures used in the manufacture of concrete paver blocks may be:

Accelerating, water reducing and air entraining admixtures conforming to IS-9103 – 1979.

Fly ash conforming to IS-3812 (Part II) 1955.

Waterproofing agents conforming to IS: 2645-1975.

Colouring pigments.

Where no India Standards apply, the additives or admixtures shall be shown by test or experience, to be not detrimental to the durability of the concrete and as approved by the Engineer-In-Charge

13.4.1 Mix

The concrete mix must be prepared and approval of the Engineer-in-charge of should e taken before proceeding with actual manufacturing of the block. Before commencing the manufacturing of blocks the supplier shall submit to the Engineer for approval full details of all preliminary trial mixes and tests.

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

In case of blocks, where compaction is done by external vibrator, concrete mix of very low consistency (Zero slump) shall be used in order to vibrate and compact the concrete under pressure.

13.4.2 Mixing

Concrete shall normally be mixed in a mechanical mixer. Mixing shall be continued until there is a uniform distribution of materials and the mass is uniform in colour and consistency.

13.4.3 Placing and Compaction

Concrete placed in the mould will be compacted by means of mechanical compaction the mould shall be filled upto overflow vibrated or mechanically tamped and struck off level.

After demoulding the blocks shall be protected until they are sufficiently hardened to permit handling without damage.

13.4.4 Curing

The block hardened as above shall then be cured in a curing water tank or in a curing yard and shall be kept moist for at least 14 days. When the blocks are cured in immersion tank, the water of the tank shall be changed at least every 4 days.

13.4.5 Drying

After curing the blocks shall be dried for a period of 4 weeks before being used on the work, they shall be stacked with voids horizontal to facilitate through passage of air, the blocks shall be allowed to complete their initial shrinkage before they are laid at site.

13.4.6 Surface Texture and Finish

The finished concrete paver blocks shall have uniform texture and finish. The colour of pigment shall be approved by the Engineer-In-Charge The colour pigment shall be non fading and shall not have any deleterious effect on concrete.

13.5 Physical Requirement

13.5.1 General

All blocks shall be sound and free of cracks or other defects which interfere with the proper placing of the blocks or impair the strength or performance.

The blocks shall be free of chips, cracks or other imperfections.

13.5.2 Dimensions

Overall dimensions of the block shall be in accordance with the specifications and the maximum tolerance in dimension will be + 2mm.

13.5.3 Block Density

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The blocks density shall conform to manufacturer's specifications or approved by the Engineer-in-charge .

13.5.4 Compressive Strength

The minimum compressive strength at 28 days shall be 400 kg/cm2 for 100mm thick concrete blocks and 350 kg/cm2 for 60mm thick concrete paver blocks.

13.5.5 Water Absorption

The water absorption shall not be more than 1% of the total mass.

13.5.6 Testing & Sampling

The testing and sampling shall be carried out as specified in IS: 2185 (Part I) 1979, for concrete masonry units.

13.5.7 Manufacturer's Certificate

The manufacturer shall satisfy that the paver blocks conform to the requirement of this specification and shall produce certificate to this effect along with each consignment.

13.5.8 Independent Testing

If the Engineer-In-Charge desires to carry out independent test, same shall be carried out in accordance with the specifications by selecting random sample from any batch. The manufacturer shall supply free of charge required number of paver blocks for testing. Cost of testing shall be borne by the manufacturer.

13.6 Laying & Fixing Paver Blocks

The interlocking Concrete Paver Block is to be fixed as explained. The sub base / ground should be levelled taking into consideration the thickness of the paver block by part excavation and part filling and properly compacting using a plate compactor. Sand bed of 50mm thick should be provided underneath the paver blocks for fixing the interlocking blocks. The interlocking blocks should be placed interlocking them as per the design and shape, as directed by the Engineer-in-charge. After laying the concrete blocks, fine sand should be spread over the paver blocks. The surface should be compacted using plate compactor, so that the fine sand will get filled up in the gaps between blocks and the blocks will be interlocked.

Providing & fixing the interlocking pavement blocks in sand bedding to the required pattern and compacting, including cost of independent testing, leveling of sub base etc. Cleaning the floor.

14. TREMIX FLOORING

Scope: These specifications covers, providing & laying concrete flooring with tremix treatment by dewatering of concrete by vacuum, as detailed hereunder. The tremix treatment shall be carried out by specialized agency only. These specification shall be read in conjunction with the item No.5 Concrete Flooring, above.

14.1 General

The Contractor shall submit the plan of work going to be followed by him, well in advance (at least a week). A sketch shall be accompanied giving details of the construction joint locations, sequence of floor casting, etc. The work shall be planned and executed so that there is no delay between the placement, screeding, de-watering and floating of concrete.

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14.2 Screeding:

After poring concrete in place, as detailed in 5.2 above, it shall be compacted, in wet condition, by screed vibrator run over the steel channel shuttering pressing concrete surface matched with the top of steel channel shuttering spaced not more than 4.0 meters apart. Poker vibrators will be used to vibrate the laid concrete thoroughly with minimum 40 mm dia needles. On completion of laying of approximate 2m to 2.5m length the surface vibrator then be run over the concrete surface to achieve better over all compaction of concrete. Water cement ratio shall be just sufficient to make concrete workable. Screed shall be run at least twice to achieve well compacted & level surface.

Undulations on the concrete surface shall be rectified immediately by local patching, in wet state of concrete.

14.3 Vacuum Dewatering:

After screeding the vacuum mat be placed on this leveled concrete and the excess water from the concrete is sucked off. It should be done in accordance with the manufacturer's recommendation, paying special attention over the edges. A time of approximate 1.5 to 2.0 minutes per centimeter thickness of concrete slab is normally adopted for Vacuum treatment. As a result of which the water cement ratio shall be reduced to in the order of 0.42 to 0.43, thereby reducing the total water content in the concrete by 20 to 25%. Care should be taken at this stage to avoid curling at the ends due to excess use of vacuum mats.

14.4 Floating & Troweling:

The hardened concrete surface after vacuum dewatering shall be leveled to achieve true horizontal surface, with the help of mechanical power floater.

Final smooth finish shall be achieved by mechanical power troweling. To give the surface metallic finish Metallic Dry shake IRONITE No. 3 (non coloured) @ 3.0 kg / sqm sprinkled over green concrete in such a way that 2/3rd of the dry shake shall be broadcasted in first pass and same shall be floated with power floater, remaining 1/3rd of dry shake shall be sprinkled in the next pass to acquire a smooth finish by floating and trowelling.

The floating shall be followed by steel trowelling after the concrete has hardened sufficiently to prevent excess of fine material from working to the surface, The finish shall be brought to a smooth and even surface free from defects and blemishes and tested with straight edges. No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix. After the concrete has been thoroughly rammed and has dried sufficiently to allow rendering to be worked up, surface shall be rendered with a thin coat of 1:1 cement mortar with fine sand and uniformly floated. If so directed by the Engineer-in-Charge, approved mineral colour pigment conforming to appendix-B of IS 657 shall be added to the cement mortar to give the required colour and shade to the flooring.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge . Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

14.5 Finishing:

The top shall be polished to give an even & smooth surface. Surface shall be protected from direct sun when it is green.

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14.6 Curing:

Curing shall start on the next day after finishing and shall be continued for 14 days. Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remnants of cement dust from the bags.

15.0 GROOVE CUTTING:

The grooves shall be cut to form the panels of floor as per architectural drawings or as directed by the Engineer-in-charge . The grooves shall be cut 6mm wide & 20mm deep, with mechanical saw and shall be filled upto10 mm deep with joint sealing compound like Polysulphide or (conforming to grade B of IS:1834 or equivalent) of approved make as directed by the Engineer-in-Charge .

15.1 Expansion Joint:

The Expansion joints shall be spaced at approximately 120 sqm. area and/or as specified and shall constitute formation of 12/20/25 mm clear joint between the two concretes. This joint be formed by placing the Shalitex board in position against the old concrete leaving 12/20/25mm x 10mm deep joint at top, which shall be filled in by Polysulphide joint sealant. The 16/20mm dia. MS dowel bars shall be so placed that the half length of bar be bonded in to concrete on one side of the joint and the other half shall be prevented from bonding with concrete. In addition, a recess at its slip end shall be provided to accommodate the movement of the slab during expansion of the concrete. The unbonded portion of the dowel bar shall be covered with an expansion cap using 25mm dia. PVC pipe, 305mm long (unless otherwise specified).

15.2 Construction Joint:

The side construction joints shall be buttered against each other and later on a joint groove shall be cut as specified in 'a)' above.

16.0 STEEL REINFORCEMENT:

Reinforcement as specified shall be placed in concrete, 50mm below the top surface of concrete. This mesh shall be for individual panels, formed by side construction joint and expansion joint.

Tie bars, 600 mm long, shall be provided at construction joints using specified dia. and at specified spacing and / or as directed by EIC.

Dowel bars, 600 mm long, shall be provided at expansion joints using specified dia. and at specified spacing and / or as directed by EIC .

1.1

PAINTING

1.0 SCOPE

These specifications cover the use of paints for the plastered and concrete surfaces. It also includes the painting of wood and metal surfaces.

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2.0 GENERAL

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The provisions of the latest revisions of the following IS Codes shall form a part of this specification.

IS: 63	Whiting for Paint & putty.
IS: 75	Specification for Linseed oil, raw & refined.
IS: 159	Specification for ready mixed paint, brushing, acid resistant.
IS: 345	Specification wood filler, transparent, liquid.
IS: 426	Specification for paste filler for colour coats.
IS: 427	Specification for Distemper, dry colour, as required.
IS: 428	Specification for Distemper, Oil Emulsion, colour as required.
IS: 533	Specification for Gum spirit of Turpentine (Oil of Turpentine)
IS: 710	Marine Plywood
IS: 1200 (Part XIII)	Method of Measurement of Building & Civil Engg Works - White Washing, colour washing, distempering & other finishes.
IS: 1477 (Part 1)	Code of practice for painting of ferrous metals in buildings Pre-treatment
IS: 1477 (Part 11)	Code of practice for finishing of ferrous metals in buildings. Painting
IS: 2338 (Part 1)	Code of practice for finishing of wood and wood based materials Operations and workmanship for finishing.
IS: 2338 (Part 11) :	Code of practice for finishing of wood and wood based materials, Schedule
IS: 2395 (Part 1) :	Code of practice for painting concrete masonry and plaster surfaces. Operation & workmanship
IS: 2395 (Part 11)	Code of practice for painting concrete, masonry and plaster surfaces. Schedule.
IS: 2524 (Part 1)	Code of practice for painting of non-ferrous metal in buildings Pre-treatment
IS: 2524 (Part II)	Code of practice for painting of non-ferrous metal in buildings Painting
IS: 3140	Code of practice for painting asbestos cement buildings:
IS: 3537	Specification for ready mixed paint, finishing, interior for general purposes to IS colour.
IS: 5410	Specification for cement paints, colour as required.
IS : 6278	Code of practice for white washing & colour washing.

Other IS Codes not specifically mentioned here, but pertaining to painting form part of these specifications.

3.0 MATERIALS

Materials shall strictly conform to the relevant IS Specifications.

4.0 PAINTING PLASTERED OR CONCRETE SURFACES

4.1 General

Wherever scaffolding is necessary, it shall be erected in such a way that as far as possible no part of scaffolding shall rest against the surface to be painted. A properly secured and well tied suspended platform ("JHOOLA") may be used for painting. Where ladders are used, pieces of old gunny bags shall be tied at top and bottom to prevent scratches to the walls and floors. For painting of ceilings, proper stage scaffolding shall be erected, where necessary.

4.2 Preparation of surfaces:

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The surface shall be thoroughly cleaned off all dirt, dust, mortar dropping and other foreign matter, before paint is to be applied. New plaster surfaces and wet patches shall be allowed to sufficiently dry, before applying paint. All unnecessary nails shall be removed. Pitting in plaster shall be made good with putty. The surface shall then be rubbed down again with a fine grade sand paper and made smooth.

The surface shall be allowed to dry thoroughly before the regular coat of paint is allowed.

The surface affected by moulds moss, fungi, algaelicnens, efflorescence shall be treated in accordance with IS 2395 (Part 1) before applying paint.

5.0 OIL-BOUND DISTEMPER

5.1 Preparation of Surfaces:

Any unevenness shall be made good by applying putty, made of plaster of Paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

5.2 Primer Coat

The primer where used as on undercoated surfaces shall be alkali resistance primer or distemper primer as specified in the item. These shall be of the same manufacture as of oil bound distemper. If the wall surface plaster has not dried completely alkali resistance primer shall be applied before distempering the walls. But if the distempering is done after the wall surface is dried completely, distemper primer shall be applied.

5.3 Application

Primer shall be applied with a brush on the clean dry and smooth surface. Horizontal strokes shall be given first and vertical strokes shall be applied immediately afterwards. This entire operation will constitute one coat. The surface shall be finished uniformly leaving no brush marks. It shall be allowed to dry for at least 48 hours, before application of oil bound distemper or any other paint.

5.4 Preparation of oil bound distemper:

The distemper shall be diluted with water or any other prescribed thinner in a manner recommended by the manufacturer. Only sufficient quantity of distemper required for days work shall be prepared.

5.5 Application of distemper coat:

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off after rubbing. Minimum two coats of distemper shall be applied with brushes in horizontal strokes followed to immediately by vertical which together shall constitute one coat. The subsequent coats shall be applied after a time interval of at least 24 hours between consecutive coats to permit the proper drying of the preceding coat.

The finished surface shall be even and uniform without patches, brush marks, distemper, drops, etc.

Sufficient quantity of distemper shall be mixed to finish one room at a time. The application of a coat in each room shall be finished in one operation and no work shall be started in any room, which cannot be completed the same day.

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15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes, which are dirty and caked with distemper, shall not be used on the work.

6.0 WATER PROOF CEMENT PAINT

6.1 Preparation of Surfaces

The surfaces shall be thoroughly wetted with clean water before the water proof cement paint is applied.

6.2 Preparation of Paint

Portland cement paints are made readily by adding paint powder to water and stirring to obtain a thick paste which shall then be diluted to a brushable consistency. Generally equal volumes of paint powder and water make a satisfactory paint. In all cases the manufacturer's instructions shall be followed. The paint shall be mixed in such quantities as can be used up within an hour of mixing as otherwise the mixture will set and thicken, affecting flow and finish.

The lids of cement paint drums shall be kept tightly closed when not in use, as by exposure to atmosphere the cement paint rapidly becomes air set due to its hydroscopic qualities.

6.3 Application of Paint

No painting shall be done when the paint is likely to be exposed to a temperature of below 7°C within 48 hours after application.

When weather conditions are such as to cause the paint to dry rapidly, work shall be carried out in the shed as far as possible. This helps the proper hardening of the paint film by keeping the surface moist for a longer period.

To maintain a uniform mixture and to prevent segregation the paint shall be stirred frequently in the bucket. For undecorated surfaces, the surface shall be treated with minimum two coats of water-proof cement paint. Not less than 24 hours shall be allowed between two coats and the second or subsequent coat shall not be started until the preceding coat has become sufficiently hard to resist marking by the brush being used. In hot dry weather the preceding coat shall be slightly moistened before applying the subsequent coat.

The finished surface shall be even and uniform in shade without patches, brush marks, paint drops, etc.

Cement paints shall be applied with a brush with relatively short stiff hog or fibre bristles. The paint shall be brushed in uniform thickness and shall be free of excessively heavy brush marks. The laps shall be well brushed out.

6.4 Curing

Painted surfaces shall be sprinkled with water two or three times a day. This shall be done between coats and for at least three days following the final coat. The curing shall be started as soon as the paint has hardened so as not to be damaged by the sprinkling of water say about 12 hours after its application.

6.5 Rate

The rate shall include the cost of all labour, materials, equipments, scaffolding necessary in all the above operations (including priming coat) as described above.

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7.0 PAINTING WOOD AND METAL SURFACES

7.1 General Requirement

The materials required for the execution of painting work shall be obtained directly from approved manufacturers and brought to the site in maker's drums, with seals unbroken. All paints shall conform to relevant Indian Standards as mentioned under sub-head "Material".

All materials not in actual use shall be kept properly protected. Lids of containers shall be kept closed and surface of paint in open or partially open containers covered with a thin layer of turpentine to prevent formation of skin. Materials which have become stale or fat due to improper and long storage shall not be used. The paint shall be stirred thoroughly in its container before pouring into small containers. While applying also, the paint shall be continuously stirred in the smaller container. No left over paint shall be put back into stock tins. When not in use, the containers shall be kept properly closed.

If for any reason thinning is necessary, in case of ready mixed paint, the brand of thinner recommended by manufacturer shall be used.

Painting except the priming coat shall generally be taken in hand after all other construction work is practically finished. The rooms shall be thoroughly swept out and the entire building cleaned up at least one day in advance of the paint work being started. The surface to be painted shall be thoroughly cleaned and dusted. All rust, dirt scales, smoke and grease shall be thoroughly removed before painting is started.

No painting on exterior or other exposed parts of the work shall be carried out in wet, humid or otherwise unfavourable weather and all the surfaces must be thoroughly dry before painting work is started.

7.2 Brushing of Paint

The brushing operations are to be adjusted to the spreading capacity advised by the manufacturers of the particular paint. The painting shall be applied evenly and smoothly by means of crossing and laying off, the later in the direction of the grain of wood. The crossing and laying off consists of covering the area over with paint, brushing the surface hard for the first time over and then brushing alternatively in the opposite directions two or three times and then finally brushing lightly in a direction at right angles to the same. In this process, no brush marks shall be left after the laying off is finished. The full process of crossing and laying off will constitute one coat.

During painting, every time after the paint has been worked out of the brush bristles or after the brush has been unloaded, the bristles of the brush, (which are drawn together due to the high surface tension) shall be opened up by striking the brush against a portion of the unpainted surface with the end of the bristles held at right angles to the surface, so that bristles thereafter will collect the correct amount of paint when dipped again into the paint container.

7.3 Spraying

Where so stipulated, the painting shall be done with spray. Spray machine used may be (a) high pressure (small air aperture) type or (b) a low pressure (large air gap) type, depending on the nature and location of work to be carried out. Skilled and experienced workmen shall be employed for this class of work. Paints used shall be brought to the requisite consistency by adding a suitable thinner.

Spraying should be done only when dry conditions prevail. During spraying the spray gun shall be held perpendicular to the surface to be coated and shall be passed over

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the surface in a uniform sweeping motion. Different air pressures and fan adjustment shall be tried so as to obtain the best application with the minimum wastage of paint. The air pressure shall not be kept too high as otherwise the paint will clog up and will be wasted.

Spots that are inaccessible to the spray pattern shall be touched up by brush after spraying.

At the end of the job, the spray-gun shall be cleaned thoroughly so as to be free from dirt. Incorrect adjustments shall be set right, as otherwise they will result in variable spray patterns, runs, sags and uneven coats.

Each coat shall be allowed to dry completely and lightly rubbed with very fine grade of sand paper and loose particles brushed off before next coat is applied. Each coat shall vary slightly in shade and shall be got approved 'from the Engineer-in-charge of before next coat is started.

Each coat except the last coat shall be lightly rubbed down with sand paper or fine pumice stone and cleaned off dust before the next coat is applied.

No hair marks from the brush or clogging of paint puddles in the corner panels, angles of moulding, etc. shall be left on the works. In painting doors and windows, the putty round the glass panes shall also be painted but care shall be taken to see that no paint stains etc. are left on the glass. Tops of shutters and surfaces in similar hidden locations shall not be left out in painting.

In painting steel work, special care shall be taken while painting over bolts, nuts, rivets, overlaps etc.

The additional specifications for primer and other coats of paints shall be according to the detailed specifications under the respective headings.

7.4 Brushes and containers

After work, the brushes shall be completely cleaned off paint and linseed oil by rinsing with turpentine. After cleaning, the brushes are wrapped in heavy paper or water proof paper for storage. It is to be used the next day it shall be hung in a thinner or linseed oil in a container. On no account shall brushes to be made to stand on bristles. A brush in which paint has dried up is ruined and shall on no account be used for painting work.

The containers, when not in use, shall be kept closed and free from air so that paint does not thicken and also shall be kept guarded from dust. When the paint has been used, the containers shall be washed with turpentine and wiped dry with soft clean cloth, before they can be used again.

7.5 Wood and wood Based Materials

7.5.1 Preparation of Surface

All wood works shall be dry and free from any foreign matter, incidental to building operation. Nails shall be punched well below the surface to provide a firm key for stopping. Moulding shall be carefully smoothened with abrasive paper and projecting fibres shall be removed. Flat portions shall be smoothened off with abrasive paper used across the grain prior to painting. Any knots, resinous, streaks or bluish sap wood that are large not enough to justify cutting out shall be treated with two coats of pure shellac knotting, applied thinly and extended about 25 mm beyond the actual area requiring treatment.

7.5.2 Plywood and Block Board: This shall be treated as for solid wood, described above.

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7.5.3 Hard Boards The surface shall be dusted off and painted with a coat of plastic emulsion paint thinned with water or with a coat of shellac varnish as specified. The surface shall then be rubbed down with fine grade abrasive paper and followed with required under coating and finishing coat as for solid wood.

7.5.4 Particle Board: The surface shall be filled with thin brushable filler and finished as for solid wood.

7.5.5 Insulation Boards: Two thin coats of water based paints shall be applied by spraying.

7.6 Priming Coat: The dirt or any other extraneous material shall be removed from the surface to be painted. In case he surface is already finished with printer coat but unsatisfactory, it shall be rubbed down to bare wood and surface reprimed. Primer shall be applied by brushing.

7.7 Application for transparent wood filler: The filler shall be applied with brush or rag in such a way that it fills up all the pores and indentations and levels up the surface. It shall be allowed to dry for 24 hours and it shall then be cut and rubbed with emery paper so that the surface of the wood is laid bare, with, the filler only in the pores and crevices of the wood.

7.8 Stopping: All holes, cracks, crevices, etc. shall be stopped carefully to true and level surface with putty before the main undercoat is applied and after the application of the priming coat, stopping shall be prepared as below:

Bees wax, resin and lac (orange in colour) in the proportion of 1: 1: 16 by weight shall be melted down together in a suitable pot using slow heat, the mix being kept well stirred. Colouring materials to produce the required shade shall be added into molten mixture and stirred. Stopping shall on cooling be rolled into stick forms for use.

7.9 Application of Paints: This shall conform to specifications under Para 7.1

7.10 Applying wood preservatives:

The preservatives of specified quality shall be applied in two coats. On new wood work, it shall be applied liberally with a stout brush and not doubled with rags or cotton waste, The first coat shall be allowed at least 24 hours to soak in before the second coat is applied. The excess of preservative which does not soak into the wood shall be wiped off with a clean dry piece of cloth.

8.0 WHITE WASHING

8.1 General

The item refers to white-washing over old and new concrete, stone masonry brick plastered surfaces and asbestos cement sheets.

White wash shall be prepared from fresh burnt white stone lime or shell lime. This lime shall be of class C type as per IS: 712. Surkhi lime or lime of equivalent quality may be used. The lime shall be dissolved in a tub with sufficient quality of water (about 4.5 litres/Kg. of lime) and the whole shall be thoroughly mixed and stirred until it attains the consistency of thin cream. The white wash shall be taken out in small quantities and strained through a clear course cloth. Alternatively whiting for paints and putty as per IS: 63 may also be used. Clean gum dissolved in hot water shall then be added in suitable proportion of 2 gm of gum Arabic to a litre of lime or whiting to prevent the white- wash coming off easily when rubbed. Rice may be used instead of gum.

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8.2 Scaffolding

This may be double or single according to requirements. If ladders are used, pieces of old gunny bags or cloth rags shall be tied on their tops to avoid damage or scratches to the wall. Proper stage scaffolding shall be created when white-washing ceiling. The contractor shall be responsible for accidents if any taken place.

8.3 Preparation of Surface

The surface shall be prepared by removing all mortar dropping and foreign matter and thoroughly cleaned with wire or fibre brush or other means as may be ordered by the Engineer to produce an approved clean and even surface. All loose pieces and the scales shall be scraped off and holes stopped with mortar. In case where the surface have been previously coloured-washed, the old colour wash must be entirely removed before the white-wash is applied. In the case of surface which have once been white-washed, the old loose white-wash shall be broomed down. In case, the loose white-wash cannot be removed by brooming, the Engineer of may order scraping of the surface.

After cleaning the surface as specified above, the unwanted nails shall be removed and all nail holes, cracks and crevices stopped with mortar similar in composition to the surface to be stopped. The mortar should be cured.

8.4 Application of white-wash

On the surface so prepared, the white-wash shall be laid. Each coat shall be laid on with a brush. The first stroke of the brush shall be from the top downwards, another from bottom upwards over the first stroke, and similarly, one stroke from the right and another from the left over the first brush before it dries. This will form one coat. Each coat must be allowed to dry and shall be subject to inspection before the next coat is applied. When dry, the surface shall show no signs of cracking. It shall present a smooth and uniform finish free from brush marks and it should not come off easily when rubbed with a finger.

No portion in the surface shall be left out initially, to be patched up later on.

For new work, the white washed surface shall present a smooth and uniform finish.

For old work, patches and repairs shall be white washed first. Thereafter, the whole surface shall be white washed with the required number of coats.

Doors, windows, floors and other articles of furniture, etc., shall be protected from being splashed upon. Splashing and droppings, if any, shall be removed and the surfaces cleaned.

Preparing the surface for white wash including the scaffolding.

Applying the white wash in required number of coats as specified above and prior white washing of repaired patched.

9.0 PLASTIC EMULSION PAINTING ON WALL & CEILING

9.1 General

Plastic emulsion paints are not suitable for application on external wood and iron surfaces and surfaces which are liable to heavy condensation and are to be used generally on masonry or plastered surfaces. Suitable primer as per manufacturer shall be provided.

9.2 Paint

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Plastic emulsion paint of approved brand and manufacture and of the required shade shall be used.

9.3 Preparation of Surface

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

9.4 Application: The number of coats shall be as stipulated in the item. The paint will be applied in the usual manner with brush or roller.

The paint dries by evaporation of the water content and as soon as the water has evaporated the film gets hard and the next coat can be applied. The time of drying varies from one hour on absorbent surfaces to 2 to 3 hours on non-absorbent surfaces.

The thinning of emulsion is to be done with water and not with turpentine.

Thinning with water will be particularly required for the undercoat which is applied on the absorbent surface. The quantity of thinner to be added shall be as per manufacturer's instructions.

The surface on finishing shall present a flat velvety smooth finish. If necessary more coats will be applied till the surface presents a uniform appearance.

9.5 Precautions

Old brushes if they are to be used with emulsion paints, should be completely dried of turpentine or oil paints by washing in warm soap water.

Brushes should be quickly washed in water immediately after use and kept immersed in water during break periods to prevent the paint from hardening on the brush.

In the preparation of walls for plastic emulsion painting, no oil base putties shall be used in filling cracks, holes etc.

Splashes on floors etc. shall be cleaned out without delay as they will be difficult to remove after hardening.

Washing of surfaces treated with emulsion paints shall not be done within 3 to 4 weeks of application.

9.6 Other Details: These shall be as per specification for "Painting" as far as they are applicable.

10.0 SYNTHETIC PLASTERING IN PLAIN / STONE OR METALLIC FINISH

10.1 General

Synthetic plaster reinforced by using fibres and shall be based on chemicals having acid and alkally resistant properties. It can be applied to any hard, plain surface both internally and externally. It does not require any further application or treatment once it is applied on the surface.

Synthetic Plaster is available in ready-mixed form in any desired colour and can be applied by using a trowel. The synthetic plaster avoids cracks formation as well as it provides a waterproofing coating on the surface treated.

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10.2 Base Coat

An average 20mm thick cement plaster shall be provided as rendering coat which shall be roughened lightly with wire brush so as to form very mild keys on the rendered surface.

The surface shall be allowed for curing for a period of minimum 14 days before the application of synthetic plaster.

10.3 Applications

Synthetic plaster is applied in three coats:

One coat of plaster by trowel and ; Subsequent two coats of chemical overcoat by brush in approved colour and finished as specified (plain/stone or metallic).

10.5 Other Details

The synthetic plaster treatment shall be executed through an approved agency and written performance guarantee shall be submitted by the Contractor for a minimum period of Ten years through the agency. The contractor and the agency shall be jointly responsible for the performance of the treated surface until the expiry of the guarantee period.

11.0 ACRYLIC PAINTING TO EXTERNAL SURFACES

Acrylic weather shield paint of approved brand shall be applied over plastered surfaces as directed by the Engineer.

Other specifications including preparation of surfaces, application of paint etc. shall conform to section 6.3 above and as directed by Engineer-In-Charge . The priming coat, anti-fungal treatment, preparation of paint etc. shall be carried out as per manufacturer's specification / as directed by Engineer-In-Charge .

WAX POLISHING

Wax polish shall either be prepared on site or obtained ready made from market. Polish made on the site shall be prepared from a mixture of pure bees wax, linseed oil, turpentine oil and varnish in the ratio of 2:1 1/2:1 1/2 by weight. The bees wax and the boiled linseed oil shall be heated over a slow fire when the wax is completely dissolved the mixture shall be cooled till it is just warm, and turpentine oil and varnish added to it in the required proportions and the entire mixture is well stirred.

Surface shall be prepared as described under French spirit Polish except that the final rubbing shall be done with sand paper which has been slightly moistured with linseed oil. Mixture of polish shall be applied evenly with a clean cloth pad in such a way that no blank patches are left and rubbed continuously for half an hour. When the surface is quite dry a second coat shall be applied in the same manner, and rubbed continuously for half an hour or until the surface is dry. Final coat shall then be applied and rubbed for 2 hours or more if necessary, until the surface has assumed an uniform Gloss and is quite dry showing no sign of stickiness when touched. Gloss of the polish depends on the amount of rubbing, therefore rubbing must be continuous and with uniform pressure and frequent change in direction.

VARNISHING

Surface shall be prepared as described above. After preparation of surface, two coats of clean boiled linseed oil shall be applied at sufficient interval of time. After the linseed oil has dried two coats of varnish obtained from approved

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manufacturer shall be applied at sufficient interval of time. If the surface fails to produce the required gloss an additional coat shall be applied without any extra cost.

OIL EMULSION (OIL BOUND) DISTEMPERING

MATERIALS

Oil bound distemper of approved brand and manufacture conforming to latest edition of IS:428 shall be used. The primer shall be cement primer or distemper primer of same brand and manufacturer preferably. Distemper shall be diluted with water or any other prescribed thinner as per manufacturer's instruction. Distemper is to be prepared for the quantity which can be consumed for the day's work.

PREPARATION OF SURFACE

The surface shall be thoroughly cleaned of dust, old white or colour wash by washing and scrubbing. The surface shall then be allowed to dry for at least 48 hours. It shall then be sand papered to give a smooth and even surface. Any unevenness shall be made good by applying putty, made of plaster of paris mixed with water on the entire surface including filling up the undulation and then sand papering the same after it is dry.

Pitting in plaster shall be made good with plaster of paris mixed with the colour to be used. The surface shall then be rubbed down again with a fine sand paper and made smooth. A coat of the distemper shall be applied over the patches. The patched surface shall be allowed to dry thoroughly before the regular coat of distemper is applied.

Application

The priming coat shall be with distemper primer or cement primer, as required.

Distemper Coat

After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth for receiving the distemper, taking care not to rub out the priming coat. All loose particles shall be dusted off rubbing. One coat of distemper properly diluted with thinner (water or other liquid as stipulated by the manufacturer) shall be applied with brushes in horizontal strokes followed immediately by vertical ones which together constitute one coat.

The subsequent coats shall be applied in the same way. Two or more coats of distemper as are found necessary shall be applied over the primer coat to obtain an even shade.

A time interval of at least 24 hours shall be allowed between consecutive coats to permit of the proper drying of the preceding coat.

15 cm double bristled distemper brushes shall be used. After each days work, brushes shall be thoroughly washed in hot water with soap solution and hung down to dry. Old brushes which are dirty and caked with distemper shall not be used on the work.

The specifications in respect of scaffolding, protective measures, measurements etc shall be as described under dry distempering.

PAINTING OIL/ENAMEL/ACRYLIC EMULSION ETC

Ready mixed oil paint, acrylic emulsion paint, ready mixed synthetic enamel paint, Aluminium paint, etc shall be brought in original containers and in sealed tins. If for

any reason thinner is necessary the brand and quantity of thinner recommended by the manufacturer or as instructed by the Employer/Architects shall be used.

The surface shall be prepared as specified above and a coat of approved primer shall be applied. After 24 hours drying, approved of specified quality paint shall be applied evenly and smoothly . If required a filler putty coating may be given to give smooth finish. Each coat shall be allowed to dry cut thoroughly and then lightly rubbed down with sand paper and cleaned of dust before, the next coat is applied. Number of coats shall be as specified in the item and if however the finish of the surface is not uniform additional coats as required shall be applied to get good and uniform finish at no extra cost. After completion no hair marks from the brush or clogging of paint puddles in the corners of panel angles of mouldings shall be left on the work. The glass panes floor etc., shall be cleaned of stains.

When the final coat is applied, if directed, the surface shall be rolled with a roller or if directed it shall be supplied with a stippling brush.

MELAMINE FINISHIES

Apcolite Natural Wood finish clear glossy is a premium quality melaminised coating specially formulated as a protective and decorative finishing clear coating for wood.

TECHNICAL DATA

Method of Application:		Brushing at 25.30 seconds by Ford Cup B4 at 30 Degree C
	:	Spraying at 20.25 seconds by Ford Cup at 30 degree C
Thinner recommended	:	Brushing - Thinner 106
		Spraying - Thinner 124
Thinner intake	:	20.25% by volume
Mixing ratio	:	Base to hardener in 10.1 by volume
Drying Time	:	8 hours
		Surface dry - less than 30 minutes Hard dry 16.20 hours
		Recoating period - Overnight.
Finish	:	25 microns film thickness smooth glossy
Flash point	:	Above 14 degree C (57 degree F)

Sand the surface along the grains with Emery paper No.180 or with a suitable grade sand paper. Brush the surface free of loose dust. Fill the wood using Apcolite Wood Filler. Remove excess filler immediately after applications. Allow 2.3 hours of drying, before sanding with Emery Paper No.240 or 280. If desired, apply Apcolite Natural Wood Finish upto 20% by volume and apply by spraying after Sealer Coat. In application by ragging allow a drying time of 5.10 minutes in between coats and 30.60 minutes before overcoating with finish coats. Apply a coat of Apcolite Natural Wood Finish Clear Sealer, After overnight drying, smooth sand with Emery Paper No.320 and wipe the surface free of loose dust. Apply Apcolite Natural Wood Finish Clear Glossy as follows. Ensure that the surface to be coated is free from loose matter.

Apcolite Natural Wood Finish Clear Glossy is a two component system consisting of base and hardener. These should be mixed in the recommended ratio. The two components should be mixed in a glass, plastic or enamelled container.

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Allow the mixture to stand for 30 minutes and then apply by brushing or spraying using the recommended thinner for consistency adjustment. The mixture of base and hardener should be used within 8 hours. To enhance gloss and decorative value Apcolite Natural Wood Finish Clear Glossy can be buffed using suitable buffing mops but only after 48 hours of application.

MATT

Apcolite Natural Wood finish clear glossy or approved equivalent is a premium quality melaminised coating specially formulated as a protective and decorative finishing clear coating for wood.

TECHNICAL DATA

Method of Application C	: Brushing at 25.30 seconds by Ford Cup B4 at 30 Degree
	: Spraying at 20.25 seconds by Ford Cup at 30 degree C
Thinner recommended	: Brushing - Thinner 106
	Spraying - Thinner 124
Thinner intake	: 20.25% by volume
Mixing ratio	: Base to hardener in 10.1 by volume
Drying Time	: 8 hours
	Surface dry - less than 30 minutes Hard dry 16.20 hours
	Recoating period - Overnight.
Finish	: 25 microns film thickness smooth glossy
Flash point	: Above 14 degree C (57 degree F)

Sand the surface along the grains with Emery paper No.180 or with a suitable grade sand paper. Brush the surface free of loose dust. Fill the wood using Apcolite Wood Filler or approved equivalent. Remove excess filler immediately after applications. Allow 2.3 hours of drying, before sanding with Emery Paper No.240 or 280. If desired, apply Apcolite Natural Wood Finish or approved equivalent upto 20% by volume and apply by spraying after Sealer Coat. In application by ragging allow a drying time of 5.10 minutes in between coats and 30.60 minutes before over-coating with finish coats. Apply a coat of Apcolite Natural Wood Finish Clear Sealer or approved equivalent. After overnight drying, smooth sand with Emery Paper No.320 and wipe the surface free of loose dust. Apply Apcolite Natural Wood Finish Clear Glossy or approved equivalent as follows. Ensure that the surface to be coated is free from loose mater. Apcolite Natural Wood Finish Clear Glossy is a two component system consisting of base and hardener. These should be mixed in the recommended ratio. The two components should be mixed in a glass, plastic or enamelled container. Allow the mixture to stand for 30 minutes and then apply by brushing or spraying using the recommended thinner for consistency adjustment. The mixture of base and hardener should be used within 8 hours.

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STEEL DOORS

STEEL DOORS & WINDOWS

1.0 APPLICABLE CODES

The provisions of the largest Indian Standards mentioned below shall form a part of these specifications:

IS: 1956	Glossary of terms relating to iron and steel.
IS:814 (Part I)	Specifications for covered electrodes for metal arc welding of structural steel.
IS:814 (Part II)	1) For welding products other than sheets. Specifications for covered electrodes for metal arc welding of structural steel. 2) For welding sheets
IS: 815	Classification and coding of covered electrodes for metal arc welding of structural steel.
IS: 816	Code of practice for use of metal arc welding for general construction in mild steel.
IS: 817	Training of Welders- Code of practice: Part 1 manual metal arc welding
IS: 818	Code of practice for safety and health requirements in electric and gas welding and cutting operations.
IS: 1948	Aluminium doors, windows & ventilators.
IS:1977	Low tensile structural steels – Specifications.
IS: 6227	Code of Practice for use of metal arc welding in tubular structure.
IS: 6248	Specifications for metal rolling shutters and rolling grill.
IS: 1081	Code of Practice for fixing and glazing of metal (steel and aluminium) doors, windows and ventilators.
IS: 2062	Weldable Structural Steel.
IS: 1361	Specifications for steel windows for Industrial Buildings.
IS:1200 (Part VIII)	Measurements for steel work and iron work.
IS.1038	Specifications for steel doors, windows and ventilators.
IS: 226	Specifications for structural steel (Standard quality).
IS: 823	Code of procedure for manual metal arc welding of metal steel.
IS: 102	Ready mixed paint, brushing, red lead non sitting, priming.
IS: 1363	For black hexagon bolts, nut and lock nuts (dia 6 to 39 mm) and black hexagon screws (dia 6 to 24 mm).
IS: 813	Scheme of symbols for welding.

Other IS Codes not specifically mentioned here but pertaining to Metal Doors, Windows & Ventilators form part of these specifications.

2.0 MATERIALS

2.1 Structural Steel

Standard quality mild steel of various varieties and designations shall be used for different works as mentioned below:

(i) St 42 - S:

This variety of steel (standard quality) shall conform to specifications given in IS: 2062 (latest) and shall be used for

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Riveted steel work

Bolted steel work

Steel work where welding is employed for fabrication provided that the thickness of material does not exceed 20 mm. When material conforming to this standard is over 20 mm thick special precautions may be required in case the material is to be welded (see IS: 823 - latest).

(ii) St 30 - 0:

This variety of steel (ordinary quality) shall conform to specifications given in IS: 1977 and is intended for general purposes such as door and window frames, window bars, grills, steel gates, hand railing , builder's hardware, fencing post, tie bars, etc. All finished steel material shall be properly and neatly rolled to dimensions, sections and weights as specified. The finished material shall be free from visible as well as hidden defects and excessive rusting. The ends of the tubes shall be cut square, unless otherwise specified.

Steel sections and tubes shall be well protected and kept free from excessive rust and scaling. In this regard, decision of Engineer-in-charge shall be final and binding on the contractor.

2.1.1 Black Bolts

Also known as machine bolts, these bolts shall be made from rods and they come from the rolling mills and are not finished to exact size. A lower working stress is taken for these types of bolts than those of rivets and 'turned fitted bolts'.

2.1.2 Welding Equipment:

The welding plant and equipment shall be of modern design and shall be got approved by the Engineer-in-charge.

The electrodes required for metal arc welding shall be 'covered electrodes' and shall conform to IS: 814 (Part I) for welding products other than sheets and IS: 814 (Part II) for welding sheets.

The type of covering shall be as per IS: 815 for classification and coding of covered electrodes for metal are welding of structural sheets.

2.2 Workmanship

2.2.1 Structural Steel Work

The steel sections as specified or required shall be cut, square and to correct lengths, as per drawing and design. The cut ends exposed to view shall be finished smooth. No two pieces shall be welded or otherwise jointed to make up the required length of a member, except as indicated in the drawings or directed by the Engineer-in-charge . All straightening and shaping to form shall be done by application of pressure and not by hammering. Any bending or cutting shall be carried out in such a manner as not to impair the strength of the metal. All operations shall be done in cold state unless otherwise directed / permitted.

All holes shall be generally drilled to the required size and at the required position. Sub-punching shall be permitted, provided it is done 3 mm less in diameter and reamed thereafter to the required size.

Holes for rivets and black bolts shall be larger by 0.4 to 0.6 mm than the nominal diameter of the rivets and black-bolts depending upon the dia of rivets.

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Holes for counter-sunk bolts shall be made in such a manner that their heads fit flush with the surface after fixing.

All bolt heads and nuts shall be hexagonal and of equal size, unless specified otherwise. The screwed threads shall conform to IS: 1363 and the threaded surface shall not be tapered. The bolts shall be of such length as to project two clear threads beyond the nuts when fixed in position and these shall fit in the bolts without any shake. The nuts shall fit in the threaded ends of bolts properly. Tapered washers shall be provided for all heads and nuts bearing and levelled surfaces. The threaded portion of the bolt shall not be within the thickness of the parts bolted together. The faces of bolt heads and nuts shutting against steel members shall be machine finished.

Welding shall generally be done by electric process. The electric arc method being economical is usually adopted. Where public electricity is not available a suitable generator shall be arranged. Gas welding shall be resorted to using oxyacetylene flame with specific prior approval of the Engineer-in-charge .

Types of welding: Welds used for joining structural members are generally of the following two types as under:

(i) Fillet weld: The cross section of fillet weld is triangular and it is used to joint two surfaces normally at right angles to each other. This type of weld is used more frequently in structural connections than any other type, and is usually in the form of isosceles triangle. The fillet welds shall be continuous or intermittent as specified in the design.

(ii) Butt welds: These are classified according to the method of grooving or preparing of the base metal. The metal pieces shall be filled or obisolled chiseled to the required shape for butt welding at the throat for which no extra payment shall be made.

Fillet and Butt welds shall conform to IS: 816. Special type of welds as slot-welds shall be used where so specified. Either direct or alternating current (but not both types) may be used throughout the whole work. An ammeter shall be provided to each arc and so situated that the Engineer-in-charge can easily check the current being used by the operator.

Each welder shall be supplied with a portable current regulator to enable him to adjust the welding current within the approved limits without leaving his work. Only qualified operators shall be employed for welding and they shall have been trained and shall be tested after every three months as per provisions of IS: 817 for "Code of Practice for training and testing of Metal Arc Welders".

In welded structure holes are necessary for service bolts required during erection. These holes shall be made as specified above. The holes in the various sections shall be filled with punches and welded properly to form a composite section.

Surfaces which are to be welded together shall be free from loose mill-scale, rust, paint, grease or other foreign matter. A coating of boiled linseed oil shall be permitted.

Before welding is commenced, the plates shall first be brought together and firmly clamped or spot welded at specified distance. This temporary connection has to be strong enough to hold the parts accurately in place without displacement.

All operators connected with welding and cutting equipment conform to the safety requirement given in IS 818 for "Safety and Health Requirements in Electric and Gas Welding and Cutting Operations".

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The following points shall be borne in mind during the process of welding:

(a) Welds shall be made in the flat position, wherever applicable.

(b) Arc length, voltage and amperage shall be suited to the thickness of material, type of groove and other circumstances of the work.

(c) The sequence of welding shall be such that where possible the members which offer the least resistance to compression are welded first.

Processor Welding

The electrode manipulation during welding shall be such as to ensure that:-

(i) The base metal is in a fused state when the filler metal makes contact with it.

(ii) The filler metal does not overflow upon any unfused based metal.

(iii) The base metal is not under-cut along the weld edges.

(iv) The flowing metal floats the slags, the oxides, and the gas bubbles to the surface behind the advancing pool.

In case any of these requirements is unattainable by manipulation, the current shall be adjusted or the electrode size changed. Each time the arc is started, the electrode shall be moved in such a way that the fusion of base metal at the starting point is assured. At the completion of a run the movement of electrode shall be slowed down to fill the arc crater.

After every interruption of the arc except at completion of a run the arc shall be restarted ahead of the previous deposit and then moved back to fill the crater, or such alternative technique shall be used as will ensure complete filling of the crater or complete fusion between the new and old deposits and the base metal at the point of junction and result in continuity of weld. Before welding operation is completed, all traces of slag shall be removed from the deposit, by chipping if necessary and the deposited and adjoining base metal shall be wire brushed and cleaned at all points. The requirements shall apply not only to successive layers but also to successive beats, and to the overlapping area whatever a junction is made on starting a new electrode:

(v) The welds shall be free from cracks, discontinuity in welding and other defects such as :-

(a) under size

(b) over size

(c) undercutting

(d) over cutting

All defective welds which shall be considered harmful to the structural strength shall be cut out and re-welded.

Finished welds and adjacent parts shall be protected with clean boiled linseed oil and after all slag has been removed, welds and adjacent parts shall be painted after the same are approved by the Engineer-in-charge .

Inspection and testing of welds:

The method of inspection and testing shall be as under:

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(a) Visual Inspection: The following factors shall be considered during the visual inspection:

(i) Dimensions of weld deposit. The size of the weld shall be as specified and it may be slightly over but not under.

(ii) Shape of profile: The profile of the weld is affected by the position of the joint, but it shall be uniform. In the case of butt and corner welds, the profile shall be slightly convex and in the case fillet welds it shall be usually slightly concave.

(iii) Uniformity of Surface: The height and spacing of the ripple shall be uniform; these being indicative of workmanship.

(iv) Degree of undercut: Undercutting is undesirable. The weld joint shall be free from undercut but slight intermittent occurrences may be disregarded.

(v) Smoothness of joints: The joints in the weld run where welding has been adopted, shall be as uniform and smooth as possible and shall show no pronounced bump or crater in the weld surface.

(vi) Freedom from surface defects. The surface of the weld shall be free from porosity, cavities and burnt on scale.

(vii) Penetration bead in Butt Welds: A slight penetration bead shall be present and it should be reasonably uniform in width and appearance. Intermittent occurrences of lack of penetration bead may be disregarded.

(viii) Degree of fusion: Fusion shall be complete over the whole area of the joint surface.

(ix) Degree of Root Penetration: These defects are most likely to occur at the root of the weld and in this position they are liable to have the maximum effects in reducing the strength of the weld. A close examination of the root shall, therefore, be made. In butt-welds, the penetration should extend to the underside of the plates producing a penetration bead of the right size. In fillet welds with good root penetration, the weld metal should reach the corner.

Note: 1: In case of fusion welding or non-fusion welding fillet welds will appear in joint, (fillets being at the cretches).

Note: 2: In case of non-fusion welding of cast iron the points shall show satisfactory penetration and adhesion.

(x) Gas Cavities and Flux Entrapments: Unless they are caused by the use of unsuitable material, they are attributable to the quality of workmanship, the desired result being to achieve uniform appearance and freedom from cavities and flux entrapments (where flux is used). In fusion welding of mild steel, cast iron and aluminium where neutral flame is used, and in fusion welding of brass or braze welding of cast iron where oxidizing flame is used, current welding technique may result in rough, porous, discolored and lusterless appearance in the fracture.

Note

(a) In case of fusion welding or non-fusion welding of cast iron isolated blow holes or concentration of pinholes in the weld metal shall be regarded as grounds for rejection but isolated pinholes shall not be so regarded.

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(b) Bending Testing (for ductility): The elongation shall be not less than 30 percent for stress relieved welds and not less than 25 percent for non-stress relieved welds.

(c) Tensile Testing: (Reduced Section Tensile Testing): The tensile strength shall be not less than minimum of the specified tensile range of the parent metal.

Radiographic Examination: This shall be done as given in IS: 4853.

3.0 ROLLING SHUTTERS WITH / WITHOUT M. S. GRILL WORK

Rolling shutters shall be motorized gate having motorized operational facility, obtained from manufacturers such as Standard quality and approved make. Shutters up to 12 Sqm. shall be push and pull type.

Shutters exceeding 12 sq.m shall be provided with gears operated by mechanical devices with chain and / or handle or shall have electrically operated arrangement as specified.

Rolling shutters of 8 Sqm or beyond shall be provided with ball bearings. The width and thickness of M.S. lath shall be 80mm and 1.25 mm.

The shutters shall be of length and width as specified. The spring shall be preferably of coiled type and shall be manufactured from high tensile spring steel wire or strip of adequate strength to balance the shutters in all positions. The spring pipe shaft etc. shall be supported on strong mild steel brackets.

Guide channels shall be of mild steel deep channel section and of rolled, pressed or built-up construction. The thickness of sheet shall not be less than 3.175mm (10 gauge). The depth of side channels shall be 60mm for clear shutter with width upto 3.0 m and 75mm for width 3.0m and above. The gap between two legs of guide channel shall be close enough to prevent rattling due to wind and wide enough for free movement of shutters.

Guide channels, each shall have 3 fixing cleats spaced at not more than 0.75m. Cleats shall be fixed to walls or RCC work with bolts or screws.

The guide channels shall be fixed to the jambs either (a) embedded in grooves (b) projecting or (c) overlapping, as directed by the Engineer-in-Charge .

Any cutting to side walls shall be made good after fixing of cleats/lugs.

The cover of shaft etc. shall be of the same gauge materials as laths. M. S. Grill work shall be manufactured with grill made out of 8mm dia. M.S. rounds bent to required shape and connected by means of flat iron 20mm x 6mm as shown on the drawings and fixed in the rolling shutter.

4.0 M.S. WICKET GATE IN ROLLING SHUTTERS

These shall be manufactured with M.S. members of sheet of sizes and as per the details shown on the drawings and fixing in position all fittings required such as hinges, locking arrangements, etc. shall be provided. Painting shall be carried out as per the parent rolling shutters.

5.0 M.S. LADDERS

M.S ladders shall be fabricated out of M.S. rounds, squares, flats etc. as described, as per the drawing or as directed. The work shall include cutting to required sizes, welding, fixing in position, bending and curving the flat iron stringer at top to form

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handles, embedding the bottom of ladders, providing and casting cement concrete at top and bottom in 1:2:4 (nominal mix) (1 cement: 2 sand: 4 stone aggregate 20mm nominal size) of 60 mm x 30 mm x 150 mm. All the work shall receive one coat of red oxide zinc chromate primer and two coats of synthetic enamel paint of approved make, quality, colour and shade.The width of the ladder shall be 450 mm in between stringers made out of 50mm x 6mm flats as specified and 16mm dia.

M.S. round at maximum 30 cm centres, notched and welded to stringer flats. The ladder shall be fixed at top with welding or with nuts and bolts as required.

6.0 S.S. RAILING

Fabricating stainless steel pipe railing for terraces/ staircase and other areas, up to 1000mm high from finished floor level made out of stainless steel pipe balusters welded to stainless steel pipe top rail and stainless steel pipe intermediate rails (stainless steel pipe shall not be less than 1.5mm thick) including profile cutting, fixing in position, necessary anchor fasteners / approved fixing arrangements, welding using special electrodes for stainless steel welding, etc. complete as per approved shop drawing and as directed by the Engineer in charge .

The railing pipe shall be of non magnetic type stainless steel and conforming grade 304 of AISI. The item also includes providing and fixing rigid type, high impact, smooth 0.8mm thick Teflon separators (both side) between dissimilar metals (MS & SS) or other non-conducting materials as approved by the Engineer in charge .

Providing and fixing upto 65mm (OD) 12G stainless steel hand rail with 40mm (OD) 14G balustrades at every alternate step fixed/slid on to suitable MS sleeve embedded in stair wall. Each balustrades shall be provided with stainless steel shoe at the wall junction. The joint of the balustrade and the sleeve shall be fixed with lead.

In railing / hand rails at all levels including necessary anchor fasteners, insert plates, scaffolding / staging etc. all complete as directed by the Engineer.

7.0 M.S. PIPE RAILING

The M.S. pipe railing shall be fabricated as per drawings and instructions of EIC , out of specific dia, which indicate nominal bore. Unless otherwise shown on the drawings or as directed, the top horizontal or inclined pipe shall be at a height of 1.0 metre and the middle horizontal or inclined pipe shall be at a height of 0.5 metre. The top pipes will be bent at ends and form into vertical support. The vertical supports shall consist of 40mm to 50mm pipe as shown in the drawing or as directed/ specified, at not more than 1.5 meter centres. All vertical pipes shall be anchored to the structure by approved fixing arrangements. The vertical pipes shall be full from bottom to the top horizontal, which shall be continuous without any break. The middle horizontal pipe shall be continuous between vertical supports. The joints shall be properly made and welded and the welding finished to give a smooth surface. The railing shall be fixed truly vertical and shall have a neat appearance. The railing shall be finished with paint / coating as specified in the item description and as per architectural requirements.

FIRE RATED DOORS

Specifications for 2 Hours 2 Criteria Fire door

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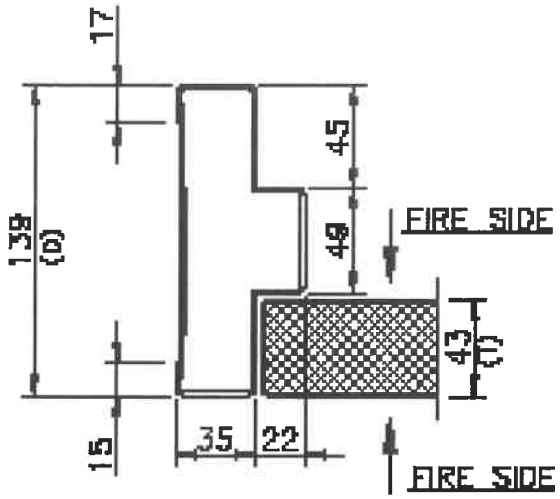

2 hours 2 Criteria Fire Rated Door, is fabricated for two hours and two criteria performance in Stability and Integrity as per BS 476 PART 22 AND IS 3614 PART II.

Frame: shall be fabricated from 1.6 mm thick galvanized steel or 2 mm thk. M.S.CRCA sheets depending on the size of the doors. Frames will have a double rebate profile. They will be provided with stiffeners for hardware/ lock mounting and holdfasts for grouting.

Shutter: of overall thickness 43 mm shall be formed from two outer skin panels of 1.25 mm thick galvanized steel sheets .shutters shall have multibend construction with lock seam joinery for high strength & resistance. Reinforcements shall be provided in the shutter at locking / hardware area. The infill material shall be mineral wool.

Material: The sheet metal used for 1.6 mm thk frame and 1.25 thk shutters panels conform to IS 277 ;1992 . The sheet metal used for 2 mm Thk.CRCA sheet conforms to IS 513: 1994. The doors shall be provided with intumescent seals between frame and shutter at top and two sides for standard and large size doors. The doors shall be provided with 4 "long SS Magnum make hinges. The number of hinges provided shall depend upon door size.

Locking - the doors should be provided with fire resistant three point locking per shutter.

Painting - Both the frames and shutters shall be coated with etch primer, followed by coats of epoxy zinc phosphate primer and final coat of Polyurethane paint.

Specifications for 2 Hours 3 Criteria Fire door.

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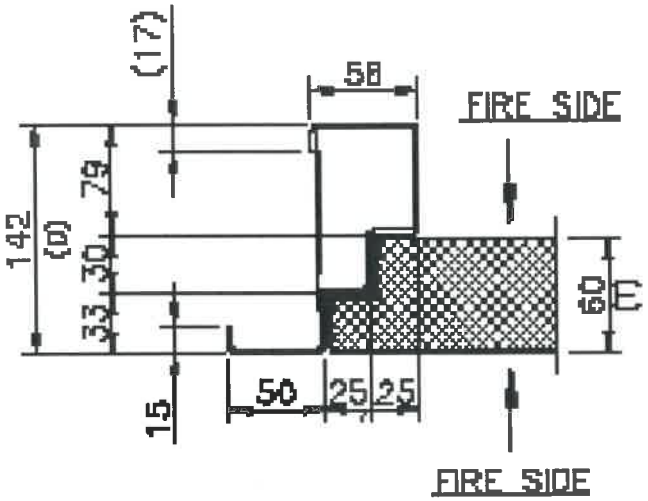

2 hours 3 Criteria Fire Rated Door, fabricated for two hours and three criteria performance in Stability, Integrity and Insulation as per BS 476 Part 22 and IS 3614 Part II, in both directions .

Frame : shall be fabricated from 1.6 mm thick galvanized steel or 2 mm thk.M.S.CRCA sheets depending on the size of the doors . frames will have a multibend profile . they will be provided with stiffeners for hardware/ lock mounting and holdfasts for grouting .

Shutter: of overall thickness 60 mm shall be formed from two outer skin panels of 1.25 mm thick galvanized steel sheets .shutters shall have multibend construction with lock seam joinery & stepped design for high strength & resistance . Reinforcements shall be provided in the shutter at locking / hardware area . The infill material shall be a Proprietary Ceramic Based Material with internal reinforcements .

Material : The sheet metal used for 1.6 mm thk frame and 1.25 thk shutters panels conform to IS 277 ;1992 . The sheet metal used for 2 mm Thk.CRCA sheet conforms to IS 513 : 1994 . The infill material shall be a Proprietary Ceramic Based Material researched and developed in collaboration with CBRI. the doors shall be provided with intumescent seals between frame and shutter at top and two sides . The doors shall be provided with 4 " long SS Magnum make hinges . The number of hinges provided shall depend upon door size.

Locking - the doors should be provided with fire resistant three point locking per shutter .

Painting - Both the frames and shutters shall be coated with etch primer, followed by coats of epoxy zinc phosphate primer and final coat of Polyurethane paint.

Specifications for Hollow Metal Pressed Sheet Doors (HMPS doors).

HMPS Doors are fabricated using multi bend design and lock seam joinery.

Frame:

shall be fabricated from 1.6 mm thick galvanized steel or 2 mm thk.M.S.CRCA sheets depending on the size of the Doors.

Frames can have a double or a single rebate profile. They will be provided with stiffeners for hardware/ lock mounting and holdfasts for grouting.

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Shutter: of overall thickness 43 mm shall be formed from two outer skin panels of 1.25 or 1 mm thick galvanized steel sheets .shutters shall have multi bend construction with lock seam joinery for high strength & resistance. Reinforcements shall be provided in the shutter at locking / hardware area.

The infill material shall be PUF which is injected under a restraining pressure of 1.5 kgs / cm2 .

Material :

The sheet metal used for 1.6 mm thk frame and 1.25 thk shutters panels conform to IS 277:1992 . The sheet metal used for 2 mm Thk.CRCA sheet conforms to IS 513 : 1994 .

PUF shall have a density of approx 0.04 kg/cm3.

The doors shall be provided with 4 " long SS Magnum make hinges . The number of hinges provided shall depend upon door size.

Locking & hardware- the doors shall be provided with standard hardware.

Painting –

Both the frames and shutters shall be coated with etch primer, followed by coats of epoxy zinc phosphate primer and final coat of Polyurethane paint.

Accessories:

vision panel 200x300x6mm as approved.

Dorma PHA 2000 single Panic Bar for Single leaf/active leaf of double leaf door / as approved.

Dorma PHA 2000 3point Panic bar for Double leaf Door/ as approved.

Dorma PHT3905 Outside Access device for Panic Bar / as approved.

Godrej 240 Mortise lock with latch, deadbolt, 2C Cylinder, SS Tubular Handles / as approved.

Godrej Heavy duty door closer:/ as approved.

Hager Door coordinator for double leaf doors/ as approved.

SS D handles: as approved.

SS Tower Bolt: (as approved if required).

Flush Doors Specifications			
TYPE	HONEY COMB	FLAX	TIMBER
A. STILE & RAIL	Mango Treated & Seasoned or Equivalent	Mango Treated & Seasoned or Equivalent	Mango Treated & Seasoned or Equivalent
	Finger Jointed 50 - 60 MM	Finger Jointed 50 - 60 MM	Finger Jointed 50 - 60 MM
B. LOCK RAIL	4" x 15" Height on two sides	4" x 15" Height on two sides	Solid battons
C. FILLER	Honey comb Honicell	Flax Board 400 - 450 Density	Treated Mango or Pine / Meranti / Neem or Equivalent
	BLS 140 15 MM Cell	Imported Flax	

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	size	Board	
D. CROSS SECTION	Plywood 3.5 MM /3 / 3.5 MM MDF	Plywood 3.5 MM /3 / 3.5 MM MDF	Core Veneer 2.5 MM x 4 Layer Balance Panel 0.5 MM x 2 Face Veneer 0.5 MM x 2 (9 Ply Construction)
E. FACE PANEL	Decorative Veneer / Laminate sheet	Decorative Veneer / Laminate sheet	Decorative Veneer / Laminate sheet
	Commercial Face Veneer	Commercial Face Veneer	Commercial Face Veneer
F. ADHESIVE	AS APPROVED	AS APPROVED	AS APPROVED

CEMENT CONCRETE PAVEMENTS

SPECIFICATIONS FOR ROAD WORKS

1.0 SCOPE

1.1 These specifications cover the work of the construction of roads including clearing and grubbing (if required), setting out, embankment / excavation, preparation of sub-grade, laying of sub-base, base, dense bituminous macadam topped by bituminous concrete. The work also involves construction of shoulders, roadside drains medians and all other related works.

1.2 The Contractor shall clear the area (if required) set out the works, provide all the materials, transportation including all leads and lifts, labour, equipment, supervision, and all other incidental temporary and ancillary works required to complete the construction described in the preceding paragraph.

2.0 CODES AND SPECIFICATIONS

The roadwork shall be done as per "Specifications for road and bridge works" published by the Indian Roads Congress on behalf of the Govt. of India, Ministry of Road Transport & Highways (MoRTH) and the various Indian Standards mentioned in the body of these specifications. The following are extracted out of MoRTH specifications.

3.0 SETTING OUT

3.1 The Contractor shall establish working Bench Marks tied with the Reference Bench Mark in the area soon after taking possession of the site. The Reference Bench Mark for the area shall be as indicated in the Contract Documents and the values of the same shall be obtained 'by the Contractor from the Engineer. The working Bench Marks shall be at the rate of four per km and also at or near all drainage structures, over-bridges and underpasses. The working Bench Marks/levels should be got approved from the Engineer. Checks must be made on these Bench Marks once every month and adjustments, if any, got agreed with the Engineer and recorded. An up-to-date record of all Bench Marks including approved adjustments, if any, shall be maintained by the Contractor and also a copy supplied to the Engineer for his record.

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3.2 The lines and levels of formation, side slopes, drainage works, carriageways and shoulders shall be carefully set out and frequently checked, care being taken to ensure that correct gradients and cross-sections are obtained everywhere.

3.3. On construction reaching the formation level stage, the centre line shall again be set out by the Contractor and when approved by the Engineer , shall be accurately referenced in a manner satisfactory to the Engineer by marker pegs set at the outer limits of the formation.

3.4. No reference peg or marker shall be moved or withdrawn without the approval of the Engineer and no earthwork or structural work shall be commenced until the centre line has been referenced.

3.5. The Contractor will be sole responsible party for safeguarding all survey monuments, benchmarks, beacons, etc. The Engineer will provide the Contractor with the data necessary for setting out of the centre line. All dimensions and levels shown on the drawings or mentioned in documents forming part of or issued under the Contract shall be verified by the Contractor on the site and he shall immediately inform the Engineer of any apparent errors or discrepancies in such dimensions or levels. The Contractor shall, in connection with the staking out of the centre line, survey the terrain along the road and shall submit to the Engineer for his approval, a profile along the road centre line and cross-sections at intervals as required by the Engineer.

Suitable references for the transverse grid lines should be left in the form of embedded bricks on either ends or by other means so that it is possible to locate the grid points for level measurements after each successive course is laid.

For pavement courses laid only over widening portions, at least one line of levels shall be taken on each strip of widening, or more depending on the width of widening as decided by the Engineer in charge .

Notwithstanding the above, the measurements may be taken at closer intervals also, if so desired by the Engineer, the need for which may arise particularly in the case of estimation of the volume of the material for profile corrective course (leveling course). The average thickness of the pavement course in any area shall be the arithmetic mean of the difference of levels before and after construction at all the grid points falling in that area, provided that the thickness of finished work shall be limited to those shown on the drawings or approved by the Engineer in writing.

As supplement to level measurements, the Engineer shall have the 3 ption to take cores/make holes to check the depth of construction. The holes made and the portions cut for taking cores shall be made good by the Contractor by laying fresh mix/material including compacting as required at no extra cost immediately after the measurements are recorded.

3.6 The lump sum rate quoted by the Contractor shall, unless otherwise specified, also include compliance with/supply of the following:

(i) General works such as setting out, clearance of site before setting out and clearance of works after completion;

(ii) A detailed programme for the construction and completion of the work (using CPM/PERT techniques) giving, in addition to construction activities, detailed network activities for the submission and approval of materials, procurement of critical materials and equipment, fabrication of special products/equipment and their installation and testing, and for all activities of the Employer that are likely to affect the progress of work, etc., including updating of all such

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activities on the basis of the decisions taken at the periodic site review meetings or as directed by the Engineer;

(iii) Samples of various-materials proposed to be used on the Work for conducting all tests thereon as required as per the provisions of the Contract;

(iv) Testing of various materials including soil / coarse and fine aggregates / cement, design of concrete mixes and all testing for the same, drilling of cores from finished work and testing the same and all other work tests as required under these Specifications and furnishing lest reports/certificates;

(v) Inspection Reports in respect various items of work as per the relevant Specifications;

(vi) Any other data, which may be required as per these. Specifications or the Conditions of Contract or any other annexure / schedules forming pan of the Contract;

(vii) Any other item of work which is not specifically provided in the Bill of Quantities but which is necessary for complying with the provisions of the Contract;

(viii) All temporary works

(ix) Establishing and running a laboratory with facilities for testing for various items of works as specified hereafter.

(x) Cost of in-built provisions for Quality Assurance:

(xi) Cost of safeguarding the environment; and

(xii) Cost of providing "as-built drawings" in original and two sets of prints.

4.0 EXCAVATION FOR ROADWAY AND DRAINS

4.1 Scope

This work shall consist of excavation, removal and satisfactory disposal of all materials necessary for the construction of roadway, side drains and waterways in accordance with requirements of these Specifications and the lines, grades and cross-sections shown in the drawings or as indicated by the Engineer. It shall include the hauling and stacking of or hauling to sites of embankment and sub-grade construction, suitable cut materials as required, as also the disposal of unsuitable cut materials in specified manner, trimming and finishing of the road to specified dimensions or as directed by the Engineer.

4.2 Classification of Excavated Material

The rate for excavation is for all soils and hence there will be no need for classification.

4.3 Construction Operations

4.3.1 Setting out: After the site has been cleared, the limits of excavation shall be set out true to lines, curves, slopes, grades and sections as shown on the drawings or as directed by the Engineer. The Contractor shall provide all labour, survey instruments and materials such as strings, pegs, nails, bamboos, stones, lime, mortar, concrete, etc., required in connection with the setting out of works and the establishment of bench marks. The Contractor shall be responsible for the maintenance of benchmarks and other marks and stakes as long as in the opinion of the Engineer, they are required for the work.

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4.3.2 Excavation - General: All excavations shall be carried out in conformity with the directions given herein under and in a manner approved by the Engineer. The work shall be so done that the suitable materials available from excavation are satisfactorily utilized as decided upon beforehand.

While planning or executing excavations, the Contractor shall take all adequate precautions against soil erosion, water pollution etc., and take appropriate drainage measures to keep the site free of water .

The excavations shall conform to the lines, grades, side slopes and levels shown on the drawings or as directed by the Engineer. The Contractor shall not excavate outside the limits of excavation. Subject to the permitted tolerances, any excess depth/ width excavated beyond the specified levels/dimensions on the drawings shall be made good at the cost of the Contractor with suitable material of characteristics similar to that removed and compacted to the requirements of Clause 6.0.

All debris and loose material on the slopes of cuttings shall be removed. No backfilling shall be allowed to obtain required slopes excepting that when boulders or soft materials are encountered in cut slopes, these shall be excavated to approved depth on instructions of the Engineer and the resulting cavities filled with suitable material and thoroughly compacted in an approved manner.

After excavation, the sides of excavated area shall be trimmed and the area contoured to minimise erosion and ponding, allowing for natural drainage to take place. If trees were removed, new trees shall be planted, as directed by the Engineer. The cost of planting new trees shall be deemed to be incidental to the work.

4.3.3 Methods, tools and equipment: Only such methods, tools and equipment as approved by the Engineer shall be adopted / used in the work. If so desired by the Engineer, the Contractor shall demonstrate the efficacy of the type of equipment to be used before the commencement of work.

4.3.4 Marsh excavation (if encountered): The excavation of soils from marshes/ swamps shall be carried out as per the programme approved by the Engineer.

Excavation of marshes shall begin at one end and proceed in one direction across the entire marsh immediately ahead of backfilling. The method and sequence of excavating and backfilling shall be such as to ensure, to the extent practicable, the complete removal or displacement of all muck from within the lateral limits called for on the drawings or as staked by the Engineer, and to the bottom of the marsh, firm support or levels indicated.

4.3.5 Excavation for surface/sub-surface drains: Where the Contract provides for construction of surface/sub-surface drains, excavation for these shall be carried out in proper sequence with other works as approved by the Engineer.

4.3.6 Slides: If slips, slides, over-breaks or subsidence occur in cuttings during the process of construction, they shall be removed at the cost of the Contractor as ordered by the Engineer. Adequate precautions shall be taken to ensure that during construction, the slopes are not rendered unstable or give rise to recurrent slides after construction. If finished slopes slide into the roadway subsequently, such slides shall be removed and paid for at the Contract rate for the class of excavation involved, provided the slides are not due to any negligence on the part of the Contractor. The classification of the debris material from the slips, slides etc. shall conform to its condition at the time of removal and payment made accordingly regardless of its condition earlier.

4.3.7 Dewatering: If water is met with in the excavations due to springs, seepage, rain or other causes, it shall be removed by suitable diversions, pumping or bailing out and

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the excavation kept dry whenever so required or directed by the Engineer. Care shall be taken to discharge the drained water into suitable outlets as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore to the original condition at his own cost or compensate for the damage.

4.3.8 Disposal of excavated materials: All the excavated materials shall be the property of the Employer. The material obtained from the excavation of roadway, shoulders, verges, drains, cross-drainage works etc., shall be used for filling up of (i) roadway embankment, (ii) the existing pits in the right-of-way and (iii) for landscaping of the road as directed by the Engineer, including leveling and spreading with all lifts and lead up to 3000 m and no extra payment shall be made for the same.

Unsuitable and surplus material not intended for use within the lead specified above shall also, if necessary, be transported with all lifts and lead beyond initial 3000 m, disposed of or used as directed by the Engineer.

4.4 Plying of Construction Traffic: Construction traffic shall not use the cut formation and finished sub-grade without the prior permission of the Engineer. Any damage arising out of such use shall be made good by the Contractor at his own expense.

4.5 Preparation of Cut Formation: The cut formation, which serves as a sub-grade, shall be prepared to receive the sub-base/base course as directed by the Engineer.

Where the material in the sub-grade (that is within 500 mm from the lowest level of the pavement) has a density less than specified in Table 6-2, the same shall be loosened to a depth of 500 mm and compacted in layers in accordance with the requirements of Clause 6.0.

Any unsuitable material encountered in the sub-grade level shall be removed as directed by the Engineer and replaced with suitable material compacted in accordance with Clause 6.0.

6.6 Finishing Operations

Finishing operations shall include the work of properly shaping and dressing all excavated surfaces.

When completed, no point on the slopes shall vary from the designated slopes by more than 150 mm measured at right angles to the slope, except where excavation is in rock (hard or soft) where no point shall vary more than 300 mm from the designated slope. In no case shall any portion of the slope encroach on the roadway.

The finished cut formation shall satisfy the surface tolerances described in Quality control of road works clause 900 of MoRTH specifications.

5.0 EMBANKMENT CONSTRUCTION

5.1 General

5.1.1 Description: These Specifications shall apply to the construction of embankments including sub-grades, earthen shoulders and miscellaneous backfills with approved material obtained from roadway and drain excavation, borrow pits or other sources. All embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be constructed in accordance with the requirements of these Specifications and in conformity with the lines, grades, and cross-sections shown on the drawings or as directed by the Engineer.

5.1.2 Materials and General Requirements

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51.3 Physical requirements:

5.1.4 The materials used in embankments, sub-grades, earthen shoulders and miscellaneous backfills shall be soil, moorum, gravel, a mixture of these or any other material approved by the Engineer. Such materials shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of the embankment/ sub-grade.

The following types of material shall be considered unsuitable for embankment:

(a) Materials from swamps, marshes and bogs;

(b) Peat, log, stump and perishable material; any soil that classifies as OL, OI, OH or Pt -in accordance with IS: 1498;

(c) Materials susceptible to spontaneous combustion;

(d) Materials in a frozen condition;

(e) Clay having liquid limit exceeding 70 and plasticity index exceeding 45; and

(f) Materials with salts resulting in leaching in the embankment.

5.1.5 Expansive clay exhibiting marked swell and shrinkage properties ("free swelling index" exceeding 50 per cent when tested as per IS: 2720 - Part 40) shall not be used as a fill material. Where expansive clay with acceptable "free swelling index" value is used as a fill material, sub-grade and top 500 mm portion of the embankment just below sub-grade shall be non-expansive in nature.

5.1.6 Any fill material with a soluble sulphate content exceeding 1.9 grams of sulphate (expressed as SO3) per litre when tested in accordance with BS: 1377 Test 10, but using a 2:1 water-soil ratio shall 'not be deposited within 500 mm or other distance described in the Contract, of concrete, cement bound materials or other cementitious materials forming part of the Permanent Works.

Materials with a total sulphate content (expressed as SO3) exceeding 0.5 per cent by mass, when tested in accordance with BS: 1377 Test 9 shall not be deposited within 500 mm, or other distances described in the Contract, of metallic items forming part of the Permanent Works.

5.1.7 The size of the coarse material in the mixture of earth shall ordinarily not exceed 75 mm when being placed in the embankment and 50 mm when placed in the sub-grade. However, the Engineer may at his discretion permit the use of material coarser than this also if he is satisfied that the same will not present any difficulty as regards the placement of fill material and its compaction to the requirements of these Specifications. The maximum particle, size shall not be more than two-thirds of the compacted layer thickness.

5.1.8 Ordinarily, only the materials satisfying the density requirements given in Table 6-1 shall be employed for the construction of the embankment and the sub-grade.

TABLE 6.1. DENSITY REQUIREMENTS OF EMBANKMENT AND SUB-GRADE MATERIALS

S.No.	Type of Work	Maximum laboratory dry unit weight when tested as per IS: 2720 (Part 8)
1.	Embankments up to 3 metres	Not less than 15.2 kN/cu.m.
	height, not subjected to	

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	extensive flooding.	
2.	Embankments exceeding 3 metres	Not less than 16.0 kN/cu. m.
	height or embankments of any height	
	subject to long periods of inundation	
3.	Sub-grade and earthen shoulders/ verges/ backfill	Not less than 17.5 kN/cu. m.

Notes: (1) This Table is not applicable for lightweight fill material e.g. cinder, fly ash etc.

(2) The Engineer may relax these requirements at his discretion taking into account the availability of materials for construction and other relevant factors.

(3) The material to be used in sub-grade should also satisfy design CBR at the dry unit weight applicable as per Table 6-2.

6.0 General requirements

6.1. The materials for embankment shall be obtained from approved sources with preference given to materials becoming available from nearby roadway excavation or any other excavation under the same Contract.

The work shall be so planned and executed that the best available materials are saved for the sub-grade and the embankment portion just below the sub-grade.

6.2. Borrow materials: Where the materials are to be obtained from designated borrow areas, the location, size and shape of these areas shall be as indicated by the Engineer and the same shall not be opened without his written permission. Where specific borrow areas are not designated by the Employer/the Engineer, arrangement for locating the source of supply of material for embankment and sub-grade as well as compliance to environmental requirements in respect of excavation and borrow areas as stipulated, from time to time by the Ministry of Environment and Forests, Government of India and the local bodies, as applicable, shall be the sole responsibility of the Contractor.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction plant is operating at the place of deposition.

No excavated acceptable material other than surplus to requirements of the Contract shall be removed from the site. Should the Contractor be permitted to remove acceptable material from the site to suit his operational procedure, then he shall make good any consequent deficit of material arising there from.

Where the excavation reveals a combination of acceptable and un-acceptable materials, the Contractor shall, unless otherwise agreed by the Engineer in charge , carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the permanent works without contamination by the unacceptable materials. The acceptable materials shall be stockpiled separately.

The Contractor shall obtain representative samples from each of the identified borrow areas and have these tested at the site laboratory following a testing programme approved by the Engineer. It shall be ensured that the sub-grade material when

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compacted to the density requirements as in Table 6-2 shall yield the design CBR value of the sub-grade.

TABLE 6-2. COMPACTION REQUIREMENTS FOR EMBANKMENT AND SUB-GRADE

Type of work/ material		Relative compaction as percentage of max. laboratory dry density as per IS: 2720 (Part 8)
1.	Sub-grade and earthen shoulders	Not less than 97
2.	Embankment	Not less than 95

The Contractor shall at least 7 working days before commencement of compaction submit the following to the Engineer for approval:

(i) The values of maximum dry density and optimum moisture content obtained in accordance with IS: 2720 (Part 7) or (Part 8), as the case may be, appropriate for each of the fill materials he intends to use.

(ii) A graph of density plotted against moisture content from which each of the values in (i) above of maximum dry density and optimum moisture content were determined.

(iii) The Dry density-moisture content -CBR relationships for light, intermediate and heavy compactive efforts (light corresponding to IS: 2720 (Part 7), heavy corresponding to IS: 2720 (Part 8) and intermediate in-between the two) for each of the fill materials he intends to use in the sub-grade.

Once the above information has been approved by the Engineer, it shall form the basis for compaction.

6.3 Construction Operation

6.3.1. Setting out: After the site has been cleared, the work shall be set out to Clause 5.3.1. The limits of embankment/sub-grade shall be marked by fixing batter pegs on both sides at regular intervals as guides before commencing the earthwork. The embankment/sub-grade shall be built sufficiently wider than the design dimension so that surplus material may be trimmed, ensuring that the remaining material is to the desired density and in position specified and conforms to the specified side slopes.

6.3.2 Dewatering: If the foundation of the embankment is in an area with stagnant water, and in the opinion of the Engineer it is feasible to remove it, the same shall be removed by bailing out or pumping, as directed by the Engineer and the area of the embankment foundation shall be kept dry. Care shall be taken to discharge the drained water so as not to cause damage to the works, crops or any other property. Due to any negligence on the part of the Contractor, if any such damage is caused, it shall be the sole responsibility of the Contractor to repair/restore it to original condition or compensate the damage at his own cost.

6.3.3 Compacting ground supporting embankment/sub-grade: Where necessary, the original ground shall be leveled to facilitate placement of first layer of embankment, scarified, mixed with water and then compacted by rolling so as to achieve minimum dry density as given in Table 6-2.

In case where me difference between the sub-grade level (top of the sub-grade on which pavement rests) and ground level is less than 0.5 m and the ground does not

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have 97 per cent relative compaction with respect to the dry density as given in Table 6-2, the ground shall be loosened up to a level 0.5 m below the sub-grade level, watered and compacted in layers in accordance with Clauses 6.3.4 and 6.3.5 to not less than 97 per cent of dry density as given in Table 6-2.

Where so directed by the Engineer, any unsuitable material occurring in the embankment foundation shall be removed and replaced by approved materials laid in layers to the required degree of compaction.

Embankment or sub-grade work shall not proceed until the foundations for embankment/sub-grade have been inspected by the Engineer for satisfactory condition and approved.

Any foundation treatment specified for embankments especially high embankments, resting on suspect foundations as revealed by borehole logs shall be carried out in a manner and to the depth as desired by the Engineer. Where the ground on which an embankment is to be built has any of the material types (a) to (f) in Clause 6.1.4 at least 500 mm of such material must be removed and replaced by acceptable fill material before embankment construction commences.

6.3.4 Spreading material in layers and bringing to appropriate moisture content

6.3.4.1 The embankment and sub-grade material shall be spread in layers of uniform thickness not exceeding 200 mm compacted thickness over the entire width of embankment by mechanical means, finished by a motor, grader and compacted as per Clause 6.3.5. The motor grader blade shall have hydraulic control suitable for initial adjustment and maintain the same so as to achieve the specific slope and grade. Successive layers shall not be placed until the layer under construction has been thoroughly compacted to the specified requirements as in Table 6-2 and got approved by the Engineer. Each compacted layer shall be finished parallel to the final cross-section of the embankment.

6.3.4.2 Moisture content of the material shall be checked at the site of placement prior to commencement of compaction; if found to be out of agreed limits, the same shall be made good. Where water is required to be added in such constructions, water shall be sprinkled from a water tanker fitted with sprinkler capable of applying water uniformly with a controllable rate of flow to variable widths of surface but without any flooding. The water shall be added uniformly and thoroughly mixed in soil by blading, discing or harrowing until a uniform moisture content is obtained throughout the depth of the layer.

If the material delivered to the roadbed is too wet, it shall be dried, by aeration and exposure to the sun, till the moisture content is acceptable for compaction. Should circumstances arise, where owing to wet weather, the moisture content cannot be reduced to the required amount by the above procedure, compaction work shall be suspended.

Moisture content of each layer of soil shall be checked in accordance with IS: 2720 (Part 2), and unless otherwise mentioned, shall be so adjusted, making due allowance for evaporation losses, that at the time of compaction it is in the range of 1 per cent above to 2 per cent below the optimum moisture content determined in accordance with IS: 2720 (Part 7) or IS: 2720 (Part 8) as the case may be. Expansive clays shall, however, be compacted at moisture content corresponding to the specified dry density, but on the wet side of the optimum moisture content obtained from the laboratory compaction curve.

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After adding the required amount of water, the soil shall be processed by means of graders, harrows, rotary mixers or as otherwise approved by the Engineer until the layer is uniformly wet.

Clods or hard lumps of earth shall be broken to have a maximum size of 75 mm when being placed in the embankment and a maximum size of 50 mm when being placed in the sub-grade.

6.3.4.3 Embankment and other areas of fill shall, unless otherwise required in the Contract or permitted by the Engineer, be constructed evenly over their full width and their fullest possible extent and the Contractor shall control and direct construction plant and other vehicular traffic uniformly over them. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Embankments and other areas of unsupported fills shall not be constructed with steeper side slopes, or to greater widths than those shown in the Contract, except to permit adequate compaction at the edges before trimming back, or to obtain the final profile following any settlement of the fill and the underlying material.

Whenever fill is to be deposited against the face of a natural slope, or sloping earthworks face including embankments, cuttings, other fills and excavations steeper than 1 vertical on 4 horizontal, such faces shall be benched immediately before placing the subsequent fill.

All permanent faces of side slopes of embankments and other areas of fill formed shall, subsequent to any trimming operations, be reworked and sealed to the satisfaction of the Engineer by tracking a tracked vehicle, considered suitable by the Engineer, on the slope or any other method approved by the Engineer.

6.3.5 Compaction

Only the compaction equipment approved by the Engineer shall be employed to compact the different material types encountered during construction. Smooth wheeled, vibratory, pneumatic tyred rollers, etc. of suitable size and capacity as approved by the Engineer shall be used for the different types and grades of materials required to be compacted either individually or in suitable combinations.

The compaction shall be done with the help of vibratory roller of 80 to 100 kN static weight with plain or pad foot drum or heavy pneumatic tyred roller of adequate capacity capable of achieving required compaction.

The Contractor shall demonstrate the efficacy of the equipment he intends to use by carrying out compaction trials. The procedure to be adopted for these site trials shall first be submitted to the Engineer for approval.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant be taken into account.

Each layer of the material shall be thoroughly compacted to the densities specified in Table 6-2. Subsequent layers shall be placed only after the finished layer has been tested according to Section 900 of Quality Control of Road Works of MoRTH specifications and accepted by the Engineer. The Engineer may permit measurement of field dry density by a nuclear moisture/density gauge used in accordance with agreed procedure and the gauge is calibrated to provide results identical to that obtained from tests in accordance with IS: 2720 (Part 28). A record of the same shall be maintained by the Contractor.

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When density measurements reveal any soft areas in the embankment /sub-grade/ earthen shoulders, further compaction shall be carried out as directed by the Engineer. If in spite of that the specified compaction is not achieved, the material in the soft areas shall be removed and replaced by approved material, compacted to the density requirements and satisfaction of the Engineer.

6.3.6 Drainage

The surface of the embankment/sub-grade at all times during construction shall be maintained at such a cross fall (not flatter than that required for effective drainage of an earthen surface) as will shed water and prevent ponding.

6.3.7 Repairing of damages caused by rain/spillage of water

The soil in the affected portion shall be removed in such areas as directed by the Engineer before next layer is laid and refilled in layers and compacted using appropriate mechanical means such as small vibratory roller, plate compactor or power rammer to achieve the required density . If the cut is not sufficiently wide for use of required mechanical means for compaction. the same shall be widened suitably to permit their use for proper compaction. Tests shall be carried out as directed by the Engineer to ascertain the density requirements of the repaired area. The work of repairing the damages including widening of the cut, if any, shall be carried out by the Contractor at his own cost, including the arranging of machinery/equipment for the purpose.

6.3.8 Finishing operations

Finishing operations shall include the work of shaping and dressing the shoulders/verge/roadbed and side slopes to conform to the alignment, levels, cross-sections and dimensions shown on the drawings or as directed by the Engineer subject to the surface tolerance as per Quality Control of Roadworks Section 900 of MoRTH Specifications. Both the upper and lower ends of the side slopes shall be rounded off to improve appearance and to merge the embankment with the adjacent terrain.

When earthwork operations have been substantially completed, the road area shall be cleared of all debris, and ugly scars in the construction area responsible for objectionable appearance eliminated.

6.4 Construction of Embankment and Sub-grade under Special Condition

6.4.1 Construction of embankment over ground incapable of supporting construction equipment

Where embankment is to be constructed across ground which will not support the weight of repeated heavy loads of construction equipment, the first layer of the fill may be constructed by placing successive loads of material in a uniformly distributed layer of a minimum thickness required to support the construction equipment as permitted by the Engineer. The Contractor, if so desired by him, may also use suitable geo-synthetic material to increase the bearing capacity of the foundation. This exception to normal procedure will not be permitted where, in the opinion of the Engineer, the embankments could be constructed in the approved manner over such ground by the use-of lighter or modified equipment after proper ditching and drainage have been provided. Where this exception is permitted, the selection of the material and the construction procedure to obtain an acceptable layer shall be the responsibility of the Contractor. The cost of providing suitable traffic conditions for construction equipment over any area of the Contract will be the responsibility of the

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Contractor and no extra payment will be made to him. The remainder of the embankment shall be constructed as specified in Clause 6.3.

6.4.2 Embankment construction under water

Where filling or backfilling is to be placed under water, only acceptable granular material or rock shall be used unless otherwise approved by the Engineer. Acceptable granular material shall consist of graded, hard durable particles with maximum particle size not exceeding 75 mm. The material should be non-plastic having uniformity coefficient of not less than 10. The material placed in open water shall be deposited by end tipping without compaction.

6.5 Surface Finish and Quality Control of Work

The surface finish of construction of sub-grade shall conform to the requirements of Clause 902 of as per Quality Control of Road works Section 900 of MoRTH specifications. Control on the quality of materials and works shall be exercised in accordance with Clause 903.of the same.

6.6 Sub-grade Strength

6.6.1 It shall be ensured prior to actual execution that the borrow area material to be used in the sub-grade satisfies the requirements of design CBR.

6.6.2 Sub-grade shall be compacted and finished to the design strength consistent with other physical requirements. The actual laboratory CBR values of constructed sub-grade shall be determined on undisturbed samples cut out from the compacted sub-grade in CBR mould fitted with cutting shoe or on re-moulded samples, compacted to the field density at the field moisture content.

7.0 SURFACE/SUB-SURFACE DRAINS

7.1 Scope

This work shall consist of constructing surface and/or sub-surface drains in accordance with the requirements of these Specifications and to the lines, grades, dimensions and other particulars shown on the drawings or as directed by the Engineer.

Schedule of work shall be so arranged that the drains are completed in proper sequence with road works to ensure that no excavation of the completed road works is necessary subsequently or any damage is caused to these works due to lack of drainage.

7.2 Surface Drains

Surface drains shall be excavated to the specified lines, grades, levels and dimensions to the requirements of Clause 5. The excavated material shall be removed from the area adjoining the drains and if found suitable, utilised in embankment/sub-grade construction. All unsuitable material shall be disposed of as directed.

The excavated bed and sides of the drains shall be dressed to bring these in close conformity with the specified dimensions, levels and slopes.

Where so indicated, drains shall be lined or turfed with suitable materials in accordance with details shown on the drawings.

All works on drain construction shall be planned and executed in proper sequence with other works as approved by the Engineer, with a view to ensuring adequate drainage for the area and minimising erosion/ sedimentation.

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8.0 PREPARATION AND SURFACE TREATMENT OF FORMATION

Preparation and surface treatment of the formation, that is top of the sub-grade, shall be carried out only after completion of any specified sub-grade drainage and unless otherwise agreed by the Engineer, immediately prior to laying the sub-base or the road base where no sub-base is required. The sequence of operations shall be as follows:

(a) All surfaces below carriageway, lay-byes, footways and hard shoulders shall, after reinstatement of any soft areas to the required Specifications be well cleaned and freed of mud and slurry.

(b) The surface shall be compacted by 4 passes of a smooth wheeled roller of 80 to 100 kN weight after spraying requisite amount of water, if required, before the commencement of rolling.

(c) The formation shall, wherever necessary, be regulated and trimmed to the requirements of Clause 6.3.8 with motor grader.

(d) The trimmed formation shall be rolled by one pass of smooth wheeled roller of 80 to 100 kN weight after spraying requisite amount of water, if required, before the commencement of rolling.

Where the completed formation is not immediately covered with sub-base or road base material, its moisture content shall be maintained to prevent cracking in the formation by suitable measures as approved by the Engineer. The entire work of surface treatment of formation shall be deemed as incidental to the work of sub-base/base course to be provided on the sub-grade and as such no extra payment shall be made for the same.

9.0 WORKS TO BE KEPT FREE OF WATER

9.1 The Contractor shall arrange for the rapid dispersal of water collected/accumulated on the earthwork or completed formation during construction or on the existing roadway or which enters the earthwork or any other item of work from any source, and where practicable, the water shall be discharged into the permanent outfall of the drainage system. The arrangements shall be made in respect of all earth work including excavation for pipe trenches, foundations or cuttings.

9.2. The Contractor shall provide, where, necessary, temporary water courses, ditches, drains, pumping or other means for maintaining the earthwork free from water. Such provisions shall include carrying out the work of forming the cut sections and embankments in such manner that their surfaces have at all times a sufficient minimum cross fall and, where practicable, a sufficient longitudinal gradient to enable them to shed water and prevent ponding.

The works involved in keeping the earthwork or any other item of works free of water shall be deemed as incidental to the respective item of work and as such no separate payment shall be made for the same.

10.0 GRANULAR SUB-BASE

10.1 Scope

This work shall consist of laying and compacting well-graded material on prepared sub-grade in accordance with the requirements of these Specifications. The material shall be laid in one or more layers as sub-base or lower sub-base and upper sub-base (termed as sub-base hereinafter) as necessary according to lines, grades and cross-sections shown on the drawings or as directed by the Engineer.

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10.2 Materials

10.2.1 The material to be used for the work shall be natural sand, moorum, gravel, crushed stone, or combination thereof depending upon the grading required. Materials like crushed slag, crushed concrete, brick metal and kankar may be allowed only with the specific approval of the Engineer.

The material shall be free from organic or other deleterious constituents and conform to one of the three gradings given in Table 10-1.

While the gradings in Table 10-1 are in respect of close-graded granular sub-base materials, one each for maximum particle size of 75 mm, 53 mm and 26.5 mm, the corresponding gradings for the coarse-graded materials for each of the three maximum particle sizes are given at Table 10-2.

The grading to be adopted for a project shall be as specified in the Contract.

10.2.2 Physical requirements

The material shall have a 10 per cent fines value of 50 kN or more (for sample in soaked condition) when tested in compliance with BS:812 (Pan 111). The water absorption value of the coarse aggregate shall be determined as per IS : 2386 (Pan 3); if this value is greater than 2 per cent, the soundness test shall be carried out on the material delivered to site as per IS : 3.83. For Grading II and III materials, the CBR shall be determined at the density and moisture content likely to be developed in equilibrium conditions which shall be taken as being the density relating to a uniform air voids content of 5 per cent.

TABLE 10-1. GRADING FOR CLOSE-GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	–	–
53.0 mm	80–100	100	–
26.5 mm	55–90	70–100	100
9.50 mm	35–65	50–80	65–95
4.75 mm	25–55	40–65	50–80
2.36 mm	20–40	30–50	40–65
0.425 mm	10–25	15–25	20–35
0.075 mm	3–10	3–10	3–10
CBR Value (Minimum)	30	25	20

TABLE 10.2. GRADING FOR COARSE GRADED GRANULAR SUB-BASE MATERIALS

IS Sieve Designation	Per cent by weight passing the IS sieve		
	Grading I	Grading II	Grading III
75.0 mm	100	–	–

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53.0 mm		100	
26.5 mm	55–90	50–80	100
9.50 mm			
4.75 mm	10–30	15–35	25–45
2.36 mm			
0.425 mm			
0.075 mm	< 10	< 10	< 10
CBR Value (Minimum)	30	25	20

Note : The material passing 425 micron (0.425 mm) sieve for all the three gradings when tested according to IS : 2720 (Pan 5) shall have liquid limit and plasticity index not more than 25 and 6 per cent respectively.

10.3 Strength of sub-base

It shall be ensured prior to actual execution that the material to be used in the sub-base satisfies the requirements of CBR and other physical requirements when compacted and finished.

When directed by the Engineer, this shall be verified by performing CBR tests in the laboratory as required on specimens remoulded at field dry density and moisture content and any other tests for the "quality" of materials, as may be necessary.

10.4 Construction Operations

10.4.1 Preparation of sub-grade : Immediately prior to the laying of sub-base, the sub-grade already finished to Clause 5 or 6 as applicable shall be prepared by removing all vegetation and other extraneous matter, lightly sprinkled with water if necessary and rolled with two passes of 80 -100 KN smooth wheeled roller.

10.4.2. Spreading and compacting: The sub-base material of grading specified in the Contract shall be spread on the prepared sub-grade with the help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer.

When the sub-base material consists of combination of materials mentioned in Clause 10.2.1, mixing shall be done mechanically by the mix-in-place method.

Manual mixing shall be permitted only where the width of laying is not adequate for mechanical operations, as in small-sized jobs. The equipment used for mix-in-place construction shall be a rotavator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer, trial runs with the equipment shall be carried out to establish its suitability for the work.

Moisture content of the loose material shall be checked in accordance with IS:2720 (Part 2) and suitably adjusted by sprinkling additional water from a truck mounted or trailer mounted water tank and suitable for applying water uniformly and at controlled quantities to variable widths of surface or other means approved by the Engineer so that, at the time of compaction, it is from 1 per cent above to 2 per cent below the optimum moisture content corresponding to IS:2720 (Part 8). While adding water, due allowance shall be made for evaporation losses. After water has been added, the

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material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately thereafter, rolling shall start. If the thickness of the compacted layer does not exceed 100 mm, a smooth wheeled roller of 80 to 100 KN weight may be used. For a compacted single layer upto 225 mm the compaction shall be done with the help of a vibratory roller of minimum 80 to 100 kN static weight with plain drum or pad foot-drum or heavy pneumatic tyred roller of minimum 200 to 300 kN weight having a minimum tyre pressure of 0.7 MN/m2 or equivalent capacity roller capable of achieving the required compaction. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional cross fall and super-elevation and shall commence at the edges and progress towards the centre for portions having cross fall on both sides.

Each pass of the roller shall uniformly overlap not less than one-third of the track made in the preceding pass. During rolling, the grade and cross fall (camber) shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material determined as per IS:2720 (Part 8). The surface of any layer of material on completion of compaction shall be well closed, free from movement under compaction equipment and from compaction planes, ridges, cracks or loose material. All loose, segregated or otherwise defective areas shall be made good to the full thickness of layer and re-compacted.

10.4.3 Surface Finish and Quality Control of Work

The surface finish of construction shall conform to the requirements of Clause 902 of Quality Control of Road works Section 900 of MoRTH Specfications.

Control on the quality of materials and works shall be exercised by the Engineer in accordance with Section 900 of MoRTH specifications.

10.4.4 Arrangements for Traffic

During the period of construction, no traffic shall be allowed over the area.

10.5 Materials

Cement concrete: The cement concrete shall generally conform to specifications for ordinary concrete. The coarse aggregates shall be carefully selected, sufficiently tough and hard stone pieces broken in a manner that will provide particles of approximately cubical shape affording good interlocking. The maximum size of coarse aggregate shall be 12 mm. The fine aggregate shall consist of properly graded particles. The proportion of mix shall not be of the grade below M20 {1: 1.5: 3 (1 cement: 1.5 coarse sand: 3 stone aggregate)}. The least amount of mixing water that will produce a workable mix and will allow finishing without excessive trowelling shall be used. Generally a water cement ratio of 0.5 should suffice.

10.6 Workmanship

The sub-grade in all cases shall be formed to proper levels and slopes, well compacted and cured. The top surface shall be kept slightly rough.

The surface of the sub-grade shall be cleaned off all loose materials and moistened immediately before laying the concrete floor. The concrete paving shall be laid in

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alternate bays not exceeding 6.25 sq.m (about 64 sf.ft) each. At least 48 hours shall elapse before the concreting in the adjacent bays is commenced.

The concrete shall be laid immediately after mixing. While being placed the concrete shall be vigorously sliced and spaded with suitable tools to prevent formation of voids or honey comb pockets. The concrete shall be brought to the specified levels by means of a heavy straight edge resting on the side forms and drawn ahead with a sawing motion in combination with a series of lifts and drops alternating with small lateral shifts. While concreting the adjacent bays care shall be taken to ensure that the edges of previously laid bays are not broken by careless or hard tamping.

10.7 Screeding

After poring concrete in place, it shall be compacted, in wet condition, by screed vibrator run over the steel channel shuttering pressing concrete surface matched with the top of steel channel shuttering spaced not more than 4.0 meters apart. Poker vibrators will be used to vibrate the laid concrete thoroughly with minimum 40 mm dia needles. On completion of laying of approximate 2m to 2.5m length the surface vibrator then be run over the concrete surface to achieve better overall compaction of concrete. Water cement ratio shall be just sufficient to make concrete workable. Screed shall be run at least twice to achieve well compacted & level surface.

Undulations on the concrete surface shall be rectified immediately by local patching, in wet state of concrete.

After striking off the surfaces to the required grade concrete shall be compacted with a wooden float. The blows shall be fairly heavy in the beginning but as consolidation takes place, light rapid strokes shall be given to complete the ramming.

No dry cement or mixture of dry cement and sand shall be sprinkled directly on the surface of the concrete to absorb moisture or to stiffen the mix.

After the concrete in the bays has set, the joints of the panels shall be filled with cement cream or with suitable bitumastic compound as shown on the drawings or directed by the Engineer-in-Charge.

Vertical edge of the bays shall be neatly marked on the surface of the concrete with a pointed trowel after filling the joints.

Brooming: When concrete is in final stage of plastic state, the pavement shall be given broom finish with approved steel / fibre broom. The broom shall be pulled gently over the pavement surface from edge to edge (perpendicular to centre line of the road). Brooming shall be completed before concrete passes plastic state.

Curing: Curing shall start on the next day after finishing and shall be continued for 14 days.

Curing shall not be commenced until the top layer has hardened. Covering with empty gunnies shall be avoided as the colour of the flooring is likely to be bleached due to the remanents of cement dust from the bags.

LANDSCAPING ENGINEERING

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1.0 SCOPE

1.1 General Scope of Work

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The scope of work of this package is shown on the drawings, tech. Specifications, the Planting Schedule (given at the end of this specification section) and any other instructions defined in this document.

The scope of work comprises but is not limited to the following;

Supply all of plants associated with landscape, water feature and related mechanical works, special lighting, other related structures.

1.2 Detailed Scope of Work

1.2.1 Construction

1.2.1.1 Planting for landscape, backfilling and leveling, refilling

2.0 SUBMISSIONS:

(To be provided by Contractor)

- Construction method statement
- Shop drawings
- Site organization chart
- Detail work schedule
- Site progress schedule report
- Site safety organization chart
- Site photos
- Construction records. QA/AC records
- Purchase orders, delivery orders
- As built drawings and documentation
- One CD containing soft copies of all the drawings produced

3.0 TECHNICAL SPECIFICATIONS

3.1 Garden Works

3.1.1 Scope of Work

This section includes execution of landscape (softscape) work as per the design drawings and the planting schedule included herein. It includes all labors, materials, tools, power supply, transportation, handle, follow-up care, direct or indirect works (supplementary or replacement included) indicated on the Contract drawings, which are necessary to complete all the newly planted avenue trees in all the streets ,shrubs, ground covers, accent plants(specimen plants) at the entrance ,four rain gardens behind administration buildings, shrub plantations & tree plantations at traffic island / medians ,flower beds at guard house.(.All the associated expense has been covered in the unit price of the Contract.

3.2 Planting Materials

3.2.1 Select Young Trees in Nursery Garden

3.2.1 The Contractor shall submit in writing to client the supply sources on plants and visit the nursery garden for selection young trees together with client.. If plants are not grown by the planter himself, the Contractor shall visit the original planting region in company with client for selection as the case may be. The plantings in jobsite neighborhood or in conservation zone, defined by the legislation in force, cannot be

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taken as the supply sources for this project. The Contractor shall submit the planting inspection record to client for approval and proceed after permission is given.

3.2.2 Inspection shall be performed on species, specification and quality. It shall be deemed as unqualified if any case is found like: wrong species, not in accordance with specification, improper visual proportion, partly withered, over weak, poor growth in the crowded garden, lots of pruning to be applied to suit the specification, root seriously damaged resulted from small root ball.

3.2.3 The arbor of trunk diameter of 5cm above (5cm included) shall be selected individually. Labels shall be lead-sealed and hung on the plant for showing the approval by the Owner. Standard plants shall be selected for those arbors (diameter below 5cm) and shrubs, and photos shall be taken as the inspection standard for planting.

3.2.4 Trees for replanting shall be inspected by client in accordance with the above-mentioned regulations.

3.2.5 The Contractor shall protect well the qualified plantings after inspection. No planting of the trees failed in inspection even if with an approved label.

3.3 Precaution for planting inspection

3.3.1 Ten trees for each kind of trees shall be ready for inspection and selection as the standard trees to be followed.

3.3.2 The plantings to be selected as the standard trees shall be in good shape and healthy conditions besides complying with the diameters and ranges specified in the Contract. The following specifications are to be satisfied or exceeded:

3.3.2.1 Arbor

1.
2. Openness / Spread
3. — min. 3 limbs with branching height above ½ of its whole height
4. — upright trunk
5. — minor pruning
6. — no plant disease and insects, no wound
7.
8. Cutting Layer
9. — upright trunk without any limb
10. — no broken sprout on the growing points
11. — over high or excessive growth (like: weak and spindling branches)
12. Erection:
13. — upright trunk
14. — clear cutting layer
15. — no excessive growth or branching
16. — no broken sprout
17. Erect tower-shape trees, such as Cypress Trees
18. — upright trunk
19. — no air or sunlight perpetration
20. — no over spread or excessive growth of branches
21. — no broken sprout
22.

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3.3.2.2 Shrubs

23.

24. – min. 3 limbs, varies depending on species (different growing forms)
25. – upright trunk in healthy condition
26. – minor pruning
27. – limbs not on one supporting point
28. – no plant disease and insects, no wounds
29.
30. To select plantings depending on their purpose:
31.
32. – For show: 3-5 branches at lower position
33. – For others: 3-5 branches may at higher position

34.

35. Ground covers and flowering plants
36. – healthy, no disease and insects
37. – branching varies depending on species, general 5 branches
38. – dense and rich branches and leaves, no spread or excessive growth resulted from lacking of growing sunlight. Ground cover suit to geographic region and characteristics.
39. – shade tolerance
40. – drought-enduring
41. – sufficient sunlight
42. – growth speed
43. – growth mode

44.

45. Flowers
46. – avoid over flourishing
47. – aging
48. – protruding
49. – weak
50.

3.3.2.3 Palms: classified as erect and fascicled

51.

52. – upright
53. – trunk
54. – bare trunk
55. – no diseases and insects, healthy

56.

3.3.3 Preparation for plantings to be selected:

57. · Pruning
58. · Cut the burlap away from the root (soil balled for bare rooted plants)
59. · natural growing, upright trunk, healthy
60. · after root cut, heel in pot to prevent any seasonal effect and increase the survive percentage
61. · good tree & crown shapes, no excessive growth (over-high or imbalance)
62.

3.3.4 The Contractor shall provide the statement on plant sources, certificate for selected nursery garden and agreement to supply trees.

3.4 Inspection for Planting Construction

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3.4.1 All the planting shall grow vigorously in good shape without diseases or insects (sterilization may be applied before transplanting to site if necessary). When the area of base of planting changes or roots needed to be cut, dig out the healthy and strong roots together with perennial soil ball, well wrapped, no falling over or departed during landscaping. Soil ball size to drawings.

3.4.2 During transplanting, well protection shall be carried out for roots, leaves and barks to avoid any damage or exposed directly under strong sunlight.

3.4.3 All the activities shall be finished within 2 days from digging plantings in the garden to the final transplantation.

3.5 Variety, Specification and Quality for Plants

3.5.1 Unless otherwise stated, the plant specified as one number shall be of the same species, variety, specification and color and high quality.

3.5.2 Species ranks the plants with same term both on genus and type in botanical terminology, while Variety groups the plants with same terms on genus, type or breed in botany. At the mean time, there may be many different cultivars for one Species. Same variety shall be applied in case the variety is specified. If not, plantings from species shall be selected.

3.5.3 Planting with same specification shall be of same tree height, crown width, crown thickness, trunk diameter, root ball, leaves density and so on. Dimensions shall only be taken after the pruning all the excessive branches and leaves.

63. · Tree Height (H): the height from treetop to ground
64. · Crown Width (W): average diameter of tree crowns in horizontal level
65. · Crown Thickness (T): tree crown thickness
66. · Diameter (ϕ): the average diameter of tree trunks 1m above the ground
67. · Ball root (Br): soil ball around the root before the specified transplanting. The average diameter shall be taken as reference.
68. · Density branch (1): nos for plant branches or density for leaves

69.

70. For plant group of same specification, follow the difference indicated, otherwise the height difference between the highest and lowest plants shall not be exceeds 10% of the standard one. The width of branches and leaves shall be controlled neither smaller than the specification (its difference shall be within 5%) nor bigger than the specified standard. All the above-mentioned width and height shall only measure after plant pruning.

71.

3.5.4 High-quality plantings are free of:

72. · Serious diseases or insects, broken or twisted branches, fertilizer or medical hazards, aging, wound barks.
73. · Dry root, withered leaves and spouts resulted from long time laying after digging out
74. · Small ball root, broken or deflected
75. · Big tree in signal trunk (unless otherwise stated) with bent trunk, sparse tree crown, deflected or abnormal growth
76. Too less branches for shrubs or herbs, not flourishing branches or leaves
77. No turf grassroots, no original soil or its thickness is less than 2cm, fall apart

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or scattered, mixed with weeds

78.

3.6 Alternatives

79. Alternatives can be applied after the written approval by the Owner if the Contractor has difficulty to supply the plants in accordance with the specifications, which may be from same Species with small sizes or other Species with same characteristics and sizes. Price shall be deducted after discussion for the plants from same species but in small size. No additional costs to be claimed by the Contractor for that from different species.

80.

81. The Contractor shall apply, at no additional cost, alternative plants in big size from the same or different species after the permission of client.

82.

3.7 Flowering beds

83. The plotting area has been indicated on the drawings. The Contractor shall submit his planting proposal regarding construction and follow-up care to client after the Contract is awarded, showing clearly the species and planting arrangement for each area. During follow-up care other than the construction period, transplantation shall be carried out at least twice to ensure there are grass flowers in bloom at one place all the time. The plantings shall cover the whole planting areas. The Contractor shall perform the activities as soon as his proposal is confirmed. No changes or additional cost, unless otherwise approved by client

84.

3.8 Rain gardens

85. The plotting area has been indicated on the drawings. The Contractor shall submit his planting proposal regarding construction and follow-up care to client after the Contract is awarded, showing clearly the species and planting arrangement for each area. During follow-up care other than the construction period.

86.

87. The plantings shall cover the whole planting areas. The Contractor shall perform the activities as soon as his proposal is confirmed. No changes or additional cost, unless otherwise approved by client.

88.

4.0 SOIL, FERTILIZER, PESTICIDE, PROTECTION AND OTHERS

4.1 Soil

4.1.1 The items of "backfilling of the imported soil" specified in the drawings, if not stated otherwise, refer to the soil imported from the farmland outside the Site. The soil shall be neutral black loamy soil, or the rich soil of three quarters' loamy soil and one quarter's organic fertilizer. The imported soil can only be excavated and filled with the permission from client soil test and analysis shall be made, if necessary, at the expense of Contractor.

The backfilling soil specified in the drawing cannot contain stone, concrete, brick or other foreign matters to the detriment of root growth.

4.1.2 Judgment of Imported soil

89 4.1.2.1 Difference in color

90

91 Color: yellow< grey< brown< dark brown<black brown

92 Quality: poor-excellent

93. Ordinary soil + compost (vegetation type)

94.

95. 4.1.2.2 Soil holding quality (squeezes the soil into a ball with water, flick it to see if it holds together).

96. The Judgment can be made on:

- no crack (clay, poorly drained)
- 3-5 pieces (good)
- crisp (sand, no water contained)

97.

4.2 Fertilizer

4.2.1 The type of fertilizer, applying frequency and time shall be in accordance with the drawings. If not specified in drawings or for any other reasons that Contractor needs to change the type, applying frequency and time, the change can only be made with the permission of client.

4.2.2 "Base fertilizer" is the organic fertilizer applied in the soil during planting. The organic fertilizer shall be compost, animal manure, or organic garbage compost certified by research institute.

4.2.3 "Amendment" is the fertilizer applied after the planting to promote the growth and blooming of the plants. Its type shall depend on the plants and its growth. For example, the flowering bud needs to be applied with the phosphate fertilizer, the leave sprout needs to be applied with the nitrate fertilizer.

4.3 Pesticide

During the period of construction and maintenance the pest or weed, if found, shall be removed immediately. The types and amount of pesticide or herbicide will be at the Contractor's decision. For any injury to plants, animals, or human beings caused by the wrong operation the Contractor shall be liable.

4.4 Protection measures

Protection shall be made against the destruction from animal and human and bad weather.

4.4.1 Rail shall be erected against the damage by animal and humans.

4.4.2 Firm staking or supporting rope shall be erected according to design drawing to support the seedlings. Staking shall depend on the size of young trees and the local wind. The staking shall be antiseptic treated timber made of fir, cassia tree or other timbers that are approved by client and be 5-10cm in diameter. The staking or rope can support the plant with proper size. At the contact point with the plant the timber shall be applied with soft material to avoid any injury to the trees. The appearance of staking shall be clean and proper, and can be painted black or dark green for a better appearance.

4.4.3 Straw or other measures shall be used to wrap trunk to protect against harsh weather.

4.4.4 Once the perennial soil ball is digged, burlap, rope or other packing material shall be used to wrap the ball in case the root ball will fall apart in transportation, disturbance, and transplantation. Root cutting shall be done with sharp saw. In transportation of big tree its bark and leaves cannot be injured.

4.4.5 All the protection expense is deemed to be included in the unit rates, the Contractor cannot charge for any extra expenses.

4.5 Watering

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Water in the works shall be at the Contractor's decision on its sources, quality, and watering time. The water, however, cannot be the industrial wastewater, sewage water containing poisonous substances. The responsibilities of any harm to plants for the wrong operation shall be borne by the Contractor.

4.6 Others

Any application of the chemicals like evaporation inhibitor, soil chemicals by Contractor shall be permitted by client and the Contractor shall be responsible for the result.

5.0 PLANTING

Unless otherwise stated, the planting schedule shall be followed as: arbor, shrub, rain garden, ground covers, flowers..

5.1 Planting of arbor, shrub, and Rain garden

5.1.1 Application of planting hole and base fertilizer

98. · As per design drawing, mark the planting location at site, dig the hole after inspection by client..

99.

100. · In accordance with the drawing specification the size of hole, unless otherwise specified, shall be two times than the root ball diameter. The depth shall be the number of root diameter plus 30cm.

101. · The debris, concrete block or any other foreign matters that will prevent the root growth shall be removed from the Site.

102.

103. · For the filling work of imported soil as specified in the design drawings, the earth excavated from the hole shall be leveled if it is little amount, or removed from the Site if it is large amount for the purpose of a better drainage of the area.

104.

105. · Lay compost or other appropriate mixture of organic fertilizer and soil at the bottom of the digged hole. The applied amount refers to the design drawings. If not specified, the proportion of organic fertilizer and soil shall be 1:4.

106.

5.1.2 Transplantation

107. · Root Cutting shall be more than 2 months.

108.

109. · Bare-root is forbidden. Root ball shall be big (diameter shall be specified).

110.

111. · Over-pruning is forbidden (pruning method will depend on the trees species)

112.

113. · Black cotton mesh or canvas shall be used to wrap the ball in transportation to avoid water evaporation.

114.

115. · Prune the injured twig after delivery at site. Planting shall be done in 24 hours. If not, watering shall be followed to protect the plant, but cannot exceed 48 hours.

116. · Locate the transplantation place. Cotton or straw rope shall be used to wrap the trunk at the fixed staking for protection.

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117.
118. · Regular watering to trees, trunk, leaves.
119.
120. · Before planting into the holes, the wrapping shall be removed if the wrapping cannot resolve into soil like straw rope, etc.
121.
122. · After the planting into the holes, the wrapping or rope shall be removed 1/3 at the top.
123.
124. · Soil backfill shall be imported soil or the excavated soil and to be packed for the support of trees.
125.
126. · Soil backfill mould can be 2cm above the ground. The edge of the hole shall be compacted with the neighboring soil. The surface of planting hole shall be a saucer shape to retain water.
127.

5.1.3 Staking

128. After the planting the staking or protection measures shall be made to support the plant.
129.

5.1.4 Pruning

130. After the proper planting the Contractor shall prune the plant to reduce the water evaporation. At the expiry of maintenance period the plant shall comply with the requirement in specification.
131.

5.1.5 Watering and fertilizing

132. Water the plants after planting. The Contractor shall be responsible for applying the "amendment" in the 90th day and the 150th day after the maintenance period. The fertilizer resolved in water shall be applied to the plant by watering. But attention shall be paid not to injure the plant.
133.

5.2 Ground covers and flowers

5.2.1 Ground Leveling

134. 5.2.1.1As per design drawings, delineate the plot to be planted with ground covers and flowers. The planting work can be started after inspection by client.
135.
136. 5.2.1.2Loosen the surface soil to 15cm depth of the ground, remove the debris, concrete, grass root, and other substances that will prevent the plant growth. Besides, keep the ground surface sloped to drain the water.

5.2.1.3Application of "Base fertilizer"

137. Apply the mixture of 10cm thickness of compost and soil with the proportion of 1:4.
138.

5.2.2 Planting

139. Plant the ground covers and grass flowers as per the Specification, but the spacing of plants can be negotiated with client. Without the permission of client and the quantity of the plants cannot be reduced.

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5.2.3 Watering and fertilizing

140. Watering shall be done immediately after the planting. "Amendment" shall be applied on the 7th day after the planting, the beginning day and the 90th and 150th day of the maintenance period. The application amount shall be 0.02kg for every square meter. The fertilizer resolved in water can be applied in watering.

141. In the grass planting area, add 10cm thick mix soil with the proportion of organic fertilizer and imported soil as 1:4.

142.

5.3 Rain gardens

5.3.1 Planting method

Excavating & Loosen the surface soil to 0.4M - 0.5M depth of the ground, remove the debris, concrete, grass root, and other substances that will prevent the plant growth spacing, location and other details are mentioned in the drawings.

5.3.2 The primary media in each pond consists of dug up in situ soil horizon of about 0.4m depth.

5.3.3 The dug up soil from the each circular or oval pond can be used for landscaping the rain garden provided the soil should be fertile if not garden soil with soil amendments should be used.

5.3.4 Application of "Base fertilizer" Apply the mixture of 10cm thickness of compost and soil with the proportion of 1:4.

6.0 Planting

143. Plant the WATER TOLERANT plants as per the Specification, but the spacing of plants can be negotiated with client. Without the permission of client and the quantity of the plants cannot be reduced.

144.

6.1 Watering and fertilizing

145. Watering shall be done immediately after the planting. "Amendment" shall be applied on the 7th day after the planting, the beginning day and the 90th and 150th day of the maintenance period. The application amount shall be 0.02kg for every square meter. The fertilizer resolved in water can be applied in watering.

146. In the grass planting area, add 10cm thick mix soil with the proportion of organic fertilizer and imported soil as 1:4.

147.

148. The gap between circular ponds/oval ponds should be filled with pebbles/in situ stones in the rain garden of thickness 6"-8" which reduces the velocity of surface runoff as well as helps obtain sediment free water entering the ponds which enhances infiltration all avoid the flow path of storm water flows.

149.

Maintenance work shall begin on the day the planting is finished. It shall be 1 year started from the next day of the final acceptance of the whole planting works.

6.2 Primary acceptance, final acceptance and inspection

6.2.1 Primary acceptance by client after the finishing of the whole planting and the whole works stipulated in the Contract.

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6.2.2 In the maintenance period the inspection shall be made every two months. The inspection result made at the end of the maintenances period shall be taken as the reference data for the settlement of planting price. The substandard planting in the expiry inspection of maintenance period shall be deducted from the price.

6.2.3 The Contractor shall apply for the expiry inspection of maintenance period by the Owner at 4th months started from the inspection made at the end of the 8th month.

6.2.4 Primary inspection, acceptance and every check and check made in maintenance period shall be in accordance with the Contract, the pruning or mowing shall be permitted from client before inspection.

6.3 Expiry of maintenance period

6.3.1 The Contractor shall be responsible to maintain the living state of plant, including watering in dry weather, drainage in rainy season, and to prevent against any injuries caused by animals, humans, wind, pest, weed, etc. If the tree is on loose ground to stand or slanted, it shall be established upright and the firming rope should be tightened.

6.3.2 Under the following conditions the Contractor shall be liable for the rework of following at his own expenses: the top withered, the living plants cannot reach to 80% of the total area, serious pest hazard and broken limb. The above shall be replaced with new planting. The flower withering shall also be replaced under the instruction of client
150.

6.3.3 At the expiry of maintenance period, the following requirement to be approved as the standard garden.

151. · All the planting shall be in accordance with the Contract
152.
153. · All the planting is living, well grown, no pest hazard or withering.
154.
155. · The specification of planting cannot be less than that stated in the Contract.
156.
157. · Ground covers shall be well grown, no pest hazard or withering, and its coverage rate shall be more than 90%. No rain washing exists.
158.
159. · The weed in the area of ground cover cannot exceed 10%, and comply with the appearance effect stated in the design drawings.
160.

6.4 Back charge at the expiry of maintenance period
At the expiry of maintenance period, the substandard planting exceeding 10% of the total planting works shall not be charged in the lump sum for the planting works. Besides, the Contractor shall reimburse client for the expenses of the substandard part planting.

7.0 Planting Schedule

Type of plantations	Screening Trees / Avenue Trees (2m) Height
Planting Time	June 3rd week –December 1st week

Methodology	1. Excavating pits of size 0.75m x 0.75m x 0.75m filling them with supplied garden soil mixture of well rotten farmyard manure or leaf mould , red earth, river sand in appropriate ratios with folidal dust/bavistine. the spacing, location and other details as per the drawings and specifications. 2. While placing the sapling /tree in the pit the tap roots should not be folded back and fibrous roots should be spread out as they are so that the root tips are not damaged this is important for the growth of the roots . 3. Press the soil firmly with feet and make a basin around the sapling/tree. 4. Support the trees/sapling with a sturdy stake put in to the pit by the side of the tree/saplings and tied to it. 5. Protect the trees with iron mesh tree guards.
Basic maintenance	1. Water the plants for every three days in first year and later once in a week from second year. 2. Remove lateral buds and lateral braches to inhibit lateral growth till 3m height to maintain proper shape of the tree 3. Usually trees are affected with caterpillars. Spray the affected trees with neem oil extract 6ml/litre .

LIST OF AVENUE TREEES (2M) HEIGHT

S.NO	BOTANICAL NAME	COMMON NAME	TAMIL NAME
1.	*Anthocephalus kadamba*	Kadamba	Kapam
2.	*Alstonia scholaris*	Devils Tree	Palai,
3.	*Bauhinia purpurea*	Camels Foot	Mandari
4.	*Polyalthia longifolia*	False Ashok tree	Asoothi
5.	*Cordia sebestena*	Scarlet Cordia	Acchinaruvihli
6.	*Delonix regia*	Gulmohar	Mayarum
7.	*Cassia fistula*	Indian Laburnum	Konnei
8.	*Cassia javanica*		
9.	*AzadirachtaIndica*	Indian Neem Tree	Vepa
10.	*Mangifera indica*	mango	
11.	*Pongamia glabra*	Indian Beech Tree	Ponga
12.	*Tabebuia rosea*	Rosy Trumpet Tree	
13.	*Filicium decipiens*	Fern Tree	Ningal

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S.NO	BOTANICAL NAME	COMMON NAME	TAMIL NAME
14.	*Peltophorum ferrugineum*	Copper Pod Tree	
15.	*Melia azedarach*	Pirde Of India	malaivembu
16.	*Terminalia catappa*	Indian almond tree	nattvaduma
17.	*Spathodea campamulata lutea*	Yellow Spathodea	Patadi
18.	*Bignonia metapotomica*		
19.	Erythrina Crista Galli		
20.	*Millingtonia hortensis*		Katte malli
21.	Plumeria alba	Temple tree white	arali
22.	Plumeria rubra	Temple tree red	arali

LIST OF ACCENT TREES

S.NO	BOTANICAL NAME	COMMON NAME
1.	*Roystonia regia (5m)*	Royal palm
2.	Wodyetia bifurcata - 4m (over all ht)	Fox tail palm
3.	*Bismarckia nobilis blue form(4m)*	
4.	*Areca catechu*	arecanut
5.	Ficus retusa	Chinese banyan tree
6.	Mimusops elengii	

SHRUBS AND GROUND COVERS

Type of plantations	Shrubs & Ground Covers/Flower beds
Planting Time	June 3rd week –December 1st week
Methodology	1. Excavating pits of size 0.30m x 0.30m x 0.30m for shrubs and 0.15m x 0.15m x 0.15m for ground covers supplied with garden soil mixture of well rotten farmyard manure or leaf mould , red earth, river sand in appropriate ratios with folidal dust. The spacing, location and other details as per the drawings and

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	specifications. 2.While placing the shrub/ground cover in the pit the tap roots should not be folded back and fibrous roots should be spread out as they are so that the root tips are not damaged this is important for the growth of the roots .
Basic maintenance	1.Water the plants daily. 2.Prune the over growth shrubs for proper shape.

LIST OF SHRUBS & GROUNDCOVERS

S.NO	BOTANICAL NAME	COMMON NAME
1.	*Cuphea hyssopifolia hybrid purple*	Cuphea blue
2.	*Cuphea hyssopifolia hybrid white*	Cuphea white
3.	*Pisonia alba*	pisonia
4.	*Alternanthera species red (broad deep red leaf)*	Alternanthera (border)
5.	*Bixa orellana*	Annatto Tree, Lipstick Tree
6.	*Caesalpinia pulcherima red yellw orange*	Peacock Flower
7.	*Acalypha rosea*	
8.	*Tabernamontana variated nana dwarf*	
9.	*Vinca rosea*	

RAIN GARDEN

Type of plantations	Water tolerant plants
Planting Time	June 3rd week –December 1st week

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Methodology	1. Excavating ponds of circular or oval surface area each of depth 0.4m-0.5m . the spacing, location and other details are mentioned in the drawings. 2. The primary media in each pond consists of dug up in situ soil horizon of about 0.4 m depth. 3. The dug up soil from the each circular or oval pond can be used for landscaping the rain garden provided the soil should be fertile if not garden soil with soil amendments should be used. 4. The gaps between circular ponds/oval ponds should be filled with in situ stones or pebbles in the rain garden which reduces the velocity of surface runoff as well as helps obtain sediment free water entering the ponds which enhances infiltration all along the flow path of strom water flows. 5. depth of the pond varies from 0.4m to 0.5m(fig 2&3)
Basic maintenance	1.Water the plants daily except rainy season . 2.Prune the over growth shrubs for proper shape of the pond.

LIST OF PLANTS FOR RAIN GARDEN

RAIN GARDEN- OPPOSITE TO PARKING

S. NO	BOTANICAL NAME	COMMON NAME	TOTAL AREA IN SQM	NO. OF PLANTS/ SQM	SPACING C/C	QNTY OF PLANTS
1.	Canna gernalis red	Canna Red Leaved	148	8	1'	1184
2.	Canna malawiensis variegata	Canna Yellow Variegated	151	8	1'	1208
3.	Hymenocallis littoralis (broad leaved)	Beach Spider Lily	273	8	1'	2184
4.	Pennisetum rueppeli	Red fountain grass	176	15	9"	2640
5.	Pennisetum species	Green fountain grass	165	15	9"	2475

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S. NO	BOTANICAL NAME	COMMON NAME	TOTAL AREA IN SQM	NO. OF PLANTS/ SQM	SPACI NG C/C	QNTY OF PLANTS
6.	Canna x generalis lineata yellow	Canna Dwarf Yellow	19	35	6"	665
7.	Canna x generalis lineata red	Canna Red Dwarf, Indian Shot	22	35	6"	770
8.	Hymenocallis narcissiflora	Narrow Leaf Spider Lily	31	8	1'	248
9.	Hymenocallis littoralis variegata	Spider Lily Variegated	192	8	1'	192
10.	Sansevieria trifasciata laurentii,/ S. zebrina	Mother In Laws Tongue/ Snake Plant	142	15	9"	2130
11.	Euphorbia pulcherrima christmas star	Poinsettia Christmas Tree/ Tamil Magilkunni	109	8	1'	872
12.	Heliconia varities	heliconia	60	15	9"	900
13.	ENSETE VENTRICOSUM	Ornamental Banana	5	-	-	1
14.	CAESALPINIA PULCHERIMA FLAVA-YELLOW	Shankasur Yellow/ Tamil-Mayikonnai	6	5	15"	30
15.	Bambusa vulgaris	Golden Bamboo	6	5	15"	30
16.	Chrysalidocarpus lutecens	Areca Palm	6	5	15"	30
17.	Bismarckia nobilis green form	Bismark Palm – Green	6	-	3'	3

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S. NO	BOTANICAL NAME	COMMON NAME	TOTAL AREA IN SQM	NO. OF PLANTS/ SQM	SPACING C/C	QNTY OF PLANTS
18.	CAESALPINIA PULCHERIMA FLAVA-YELLOW-ORANGE-RED	Shankasur Yellow(10)-orange(10)-red(10)Tamil-Mayikonnai	6	5	15"	30

RAIN GARDEN-ADMINSTRATION-202

S. NO	BOTANICAL NAME	COMMON NAME	TOTAL AREA IN SQM	NO. OF PLANTS/ SQM	SPACING C/C	QNTY OF PLANTS
1.	CANNA X GENERALIS LINEATA YELLOW	Canna Dwarf Yellow	38.5	35	6"	1365
2.	PANDANUS AMARYLTIFOLIUS VARIEGATUS	Pandanus	19.5	8	1'	20
3.	CANNA GERNALIS RED	Canna Red Leaved	8.5	15	9"	135
4.	PENNISETUM SPECIES	Green fountain grass	55.5	15	9"	840
5.	HYMENOCALLIS LITTORALIS (BROAD LEAVED)	Beach Spider Lily	46	8	1'	368
6.	PENNISETUM RUEPPELI	Red fountain grass	42	15	9"	630
7.	Heliconia varities	heliconia	30	15	9"	450
8.	Chrysalidocarpus lutecens	Areca Palm	5.5	5	15"	30

RAIN GARDEN-COUNTRY ZONE

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S. NO	BOTANICAL NAME	COMMON NAME	TOTAL AREA IN SQM	NO. OF PLANTS/ SQM	SPACING C/C	QNTY OF PLANTS
1.	Bambusa vulgaris	Golden Bamboo	5.5	5	15"	30
2.	Euphorbia pulcherrima christmas star	Poinsettia Christmas Tree/ Tamil Magilkunni	55.5	8	1'	480
3.	Licuala grandis/Pritchardia Grandis	Prichardia Palm	5.5	-	36"	3
4.	Sansevieria trifasciata laurentii,/ S. zebrina	Mother In Laws Tongue/ Snake Plant	55.5	15	9"	900
5.	PENNISETUM SPECIES	Green fountain grass	55.5	15	9"	900
6.	HYMENOCALLISLITTORALIS (BROAD LEAVED)	Beach Spider Lily	55.5	8	1'	480
7.	PENNISETUM RUEPPELI	Red fountain grass	55.5	15	9"	900
8.	ENSETE VENTRICOSUM	Ornamental Banana	5.5	-	-	1
9.	CAESALPINIA PULCHERIMA FLAVA-YELLOW-ORANGE-RED	Shankasur Yellow(10)-orange(10)-red(10)Tamil-Mayikonnai	55.5	5	15"	300

RAIN GARDEN-ADMINSTATION-202

S.NO	BOTANICAL NAME	COMMON NAME	TOTAL AREA IN SQM	NUMBER OF PLANTS/SQM	SPACING C/C	QNTY OF PLANTS
1	PENNISETUM	Green fountain	29	15	9"	435

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	SPECIES	grass				
2.	HYMENOCALLIS LITTORALIS (BROAD LEAVED)	Beach Spider Lily	58	8	1'	928
3.	PENNISETUM RUEPPELI	Red fountain grass	83	15	9"	1245

Earth Works for	Providing top Soil Mix for Plants and Mounds
Avenue Trees (2m) Height	1.In the ratio of 2:1:1 of good quality red earth, river silt and manure with all pesticides, fungicides, nutrients and plant growth regulators.
Shrubs & Ground Covers/Flower beds.	2.Additives / m3 of Top soil mix 19:19:19 complex of NPK @ 1Kg/m3
Rain garden	3.Bavistine @ 50 gm / m3
	4.Bio organic fertiliser with all Bio inoculants such as trichoderma, azorpyrillum, azatobacter, psuedomonas, 10 Kg / m3

HARD LANDSCAPING WORKS

1.0 GENERAL CIVIL WORKS

This specifications covers the general requirement for excavation, brick masonry, plastering, flooring, doors, windows, ventilators, wood work, water proofing, painting, plumbing and sanitary work etc., and such other related work forming a part of this job which may be required to be carried out though not specifically mentioned above. The work under this specification shall consist of furnishing of all tools, plants, labour, materials, any and everything necessary for carrying out the work.

2.0 BRICKWORK

2.1 Material – Bricks

Bricks shall be sound, hard, homogeneous in texture, well burnt in kilns without being vitrified, table moulded, deep red, cherry or copper coloured of regular shape and size and shall have sharp and square edges and parallel of faces. The bricks shall be free from pores, chips, flaws or humps of any kind. Bricks containing unground particles and/or which absorb water more than 1/6th of their weight when soaked in water for twenty-four hours shall be rejected. The bricks shall give clean / ringing sound when struck and shall have minimum crushing strength of 50 Kg/sq.ct. Sample bricks shall be submitted to the engineer for approval. If demanded by

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engineer brick sample shall be got tested as per IS-3495 by Contractor at no extra cost to owner. Bricks rejected by Project Consultant shall be removed from site within 24 hours.

2.2 Mortar

The sand used shall be free from clay, shale, loam, alkali and organic matter and shall be of sound, hard, clean and durable particles. Sand shall be approved by Project Consultant. The mixed mortar shall be used within 25 minutes of mixing. Mortar left unused beyond 25 minutes shall be rejected.

2.3 Workmanship

Workmanship shall confirm to I.S. 2212.

All bricks shall be thoroughly soaked in clean water for at least one hour immediately before being laid. The cement mortar for brick masonry shall be as specified in the respective item of work. Brickwork 230mm thick and over shall be laid in English bond unless otherwise specified. 115mm thick brick work shall be laid with stretchers. The thickness of joints shall be well filled with mortar with minimum thickness of 6mm and maximum depth of 12mm by raking tools daily during the progress of work when mortar is still green. The face of brickwork shall be cleaned daily and all mortar droppings removed. All brickwork shall be built tightly against columns floor slabs or other structural members. Miscellaneous inserts in masonry e.g. sleeves, wall ties, anchors conduits, structural steel, steel lintels, doors, windows shall be installed by the Contractor at no extra cost to the owner.

It shall be clearly understood that the rates quoted by the Contractor include for fixing of inserts, leaving openings, cutting chases etc.

3.0 PLASTER WORK

3.1 Material

The proportion of the mortar shall be as specified under the respective item of work. The quality of water, sand and cement shall be as per respective I. S. Code. The mortar shall be used immediately after mixing and in no case shall be allowed to stand in more than 25 minutes after mixing with water.

3.2 Workmanship

The surface to be rendered shall be washed with fresh clean water, free from all dirt, loose material, grease etc. and thoroughly wetted for 6 hours before plastering work is commenced, concrete surfaces to be rendered will however be kept dry. The wall should not be too wet but only damp at the time of plastering.

3.3 Internal Plaster

This plaster shall be laid in a single coat of 20mm thickness. The mortar shall be dashed on the prepared surface with a trowel and finished smooth by wooden floats. Interior plaster shall be carried out on jambs, lintels, sills, soffits as shown in drawing or as directed by Architect. Rate quoted shall be deemed to include plastering of all surfaces and no separate payment will be considered for any particular, surface like jambs etc.

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3.4 Curing

Curing of both interior plaster shall be started as soon as the applied plaster has hardened enough so as not to be damaged. Curing shall be done by continuous applying water in a fine spray.

At places the thickness of plaster may go higher than specified thickness. In such event Contractor shall provide chicken mesh and perform plastering in layers without additional cost.

3.5 Measurement

3.6 Admixture

If directed by Project Consultant, the Contractor shall use approved water proofing / water reducing admixtures in the mortar for plaster work, in the proportion and method prescribed by the manufacturer. Payment shall be made for actual quantity of such admixtures used unless it is already covered in the rates for the work concerned.

4.0 STONE FLOORING FOR LANDSCAPING

4.1 Material

Stones should be of approved quality, hard, sound, durable and uniform in thickness as specified. Edges shall be machine cut / hand cut, machine dressed / hand dressed as specified in respective item of work. Top surface shall be pre machine polished, machine polished at site, hand polished, any other finish as specified in Schedule of Quantities. Stone slabs should meet all the required properties and test requirements as stipulated in I. S. Standard.

4.2 Workmanship

Stone should be laid on a bed of cement mortar of specified mix. Thickness of mortar bedding shall not be less than 12mm and shall not be more than 25mm. Before laying the stone slabs should be thoroughly wetted with clear water, Neat white cement should spread over the mortar bed (at the rate of 5 kg per 1 sq.meter.) over as much area as could be covered with slabs within half an hour. The slabs are then laid and gently tapped with wooden mallet till it if firmly and properly bedded. There should be no hollows left. The joints should not be more than 2mm thick. The joints should be struck smooth. The joints should run true and parallel. The floor should be kept covered with damp sand or water for a week.

Stones laid adjoining the wall shall project 12mm under the plaster / dado / skirting.

For skirting work the vertical surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 0.5"mm thick 1:2 cement mortar. The back of each tile to be fixed shall covered with a thin layer on neat white cement plaster pigmented to match the shade of the stone slab and tile shall then be gently tapped against the wall with a wooden mallet. The joints shall be as close as possible and the work shall be truly vertical and flush.

5.0 PAINTING

5.1 Material

Paints to be used for various terms of work should be of approved make and colour. The Contractor shall obtain Project Consultant's approval in regard to the make and colour of paint that is proposed to be used for various items of work.

5.2 Workmanship

The painting work shall be carried out as directed by the Consultant, keeping however, in view the recommendations of the manufacturer. In case of plastic emulsion paint, all uneven surfaces shall be made up by use of putty of appropriate quality, after the surface has been thoroughly cleaned of all dust, dirt and sand papered. Two coat of primer, and two/three coasts of emulsion as specified shall be applied. Workmanship shall conform to the requirement of I.S. 2395.

6.0 CERAMIC TILE WORK IN FLOORING AND DADO

6.1 Material

The tiles used shall be as specified and of approved make, size and shade. The tiles shall be of standard size without warp and straight edges, true and even in shape and size and uniform colour.

6.2 Workmanship – Flooring

Tile shall be laid on base of minimum 12mm thick cement mortar of specified mix. Neat white cement pigmented to match the shade of the tile shall be spread at the rate of 5 kg. Per 1 Square metre area over mortar before laying the tiles. The joints shall be filled with joint filling cement based compound.

6.3 Dado work

The vertical surface shall be thoroughly cleaned and wetted. Thereafter it shall be uniformly covered with about 12mm thick 1:3 cement mortar plaster for leveling purpose. The back of each tile to be fixed shall be covered with a thin layer of approved waterproof tile adhesive cement and the tile shall then be gently tapped against wall and fixed as per adhesive cement manufacturer's instructions. The joints shall be very thin, uniform, perfectly straight and truly vertical. The joints shall be filled with joint filling cement based compound specially manufactured for the purpose.

Flooring, Treads, Skirting – Dado – Risers

6.4 Material

Size, shade and colour of tiles shall be approved by Project Consultant before starting of the work.

6.5 Workmanship

Tiles shall be laid on a bed of cement mortar of specified mix. Thickness of mortar bedding shall not be less than 20mm and shall not be more than 25mm. Tiles shall be covered with white cement / and placed over mortar bed and tapped gently till it is firmly and properly bedded. There should be no hollows left. The joints should run true and parallel. The floor should be cured for one week.

Tiles laid adjoining the wall shall project 12mm under the plaster / dado / skirting.

6.6 Skirting-dado-risers

The masonry surface shall be thoroughly cleaned and wetted. Thereafter it shall be evenly and uniformly covered with 12mm thick 1:3 cement mortar. The back of each tile shall be covered with tile adhesive cement and then the tile shall be fixed as per manufacturer's instructions. The joints shall be filled with tile joint filling coloured cement specially manufactured for the purpose.

7.0 MARBLE / GRANITE WORK

Marble / granite shall be hard, sound, dense and homogeneous in texture with crystalline texture as far as possible. It shall generally be uniform in colour and free from stains, cracks, decay and weathering.

7.1 Classification

The marble / granite blocks, slabs and tiles shall be classified broadly in the following two categories:

White Marble / granite.

Coloured Marble / granite such as Black, Green, Pink, Brown, Grey Marble / granite etc.

7.2 Approval of Sample

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

7.3 Sampling

In any consignment all the blocks / slabs / tiles of the same group, size and finish shall be grouped together to constitute a lot. Sample shall be selected and tested separately for each lot for determining its conformity or otherwise to the requirements of the specification. The number of blocks / slabs / tiles to be selected for the samples shall depend upon the size of the lot and shall be in accordance with the Table given below:

7.4 Sample size and Criteria for Conformity.

Number of Blocks / slabs /tiles in the lot	Number of blocks slabs / Tiles to be selected in sample	Permissible number of defectives	Sub sample size in No.
(1)	(2)	(3)	(4)
Upto 25	3	0	2
26 to 100	5	0	2
101 to 200	8	0	3
201 to 500	13	0	4
501 to 1000	20	1	5

Note: The blocks/ slabs/ tiles in the sample shall be taken at random and in order to ensure to randomness of selection, random tables may be used.

Explanation 1: All the blocks / slabs / tiles, selected in the sample, shall be examined for dimensions workmanship and general requirements.

Any block / slab / tile failing in any one or more of the above requirements shall be considered as defective. All lot shall be considered as conforming to these requirements if the number of defectives obtained is not more than permissible no. of defectives given in Col. 3 pf the Table.

Explanation 2: The lot having been found satisfactory with respect to dimensions, workmanship and general requirements shall be tested for physical properties of the

marble / granite. For this purpose a sub sample of the size given in Col. 4 of table shall be selected at random.. These blocks/ slabs / tiles in the sub sample shall be tested for moisture absorption, hardness and specified gravity. The lot shall be considered having satisfied the requirements of the physical properties if none of the blocks / slabs / tiles tested for the requirements fails in any of these tests.

7.5 Marble / granite Work in Floor, Jambs, Steps and other Plain Work

Dressing and Rubbing

Every marble / granite stone shall be cut to the required size and shape, chisel dressed on all beds and joints, so as to be free from any waviness and to give truly vertical, horizontal, radian or circular joints as required. The exposed faces and sides of stones forming joints upto 6mm. from the face shall be fine tooled such that a straight edge laid along the face of the stone is in contact with every point on it. These surfaces shall then be rubbed smooth. All visible angles and edges shall be true, square and free from chipping. Beyond the depth of 6mm from face, the joints shall be dressed with a slight splay so that the thickness of joint increases, in an inverted 'V' shape so as to give good mortar bond between two stones. The inverted portion of the joints shall be filled with bedding mortar and face 6mm portion with pointing mortar. The surfaces of the stones coming in contact with backing need not be chisel dressed.

A sample of dressed and rubbed stone shall be prepared for approval and it shall be kept on worksite after being approved by the Engineer in-charge.

7.6 Mortar

The Mortar used for jointing shall be as specified.

7.7 Laying: All marble / granite stones shall be wetted before placing in position. These shall then be floated on mortar and bedded properly in position with wooden mallets without the use of chips or under pinning of any sort. The walls and pillars shall be carried up truly in plumb or battered as shown in the drawings. All courses shall be laid truly horizontal and all vertical joints shall be truly vertical.

When necessary jib crane or other mechanical appliances shall be used to hoist the heavy pieces of stones and place these in to correct positions, care being taken that the corners of the stone are not damaged. Stone shall be covered with gunny bags, before putting chain or rope is passed over it, and it shall be handled carefully. No piece which has been damaged shall be used in work. The matching of grains shall be carried out as direct by the Engineer in-charge.

7.8 Curing The work shall be kept constantly moist on all faces for a period of at least seven days.

7.9 Finishing After the marble / granite work is cured, it shall be rubbed with carborandum stone of different grades No. 60, 120 and 320 in succession, so as to give a plane true and highly smooth surface. It shall then be cleaned with a solution of oxalic acid, washed and finished clean.

7.10 Protection Green work shall be protected from rain by suitable coverings. The work shall also be suitably protected from damage during construction.

7.11 Scaffolding Double scaffolding having two sets of vertical supports shall be provided where necessary. The supports shall be sound and strong, tied together by horizontal pieces over which the scaffolding plank shall be fixed.

7.14 Use of Finished Marble / granite Slabs and Tiles

In case such finished tiles are used, these shall be measured and paid for separately under different head of the schedule of quantities.

8.0 WALL LINING / VENEER WORK

Unless and otherwise specified in the nomenclature of the item, the marble slabs used for wall lining / veneer work shall conform to dimensions as shown on the drawings.

8.1 Dressing: Dressing shall be same as specified in earlier para except that the back shall not be dressed, but left rough cut, in order to ensure a good grip with the hearting of backing. The dressed slabs shall be of the thickness as specified with permissible tolerance. The tolerance in wall lining when straight edge of 3m length is placed should not be more than 2mm.

8.2 Laying: The stone shall be wetted before laying. They shall then be fixed with mortar in position without the use of chips or under pinning of any sort. Care shall be taken to match the grains of veneer work as directed by the Engineer-in-Charge. For purpose of matching the grains, the marble slabs shall be selected judiciously having uniform pattern of veins/ streaks. Preferably the slabs shall be those got out of the same block from the quarry. The area to be veneered shall be reproduced on the ground and the marble slabs laid in position and arranged in the manner to give the desired matching of grains. Any adjustment needed for achieving the best results shall be then carried out by replacing or interchanging the particular slabs. Special care shall be taken to achieve the continuity of grains between the two slabs one above the other along the horizontal joints. This shall then be got approved by the Engineer-in-Charge and each marble slabs numbered properly and the same number shall be marked on a separate drawing as well as on the surface to be actually veneered, so as to ensure the fixing of the particular slabs in the correct location.

For the facing of the columns also the same procedure as mentioned above shall be followed. Where so desired, the adjoining stones shall be secured to each other by means of copper pins 75m long and 6mm diameter or as specified. Further the stones shall be secured to the backing by means of clamps. The material for clamps shall have high resistance to corrosion under condition of dampness and against the chemical action of mortar or concrete in which clamps are usually embedded.

Clamps shall be of 25 x 6 mm and 30 cm long in case of backing of stone masonry walls and brick masonry walls thicker than 230mm. In case of backing with brick masonry walls 230 mm or less thick or RCC members clamps shall be of 25 x 6mm and length as per requirement made out of gun metal or any other metal specified. Generally the outer length of clamp in half brick work backing shall be 115 mm and in one brick work backing it shall be 150mm. Clamps shall be spaced not more 60 cm apart horizontally.

The adjoining stones shall be secured to each other by means of gun metal clamps or copper pins of the specified size. Clamps may be attached to its sides or top and bottom. The actual number of clamps and their sections, however, shall be as per requirements of design to carry the loads.

Where clamps are used to hold the unit in position only, the facings shall be provided with a continuous support on which the stones rest at the ground level and other storey levels, the support being in the form of project from or recess into the concrete floor slab, or a beam between the columns or a metal angle attached to the floor slab or beams. These supports shall preferably be at vertical intervals not more than 3.5 m apart and also over the heads of all openings. Such supports shall also be provided where there is transition from thin facing below to thick facing above.

Alternatively clamps may be used to hold the units in position and in addition to support the units thus transferring the weight of the units to the backing. Such clamps should be properly designed as per IS : 4101 (Part 1). The clamps may be of copper alloyed with zinc, tin, nickel, lead or stainless steel. The pins, clamps and dowels shall be laid in cement mortar 1:2 (1 cement : 2 fine sand) and their samples got approved by the Engineer-in-Charge and kept at site. All joints shall be full of mortar. Special care shall be taken to see that groundings for veneer work are full of mortar. If any hollow groundings are detected by tapping the face stones, these shall be taken out and re-laid. The thickness of the face joints shall be uniform, straight and as fine as possible, not more than 1.5mm and in the face joint, the top 6mm depth shall be filled with mortar specified for the pointing.

8.3 Mortar: The mortar used for jointing slabs shall be as specified.

8.4 Curing, Finishing, Protection and Scaffolding.: It shall be as specified in earlier Para.

ALUMINIUM WINDOWS, VENTILATORS, COMPOSITE

Scope of work :

The scope of work in the tender item includes fabrication supply and installation of anodized matt finished aluminium windows, ventilators, composite units, glazing etc. strictly in accordance with these specifications and relevant detailed approved shop drawings.

General :

The contractor shall submit six copies of shop drawings covering all types. Details of work as generally shown in Architectural drawing and envisaged under these specifications before manufacture. The drawing shall show all dimensions, details of construction, installation, fixtures and relation to adjoining and related work. No fabrication work shall be undertaken prior to the approval of the shop drawings from the Engineer-in-charge. The tenderer shall intimate at the time of tendering, the types of sections he proposes to use on the works.

Materials :

The aluminium alloy used in the manufacture for extruded window section shall correspond to IS 733- 1966 (or any further revision thereof). Extruded sections shall conform to IS designation HE9-WP and Hollow sections shall conform to IS Designation HV9-WP. The frame work, stiles, mullions, beadings, transoms, hinges, peg stays, handles etc. shall be structurally suitable to withstand all the load, the members have to sustain. Conter sunk screws, nuts, bolts, washers, rivets and other miscellaneous fastening devices shall be of approved cadmium plated or stainless steel as specified in the approved drawings.

Fabrication :

The frames shall be manufactured square and flat. The corners of the frames shall be fabricated to true right angles. All the fixed, sliding, openable frames shall be constructed from sections which have been cut to length, mitred and mechanically jointed or welded at the corners. Where hollow sections are used with welded joints, argon are welding or flash butt welding shall be employed (Gas welding or brazing not to be done). Sub-dividing bars of units shall be tennoned an riveted into the frames. Water bar in aluminium section shall be provided. The dimensions shown in the drawings are overall heights and widths to the outside of frames of aluminium windows. The side hung shutters shall have projected friction type hinges of aluminium alloy. Concealed projected hinges having structural stability and of

good quality will also be considered only after the inspection of the sample submitted by the tenderer. The necessary peg stays, handles, windows fasteners etc. shall be of aluminium. The handle shall be mounted on a handle plate riveted to the opening frame.

The peg stays shall be 300mm. long or as required complete with peg and locking bracket and shall have holes for keeping the shutters open in three different positions. No field fabrication of frames is permitted. The complete fabricated assembly shall be anodized in approved satin finish with minimum film thickness of 0.015 mm. for the entire surface. A thick layer of clear transparent lacquer based on methacrylate or cellulose butyrate shall be applied on the finished sections for the aluminium windows etc. by the supplier to protect the surface from wet cement, lime, dirt, dust etc. during the installation. This lacquer coating shall be removed after installation is complete, if approved by the Engineer-incharge and all sections of the windows shall be protected by the Engineer-in-charge and all sections of the windows shall be protected by P.V.C. film covering.

Hardware :

All cut outs, recesses, mortising or milling and operation required for fixing the hardware shall be accurately made reinforced with packing plate as required to ensure adequate strength of the connection. All the hardware, accessories shall be of best approved type and of anodized finish same as for the frame and other sections. All hardware shall be

free from defects which may affect the appearance and serviceability. All hardware shall be fixed after obtaining the prior approval of the Engineer-in-charge. Approved samples of hardware shall be kept in the custody of Engineer-in-charge.

Fixing :

The window frames shall be accurately fixed in the brick masonry or R.C.C. work.

The fixing of the frame shall be done with cadmium plated brass counter sunk screws driven on the teak wood rough grounds if required or fixed tot eh walls with holdfasts. All aluminium windows shall be fixed in position as per IS 1081-1960 (or any revision thereof):Code of practice for fixing and glazing of aluminium windows. All joints between metal and masonry / rough ground wooden frame shall be fully caulked and mastic or polysulphide compound in order to ensure water tight joints. Joints shall be neatly painted with matching cement an excess materials shall be removed. Hardware shall be fixed in workman like manner all as directed by the Engineer-in-charge.

Samples :

The sample of different windows shall be submitted to the Engineer-in-charge for approval.

Glazing :

The glazing shall be of Indian make plain sheet / frosted figured glass of special selected quality and size as mentioned in item description and drawings shall be of M/s Triveni / Saint Gobain / I.A.G./ Modi / approved make

The specifications specified herein before shall hold good as far as applicable Glazing will be paid on square metre basis.

Guarantee :All materials and workmanship in above work shall be guaranteed for a period of one year (unless otherwise specified) from the date of handling over.

Unqualified performance

guarantee for smooth operations of the windows, doors, wall spans and precautionary measures against leakages etc. shall be furnished by the contractor on stamped paper. If so specified, in schedule of quantities. Any defect found during the guarantee period shall be replaced / made good to the original conditions/positions entirely at the cost of the contractor.

Testing:

All windows shall be tested for water tightness. Any leakage found during testing shall be rectified by the contractor without extra charge.

M.S. GRILLS/RAILING

1.0 GENERAL

The contractor shall submit 6 copies of shop drawings shall show all dimension, details of construction, installation relating to the adjoining work.

2.0 MATERIALS:

All structural steel shall conform to IS 226-1963 sections for grills and shall be free from loose mill scales, rusts, pitting or any other defects affecting its strength and durability.

3.0 FABRICATION:

The grills shall be fabricated to the design and pattern shown in the drawings. All joints shall be made in best workman like manner with slotting and welding as required to the specified size and shape. The edge of the M.S. flats shall be suitably mitred before welding to get the desired shape.

The joints shall be filled to remove excess stay after welding screws, nuts, washers, bolts, rivets and any other miscellaneous fastenings devices shall be of steel and shall be provided by the contractor Manufactured M.S. Grills then be fixed in between the posts, balusters, M.S. frame work etc. to correct alignment. Any undulations, bends etc. found shall be rectified by the contractor at his own cost. The complete assembly of rill / railing so fixed shall be firm and there shall not be any lateral movements.

4.0 SAMPLES:

Samples of grill and railings shall be submitted for approval of the Engineer-in-charge and to be got approved before taking up for mass fabrication.

Installation: The approved grills shall be fixed in position where specified and shown in drawings including in masonry walls, teakwood frames, hand railings etc. Any damages to walls, frames etc. caused during fixing the grills shall be made good by grouting with cement mortar/packing /repairing properly at the contractors cost.

5.0 PAINTING:

Painting shall be done as per the specification specified under painting.

Finishing / Painting/Polishing for railing: Teak wood hand rail shall be polished with wax polish / French polish / melamine with two or more coats over one coat of wood primer or painted with two coats of synthetic enamel paint / flat oil paint of approved make and shade over one coat of approved primer. M.S. grills, balusters, etc. also to be painted as per specifications specified under Painting/ Polishing.

BIDDER SEAL & SIGN

ACCESS FLOORING

1.0 GENERAL:

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions, apply to this Section.

1.2 SUMMARY

A. This Section includes the following:
   1. Gravity-held panels on bolted stringer understructure.

B. Related Sections:
   1. Section for Reinforced Cement Concrete for concrete floor sealer.
   2. Sections for computer room air-conditioning units.
   3. Electrical Specifications for connection to grounding of access flooring understructure.

1.3 PERFORMANCE REQUIREMENTS

A. Performance Requirements, General: Provide access flooring systems that comply with the following requirements:
   1. Access flooring systems are proprietary portable systems composed of modular floor panels on elevated supports (understructures) forming accessible underfloor cavities (air spaces) to accommodate electrical and mechanical services.
   2. Access flooring systems comply with performance requirements specified as determined by testing manufacturers' current standard products representing those indicated for this Project.

B. Structural Performance per CISCA A/F: Provide access flooring systems capable of supporting the following loads, within limits and under conditions indicated, as demonstrated by testing according to the referenced procedures in Ceilings and Interior Systems Construction Association's (CISCA) "Recommended Test Procedures for Access Floors." This publication and its procedures are referenced elsewhere in this Section as CISCA A/F.
   1. Concentrated-Load Performance: Capability of floor panels, including those with cutouts, to support concentrated design loads of the following magnitude, with a top-surface deflection under load and a permanent set not to exceed, respectively, 0.10 and 0.010 inch, according to CISCA A/F Section I.
      a. 1250 lbf.
   2. Ultimate-Load Performance: Capability of access flooring systems to support a minimum ultimate concentrated load equal to the value obtained by multiplying the specified concentrated floor panel design load by the factor indicated below, without failing, according to CISCA A/F Section II. Failure is defined as the point at which the access flooring system will not take any additional load.
      a. Factor: 2.
   3. Rolling-Load Performance: Capability of access flooring system to withstand rolling loads of the following magnitude applied to panels, with a combination of local and overall deformation not to exceed 0.040 inch after exposure to rolling load over CISCA A/F path A or B, whichever path produces the greatest top-surface deformation, according to CISCA A/F Section III.
      a. CISCA A/F Wheel 1 rolling load: 1000 lbf.; 10 passes
      b. CISCA A/F Wheel 2 rolling load: 800 lbf.; 10,000 passes
   4. Stringer Concentrated-Load Performance: Capability of stringers, without panels in place, to support a concentrated load of 200 lbf at center of span with

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a permanent set not to exceed 0.010 inch, as determined per CISCA A/F Section IV.

5. Pedestal Axial-Load Performance: Capability of pedestal assemblies, without panels or other supports in place, to withstand the following axial load per pedestal, according to CISCA A/F Section V.
   a. 5000 lbf.

6. Pedestal Overturning-Moment Performance: Capability of pedestal assemblies, without panels or other supports in place, to withstand the following overturning moment per pedestal, according to CISCA A/F Section VI.
   a. 1000 lbf x inches.

C. Floor Panel Impact-Load Performance: Capability of access flooring system to withstand the following impact load when dropped from 36 inches onto a 1-sq. in. area located anywhere on panel, without failing. Failure is defined as the point at which the access flooring system will not take any additional load.

1. 150 lbf.

D. Static-Conductive Floor Covering Resistance: Not less than 25,000 ohms, nor more than 1 megohm, as determined by testing identical products according to the method for conductive flooring specified in Chapter 12 of NFPA 99 but modified to place 1 electrode on floor surface and to attach the other electrode to understructure.

E. Panel to Understructure Resistance: Not more than 10 ohms.

1.4 SUBMITTALS

A. Product Data for each type of access flooring specified.

B. Shop Drawings showing complete layout of access flooring based on field-verified dimensions; include dimensional relationships to adjoining work and installation tolerances. Include details, with descriptive notes indicating materials, finishes, fasteners, typical and special edge conditions, accessories, understructure, and other data to permit a full evaluation of entire access flooring system.

C. Samples for initial selection in the form of manufacturer's color charts consisting of actual units or sections of units showing the full range of colors, textures, and patterns available for each type of floor covering and exposed finish indicated.

D. Samples for verification in full-size units of each type of floor covering and exposed finish indicated.
   1. In addition, submit one complete full-size floor panel, pedestal, and understructure unit for each type of access flooring system required.

1.5 QUALITY ASSURANCE

A. Installer Qualifications: Engage an experienced Installer who is approved by the access flooring manufacturer for installing the types of access flooring indicated for this Project.

B. Single-Source Responsibility: Obtain access flooring from one source and by a single manufacturer.

C. NFPA Standard: Provide access flooring complying with NFPA 75 requirements for raised flooring.

D. Provide floor panels that are clearly and permanently marked on their underside with the panel type and concentrated-load rating.

E. Mockups: Prior to installing access flooring, construct mockups for each type of panel and understructure required to verify selections made under Sample submittals

and to demonstrate aesthetic effects as well as qualities of materials and execution. Build mockups to comply with the following requirements, using products indicated for final access flooring installation.

1. Locate mockups on-site, in the location and of the size indicated or, if not indicated, as directed by Architect.
2. Notify Construction Manager one week in advance of the dates and times when mockups will be constructed.
3. Obtain Architect's approval of mockups before start of final unit of Work.
4. Retain and maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
   a. Approved mockups in an undisturbed condition at the time of Substantial Completion may become part of the completed Work.

F. Preinstallation Conference: Conduct conference at Project site

1.6 DELIVERY, STORAGE, AND HANDLING

A. Deliver access flooring components in original, unopened packages, clearly labeled with manufacturer's name and item description.

B. Handle and store packages containing access flooring in a manner which avoids overloading building structure.

1.7 PROJECT CONDITIONS

A. Environmental Conditions: Do not proceed with installation of access flooring until installation area is enclosed and has an ambient temperature of between 40 and 90 deg F and a relative humidity of not more than 70 percent.

B. Field Measurements: Check actual locations of walls and other construction to which access flooring must fit by accurate field measurements before preparing Shop Drawings; show recorded measurements on Shop Drawings. Coordinate fabrication schedule with construction progress to avoid delaying the Work.

1. Where field measurements cannot be made without delaying the Work, guarantee dimensions and proceed with preparing Shop Drawings for access flooring without field measurements. Coordinate construction to ensure that actual dimensions correspond to guaranteed dimensions.

1.8 COORDINATING AND SCHEDULING

A. Coordination of Work: Coordinate location of mechanical and electrical work in underfloor cavity to prevent interference with access flooring pedestals.

B. Mark pedestal locations with a grid of size indicated below on concrete subfloor so that mechanical and electrical work can proceed without interfering with pedestals.

1. 120 by 120 inches.

C. Do not proceed with installation of access flooring until after Substantial Completion of other construction within affected spaces.

1.9 EXTRA MATERIALS

A. Furnish extra materials described below that match products installed, are packaged with protective covering for storage, and are identified with labels clearly describing contents.

1. Field Panels and Understructure: Furnish quantity of standard field panels and understructure components equal to 2 percent of amount installed.

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B. **PRODUCTS**

1.10 MANUFACTURERS

A. Manufacturers: Subject to compliance with requirements, provide access flooring by one of the following or an system with matching or better specifications:
   1. Systems with Cementitious-Filled Formed-Steel Panels:
      a. Maxcess Technologies, Inc.; RWC 200
      b. Tate Access Floors, Inc.; Concore SF 1250

1.11 FLOOR PANELS

A. Provide modular field panels complying with the following requirements that one person, using a portable lifting device, can interchange with other field panels without disturbing adjacent panels or understructure and that are free of exposed-metal edges with floor covering in place.
   1. Nominal Panel Size: 24 by 24 inches.
   2. Fabrication Tolerances: Fabricate panels to the following tolerances with squareness tolerances expressed as the difference between diagonal measurements from corner to corner.
      a. Size and Squareness: Plus or minus 0.015 inch of required size, with a squareness tolerance of plus or minus 0.015 inch, unless tolerances are otherwise indicated for a specific panel type.
      b. Flatness: Plus or minus 0.020 inch, measured on a diagonal on top of panel.
   3. Panel Attachment to Understructure: By gravity.

B. Cementitious-Filled Formed-Steel Panels: Cementitious-filled panels fabricated with die-cut flat top sheet and die-formed and stiffened bottom pan formed from cold-rolled steel sheet and joined together by resistance welding to form an enclosed assembly, with metal surfaces protected against corrosion by manufacturer's standard factory-applied finish.

1.12 FLOOR PANEL COVERING

A. Provide floor panels prepared to receive carpet tile where access flooring is scheduled for carpet tile.

B. Provide factory-applied floor coverings laminated by the access flooring manufacturer to tops of floor panels other than carpet tile applications.

C. Colors and Patterns: Provide floor covering materials in colors and patterns as indicated below:
   1. Provide Architect's selections made from manufacturer's full range of colors and patterns.

D. Conductive Plastic Laminate: NEMA LD 3, High-Wear Type, of grade indicated below, fabricated in one piece to cover each panel face within perimeter plastic edging or with integral trim serving as edging, and with static decay of 5000 to 0 V in less than 0.5 seconds per FED-STD-101C/4046 at 15 percent relative humidity.
   1. Grade: HW 62.

E. Edging: Manufacturer's standard form of edge trim. For applied edge trim, use method standard with manufacturer to attach edge trim to perimeter of each panel. Provide size and profile of applied edge trim that fits floor covering selected.

1.13 UNDERSTRUCTURE

A. Pedestals: Assembly consisting of base, column with provisions for height adjustment, and head (cap); made of steel.
   1. Base: Square base with not less than 16 sq. in. of bearing area.

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2. Provide vibration-proof leveling mechanism for making and holding fine adjustments in height over a range of not less than 2 inches. Include means of locking leveling mechanism at a selected height that requires deliberate action to change height setting and prevents vibratory displacement.
3. Provide units of sufficient height to achieve underfloor clearance indicated.
4. Head: Designed to support understructure system indicated.
5. Postinstalled Expansion Anchors: Where required to comply with performance requirements, provide expansion anchors for bolting pedestal bases to subfloor that have the capability to sustain, without failure, a load equal to 5 times that specified under Part 1 Article "Performance Requirements."

B. Stringer Systems: Modular steel stringer systems made to interlock with pedestal heads and form a grid pattern placing stringers under each edge of each floor panel and a pedestal under each corner of each floor panel. Protect steel components with manufacturer's standard galvanized or corrosion-resistant paint finish.
1. Bolted Stringers: System of main and cross stringers connected to pedestals with threaded fasteners accessible from above.
a. Provide continuous gasket at contact surfaces between panel and stringers to deaden sound, to seal off underfloor cavity from above, and to maintain panel alignment and position.

C. Lateral Bracing: Provide manufacturer's recommended lateral diagonal bracing bolted to pedestals and bolted to floor with post-installed expansion anchors.

1.14 ACCESSORIES

A. Colors and Finishes: For exposed accessories available in more than one standard color or finish, provide color or finish complying with the following requirements:
1. Match Architect's sample.
2. Match color or finish indicated by referencing manufacturer's standard designations for these characteristics.
3. Provide Architect's selections made from manufacturer's full range of available colors and finishes.

B. Cutouts: Provide cutouts in floor panels for cable penetrations and service outlets. Comply with requirements indicated for size, shape, number, and location. Provide reinforcement or additional support, if needed, to make panels with cutouts comply with standard performance requirements.
1. Trim edge of cutouts with manufacturer's standard plastic molding.
2. Fit cutouts with manufacturer's standard grommets in sizes indicated or, where size of cutouts exceed maximum grommet size available, trim edge of cutouts with manufacturer's standard plastic molding having tapered top flange.
a. Furnish removable covers for grommets.
3. Provide foam-rubber pads for sealing annular space formed in cutouts by cables and trim edge of cutout with molding having flange and ledge for capturing and supporting pads.

C. Service Outlets: Standard UL-listed and -labeled assemblies, for recessed mounting flush with top of floor panels, for power, communication, and signal services, and complying with the following requirements:
1. Structural Performance: Cover capable of supporting a 1000-lbf concentrated load.
2. Cover and Box Type: Hinged polycarbonate cover with opening for passage of cables when cover is closed and including frame and steel box or formed-steel plate for mounting electrical receptacles.
3. Location: Locate outlets in center of panel quadrant.
4. Receptacles and Wiring: Equip each service outlet with power receptacles to comply with requirements indicated below.

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a. Type of Receptacle: Heavy-duty duplex, 2-pole, 3-wire grounding, 20 A, 125 V, NEMA configuration 5-20R, unless otherwise indicated.
b. Number of Receptacles for Outlet: 4.
c. Wiring Method: Power-in connectors, built into outlet housing, of type to fit power-in and power-out connectors of branch circuit cables supplied with building electrical system.

D. Die-Cast Aluminum Floor Grates: Standard load-bearing die-cast aluminum grates complying with the following requirements:
1. Air-Distribution Characteristics of Units Without Dampers: 56% free area.
2. Structural Performance: Capable of supporting a 1000-lbf concentrated load.

E. Panel Lifting Device: Manufacturer's standard portable lifting device of type and number required for lifting panels with floor covering provided.
1. Provide 4 lifting devices of each type required.

F. Perimeter Support: Where indicated, provide manufacturer's standard method for supporting panel edge and form transition between access flooring and adjoining floor covering at same level as access flooring.

G. EXECUTION

1.15 PREPARATION

A. Locate each pedestal, complete any necessary subfloor preparation, and vacuum clean the subfloor to remove dust, dirt, and construction debris before beginning installation.

1.16 INSTALLATION

A. Install access flooring system and accessories under supervision of the access flooring manufacturer's authorized representative to produce a rigid, firm installation that complies with performance requirements and is free of vibration, rocking, rattles, and squeaks.

B. Attach pedestals to subfloor by postinstalled expansion anchors.

C. Lay out floor panel installation to keep the number of cut panels at the floor perimeter to a minimum. Scribe perimeter panels to provide a close fit with adjoining construction with no voids greater than 1/8 inch where panels abut vertical surfaces.

1. To prevent dusting, seal cut edges with sealer recommended by panel manufacturer:

2. Connect grounding strips embedded in static-conductive floor covering to connector clips attached to pedestals at the intervals needed to comply with performance requirements for electrical resistance of floor covering.

D. Secure stringers to pedestal heads according to the access flooring manufacturer's instructions.

E. Clean dust, dirt, and construction debris caused by floor installation, including vacuuming the subfloor area, as installation of floor panels proceeds.

F. Cut and trim access flooring and perform other dirt-or-debris-producing operations as remotely as possible from installation area and to prevent contamination of subfloor under access flooring already installed.

G. Level installed access flooring to within 0.10 inch of true level over the entire access flooring area and within 0.062 inch in any 10-foot distance.

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1.17 ADJUSTING, CLEANING, AND PROTECTION

A. After completing installation, vacuum clean access flooring and cover with continuous sheets of reinforced paper or plastic. Maintain protective covering until the time of Substantial Completion.

B. Replace access flooring panels that are stained, scratched, otherwise damaged, or not complying with specified requirements.

THEORETICAL, STANDARD REQUIREMENT OF CEMENT FOR VARIOUS ITEMS OF WORK FOR GUIDANCE OF CONTRACTOR.

Sl. No.	Brief description of item	Unit	Qty. of cement in bags
1	Cement Concrete 1:5:10	Cum	2.60
2	Cement Concrete 1:4:8	Cum	3.40
3	Cement Concrete 1:3:6	Cum.	4.40 *
4	Cement Concrete 1:2:4	Cum	6.40 *
5	Reinforced Cement Concrete1:2:4	Cum.	6.40 *
6	Reinforced Cement Concrete:1:1½:3	Cum.	8.00 *
7	Reinforced Cement Concrete 1:1:2	Cum.	12.20 *

Note : For controlled concrete items like M-10, M-15, M-20, M-25 etc. the Consumption of cement will have to be assessed by the Engineer-in-charge on the basis of design mixes approved for individual work.

8	Brick Masonry in C.M. 1:4	Cum.	1.90
9	Brick Masonry in C.M. 1:6	Cum.	1.25
10	Half brick masonry in C.M. 1:4 with RCC 1:2:4 stiffeners	Sqm.	0.27
11	Half brick masonry in 1:4	Sqm.	1.21
12	a. R.R. Masonry in C.M. 1:6	Cum.	1.65
	b. C.R. Masonry in C.M. 1:6	Cum.	1.56
13	IPS Flooring (C.C. 1:2:4, Finished smooth)		
	a. 30 mm thick	Sqm	0.23
	b. 40 mm thick (smooth / broom finish)	Sqm.	0.30
	c. 50 mm thick	Sqm.	0.36
	(+) 20 mm thick skirting /dado in cm. 1:3	Sqm.	0.30
14	Hardonate flooring – 50 mm thick (C.C. 1:2:4, finished smooth)	Sqm.	0.41
15	Kota Stone :		
	a. Flooring (with lime mortar bedding pointed with matching cement slurry)	Sqm.	0.13
	b. Skirting with 20mm thick C.M. 1:3 backing	Sqm.	0.27
	c. Coping Sqm. 0.13 16 Terrazzo Tile :		

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Sl. No.	Brief description of item	Unit	Qty. of cement in bags
	a. Flooring (with lime mortar bedding and pointed with cement slurry)	Sqm.	0.18
	b. Skirting with 20 mm thick C.M. 1:3	Sqm.	0.28
	c. Treads, hydraulically pressed with C.M. 1:3 bedding	Sqm	0.37
	d. Treads in one piece	Sqm	0.28
	e. Risers, hydraulically pressed with C.M. 1:3 backing	Sqm.	0.28
	f. Risers in one piece	Sqm.	0.23
	a. Flooring 40 mm thick (28 mm C.C. 1:2:4 + 12mm with marble chips & powder)	Sqm.	0.26
	b. Skirting, 20mm thick (12mm C.M. 1:3 + 8 mm marble chips with cement & marble powder)	Sqm.	0.25
	White glazed tile flooring and dado over 20mm C.M. 1:3 bedding	Sqm.	0.31
	Cement tile :		
	a. Flooring (Lime mortar bedding)	Sqm.	0.18
	b. Skirting with 20 mm thick C.M. 1:3	Sqm.	0.28
20	Plaster skirting, 20 mm thick in C.M. 1:3	Sqm.	0.30
21	Cuddapah stone kitchen platform over 20mm thick C.M. 1:4	Sqm	0.30
22	Cuddapah stone window sill over 20mm thick C.M. 1:4	Sqm.	0.27
23	Fixing hold fasts in cement concrete 1:3:6 of size 300 X 100 X 150mm for door & windows	100 nos.	2.20
24	Cement plaster in C.M. 1:4 / 1:5 with neeru finish		
A.	Cement mortar 1:4		
a.	12 mm thick	Sqm.	0.1
b.	15 mm thick	Sqm	0.13
c.	20 mm thick	Sqm.	0.1
B.	Cement mortar 1:5		
a.	12 mm thick	Sqm.	0.09
b.	15 mm thick	Sqm.	0.11
c.	20 mm thick Sqm. 0.14 25 Cement plaster in C.M. 1:4 in two coats with neat cement punning		
a.	12 mm thick 10 mm + 5 mm (for ceiling)	Sqm.	0.18
b.	15 mm thick 15 mm + 5 mm (for internal walls)	Sqm.	0.22
25 .	Cement plaster in C.M. 1:4, 20 mm thick rough finish (for external brick / concrete surfaces)	Sqm	0.17
26.	Sand faced plaster, 20 mm thick (12 mm C.M. 1:4 + 8mm C.M. 1:3)	Sqm.	0.21
27	Rough cast plaster, 25mm thick (12 mm C.M. 1:4 + 13mm C.M. 1:3)	Sqm.	0.27
28	( ) 10 mm wide & 18 mm thick plain or		

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Sl. No.	Brief description of item	Unit	Qty. of cement in bags
	moulded cement mortar band in CM 1:4	100 RM	0.152
29 .	Cement plaster in C.M. 1:3 with water proofing compound finished smooth with neat cement		
	a. 12 mm thick	Sqm.	0.19
	b. 20 mm thick	Sqm	0.27
30 .	Cement pointing in C.M. 1:3		
	a. Ruled pointing (groove pointing)	Sqm.	0.02
	b. Raised & cut pointing	Sqm.	0.04
31.	Cement based waterproofing work		
	a. Terrace type average 115mm thick	Sqm.	0.45
	b. Basement type (Box type)	sqm .	0.70
	c. Basement type (surface)	Sqm.	0.60
	d. In sunken floor of toilets, chajjas, parapets	Sqm	0.30
	e. Brickbat coba in toilets, extra in roof terrace	Cum.	3.00
	f. O.H. water tanks	Sqm.	0.50
	g. Expansion joints	RM	0.50
32.	Damp proof course in CC 1:2:4		
	a. 25 mm thick	Sqm.	0.16
	b. 38 mm thick	Sqm.	0.24
33.	Laying R.C.C. spun pipes in C.M. 1:1 / 1:2		
	A. 100 mm dia	10 m	0.1
	B. 150 mm dia	10 m	0.12
	C. 250 mm dia	10 m	0.18
	D. 300 mm dia	10 m	0.22
	E. 450 mm dia	10 m	0.48
	F. 600 mm dia	10 m	0.64
34.	Cement mortar 1:4 screed		
	a. 20 mm thick	Sqm.	0 .30
	b. 50 mm thick	Sqm.	0.60

35. Chain link fencing / barbed wire fencing C.C. 1:3:4 pockets of 45 X 450 X 600 mm

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Sl. No.	Brief description of item	Unit	Qty. of cement in bags
	a. Angle iron posts	m	0.21
	b. Cement concrete 1:2:4 posts	m	0.37
36	Kerb stone in CC 1:3:6 of size 125 X 375 mm	m	0.21
37	Shahabad stone paving, pointed in C.M. 1:3 15 X 10 mm groove	Sqm.	0.02
38	Pointing & grouting stone pitching in CM 1:3	Sqm.	0.14

METAL CLADDING

1.2 1.0 GENERAL

1.1 WORK INCLUDED

A. This Section specifies the requirements necessary to furnish and install the metal cladding systems.

1.2 RELATED WORK

A. This Section shall be used in conjunction with, but not necessarily limited to, the other relevant specifications, the Drawings and the Contract Documents to establish the total requirements for the metal cladding.

B. CAUTION: Using this Section without including the above-listed items will result in omission of basic requirements

C. In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Purchaser, who shall then instruct the Contractor thereon. In the event of conflict regarding the metal cladding requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Purchaser in writing otherwise.

1.3 DESIGN CRITERIA

A. The work in this Section shall include the design, supply, installation, completion and maintenance of all metal cladding systems.

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B. The work in this Section shall include all accessories, parapet cappings, end cappings, soffit trims, reveal linings, jamb linings, sills, and the like, which may not be expressly indicated on the drawings, but which are necessary to provide a total metal cladding systems package, which interfaces in a complete manner with the adjacent building surfaces.

C. The proposed cladding systems shall include all required sealant systems, fixing systems, anchorage systems, and framing systems.

D. The Contractor shall provide all additional structural support systems, which are required for the proposed cladding systems, but not already provided under a separate contract, in the building structural works.

E. A set of "Only For Reference" structural works drawings form part of the Contract Documents. The Contractor will be deemed to have acquainted himself with the contents of these drawings and shall include in his tender any costs in respect to additional structural support systems which are not shown on these drawings, but which are required for the proposed cladding systems.

F. No consideration will be granted to any misinterpretation or unforeseen difficulties for which provision has not been made in the tender and this will in no way relieve the Contractor from the full execution of the Contract.

G. The Contractor shall note that the structural columns of the building superstructure, provided under a separate contract, are constructed of both cast in-situ and pre-cast concrete, with no provision for cast-in components for the anchorage systems of the proposed cladding systems.

H. Any cast-in anchorage components, which are required, shall be provided by and placed in position by the Contractor, ready for casting of concrete. Provide shop drawings of proposed anchorage systems.

H. The proposed cladding systems shall be so designed to meet or exceed the specified performances required for the prevailing local weather conditions. All fixings and joints shall be designed to provide for the expected thermal expansion and contraction, and to accommodate structural movement. The cladding systems shall be designed for air and water tightness, and moisture disposal.

J. The entire metal cladding systems shall be designed, constructed and installed to bond to the lightning protection systems as specified in Clause 1.12 Bonding of Cladding to Lightning Protection System.

1.4 QUALITY ASSURANCE

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A. The metal cladding shall comply with Authorities' requirements and regulations in force in Tamil Nadu and shall guarantee durability with particular attention to the following critical factors:

- Effects of atmospheric corrosion typical to the area.
- Avoid contact between dissimilar metals to avoid electrolytic corrosion.

1.5 WARRANTY

A. Provide a two (2) year warranty under the provisions of Conditions of Contract.

B. The Contractor and the Specialist Sub-Contractor shall jointly provide a two (2) year warranty for the completed works on its performance against any defects and failure as a cladding system, in particular to its prevention of corrosion.

1.6 ORDERING AND DELIVERY

A. The Contractor shall be responsible for timely ordering, scheduling, delivery, receiving, protection and installation of all materials necessary for completion of the Contract work, on site or in transit.

B. The Contractor shall be responsible for all carriage freight, insurance, damage, breakage, duties, customs, clearance, etc.

C. All materials to be used shall be new and unused. Proof of ordering and delivery including shipping documents may be required to be given by the Contractor on demand at the discretion of the Purchaser.

1.7 DELIVERY, STORAGE AND HANDLING

A. Deliver, store, protect and handle products to site.

B. Protect prefinished aluminum surfaces. Do not use adhesive papers or sprayed coatings, which bond when exposed to sunlight or weather.

C. The Contractor shall replace any defective, damaged, or broken cladding system components at his own expense and shall leave the systems clean and perfect on completion.

1.8 SUBMITTALS

A. Provide the following with the bid:

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Product Data
Proposed Work Programme
Method Statement

B. The Contractor shall submit with his bid design recommendations including relevant information and physical properties of the selected elements. Notwithstanding the acceptance of the design recommendations by the Purchaser, the Contractor shall remain solely responsible for the adequacy of all the works and shall make good any damages arising from any inadequate design or provision.

C. Shop Drawings: Submit shop drawings for fabrication and installation of cladding units and accessories. Include schedules, plans, elevations and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joints, trims, and other information to determine compliance with specified requirements.

Shop drawings shall give all pertinent information of construction method proposed, together with all required dimensions for proper fitting and connection with other work and materials, together with all special conditions as may be required to complete the installation.

Indicate system and component dimensions, framed opening requirements and tolerances, anchorage and fasteners, anticipated deflection under load, affected related work, and field welding required. Include components within assembly, weep drainage network, and expansion and contraction joint locations and details. Submit preliminary data with the bid. After preliminary submission, all shop drawings shall be computer generated, Autocad-14 files. Shop drawings, product data, and samples shall be submitted to the Purchaser for review and approval, before ordering materials and commencing fabrication.

D. Product Data: Submit manufacturer's specifications including finishes and materials; certified test data, where applicable; and installation instructions; for required products. Provide framing member structural and physical characteristics, dimensional limitations, special installation requirements. Provide data on components within assembly, anchorage and fasteners, sheets and panels, sealant systems and drainage systems. Data sheets shall fully describe properties of materials, processes and finishes.

E. Proposed Work Programme: The Contractor shall prepare and submit a detailed programme of all phases of the work, including but not limited to the design, submissions, testing, ordering, fabrication, transportation, installation and after care, for the completion of the whole works to the Purchaser following award. Submit a preliminary work programme with the bid.

F. Method Statement for Site Installation and Quality Control: The Contractor shall prepare and submit a detailed step by step method statement for approval. Submit a preliminary method statement with the bid. The method statement shall include:

1. Setting out.
2. Transportation of cladding and framing.
3. Structural surface preparation if necessary.
4. Installation of fixings, such as drilling, installation of shims, angle, plate, anchors and bolts, inclusive of testing (pull out test) of anchor
5. Installation of cladding and framing.
6. Method of replacement of damaged units, framing, etc, if necessary.

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G. Samples: The Contractor shall submit the following to the Purchaser for approval.

Samples of profiled metal sheet cladding.
Samples of aluminum flat panel cladding.
Samples of edge and corner details for cladding units.
Samples of support frame systems.
Samples of fixing and anchoring systems.
Samples of sealant systems.
Submit samples not less than 300 x 300mm in size illustrating finishes and materials.
Samples of coating for color.

H. Certificates: Submit manufacturer's certification, and other independent certification where applicable, that products meet or exceed specified requirements.

I. Test Reports: Submit substantiating engineering data, test results of previous tests by independent laboratory of the systems which purport to meet performance criteria, and other supportive data

J. Manufacturer's Instructions: Indicate special installation procedures.

K. Professional Engineer's Certificate: The design, fabrication and installation of the cladding systems shall be certified by the Contractor's Professional Engineer as safe, and in compliance with the regulations and requirements of the Authorities.

L. As-Built Drawings: During construction, the Contractor shall keep accurate records of the contract works, "as-built", on Autocad-14 construction drawings and details. This information shall be supplied to the Purchaser on Autocad-14 files, and shall form the basis of an "as-built" record of the construction of the building.

M. Prior to the issue of the Final Acceptance Certificate, the Contractor shall hand over to the Purchaser transparencies and Autocad-14 files of all as-built drawings, all Professional Engineer's certificates, and all other documents related to the Contract work, which will be required for the application for Temporary Occupation Permit.

1.9 SEQUENCING

A. Coordinate work under provisions of Conditions of Contract.

B. Coordinate work with installation of structural works, masonry works, waterproofing and roofing works, door / roller shutter works, and other cladding systems works.

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1.10 MOCK-UPS AND SAMPLES

A. The Contractor shall install mock-ups of the typical metal cladding systems in conjunction with the other systems as and when directed by the Purchaser for his review and approval. These mock-ups are to ensure proper installation and coordination. Once accepted these mock-ups will be used as acceptance yardsticks for all production units.

B. Provide mock-ups of system components as part of the exterior wall mock-ups. Assemble to illustrate component assembly including cladding materials, weep drainage system, moisture disposal, attachments, anchors, and perimeter sealant.

C. Samples of components, fixtures, etc, shall, where required, be submitted to the Purchaser for review and approval before commencement of work.

D. The Contractor shall replace or modify such mock-ups and samples if deemed necessary by the Purchaser, and such final mock-ups and samples shall be used as the basis of installation work. However, any agreement by the Purchaser to such mock-ups and samples does not exonerate the Contractor from any responsibility under the terms and conditions of the Contract.

E. Delays caused by late installation of mock-ups or submission of samples, or delays caused by modifications of mock-ups / samples due to repeated errors, will under no circumstances be construed as reasons for extension of the Contract Period.

F. If the Contractor requires early review and approval of any mock-up / sample to avoid delay in the delivery or installation of the works, he shall advise the Purchaser to such effect when submitting them.

G. The Contractor shall be responsible for any claims arising out of errors / omissions in samples and mock-ups.

H. The Contractor shall obtain and pay for permits required for the work.

1.11 VERIFICATION AND PERFORMANCE TESTING

General

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The Contractor will be required to verify that the work of this section meets the specified design criteria as well as all other conditions of this specification, through submission of shop drawings, calculations, data sheets, samples and test results.

Structural calculations, engineering data, and test data, shall be provided by a registered Professional Engineer, acceptable to the Purchaser.

Testing by independent testing laboratory or review of data by the Purchaser shall not avoid or reduce the Contractor's responsibility for performance of the work, nor relieve the Contractor of his responsibility to verify for himself that the work conforms to the intent of the Contract documents.

Data sheets shall fully describe properties of materials, processes, and finishes.

B. Performance Testing

1. After approval of structural calculations and shop drawings of the installation, the Contractor shall fabricate and erect test units of sizes and configurations acceptable to the Purchaser for testing.

2. Prior to fabrication of the test units, submit shop drawings of the test units and the test programmes for the Purchaser's approval.

3. Fabrication of test units and testing shall be carried out expeditiously and concluded in such time as not to delay fabrication and erection schedule.

4. The Contractor shall be responsible for all costs in connection with the performance testing.

5. If the test units fail to meet the performance requirements of this specification during testing, the Contractor shall make the necessary corrections to the test unit, and shall have the test unit re-tested until it passes the tests. The cost of corrections to the test unit, and of re-testing, shall be paid by the Contractor at no cost to the Purchaser.

6. The test programme shall require meeting the structural criteria at design load and at 1.5 overload (1.5 times the design load) at which no failure shall occur. The Contractor shall propose method of testing.

1.12 BONDING OF CLADDING TO LIGHTNING PROTECTION SYSTEM

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A. *The entire metal cladding systems shall be designed, constructed and installed so that all metal parts are electrically continuous. Sampling tests shall be carried out on site to verify the electrical continuity.*

B. ***Earthing bosses shall be provided behind the cladding and curtain wall panels / frames. Each earthing boss shall basically consist of an "ear" piece of the same material as the cladding and shall have a hole of 10mm diameter to permit connection of 25mm x 3mm bonding aluminum tapes. The Contractor shall provide earthing boss "ears" as shown in the Lightning Protection System Drawings. The bonding of the aluminum tapes and connection of the tapes to the earthing bosses will be provided / undertaken by the C43 contractor under a separate contract. A set of Lightning Protection System Drawings form part of the Contract Documents.***

C. ***At areas where the top of the cladding wraps round the parapet walls, 25mm x 3mm aluminum tapes will have to be mounted on the top of these claddings. To avoid puncturing the cladding, the Contractor is to supply and install saddles at every 600mmm along the top of the cladding. The details of the saddle are as shown in the Lightning Protection System Drawings.***

D. *The Contractor shall coordinate with the C43 contractor to ascertain the **exact positions of the earthing bosses to suit the lightning protection system***

1.3 2.0 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. To the extent that products of the following manufacturers meet or exceed specified requirements, the following are acceptable:

1 <u>For Main Wall Cladding System</u>:

Lloyd

Kirby

Metecno

2 <u>For Canopies and Sun Shades above doors and windows</u>

Aluminium Panel

Alucobond

Durobond

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B. Products of manufacturer's other than the above-listed will be considered for acceptance providing they meet the specified criteria and that the substitution requests are made in accordance with the Conditions of Contract.

2.2 TECHNICAL SPECIFICATIONS & INSTALLATION METAL WALL CLADDING SYSTEM

2.2.1 Supplying and Fixing Pre-Fabricated Rockwool Sandwich Panels For Walls Comprising Of

A. **Exterior sheet** : Profiled sheets with 1000 mm cover width, 35 mm crest height at 333 mm centres, made out of 0.5 mm TCT, 300 Mpa – yield stress, Galvalume Steel, 150 gsm Zinc – Aluminium alloy (as per ASTM : A 792) coating with 20 microns polyster coating.

B **Core Insulation Material :** High density Rockwool of 100 kg/cu.m density converted to lamellar in 80 mm thick and bonded to steel sheets with industrial Grade adhesive.

C. **Interior sheet :** Plain sheet with slight ribs, with 1000 mm cover width, made out of 0.5 mm TCT, 300 Mpa – yield stress, Bare Galvalume steel, 150 gsm Zinc-Aluminium alloy (as per ASTM : A 792) coating with 20 microns polyester coating.

D. Panel shall be supplied in 1 m width and in single length upto 12 m without any joints depending on site requirements.

E. **Fixing:** Panel shall have tongue and groove joint with concealed fixing system and shall be fixed on to the support system with self drilling and self tapping fasteners as per manufacturer's specification.

2.2.2 Supplying & Fixing Site Fabricated Double Skin Insulated Cladding Comprising Of

A **Exterior sheet** : Profile sheet 1000 mm cover width, 28 + 2 mm crest height at 195 centres made out of 0.6 TCT, 550 MPa – yield stress, Galvalume Steel, 150 gsm Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating.

B **Vapour Barrier** : Providing and fixing SIL / Polynum Refective Vapour Barrier of Supreme Industries Ltd,./ Polyon Barkai Industries between exterior sheet & Insulation.

C **Core Insulation Material** : Bonded Rockwool slabs of 64 Kg/cu.m density in 100 mm thickness encased in Black Polythene sheet.

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D **Interior sheet** : Profile sheet 1000 mm cover width, 28 + 2 mm crest height at 195 centres made out of 0.6 TCT, 550 MPa – yield stress, Galvalume Steel, 150 gsm Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating.

E **Fixing procedure** : The internal sheets shall be fixed to the purlins with self drilling self tapping fasteners, Z Sub-girts shall be 50 x 100x 50 and made out of 1.6 mm Galvanised steel sheet shall be provided at purlin locations and collinear to the purlin.

F. The insulation material shall be then laid between the Z sub-girts as exterior sheet shall then be fixed to Z Sub-girts with self drilling self tapping screws.

G. The wall cladding shall be complete with necessary flashings and wherever necessary

2.2.3 Supplying & Fixing Partitions with Pre-Fabricated Rockwool Insulated Panels comprising of

A. **Exterior sheet** : Plain sheets with micro ribs, made out of 0.5 mm TCT, 300 MPa – yield stress, Galvalume Steel, 150 gsm Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating over 5 microns primer.

B **Core Insulation Material** : High Density Lamellar Rockwool having 100 Kg/cu.m density in 80 mm thick.

C **Interior sheet** : Plain sheets with slight ribs, made out of 0.5 mm TCT, 300 MPa – yield stress, Galvalume Steel, 150 gsm Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating over 5 microns primer.

D Panels shall be supplied in 1000 mm width and in single length upto 12 m without any joints depending on site requirements and shall be laid vertically.

E **Fixing procedure** : Panels shall have tongue and groove joint with concealed fixing system and shall be fixed on to the support system with self drilling and self taping fasteners as per manufacturer's specification.

2.2.4 Supplying And Fixing Single Skin Partitions Comprising Of

A. **Partition sheet** : Profile sheet 1000 mm cover width, 28 + 2 mm crest height at 195 centres made out of 0.6 TCT, 550 MPa – yield stress, Galvalume Steel, 150 gsm Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating.

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B **Fixing procedure** : The partition sheets shall be fixed to the support structure with self drilling self tapping at crest locations with required overlaps

and partitions shall be complete with all necessary flashings wherever necessary.

2.2.5 Accessories

A **Cappings, Flashings and Trims** : Cappings, Flashings and Trims shall be made out of 0.7 mm TCT, 550 Mpa – yield stress, Galvalume Steel, 150 gsm, Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating.

B Cappings, Flashings and Trims may be formed to required shape and profile based on shop drawings in 2.5 m lengths of profile of external / internal sheet except where metal crapped foam fillers are used.

C **Fixing** : Cappings, Flashings and Trims shall be screwed to the external / internal sheeting with colour matched nylon head self drilling stitching fasteners at max. 500 mm centres along the length of the capping / flashing shall be installed at 90°C to the material being fastened.

D All longitudinal joints in cappings and flashings shall be overlapped a minimum of 50 mm and sealed with a continuous run of sealant.

2.2.6 Fixing Accessories :

A **Fastners**

12 – 14 x 90 Galvanised head self drilling screws with integral washers shall be used for fastening Pre-fabricated sandwich Panels for Wall Cladding.

12 – 14 x 55 Galvanised head self drilling screws with integral washers shall be used for Partition Sheets and fastening Double Skin Insulated Cladding.

10 -16 x 16 hexagonal head stitch fasteners shall be provided on side laps at 900 mm centers maximum.

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The fasteners shall generally confirm to ASTM A 3566 and shall be Hilti / Corroshield make.

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B **Profiled Foam Fillers** :

Profiled foam fillers shall be provided wherever required to close the voids between capping and the troughs of the external sheet so as to provide a weather tight exterior. These shall be made out of closed cell Polyethylene Foam die cut in profile to match external sheeting.

C **Gutters, down-spouts and down-takes**:

Gutters shall be provided wherever shown on the drawings, Gutters shall be fabricated and brake-formed from 3.15 mm Cold Rolled Steel conforming to IS 513.

For reinforcing gutters 38mm x 38mm x 3 mm angle shall be provided at 1000 mm c/c and support bottom of gutters to structural steel at 1000 mm c/c. longitudinal joints in gutter shall be continuously welded. The gutter surfaces shall be cleaned, and provided with 2 mm thick FRP coating.

The mouth of each down take pipe in the gutter shall be provide with a weld mesh screen with mesh size of 6 mm x 6 mm.

D Down spouts:

Down spouts will be either 200 mm dia or 300 mm dia UPVC pipes, as indicated in the drawings. Pipes shall have joints sealed and shall be laid plumb or to horizontal slope as indicated in drawings. Pipes shall be clamped to the columns / cladding runners by means M S clamps bent to shape and fixed by colour matched self drilling screws.

E Roof Openings:

Roof Openings with curbs shall be located at the place of openings. Wherever such framed openings are to be provided, the contractor shall provide flashing around such framed openings or curbs.

Flashings around such openings shall be formed of same material as flashings. The flashing shall normally be with a flat sheet of size adequate to overlap the roof sheeting all around the opening by at least 200 mm. This flat sheet flashing shall be sealed to roof sheeting at transverse laps with foam fillers and at side laps with continuous runs of sealant.

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Where required, curbs shall be fabricated from 14 G (2 mm) pre painted steel and flashed around the opening. All curbs shall be min. 300 mm high and shall feature a 50 mm wide MS angle flange around the top of the curb and a sloped drainage surround. Contractor shall furnish details of curb construction for approval prior to commencement of work. All structural loads will be supported by structural framing in roof by others.

Such framed openings may be provided-while the roof sheeting is being installed or subsequent to the roof sheeting installation

2.3 TECHNICAL SPECIFICATIONS AND INSTALLATION ALUMINIUM PANEL CLADDING SYSTEM FOR CANOPIES AND SUN SHADES

Description of the work: The aluminum composite cladding panels shall be fixed securely to the aluminum extrusion supports. The fixing shall allow for building tolerance adjustment. Where reinforcement of the panel is required, extruded aluminum profiles of suitable cross-section and strength shall bonded to the reverse side of the panel. Application of the bonding systems shall be strictly in accordance with the manufacturer's specification. No cladding element shall sustain permanent deformation or failure under loading equivalent 1.5 times of design wind pressure (positive and negative) specified. Deflection of any aluminum frame shall not exceed 1/500 of the clear span. All component parts shall be installed level, true to line with uniform joints and reveals.

Maximum deviation for vertical member: 3mm max. in an 5.2m run.

Maximum deviation for horizontal member: 3mm max. in an 8.5m run.

Maximum deviation form true alignment between the abutting member shall not exceed 1.0mm.

The tolerance of the width of the joints between two panels shall be maximum ± 2mm.

1.4 3.0 EXECUTION

3.1 See execution notes under various products and items listed under 2.2 above

3.2 SITE INSPECTION

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The Contractor is to examine and satisfy himself of other related-trades site conditions under which, the metal cladding is to be installed. Do not proceed until unsatisfactory conditions have been rectified. The Contractor shall compensate the owner any additional cost due to above reason.

All parts of the works done on site will be subject to inspection and shall be completed to the satisfaction of the Purchaser. The Contractor shall provide all facilities and assistance for inspection during the progress of the site works and until the completion of the contract.

SPECIFICATIONS FOR FAÇADE ALUMINIUM AND GLAZING WORKS

1.0 SCOPE OF WORK:

The scope of work under this sub-head includes structural analysis and design, preparation of shop drawings, setting out, fabrication, supply, installation, aligning, fixing and protection of the Fixed Glazing butt to butt joint, patch fitted door, Aluminum Composite Panel Cladding, Conventional curtain wall with butt flat & Cap, Skylight, Sunshade Louvers, Suspended Spider Glazing etc. it also includes guarantee for the works under this sub head as described above, for the system, materials and performance requirements for a period of 10 years form the date of completion of the work.

The work under this section includes cost of all inputs of labour, materials including wastages, hardware and accessories, transport & packaging, access equipments such as cranes or cradles, scaffolding etc., other enabling temporary structures and services and all other incidental charges, if any, not specifically mentioned here, but as required for complete design, engineering, fabrication, assembling delivery, anchorage, installation, protection of Fixed Glazing butt to butt joint, patch fitted door, Aluminum Composite Panel Cladding, Conventional curtain wall with butt flat & Cap, Skylight, Aluminium Louvers, Suspended Spider Glazing etc water tight and complete all in accordance with the true intent and meaning of the specifications and the drawings taken together regardless of whether the same may or may not be particularly shown on the drawings and / or described in the specifications, provided that the same can be reasonably inferred there from. All items as mentioned in the above scope of work shall be structurally and mechanically designed to achieve the architectural elevations as well as performance parameters specified herein. Anchorage shall include all supporting brackets and anchor fasteners, as required to rigidly secure the structural framing to the RCC/ Masonry / Structural steel members of the building.

Fixed Glazing butt to butt joint, patch fitted door, Aluminum Composite Panel Cladding, Conventional curtain wall with butt flat & Cap, Skylight, Sunshade Louvers, Suspended Spider Glazing etc described hereafter shall include but will not necessarily be limited to the following:

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a. Frames, fixed vision panels, spandrels, openable panels, as indicated in the drawings inclusive of all accessories and fittings. The scope of work also includes replacement of any defective and / or broken glass panes [single or insulated Glazed Units (IGUs) (breakage not attributable to vandalism or accident), evident due to condensation or dirt between the lites, failure of seal and damage to internal glass panes, staining, damage to the coating etc., for a period of 10 years from the date of completion of work for which nothing extra shall be payable. The decision of Engineer-in –Charge as regards for reason for breakage of glass shall be final and binding on the contractor.

b. Glass wool insulation panel fire stop (barrier) –cum –smoke seals, splice plates, connectors, sleeves, anti-buckling clips etc.

c. Access panels and inspection of lightening protection and test clamps including ironmongery and accessories to all the open able panels of curtain glazing, structurally glazed aluminum windows and doors etc.

d. Doors and vents where indicated.

e. Structural, weather and other silicone sealants within and all round the perimeter of all the work under this sub head for fabricating IGUs, holding the glass to the aluminum and glass to glass and to provide water tightness to the Fixed Glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, Glass Canopy, Sandstone Cladding, Aluminum Composite Panel Cladding, conventional Curtain wall with butt flat & cap, skylight, Sunshade Louvers etc.

f. Ozone resistant EPDM/ silicone gaskets, trims, shims, setting blocks, double sided spacer tape, spacer blocks, weathering strips etc.

g. All caulking, sealing and flashings including sealing at junctions with the building members.

h. All brackets, anchor fasteners, screws, inserts, nuts, bolts & washers, and attachments required for complete installation and fixing to the RCC, Masonry and / or the structural steel members of the building.

i. All accessories, fasteners, screws, nuts and bolts, toggles, rivets etc. and other items implied in the drawings and the specifications through are not specifically indicated or mentioned here

j. Isolation of all dissimilar metal surfaces as well as moving surfaces by use of suitable separators.

k. Electrolytic & Bimetallic isolation Different metals that are in direct contact and at risk of electrolytic and bimetallic corrosion shall be isolated form one another to prevent electrical connectivity and interment corrosion between the metals.

l. Aluminium composite panel Cladding and trimmers etc. as per the drawings.

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m. Engineering proposals, design, drawings and architectural data.

n. Shop drawings, engineering data and structural calculations (analysis & design) of all systems including aluminium structural framing, fasteners, sealants etc.

o. Scheduling and monitoring of the work.

p. Cost of all samples of the individual components mock-ups at site, field tests for individual materials/ components and the curtain wall system as a whole, as specified.

q. Coordination with work of other agencies / contractors employed on site.

r. Protection, during storage and construction until handing over the building for occupation, of Fixed Glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, glass canopy, sandstone Cladding, Aluminium composite panel cladding, conventional Curtain wall with butt flat & cap, skylight, sunshade louvers etc.

s. All final exterior and interior cleaning of the Fixed Glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, glass Canopy, Sandstone Cladding, Aluminium Composite panel cladding, Conventional Curtain wall with butt flat & Cap, Skylight, Sunshade Louvers etc before handing over the building for occupation to the satisfaction of the client.

t. Hoisting, staging, scaffolding and temporary enabling structural work/ services, cranes and cradles etc,

u. All the loading, unloading cartage, insurance and other incidental charges of any kind on account of transporting material to site / factory shipment etc., all complete as required for the execution of the work.

v. Specified tests, of necessary records, reports, logbook etc. including all certifications and documentation from the contractor/ curtain wall fabricator / specialist agency / manufacturer / suppliers/ processors etc. as specified.

w. Maintenance manuals. Design and performance guarantees in the enclosed formats.

x. Construction monitoring for regular quality control and technical inspection to ensure the work conforms to the approved shop drawings and details (including any modifications made after initial/ mock up testing) and acceptable standards of quality including monitoring the progress of the work.

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2.0 STANDARDS

2.1 RELEVANT CODES AND STANDARDS

The Contractor shall, as a minimum, comply with all the relevant regulations and with the current edition of the relevant Standards and Codes. Where conflicts arise between this specification and the code or standard listed below the more stringent requirement shall apply.

Materials and workmanship shall, in general, comply with the latest editions of the following standards as a minimum. The following standards are applicable to the design of the works covered by this specification. This is not an exclusive list and additional standards shall be referenced where required to meet the contract intent, Indian standards shall also be referred as appropriate.

ANSI Z97.1	Safety glazing material used in Buildings
ASTM C 1036	Specification for float glass
ASTM C 1048	Specification for Heat – treated Float Glass
ASTM E 774	Specification for sealed insulating Glass Units
ASTM C 864	Specification for compression Seal Gaskets
ASTM C 1115	Specification for Silicone Rubber Gaskets
ASTM C 920	Specification for Sealants
ASTM C 509	Specification for sealing material
CPSC 16 CFR 1001	Specification for safety glass
GTA Specification No. 89-1-6	Specification for environment durability for heat strengthened spandrel Glass with Applied opacifiers.
BS EN12150 BS EN14179 BS EN12600	Specification for toughened safety glass(Shatter proof) Heat-soak test Pendulum test
BSCP 118	Structural use of Aluminium

2.2 International Standards

In general, the Contractor shall follow either of the latest Indian/ international standards issued by BIS, ASTM, SAA, AAMA, BSS, ISO, & SSIR. The contractor

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shall state reasons for adopting particular standards / codes. Nothing in this clause shall relieve the contractor of his obligations to provide high standard of quality and workmanship as required.

2.3 Submittal of Codes

All relevant codes proposed to be followed for design, materials, installation and testing etc. shall be procured by the contractor and submitted to the Engineer –in – charge within 2 months of the issue of letter for commencement of work failing which these shall be purchased by the Engineer-in-charge and cost shall be recovered from the contractor.

2.4 Building Regulations

Design of the Fixed Glazing butt to butt joint, perforated metal sheet cladding, Patch fitted door, Glass Canopy, Sandstone Cladding, Aluminium Composite panel Cladding, conventional Curtain wall with butt flat and skylight , toughened safety glass(Shatter proof), sunshade louvers etc shall comply with all Government codes and regulations. The design for dead loads, wind loads, seismic loads, and other loads, shall comply with the requirements of the relevant National Building Code and Indian standard code / international standards, unless specified otherwise.

2.5 Structural Adequacy

- Installation:- Erect panel ,plumb. level and true. Panel shall be erected as per the approved shop drawings if required.
- Specialized Contractors are required to do this kind of job

Any façade system is to be structurally adequate to resist the loads that it will experience over its structural design life. These are considered to be the following:

2.6 Dead Loads

All Systems Are To Support And Transfer Their Own Self Weight And Other Associated Dead Loads To The Main Building Structure. The Contractor Will Be Required To Identify, Design, Co-Ordinate And Supply All Necessary Sub Frames And Secondary Structure

2.7 Live loads

Sunshades with a dimension greater then 600mm: 0.50kp

Canopy and skylights with access only for maintenance: 0.75kpa

Accidental human point load on sunshade and fins: 075kn in any direction

Horizontal barrier loads for walls to all occupied spaces: 0.36kn/m @ +1m

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Above Floor Finish Level

Large panels forming horizontal surface should be designed for multiple concentrated loads of 2.25 kN concentrated at any critical location.

Component	Material & Grade	Comments and other requirements
Glass	Following should be considered in the absence of any specific glass types noted during tender. Use Annealed –generally Use Head Strengthened (HS), if required to resist thermal stress, impact loads and comply regulations. Use Toughened, it HS is not adequate for strength and impact loads. Use Laminated, if required for safety	All toughened glass to be 100% head soaked. Base float glass (uncoated) to be any one of the following glass manufacturers • Asahi • Glaverbel • Guardian • Saint Gobain • Pilkington High performance coated glass to be any one of the following 1. Glaverbel 2. Saint Gobain 3. Pilkington 4. Viracon All glasses should be sourced form one single source. Glass type and thickness should satisfy respective standards and special conditions as mentioned in the tender.
Toughened safetyglass(Shatter proof)	Thermally toughened safety glass which has increased resistance to mechanical and	High performance safety glass to be any one of the following

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	thermal stresses than conventional annealed glasse.if the glass breaks; it fragments safely into small pieces with dulled edge.	2. Saint Gobain 3. Pilkington All glasses should be sourced form one single source. Glass type and thickness should satisfy respective standards and special conditions as mentioned in the tender.
Laminated glass	PVB laminated	Use PVB from saflex or Dupont Resin laminated shall to be acceptable as an alternate to PVB. Contractor should seek approval to use resin laminated glass.
Vision glass for curtain walls	Double glazing for typical areas single glazing for glass screens Thickness to suit strength	Must satisfy performance requirements toughened glass to be used for fire access panels and laminated inner lite adjacent to floors. Comply with local statutory requirements. Contractor to check for strength.
Spandrel Glass for curtain walls	Single glass –Heat strengthened thickness of glass to suit strength	Contractor to check for strength.
Glass for windows	Single glass- clear HS Thickness of glass to suit strength	
Framing Extrusions	Aluminium grade 6063 T5 or T6 min wall thickness 2.5 mm(struct) 1.5mm (non-struct). For coating refer to specification.	Use of thinner walls acceptable if supported by calculation and demonstration of extrusion quality. Contractor should seek prior approval to select Aluminium extruder. The proposed extruder shall only be acceptable upon review by consultants.

Spandrel air seal (back pan)	Alumiium (Minimum thickness 1.6mm) or zicalume (minimum thickness 1.2mm)	Thickness to be verified by calculation thickness should be adequate to achieve flat and consistent paint finish.
Alum panels (vertical and part of sunshades)	4 mm min. solid aluminium or composite panel fire rated with metallic finish.	Acceptable Aluminium composite panel brands: alplic, alucobond and Reynobond to be fire resistance (FR) grade PVDF coated

2.8 Wind Loads

The façade is to be designed in accordance with the minimum design pressures as per Indian Standard is 875 and appropriate pressure coefficients to be taken from the codes of practice. Basic wind speed is 47 m/s with terrain category 2, in any case the design with pressure shall not be less than 1.8kpa (including Factor of safety).

Dynamic response to wind effects and associated loads, deflections and vibrations are to be considered for all elements of the façade.

2.9 Maintenance Loads

All trafficable areas including parapet copings shall make allowance for maintenance loadings this will include person loadings, point loads and indirect loads form abseiling ropes.

2.10 Building Maintenance Unit (BMU) Loads

BMU restraint Points: 1.50 kN (in any direction)

BMU impact loads: in accordance with requirements of the equipment supplier.

2.11 Movement Related Loads

Any forces resulting from support structure movements, thermal effects, etc to be accommodated.

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2.12 Verification Methods

Acceptable evidence of adequacy may be provided by:

- Calculation
- Testing / demonstration – small prototypes, mock-ups and in-situ testing

Where the calculation will not be adequate to demonstrate the strength then façade contractor should carry out testing as instructed by consultant.

3.0 MATERIALS AND MINIMUM REQUIREMENTS

In addition to meeting the performance standards the following minimum material properties are required

Sealants	Silicone	Acceptable suppliers: dow corning, GE silicones Structural sealants must be clearly identified and suitable material used .
Backing Roads	Open cell	Closed cell accepted upon review of glazing method
Glazing Tapes	Breathable spacer tape	Double sided tape from Norton or 3m
Insulation	50 mm glass fibre insulation min. weight 60 kg/m^3	
Fire Proof	Glass fibre insulation Min. Weight 70 kg/m^3	
Stainless steel elements	Grade 316 linished finish with passivation	Large SS elements to be isolated from aluminium and mild steel frames
Fixings	External (visible) stainless steel grade 316 Inside of air seal: hot-dipped Galvanised steel	

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Screws & Bolts	Non-visible: Stainless steel gr 304 Visible grade 3160	
Pop Rivets	Stainless steel with stainless steel mandrel. Stainless steel grade 316 or higher	Aluminium rivets with SS madrels may be accepted providing the design allows for redundancy.
Concrete inserts/ cast –in	Hot –dipped galvanized steel.	
Anchor bolts	Stainless steel for building external (visible or non-visible area) Hot dip galvanized or electro galvanized for internal space i.e. inside airseal	Acceptable brands are fischer or hilti
Brackets (internal space, invisible) Brackets (visible)	Aluminium extrusions or hot dip galvanized mild steel with intermediate coat- Epoxy MIO 125 micom. Stainless steel (Gr. 316)	Systems and corrosion protection to consider finished and construction environment
Flashings	0.8mm (min.) aluinium sheet anodized or chromate	Thickness verified for wind loads
Sub- frames/ support frames (invisible) Panel Fixing brackets	Mild steel gr.43/50 Hot dip galvanized (min75um) in exposed conditions or in contact with envelope. Aluminium 6061 –T6 extrusions SS Gr. 316	Structural steel specifications apply concealed elements. Finish for exposed steelwork to be determined. Min 3.0 mm thk – anodized or chromate Min 1.5 mm thick

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Cladding Support frame (runners)	Aluminimum extrusion 6063 – T5 or SS Gr. 316	Min 3.0 mm thk- Hollow sections to be sealed
Backing wall waterproofing	Water resistant render or flexible membrane system	Full submissions, sample and testing to be conducted
Hardwares (handle, stay arms etc.)	Stainless steel	Acceptable brands are Alutec, Giesse, Sobinco and securistyle

4.0 CURTAIN WALL CONTRACTOR'S QUALIFICATIONS:

Work of this section shall be performed by one contractor, who is regularly engaged in the engineering, fabricating, finishing and installation of curtain walls including glazing and sealing of glass, comparable to work on this project. The contractor shall demonstrate to the satisfaction of Architect and Client that the has successfully performed comparable projects over the previous five years.

Subcontracting any part of the work is specifically prohibited, except for that which may be approved by the architect/ Client in writing prior to award of the contract. If approval is granted to subcontract installation and / or glazing, approval is contingent upon the supervision of his subcontractor (s) by the same full time supervisor who coordinates and supervises mock-up work and installation at the project.

5.0 PERFORMANCE GUARNTEE

5.1 The contractor shall be solely responsible for the design including shop drawings and performance of the installed Fixed Glazing butt to butt joint, perforated metal sheet cladding, patch fitted door , glass canopy, sandstone cladding, aluminium composite panel cladding, conventional curtain wall butt flat & cap, skylight, sunshade Louvers etc. the installations shall be guaranteed by the contractor during the guarantee period for materials used, workmanship, water tightness (wherever specified) structural design, performance requirements and other requirements as given in the specifications. The contractor shall submit in the enclosed format a written guarantee for the same for period of 10 years form the date of completion of the work. In addition, the contractor shall obtain and submit to the engineer-in-charge a similar back- to back guarantee for same duration from the specialist agency engaged by

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them.

5.1 The design , fabrication, supply and installation of the fixed glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, glass Canopy, sandstone cladding, aluminum composite panel cladding, conventional curtain wall but flat & cap, skylight, sunshade louvers etc. shall be to the best of national / international standards and shall be guaranteed to take the dead loads, wind and seismic loads, storms, air pollution, thermal stresses, building movements and the consequent deflection without compromising the performance characteristics. It shall be water tight wherever specified and prevent ingress of water / moisture , pollutants etc. further, the individual members of the structural framing shall not deflect beyond permissible limits as specified.

5.2 In addition, guarantee for 10 years for all the material used and their performances shall be submitted by the contractor. Besides the contractor shall obtain and submit similar back to back guarantees form the specialist agency and also from the manufacturers / suppliers / processors, as applicable, of various materials to the tune that they conform to the specifications and other criteria as specified herein for:

5.3 Glass (single or IGUs, Ceramic frit glass) substrate, coatings, assembly of IGUs etc.

5.4 Sealants- usage as per requirement of structural design and functional requirements, compatibility with different substrates and sealants, bite size, quality assurance during sealing of IGUs and fixing glass to glass and glass to the aluminium frame, etc.

5.5 EPDM/ silicone gasket –for ozone resistance and other properties as specified etc.

5.6 Aluminium material quality, tem penning requirements, suitability of aluminium grade and anodizing etc.

5.7 Anchor fasteners – suitability and strength requirements as per manufacturers' specifications etc.

5.8 Aluminium composite panel cladding- material quality and PVDF coating etc.

5.9 The contractor shall also submit guarantee in the enclosed format for replacement of glass during the guarantee period of 10 years form the date of completion of work. All the guarantees shall be submitted before final payment is released after the date of the completion of work and shall not in any way limit any other rights, which the engineer-in –charge may have under the contract.

6.0 CONTRACTOR'S RESPONSIBILITY FOR DESIGN

a. Architectural drawings and specifications only indicate the required basic dimensions, profiles and performance criteria..
b. The contractor shall design the Fixed Glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, glass canopy, sandstone cladding, aluminium composite panel cladding, conventional curtain wall with butt flat and cap,

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skylight, sunshade louvers etc. as per the parameters specified and submit the same for the approval of the Engineer –in –charge if required, the contractor shall re-design the system based on the directions of the Engineers-in-charge and / or based on the outcome of the mock up test(s) in the laboratory . Nothing extra shall be payable on these accounts.

c. The contractor may, at his own cost, have the option of minor modifications and addition of details and profiles subject to the approval of the Engineer -in –charge provided the architectural concept and performance requirements are achieved.
d. The acceptance by the contractor, of any modifications(s) suggested by the Engineer-in –charge, shall to relieve the contractor form his sole responsibility for the structural design and performance.
e. The contractor shall be solely and fully responsible for proper structural analysis and design for various load cases and their combination, fabrication, supply and installation and its satisfactory performance. This shall include design and proper sizing of all sections, meeting structural and architectural requirements. The anchor assemblies shall meet the performance and design requirements including installation of all inserts, clips, bracing and framework, as required for the proper anchorage to the structure, unless otherwise specified.
f. The approval of the structural design and shop drawings by the Engineer-in –charge shall not relieve the contractor from his responsibility for the structural design.
g. In the end, the contractor shall be solely and fully responsible for design of the Fixed Glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, Glass Canopy, Sandstone Cladding, Aluminium composite panel cladding, conventional curtain wall with butt flat & cap, skylight , sunshade Louvers etc. including providing and installing a stable, safe and completely water tight (wherever specified) Fixed glazing butt to butt joint, perforated metal sheet cladding, patch fitted door, Glass Canopy, Sandstone cladding, Aluminium composite panel cladding conventional curtain wall with butt flat & cap, skylight , sunshade louvers etc pergola with sun- Breaker Louvers etc. which shall perform to the required standards during the guarantee period of 10 years from the date of completion of work . The contractor shall indemnify the Department against all claims, of whatsoever nature, due to defective designing and / or non-performance during the 10 years guarantee period. The provisions of this clause shall not in any way limit the rights of the Engineer-in- charge to take action under other clauses of the contract agreement .

7.0 SHOP DRAWINGS

7.1 Submittals

Within seven days after the issue of letter for commencement of works / letter of intent (LOI), the contractor shall prepare and submit preliminary shop drawings by incorporating necessary modifications to the architectural drawings and within seven days thereafter should submit four (4) copies of all shop drawings to the Engineers-in- charge for review and final approval. Based on the review of the preliminary shop drawings, the Fabricator to order all necessary raw materials such as extrusions, glass, Aluminium Composite panel etc.

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The review of the shop drawings by the Engineer-in –charge shall be limited to their conformity to the architectural and structural design concept & specification. However the approval of the shop drawings by the Engineers –in –charge shall not relieve the contractor from any of his responsibilities and requirements as specified herein.

No fabrication shall be taken up until the shop drawings and all other related submittals, documentation, certification, samples and the mock-up for that work have been reviewed and approved by the Engineers –in charge.

On approval by the Engineer-in –charge, the contractor shall submit four (4) sets of the approved shop drawings to the Engineer –in –charge within two (2) weeks thereafter. After the completion of work, two (2) sets and two (2) CD's each of the as built drawings incorporating final approved shop drawings incorporating all the approved modifications, if any, as per the site requirements, shall be submitted to the Engineer-in-charge within fifteen days from the date of completion of work.

7.2 Scope of Shop Drawings

Shop drawings shall incorporate scaled and dimensioned plans, elevations, section and complete size details for all the woks including site survey as carried out.

The shop drawings shall indicated the required dimensional profiles and modules, function design and performance standards and in general cover all dimensional and details required fabricating and installing the curtain wall at site.

The contractor shall verify and co-ordinate the shop drawings with all applicable and inter-related trades, drawings and specifications.

All dimensions/ modules, etc, shall be field checked and the drawings shall be modified, if required based on actual measurements at site.

Details shall show and specify all metal sections, types of finishes, areas to be sealed and sealant materials gaskets, applicable construction materials including fasteners and welds, all anchorage assemblies and components, fabrication and reaction tolerances for the work.

All details shall be subject to the approval of the Engineer-in-charge, after incorporating all the modifications as suggested by the Engineer-in-charge or otherwise.

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All dimensions / modules, etc, shall be field checked and the drawing shall be modified, if required, based on actual measurements at site.

Details shall show and specify all metal sections, types of finishes, areas to be sealed and sealant materials, gaskets, applicable construction materials including fasteners and welds, all anchorage assemblies and components, fabrication and erection tolerances for the work.

All details shall be subject to the approval of the Engineer-in-change, after incorporating all the modifications as suggested by the Engineer-in-change or otherwise.

7.3 Section Profiles

Profile adjustments, if required as per the site conditions may be allowed by the Engineer-in-change subject to meeting the architectural / performance requirements. However, this shall be carried out only with the approval of the Engineer-in-charge Provided that the general design and intent of the drawings and specifications are also maintained. Also, if any new / non-standard aluminium extruded section is required as per the site requirement and /or the architectural drawings for the structural, functional and / or aesthetic reasons, the contractor shall procure the same from the approved manufacturers for the aluminium sections, even if it entails preparing new die, etc. Nothing extra shall be payable to the contractor on this account.

8.0 STRUCTURAL DESIGN AND CALCULATIONS

A The contractor / specialist agency shall employ a competent curtain wall design engineer to design the system and its components for Fixed Glazing butt to butt joint, Perforated mental sheet cladding, Patch fitted door, Glass Canopy, Sandstone Cladding, Aluminium Composite Panel Cladding, Conventional curtain wall with butt flat & Cap, Skylight, Sunshade Louvers etc. The design engineer shall have fich past experience of successfully designing and detailing of similar system installed for at least three prestigious projects during last five calendar years.

B During the design stage, the contractor shall interact actively with the Engineer-in-charge, concerning all aspects of design and detailing and shall obtain the relevant information on architectural and structural design parameters concerning the structure, probable deflections and other building movements etc.

C The design shall account for all design considerations, codal provisions, possible loads & building movements as well as the movements within and relative movements etc. The Contractor shall obtain the approval of the Engineer-in-charge for the provisions made in his design in this regard.

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D The Contractor shall submit his detailed structural analysis and design calculations for the system and cach of its typical and non-typical components along with the shop drawing for the approval of the Engineer-in-charge. Also, the contractor shall guarantee that his design ensures the structural stability, safety, integrity and required performances against all natural forces, superimposed loads, building movements and environmental effects, as specified and as called for under various codal provisions. The contractor shall also get the structural design checked and the shop drawing vetted from the Principals of the curtain wall system.

E The Contractor shall modify his design as required by the Engineer-in-charge for meeting the various provisions as specified and resubmit the same for the approval till the design is finally approved. Nothing extra shall be payable on this account.

F The Grade of R.C.C. in the building structure is as specified in DESIGN DATA. The Contractor shall design anchorages (capacity and numbers of the anchor fasteners) for this grade of concrete.

G The contractor shall submit for record only the glass manufacturer's wind pressure analysis and thermal analysis showing that the specified maximum deflection and probabilities of breakage are not exceeded.

9.0 DOCUMENTATION AND CERTIFICATION

The contractor shall obtain and submit to the Engineer-in-charge the manufacture's certificate for compliance of the various parameters for the various components to be used in the work (under this sub head) as per the manufacturer's specifications. A copy of the manufacturer's test report, for each lot of material procured and supplied for the work shall also be obtained from the respective manufacturers and submitted to the Engineer-in-charge for the record.

9.1 Glass and Glazing Documentation

a. Before taking up the work, the glass manufacturer / processor shall submit written certification for the review of the Engineer-in-charge and record, stating that all glass (properties as specified such as U value, shading coefficient, light transmission, light reflection (internal as well as external), solar factor, relative heat gain etc.) and glazing requirements (including heat strengthening / toughening, fabrication of IGUs including sealants etc.) as per the shop drawings are recommended by them for use related to their specific applications and design parameters and that they are in conformity with the specifications.

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b. Tests shall be carried out for glass, including properties after processing, for each lot supplied, by the glass manufacturer / processor in his factory / laboratory or any other accredited international laboratory at his own cost and the copies of the test results shall be obtained by the contractor and submitted to the Engineer-in-charge for the record.

9.2 Sealant Documentation

a. All sealant applications must be clearly designated on shop drawings. Before taking up the work, a master sealant schedule shall be prepared and submitted to the Engineer-in-charge specifying materials, special instructions and application procedures.

b. The sealant manufacturer shall certify that all sealant requirements as detailed and specified on the shop drawings have been reviewed and approved for use related to their specific applications and / or design intent, compatibility to adjacent materials and in conformity with specifications including size of the structural silicone bite for tensile and shear requirements and for silicone sealant and its compatibility with adjacent materials shall also be certified by the sealant manufacturer. The sealant manufacturer shall also certify against streaking of the silicone. The contractor shall obtain certificate from the sealant manufacturer for the performance requirements of the sealant during the 10 years guarantee period from the date of completion of work and submit the same to the Engineer-in-charge for records.

c. The sealant manufacturer shall certify that the Contractor / specialist agency / curtain wall fabricator / glass processor has followed all application and quality assurance procedures recommended by them for fabrication and installation of panels including cleaning, curing sealant storage, application at a controlled temperature and clean dust free environment as per the relevant specifications. The sealant manufacturer shall also carryout field and laboratory tests on the samples of the sealants being used and collected from the factory / workshop of the Contractor / specialist agency / glass processor like butterfly test and snap-time tests on pump start –up, peel and pull adhesion tests by deglazing, compatibility test, water immersion test, UV chamber test, weather meter test, etc., as specified and submit the copies of the test reports to the Engineer-in—charge for records.

d. The deglazing tests for sealant adhesion on the working glazed panels shall be performed by the sealant manufacturer / supplier who shall certify the test results and the quality assurance of the same.

e. The contractor shall maintain a log book indicating the details of glass panel number, batch number of silicone sealants and the solvents including its shelf life

and the name of the operator who fabricated the particular panel which shall be reviewed periodically and countersigned by the sealant manufacturer who shall also carry out deglazing test on the working panels, as specified and prepare deglazing summary report. The logbook and the deglazing summary report, duly authenticated by the sealant manufacturer, shall handed over to the Engineer-in-charge, for record, after the completion of the work. This logbook and the deglazing reports shall also be available for the review by the Engineer-in-charge during the execution of the work.

9.2 Aluminum Composite Panel Cladding Documentation

Before taking up the work, the Aluminum Composite Panel manufacturer shall submi9t written certification for the review of the Engineer-in-charge and record, stating all the quality parameters and other characteristics for the material for the use related to their specific application and design parameter and that, they are in conformity with the specifications. The test shall be carried out for the PCDF / lumiflon-based fluoropolymer resin coating to the Aluminum Composite Panel Cladding material, for each lot supplied, by the manufacturer in his factory / laboratory or any other accredited international laboratory at his own cost and the copies of the test results shall be obtained by the contractor and submitted to the Engineer-in-charge for the record.

9.2.1 Quality Control Documentation

a. The contractor shall submit the methodology and quality assurance statement for in-plant and job site quality control procedures for the review and approval of the Engineer-in-charge before taking up the work to ensure the design integrity and performance of the curtain wall with Fixed Glazing butt to butt joint, Perforated matel sheet cladding, Patch fitted door, Glass canopy, Sandstone Cladding, Aluminum Composite Panel Cladding, Conventional curtain wall with butt flat & Cap, Skylight, Sunshade Louvers etc.

b. Documentation shall include schedules, details and / or schematic explanatory sketches cross-referenced to the shop drawings, data sheets, etc., all as required to assess methods and materials and to ensure that both the fabrication and quality assurance procedures.

c. The Engineer-in-charge or his authorized representatives may, time to time, visit the plant / workshop / factory to inspect material, fabrication and quality assurance procedures.

i) The in-plant quality control procedures shall include but not be limited to the following items:

- Material : Visual inspection and other field tests.
- Fabrication : Tolerances, Joinery, Sleeves, screws, cleats, etc.

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- Finish Match : Approved finished and controls required for matching the exposed surfaces.
- Assembly : Welds, fasteners, sealants, gaskets, separators, setting blocks,
- Glazing, structural silicone bite.
- Protection : Handling, protection, shipping

ii) The job site quality control procedures shall include, but not necessarily be limited to the following items:

- Anchorage : Lines, grades and related tolerances.
- Installation : Setting-out, tolerances, finish match, connections, Sleeves, flashing, welds, fasteners, sealants, bolt Tensioning.
- Sealing : As recommended by the respective manufacturer.
- Storage : As recommended by the respective manufacturer(s) / processor(s).
- Protection & : As recommended by the respective material Cleaning manufacturer(s) / processor(s).

10.0 SAMPLES AND MOCK-UP AT SITE

10.1 Submittals

The samples of the following materials together with detailed technical data / catalogues shall be submitted in triplicate for review of the Engineer-in-charge and approval along with the shop drawings. Any omission of an item or items which require the compliance of the contractor shall not relieve him from responsibility.

a) Aluminum Composite Panel : Each type and thickness 600 mm x 600 mm

b) Aluminum extrusions: Each section: 500mm long

c) Glass : each type 600mm x 600mm.

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Gaskets, separators, glass setting blocks, double sided spacer tape, backer rods etc: Each section or unit, 300mm long or unit.

Brackets of each type (material), anchor fasteners and connecting devices: Each type and size.

Finish samples: After approval of the final finish coating, the Engineer-in-charge shall be provided with three (3) approved samples.

Window and door ironmongery and accessories, as applicable.

Finished flashing samples.

Finished samples of shadow boxes, fire stop (barrier)-cum smoke seals

Structural and weather silicone sealant

In addition to the above, the contractor shall also submit one sample of the assembly of various components forming a typical fixing detail of curtain glazing, composite panel Cladding, structurally glazed aluminum window.

10.2 Mock-up at site

Before the fabrication and site installation is taken up and within Seven (7) days after the approval of shop drawings by the Engineer-in-charge, the Contractor shall prepare mock-ups of the proposed curtain wall and fix it on the building. The width of the mock up for curtain glazing (including one openable panel) shall be not less than three typical adjoining wall panels / units. The height of the mock up test sample of curtain glazing shall be not less than 1 storey high and must contain full height modules. The mock up shall also incorporate all types of in fill panels, fire stop / barrier-cum-smoke seal, flashings, shadowbox, bracketry, hardware and fixtures etc. A typical mock up shall also be put up for the aluminum windows including fittings and the other hardwares. The mock ups shall be essentially put up at site for final approval of all materials and installation details by the Engineer-in-charge. The mock up shall not form part of the work and shall not be paid for separately. It shall be dismantled and taken away by the contractor at this own cost, with the prior permission of the Engineer-in-charge. Nothing extra shall be payable on this account.

10.3 Maintenance Manual

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After the completion of the work, the contractor shall submit two (2) copies each, of detailed procedures for the periodic inspection, maintenance and cleaning of all the Fixed Glazing butt to butt joint, Perforated metal sheet cladding, Patch fitted door, Glass Canopy, Sandstone cladding, Aluminum Composite Panel Cladding, Conventional Curtain wall with butt flat & Cap, Skylight, Sunshade Louvers etc to the Engineer-in-charge.

11.0 WORK SCHEDULE

Immediately after award of work, the Contractor shall submit the final programmed micro work schedule/Bar chart for the completion of whole of the work under this sub-head Fixed Glazing butt joint, Perforated metal sheet cladding, Patch fitted door, Glass Canopy, Sandstone Cladding, Aluminum Composite Panel Cladding, Conventional Curtain wall with butt flat & Cap, Skylight, Sunshade Louvers etc including submittals, mock up test at site as well as in the approved laboratory (optional), approvals, fabrication, supply of materials at site & installation etc.

12.0 STORAGE, PROTECTION AND PROGRAMME

a. The contractor shall submit a schedule of procedure for inspection during installation so as to control and assure quality on the job site.

b. The Contractor shall submit a detailed method statement for the protection of the surface of the Fixed Glazing butt to butt joint, Perforated metal sheet cladding, Patch fitted door, Glass Canopy, Sandstone Cladding, Aluminum Composite Panel Cladding, Conventional Curtain wall with butt flat & Cap, Skylight, Sunshade Louvers etc during delivery and erection, with description as to when the protection can be removed. The protection paper shall not be kept for more than 45 days and shall be replaced with the fresh protection paper. Further, it shall not have acid content, which in any manner may affect the substrate.

c. The Contractor shall submit fortnightly reports on supplying, fabrication and installation as directed by the Engineer-in-charge.

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

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i. Factory made Aluminum composite panel Cladding / glazing units and / or their components shall be transported, handled and stored in a manner to preclude damage of any nature.

II. Accessory materials, required for erection at the site shall be delivered in labeled containers by the Manufacturer / supplier.

III. All units or components, which are cracked, bent, chipped, scratched or otherwise defective and unsuitable for installation shall be removed and replaced by the contractor. Nothing extra shall be Payable on this account.

METAL ROOFING

1.0 PART 1 – GENERAL

1.1 WORK INCLUDED

This Section specifies the requirements necessary for the supply and installation of the metal roofing system including rain water gutter.

1.2 RELATED WORK

This Section shall be used in conjunction with, but not necessarily limited to, the other relevant specifications, the Drawings and the Contract Documents to establish the total requirements for the metal decking.

CAUTION: Using this Section without including the above mention will result in omission of basic requirements.

In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Purchaser, who shall then instruct the Contractor thereon. In the event of conflict regarding the metal decking requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Purchaser in writing otherwise.

1.3 DESIGN CRITERIA

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The metal roofing system shall be in accordance to architectural requirement. The system shall be so designed to meet the specified performances for the prevailing local weather conditions and local Authority requirements.

QUALITY ASSURANCE

Materials used in the works shall be of best qualities and kinds specified herein and equal to approve sample. Delivery shall be made sufficiently in advance to enable samples to be taken and tested if required. No materials shall be used until and unless approved by the Purchaser/ Architect. Materials not approved shall be immediately removed from the work site at the Contractor's expense.

The Contractor is to examine and satisfy himself of other related-trades condition on site under which, the metal roof is to be installed. Do not proceed until unsatisfactory conditions have been rectified. The Contractor shall be responsible for any additional cost incurred and compensate the owner due to above reason.

WARRANTY

a) The Contractor shall provide a warranty for the completed work against any defects of materials and workmanship, which comprise a water-tightness for the roof.

b) Warranty shall be for a period of 20 years and shall begin following Date of Substantial Completion of the project.

c) Warranty shall include all labour and material necessary to complete required activities and repairs, including joint scaling, penetration seals, bolts, and anchoring and grounding details.

1.6 SUBMITTALS

1.6.1 SAMPLES

The contractor shall submit the following to the Purchaser / Architect for approval before any work in this trade commences on site:

a) Sample of Metal Roofing System panel system;

b) Sample of fixing system elements.
(In compliance with the rules and requirements of the local authorities and to comply with FM guidelines for I-90 wind uplift).

1.6.2 SHOP DRAWINGS

The Contractor is to submit a design recommendation to the Purchaser/ Architect with the preliminary shop drawings showing fabrication and installation of the works including relevant information about the selected elements.

The shop drawings shall provide details including cuts, connections, and holes. The drawings shall show the size, length and type of each member, details for accessories, and method of assembly.

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The Contractor shall submit to the Purchaser/ Architect with the final shop drawings for approval. Once approved, the typical installation details shall be fabricated strictly in accordance with the shop drawings.

After preliminary submission, all shop drawings shall be computer generated, AutoCad-2007 file.

During construction, the Contractor shall keep accurate records of the contract works, "as built", on AutoCad-2007 construction drawings and details.

Prior to the issue of the Final Acceptance Certificate, the Contractor shall hand over to the Purchaser transparencies and AutoCad-2007 files of all as-built drawings, all Professional Engineer's certificates, and all other documents related to the Contract work, which will be required for the application for Temporary Occupation Permit.

1.6.3 *PROFESSIONAL ENGINEER'S CERTIFICATE:*

The design, fabrication and installation of the metal roof system shall be certified by the Contractor's Professional Engineer are safe and the systems are in comply with the manufacturer's requirements and the rules and requirements of the local authorities.

1.6.4 *QUALITY ASSURANCE DOCUMENT*

Materials used in the works shall be of best qualities and kinds specified herein and equal to approve sample. Delivery shall be made sufficiently in advance to enable samples to be taken and tested if required. No materials shall be used until and unless approved by Purchaser/ Architect. Materials not approved shall be immediately removed from the work site at the Contractor's expense.

Materials shall be transported, handled and stored on site or elsewhere in such a manner as to prevent damage, deterioration or contamination all to the satisfaction of the Purchaser/ Architect. The Purchaser/ Architect reserve the right to inspect any materials to be used on the works at any time and at any place of storage.

Unless otherwise specified or otherwise agreed by the Purchaser/ Architect, materials shall comply with the appropriate Standards, In compliance with the rules and requirements of the local authorities and to comply to FM guidelines for I-90 wind uplift with preference for materials of local manufacture. Where the requirements of the relevant standards are in conflict with this Specification then this Specification shall take precedence accordingly.

1.6.5 *DELIVERY AND WORK SCHEDULE*

The contractor shall submit a proposed delivery and installation work schedule for approval.

2.0 PART 2 - PRODUCTS

2.1 *MATERIALS*

2.1.1 *METAL ROOFS*

The metal roof has to comply with the authorities requirements in force in Tamil Nadu and has to be durable with particular attention to the following critical factors:

- Effects of atmospheric corrosion typical to the area.
- Electrolytic corrosion where dissimilar metals are used in contact.

a) The metal roof shall comprise of components that result in a "Klip Lock" type Metal Roofing System with insulation and complete with all accessories and installed at centres in accordance with the manufacturer's instructions.

b) The metal roof material shall be 0.60 mm (BMT) in Hi Tensile (min tensile strength 550 Mpa) with a standard Z275 underside galvanised coating in accordance with ASTM A 525 G90 and Polyester Powder Coated on top side.

c) Contractor to provide a direct twenty (20) year's guarantee against any failure of the roofs system in particular water-leakage.

2.2 *METAL ROOFING*

2.2.1 Supply and Fixing Single Skin Insulated Roofing System Complete Comprising Of

1.5 PROFILED STEEL ROOFING SHEETS

The Hi Tensile steel "Klip Lock" roof panel is designed for quick installation and easy handling. It is Hi Tensile galvanised steel sheet and is lightweight, trapezoidal ribbed. It has bold, widely spaced ribs and is available in long length, governed only by local transport considerations. The Contractor shall check whether the design for the roof and comply with the Manufacturer's specification before the actual installation of the structure.

The Contractor's Professional Engineer shall provide the metal roof structural plans and fastening details, supported by design calculations accordingly. The design shall satisfy the Performance Requirements for its intended use and that include withstanding wind load, Air and weather tightness. The Contractor's Professional Engineer shall submit a **Certificate of Supervision** not later than two (2) weeks after completion of the works, stating that he has carried out such supervision works and is fully satisfied that the works have been constructed with such structural plans and fastening details.

The accessories such as capping, fascia capping, valley gutter, longitudinal and transverse parapet flashing cap flashing and corner moulds and others shall be shown in the drawings where applicable.

EXTERIOR SHEET: Kliplock Sheets of 500 mm cover width with 47 mm crest height at 250 mm centres and made out of 300 Mpa - yield stress, 0.6 mm TCT Galvalume Steel, 150

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gsm Zinc – Aluminium alloy (as per ASTM : A 792) coating with 20 microns polyester coating.

CORE INSULATION MATERIAL: Bonded Rockwool Blankets as per IS : 8183 100 mm thickness (in 2 layers) with Aluminium Foil on one side and with flaps for over lapping at the joint locations.

VAPOUR BARRIER: Providing and fixing SIL / Polynum refective Vapour Barrier of Supreme Industries Ltd,. / Polyon Barkai Industries between exterior sheet & Insulation.

WELD MESH: Galvanised weld mesh of Size: 75 mm x 75 mm x 2 mm (120 gsm / Sqm Zinc coating mass) provided over the purlins.

FIXING PROCEDURE: The kliplock sheet shall be fixed to the purlins with special clips made out of 1.6 mm thick GI Steel with 120 gsm Zinc coating. The clips shall be fixed to the purlins with 10 – 16 x 25 mm self drilling wafer head fasteners as per manufacturer's specification and drawing.

The Kliplock sheets shall be site rolled and shall be in single length from roof ridge to eve or eve to ridge. Kliplock sheets shall be provided with suitable end closures made out of Closed cell polyethylene foam at the ridge locations. The insulated Roofing shall be complete with all accessories like ridge cappings, flashings at eve locations and barge locations and wherever necessary.

HANDLING AND STORAGE: To preserve the surface, handling should only be carried out using clean, dry, gloves. Do not slide sheets over rough surfaces or each other. Packs of the claddings in all finishes must be kept dry in transit, and stored clear off the ground under cover to prevent water and / or condensation being trapped between adjacent surfaces.

2.2.2 Supply & Fixing Of Pre-Fabricated Rockwool Sandwich Panels For Roofing Comprising Of

A *Interior sheet : Plain sheets with slight ribs, with 1000 mm cover width, made out of 0.5 mm TCT, 300 Mpa – yield stress, Galvalume Steel with150 gsm Zinc – Aluminium alloy (as per ASTM : A 792) coating with 20 microns polyester coating.*

B *Core Insulation Material : High density Rockwool 100 kg/cu.m density converted to Lamellar in 80 mm thick and bonded to steel sheets with Industrial Grade Adhesive.*

C *Exterior sheet : profiled sheets with 1000 mm cover width, 35 mm crest height at 333 mm centre, made out of 0.5 mm TCT, 300 Mpa – yield strength, Galvalume Steel, 150 gsm Zinc-Aluminium alloy (as per ASTM : A 792) coating with 20 microns polyester coating.*

D *Panel shall be supplied in 1 m width and in single length upto 12 m without any joints depending on site requirements.*

E *Fixing Procedure : The panel shall be fixed on to the purlins with self drilling fasteners and with necessary overlap as per manufacturer's specification. The Insulated Roofing shall be complete with all accessories like capping, flashings wherever necessary*

2.2.3 Accessories

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A *Cappings, Flashings and Trims: Cappings, Flashings and Trims shall be made out of 0.7 mm TCT, 550 Mpa – yield stress, Galvalume Steel, 150 gsm, Zinc-Aluminium Alloy (as per ASTM : A 792) coating and with 20 microns of Polyster coating.*

Cappings, Flashings and Trims may be formed to required shape and profile based on shop drawings in 2.5 m lengths of profile of external / internal sheet except where metal crapped foam fillers are used.

Fixing: Cappings, Flashings and Trims shall be screwed to the external / internal sheeting with colour matched nylon head self drilling stitching fasteners at max. 500 mm centres along the length of the capping / flashing shall be installed at 90°C to the material being fastened.

All longitudinal joints in cappings and flashings shall be overlapped a minimum of 50 mm and sealed with a continuous run of sealant.

B *Fixing Accessories:*

12 – 14 x 125 Galvanised head self drilling screws with integral washers shall be used for fastening Pre-fabricated Sandwich Panels for Roofing.

12 – 14 x 90 Galvanised head self drilling screws with integral washers shall be used for fastening Pre-fabricated sandwich Panels for Wall Cladding.

12 – 14 x 55 Galvanised head self drilling screws with integral washers shall be used for Partition Sheets and fastening Double Skin Insulated Cladding.

10 -16 x 16 hexagonal head stitch fasteners shall be provided on side laps at 900 mm centers maximum.

The fasteners shall generally confirm to ASTM A 3566 and shall be Hilti / Corroshield make.

C *Profiled Foam Fillers:*

Profiled foam fillers shall be provided wherever required to close the voids between cappings and the troughs of the external sheet so as to provide a weather tight exterior. These shall be made out of closed cell Polyethylene Foam die cut in profile to match external sheeting.

D *Gutters, down-spouts and down-takes:*

Gutters shall be provided wherever shown on the drawings, Gutters shall be fabricated and brake-formed from 3.15 mm Cold Rolled Steel conforming to IS 513.

For reinforcing gutters 38mm x 38mm x 3 mm angle shall be provided at 1000 mm c/c and support bottom of gutters to structural steel at 1000 mm c/c. longitudinal joints in gutter shall be continuously welded. The gutter surfaces shall be cleaned, and provided with 2 mm thick FRP coating. The mouth of each downtake pipe in the gutter shall be provide with a weldmesh screen with mesh size of 6 mm x 6 mm.

E *Down spouts:*

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Down spouts will be either 200 mm dia or 300 mm dia UPVC pipes, as indicated in the drawings. Pipes shall have joints sealed and shall be laid plumb or to horizontal slope as indicated in drawings. Pipes shall be clamped to the columns / cladding runners by means M S clamps bent to shape and fixed by colour matched self drilling screws.

F *Roof Openings:*

Roof Openings with curbs shall be located at the place of openings. Wherever such framed openings are to be provided, the contractor shall provide flashing around such framed openings or curbs. Flashings around such openings shall be formed of same material as flashings. The flashing shall normally be with a flat sheet of size adequate to overlap the roof sheeting all around the opening by at least 200 mm. This flat sheet flashing shall be sealed to roof sheeting at transverse laps with foam fillers and at side laps with continuous runs of sealant.

Where required, curbs shall be fabricated from 14 G (2 mm) pre painted steel and flashed around the opening. All curbs shall be min. 300 mm high and shall feature a 50 mm wide MS angle flange around the top of the curb and a sloped drainage surround. Contractor shall furnish details of curb construction for approval prior to commencement of work. All structural loads will be supported by structural framing in roof by others. Such framed openings may be provided-while the roof sheeting is being installed or subsequent to the roof sheeting installation.

3.0 PART 3 -- EXECUTION

3.1 INSTALLATION

3.1.1 INSPECTION & PREPARATION

Verify all field coordination and examine the substrates before start of installation. Beginning of installation means acceptance of the existing conditions. Do not install roofing sheets that are observed to be warped, bowed, deformed or damaged to such extent as to impair strength or appearance.

3.1.2 FASTENING METHOD

See in item 2.2 above. The panels shall be fixed to the purlin supports with a minimum of 4 fasteners per panel (i.e.: one fastener at every alternative valley). All stainless steel self tapping fasteners shall attach with EPDM washer for metal deck fastening. All sheeting shall be fixed in a workman like manner, leaving the job clean. All debris (nuts, screws, cuttings, filings etc.) shall be cleaned off daily.

The Contractor shall be responsible for supplying the following information to the Purchaser / Architect and obtain his approval prior to commencing work.

a) Detail to scale showing all relevant information in connection with roof sheeting such as falls, sumps, expansion joints, pipe penetration roofs, etc.

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It shall be the responsibility of the Contractor to inspect all roof construction prior to the laying of roofing including checking work by others connected with roof coverings such as cover flashing, etc. All labour employed on roofing shall be skilled roofing labour. A section of roof shall be laid as prototype for final approval of the Purchaser/Architect of materials and method of fixing before the main work is put in hand. This shall involve showing all detailed fixings as required for the whole of the roofing.

3.1.3 END LAPS

Should the end laps occur and necessary to use two or more shorter sheet to provide full length coverage, the locking ribs of the "Klip Lock" Hi Tensile steel Roofing System shall have sufficiently flexibility to enable it to be end lapped.

3.2 TESTS

The Purchaser / Architect reserves the right to take samples of roofing materials or accessories delivered or used at the work and subjects them to chemical or physical tests to determine if they have comply with specifications. If they do not comply, the materials shall be rejected and any materials that have been built shall be taken out and removed from the site immediately. Any replacement of proper materials in compliance with the specification shall at Contractor's expense.

3.3 GUARANTEE OF WATERTIGHTNESS

The Contractor shall lodge with the Purchaser / Architect a 20-years guarantee against any defects in the workmanship, quality of materials, installation, water- tightness or deterioration in the works. Under this guarantee, the Contractor will be required to make good any defects and will be responsible for any consequential loss directly attributable to any leakage during the warranty period.

If, in the opinion of the Contractor, the foregoing Specifications are insufficient for him to give the Guarantee then he shall allow for upgrading as he shall deem necessary to enable him to do so guarantee.

3.4 CLEANING

On completion, clean down all roofs, including underside of metal decking, remove all debris, loose nails, mortar droppings, paint drips, clean out gutters and outlets and test all roofing and down pipes and leave the whole roofing and rainwater disposal system clean and water-tight to the complete satisfaction of the Purchaser / Architect.

Ensure that metallic particles are swept off sheet surfaces immediately following any cutting, drilling.

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LOUVERS

1.6

1.7 PART 1 -- GENERAL

1.1 WORK INCLUDED

This Section specifies the requirements necessary to supply and install metal wall louvers, complete with frames, sealant, bird and insect screens, and blank-out panels.

1.2 RELATED WORK

A. This Section shall be used in conjunction with, but not necessarily limited to, the other relevant specifications, the Drawings, the Schedules, and the Contract Documents to establish the total requirements for metal louvers.

B. CAUTION: Using this Section without including the above-listed items will result in omission of basic requirements.

C. In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Purchaser, who shall then instruct the Contractor thereon. In the event of conflict regarding metal louver requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Purchaser in writing otherwise.

1.3 DESIGN CRITERIA

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A. General

Install louvers to permit passage of air at required velocity, without blade vibration or noise, without exceeding the maximum permissible static pressure loss. The Contractor shall provide written support material with respect to system performance with respect to, airflow performance, rain defense performance, and structural loading under design conditions of the building. Comply with AMCA and BSRIA test requirements.

B. References

AMCA 500 (Air Movement Control Association) – Test Method for Louvers, Dampers, and Shutters.
BSRIA (Building Services and Research Information Association) – Test Method for Determining Louver Effectiveness.

C. Airflow Design Requirements

1. Maximum Permissible Pressure Drop: 50 Pa at 2.5 m/s face velocity

D. Rain Defense Performance Requirements

The Contractor shall submit certified test data to the requirements contained in the 4th edition of HEVAC Technical Specification - Laboratory testing of weather louvers when subjected to simulated rain, based on a 1m x 1m unit tested at rain fall rate of 75mm/hr and with wind directed at louver face of velocity of 13m/s.

Test data will show the following:

1. Single-Bank Louvers: The louver system shall achieve a 'C' rating providing proof of a rain performance effectiveness of between 80.0% to 94.9% for airflow velocity between 0 m/s to 3 m/s (ventilation rate of 0 to 3 m3/s/m2) and a maximum allowed penetration of simulated rain of 15.0 litre/hr/m2.

2. Double-Bank Louvers: The louver system shall achieve a 'B' rating providing proof of a rain performance effectiveness of between 95.0% to 98.9% for airflow velocity between 0 m/s to 3 m/s (ventilation rate of 0 to 3 m3/s/m2) and a maximum allowed penetration of simulated rain of 3.75 litre/hr/m2.

E. Structural Requirements

1. Wind Load Requirements: In accordance with requirements of applicable building code.

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F. Appearance Requirements

1. Louvers shall match in appearance, configuration, profile and elevation with the louvers in the approved samples.

G. The Contractor shall provide factory pre-assembled louver units, and take into consideration the necessity of fixing the louver units to the sub-surface structure from outside the wall.

H. Where louvers are operable, they shall be equipped with a fixed frame.

I. Where louver doors are incorporated in louver units, they shall be concealed frame louver doors.

J. The work in this Section shall include the design, supply, installation, completion and maintenance of all metal louver systems, including metal louvers used as wall/screen cladding systems.

K. The work in this Section shall include all accessories, parapet cappings, end cappings, soffit trims, reveal linings, jamb linings, sills, and the like, which may not be expressly indicated on the drawings, but which are necessary to provide a total wall/screen cladding systems package, which interfaces in a complete manner with the adjacent building surfaces.

L. The proposed wall/screen cladding systems shall include all required sealant systems, fixing systems, anchorage systems, and framing systems.

M. The Contractor shall provide all additional structural support systems, which are required for the proposed wall/screen cladding systems, but not already provided under a separate contract, in the building structural works.

N. A set of "Only For Reference" structural works drawings form part of the Contract Documents. The Contractor will be deemed to have acquainted himself with the contents of these drawings and shall include in his tender any costs in respect to additional structural support systems which are not shown on these drawings, but which are required for the proposed wall/screen cladding systems. No consideration will be granted to any misinterpretation or unforeseen difficulties for which provision has not been made in the tender and this will in no way relieve the Contractor from the full execution of the Contract.

O. The Contractor shall note that the structural columns of the building superstructure are constructed of concrete, with no provision for cast-in components for the anchorage systems of the proposed wall/screen cladding

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systems. Some structural beams are of post-tensioned concrete construction, requiring special coordination of the cladding anchorage systems.

P. Any cast-in anchorage components, which are required, shall be provided by and placed in position by the Contractor, ready for casting of concrete. Provide shop drawings of proposed anchorage systems.

1.4 QUALITY ASSURANCE

Performance Requirements: Where louvers are indicated to comply with specific performance requirements, provide units whose performance ratings have been determined in compliance with Air Movement and Control Association (AMCA) Standard 500.

AMCA Certification: Where indicated, provide louvers with AMCA Certified Ratings Seal evidencing that product complies with above requirements.

Field Measurements: Verify size, location and placement of louver units prior to fabrication, wherever possible

Shop Assembly: Coordinate field measurements and shop drawings with fabrication and shop assembly to minimize field adjustments, splicing, mechanical joints and field assembly of units. Pre-assemble units in shop to greatest extent possible and disassemble as necessary for shipping and handling limitations. Clearly mark units for re-assembly and coordinated installation.

All the elements shall be determined with due consideration to the India Standard Codes of Practice.

The Contractor is responsible for the calculation of the maximum admissible panel span.

The manufacturer of the louvers shall be a company with minimum 10 years experience in supply and installation of AMCA-certified and BSRIA-certified louvers. All aluminum alloy components shall comply with BS 1470.

1.5 SUBMITTALS

A. Provide the following with the bid:

1. Product Data
2. Proposed Work Programme
3. Method Statement

B. Preliminary Shop Drawings: The Contractor shall submit with his bid design recommendations with preliminary shop drawings showing fabrication and installation of the works including relevant information and physical properties of the selected elements.

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Notwithstanding the acceptance of the design recommendation by the Purchaser, the Contractor shall remain solely responsible for the adequacy of all the works and shall make good any damages arising from any inadequate design or provision.

C. Product Data: Submit manufacturer's specifications; certified test data, where applicable; and installation instructions for required products, including finishes and materials.

D. Samples: Submit samples not less than 300 x 300mm in size illustrating finishes and materials, and colour of exterior and interior surfaces.

E. Manufacturer's certificate: Submit manufacturer's certification that products meet or exceed specified requirements.

F. Shop Drawings: Submit shop drawings for fabrication and erection of louver units and accessories. Include plans, elevations and details of sections and connections to adjoining work. Indicate materials, finishes, fasteners, joints, trims and other information to determine compliance with specified requirements.

After preliminary submission, all shop drawings shall be computer generated, on Autocad-2008 files. Shop drawings, product data, and samples shall be submitted to the Purchaser for review and approval, before ordering materials and commencing fabrication.

G. Proposed Work Programme: Submit a work programme for approval by the Purchaser.

H. Method Statement for Site Installation and Quality Control: The Contractor shall prepare and submit a detailed step by step method statement for approval. Submit a preliminary method statement with the bid.

1.6 SEQUENCING

A. Coordinate work under provisions of Conditions of Contract.

B. Coordinate work with mechanical ductwork.

C. Coordinate work with installation of masonry works flashings.

1.7 WARRANTY

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A. Provide a two (2) year warranty under the provisions of Conditions of Contract.

B. The Contractor and the Specialist Sub-Contractor shall jointly provide a two (2) year warranty for the completed works on its performance against any defects and failure. Include warranty coverage on PVdF Kynar 500 finish.

1.8 PART 2 – PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Not used

2.2 MATERIALS

A. Aluminium Extrusions: ANSI /ASTM B221 alloy 6063-T5, or BS 1474 6063-T6. Extrusions shall be not less than 0.081 inches (2.06 mm) thick.

B. Aluminum shall have stoved polyester powder coat finish.

C. Fastenings: Stainless steel philips flat head machine screws.

D. Anchors and Inserts: Stainless steel anchors and inserts for exterior installations.

E. Bituminous Paint: SSPC Paint 12 (cold-applied asphalt mastic).

2.3 METAL FINISHES

A. General:

1. Comply with NAAMM "Metal Finishes Manual" for finish designations and application recommendations, except as otherwise indicated. The colours of the louvers shall be Ultramarine Blue, RAL colour code no. and Silver Metallic, RP 25 Alucobond colour code no. as specified in the finishes schedules. The Contractor shall submit samples of the coloured louver types for the Purchaser's approval.

2. Apply finishes in factory after products are assembled.

3. Protect finishes on exposed surfaces with protective covering, prior to shipment.

4. Remove scratches and blemishes from exposed surfaces which will be visible after completing finishing process.

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B. Preparatory Work:

1. Grind welds flush and smooth.

2. Polish exposed weld marks to match the approved sample.

4. Use pretreatment complying with FS TT-C-490 to remove grease, oil, dirt and other foreign matter.

C. High-Performance Coating: AA-C12C42R1x (cleaned with inhibitive chemicals, conversion coated with an acid-chromate-fluoride-phosphate treatment and painted with fluorocarbon coating specified below).

Fluorocarbon Coating: Inhibitive thermo-cured primer, 0.2 mil (0.05 mm) minimum dry film thickness, and thermo-cured fluorocarbon coating containing "Kynar 500" resin, 1.0 mil (0.25 mm) minimum dry film thickness.

2.4 FABRICATION

A. Fabricate units rigid, neat in appearance, to true alignment, free from defects, warp or buckle. Dress exposed welds for smooth flush appearance.

B. Finished louver shall be free of exposed horizontal and vertical intermediate mullions. Provide mitered corners on louvers.

C. Provide continuous blade type louvers.

D. Joint frame members to one another and to fixed louver blades by welding. Maintain equal blade spacing to produce uniform appearance.

E. Blades shall be equally spaced at 2" (51mm) o.c.

F. Provide custom extruded aluminum sill to duplicate the spacing of top blade to head section. Profile and finish to match the approved louver sample.

G. Provide sill extensions and loose sills in metal and finish matching louvers.

H. Powder coated blade metal louvers and frames of aluminum alloy complying with BS 1470.

I. Proper brackets made of extruded aluminum shall be provided to ensure installation of the louvers.

J. Fasteners and anchors of aluminum or stainless steel type.

2.5 LOUVERED DOGHOUSE

A. Roof: 12 gauge (2.75 mm) 3003-H14 Aluminum sheet with condensation barrier on underside.

B. Unless otherwise specified, provide same louver profile in the penthouse as specified elsewhere, in matching metal and finish.

C. Posts: Aluminum support angles, of size as required to support penthouse.

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2.6 LOUVER SCREENS

A. Fabricate screen frames in metal and finish matching louver units to which secured. Frames shall consist of U-shaped metal for permanently securing screen mesh.

B. Use bird screen of 1/2inch (12.7 mm) sq. mesh, 0.063 inch (1.6 mm) aluminum wire.

C. Locate screens on inside face of louvers, unless otherwise indicated. Secure screens to louver frames with machine screws, spaced at each corner and in between at 12" (300mm) o.c.

2.7 ACCESSORIES

A. Flashings: Of same material as louver frame. Thickness as required to avoid warping, buckling and "oil canning"; minimum 0.081" (2.06 mm) thick.

B. Sealants: Type as specified in Division 7.

C. Fasteners: Manufacturer's standard, compatible with items.

D. Blank-Out Sheeting on Interior of Louver: Metal, finish and colour matching louver and frame.

2.8 MANUFACTURED LOUVERS

The louver types shall be single, double and triple bank louvers. All louvers, mullions, frames, blades, braces, and associated components shall be manufactured to give the required rigidity and strength stipulated by AMCA and BSRIA.

PART 3 – EXECUTION

3.1 INSPECTION

A. Examine conditions, verify that prepared openings and flashings are ready to receive work, and that opening dimensions are as indicated on the shop drawings.

B. Beginning of installation means acceptance of existing conditions.

3.2 PREPARATION

A. Coordinate setting out drawings, templates, instructions and directions for installation of anchors, which are to be embedded in, or attached to, concrete, masonry or steel construction.

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3.3 INSTALLATION

A. Install louver assembly in accordance with manufacturer's instructions.

B. Install louvers level and plumb.

C. Install flashings and align louver assembly to ensure moisture is shed from flashings and to ensure diversion of moisture to exterior.

D. Install insect screening to interior of louvers as indicated on louvers schedule.

E. Install perimeter sealant and backing rod.

F. Where indicated, prepare louvers to receive ductwork attachment.

G. Where louvers are fixed over a backing wall, the surface behind shall be painted black by the Contractor.

H. Locate and place louver units plumb, level and in proper alignment with adjacent work.

I. Use concealed anchors wherever possible. Provide stainless steel washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.

J. Form tight joints with exposed connections accurately fitted together. Provide reveals and openings for sealants and joint fillers.

K. Repair finishes damaged by cutting, welding, soldering and grinding operations required for fitting and jointing. Restore finishes so there is no evidence of corrective work. Return items to shop, make required alterations, and refinish entire unit, or provide new units.

L. Protect galvanized and non-ferrous metal surfaces from corrosion or galvanic action by application of a heavy coating of bituminous paint on surfaces which will be in contact with concrete, masonry or dissimilar metals. Wherever possible, the design of the installation shall avoid dissimilar metals being placed in contact with, or in close proximity of, each other.

M. Adjust operable louvers for freedom of movement of control mechanism. Lubricate operating joints.

N. Clean surfaces and components.

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O. Refer to Division 7 sections for sealants in connection with installation of louvers.

3.4 CLEANING

At completion, clean surfaces and components to remove foreign substances.

TOILET COMPARTMENTS AND CUBICLES

1.9

1.10 PART 1 - GENERAL

1.1 WORK INCLUDED

A) This Section details works, which shall be carried out by the Interior Works Sub-Contractor, hereinafter referred to as the Contractor, in this Section. The Interior Works Sub-Contract is hereinafter referred to as the Contract, in this Section.

B) This Section specifies the requirements necessary to furnish and install the partition walls and accessories of the toilet cubicles.

1.2 RELATED WORK

A) This Section shall be used in conjunction with, but not necessarily limited to, the other relevant specifications, the Drawings, the Room Finishes Schedule, and the Contract Documents to establish the total requirements for compartments and cubicles in toilets.

B) CAUTION: Use of this Section without including the above - listed items will result in omission of basic requirements.

C) In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Purchaser, who shall then instruct the Contractor thereon. In the event of conflict regarding compartments and cubicles requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Purchaser in writing otherwise.

1.3 DESIGN CRITERIA

A) The partition walls and doors of the cubicle toilets shall be sandwich construction made from 3mm high-pressure laminated decorative panels, with CFC free polyurethane foam core or Phenolic core board.

B) Doors and all exposed edges of the laminate to be chamfered.

C) Fully framed in extruded anodized aluminium E6/EU1with perimeter head stabilising section and continuous side fixing channels.

1.4 QUALITY ASSURANCE

A) The partition walls and doors of the toilet cubicles shall be of approved manufacturer. The integral laminate contracts dimensionally at low humidity and expands at high humidity: therefore enlarged holes for the stay-bolts and adequate spaces on the joints will have to be calculated at the time of project engineering and the cost of this will be borne by the Contractor.

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B) Manufacturer Qualifications: company specializing in plastic laminate toilet cubicles with 5 years' minimum documented experience.

C) Installer Qualifications: company with 5 years' minimum documented experience and approved by manufacturer.

1.5 WARRANTY

The Contractor and the Specialist Sub-contractor shall jointly provide a two (2) years warranty for the completed works on its performance against any defects and failure.

1.6 SUBMITTALS

A) Product Data - Submit manufacturer's technical data for materials, fabrication, finishing, fastenings, hardware, and installation details.

B) Shop Drawings - Submit shop drawings indicating elevations of partitions, thickness of material, fastenings, proposed method of anchoring, size and spacing of anchors, details of construction, hardware, fittings, mountings and other related items and installation details.

C) Samples - Submit samples of materials to be used, and colours and patterns selected for verification.

D) Proposed Work Schedule.

1.7 MOCKUPS

Provide a field sample of 1 partition wall complete with the partition door, urinal divider with all accessories for approval. Locate where directed.

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1.12 PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A) Formica, century ply, green lam/ply, kitpy

B) Others approved equivalent manufacturers meets the standards and specifications will be evaluated by the owner.

2.2 MATERIALS

A) Toilet cubicles shall be floor mounted, and made of 15mm thick solid compact laminate board with rough matt finish on both sides, complete with extruded anodized aluminium E6/EU1 or powder coated aluminium round profile framing. The panels shall be water, scratch and impact resistant. Accessories shall be made of Nylon.

B) The system shall be constructed of pilasters fixed with 45mm diameter extruded aluminium profile on both edges. The vertical profile shall have a rebated edge that supports the door and a rubber strip to cushion the door closing.

C) Adjustable leg (partition columns) shall be of 40mm diameter stainless steel with nylon sleeve and collar, slotted into the vertical profile and secured firmly to the floor with stainless steel screws and plug. It shall be covered with a nylon rosette after fixing.

D) Top portion of the pilasters shall be slotted with a 45mm x 86mm extruded aluminium head-rail with rounded corner. The head-rail shall run the total length of the cubicle front with fixing point at the pilaster vertical profiles for rigidity and stability.

E) Revolving doors, flush fitting shall be 600 mm wide (unless otherwise specified) and complete with the following accessories:

1) Nylon spring hinges or Stainless steel hinges (3 nos. per door)

2) Nylon pull Door knob handle on both sides of door

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3) Nylon lock fitting with vacant/engaged sign Indicator lockset with emergency opening

4) Coat hook

F) Toilet cubicles shall have a continuous dividing partition without joint.

G) The total height of the toilet cubicles shall be 2150mm high inclusive of a 150mm from floor clearance.

H) Color of the toilet cubicles shall be selected by the Purchaser/Owner, and the entire installation work shall be carried out by the Specialist.

I) Color Scheme: To be selected from the standard range.

J) The solid compact laminate shall comply with the following physical properties:

Physical Property	Test Method	Test Results
Gross density	DIN 53479	1430 kg/m^3
Thickness tolerance	DIN 16926	+0.50 mm
Thickness swelling (24 hr at 20+1°C)	EN 317	0.07%
Flexural strength	BS 2782	> 120 N/mm^2
Tensile strength • Machining direction • Cross direction	BS 2780	> 130 N/mm^2 > 90 N/mm^2
Resistance to surface wear (Taber Abrasion Test)	BS 2782	> 500 cycles（周）
Resistance to impact	EN 438-2	> 40 N
Resistance to scratching	EN 438-2	> 4 N
Resistance to colour change in Xenon arc light	EN 438-2	> Blue wool standard No. 6

K) The solid compact laminate shall comply with the following physical properties:

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Physical Property	Test Method	Test Results
Resistance to immersion in boiling water (100°C for 2 hrs) • increase in weight • increase in thickness	EN 438-2	0.44% 0.28%
Resistance to dry heat (180°C)	EN 438-2	No visible change
Resistance to cigarette burns	EN 438-2	No visible change
Resistance to steam (1 hr)	EN 438-2	No visible change
Coefficient of thermal conduction	DIN 52612	0.3 W/mK
Surface hardness • Micro-Vickers	Mitutoyo MVK-G1 Hardness tester 100 gf load	60

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2.3 ACCESSORIES

- Coat hooks: Hewi No. 520.501 or equivalent
- Paper holder: Hewi No. 450 or equivalent
- Toilet brush: Hewi No. 475.2.171 or equivalent
- Door stopper
- Anti-trap protection: soft PVC finger guard fitted on the hinges side

1.14

1.15 PART 3 – EXECUTION

3.1 EXAMINATION

A) Before covering wall and ceiling framing with finish materials, examine framing to ensure that backing plates and structural framing have been installed in such position as to receive all attachment screws.

B) Verify spacing of plumbing fixtures to ensure compatibility with installation of compartments.

C) Do not start the work of this section until all deficiencies have been corrected.

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3.2 INSTALLATION

Install toilet compartments as shown on the shop drawings and in accordance with the manufacturer's specifications and printed installation instructions. Install toilet compartments and doors in a rigid and substantial manner, straight and plumb, with horizontal lines level.

Secure pilasters to supporting members and level, plumb and tighten the installation with leveling nuts and washers.

Secure panels and doors to pilasters so that exterior faces are flush. Secure panels to walls, with 2 stirrup brackets located near the top and bottom of each panel, or with one continuous bracket from top to bottom. At concrete or masonry walls, fasten brackets with screws and expansion anchors. At light gauged steel-framed walls, fasten brackets with toggle bolts into metal studs or backing plates fastened directly to the studs. At wood framed walls, fasten brackets with wood screws into wood studs or blocking fastened directly to the studs.

3.3 ADJUSTING AND CLEANING

Hardware Adjustment - After installation, carefully adjust hardware for proper operation. Set hinges on in-swing doors to hold open approximately 30 degrees from the closed position when unlatched. Set hinges on out-swinging doors to return to the fully closed position. Adjust doors so that bottoms of doors are level with the bottoms of the pilasters when the doors are in the closed position.

Cleaning - Clean compartments and doors upon completion and leave free from imperfections.

3.4 INSPECTION

A) The installation shall be subject to inspection and shall be completed to the satisfaction of the Purchaser, failing which the works shall be rectified at the Contractor's expense.

TOILET ACCESSORIES

PART 1 - GENERAL

1.1) WORK INCLUDED

A) This Section details works, which shall be carried out by the Interior Works Sub - Contractor, hereinafter referred to as the Contractor, in this Section.

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The Interior Works Sub - Contract is hereinafter referred to as the Contract, in this Section.

B) This Section specifies the requirements necessary to furnish and install the following:

1) Toilet and washroom accessories.

2) Attachment hardware inclusive Hand dryer – Hand Paper holder.

3) Provisions for handicapped toilets (i.e. grab bars).

1.2) RELATED WORK

A) This Section shall be used in conjunction with, but not limited to, the other relevant specifications, drawings and Contract Documents to establish the total requirements.

B) CAUTION: Use of this Section without including all of the above-listed items will result in omission of basic requirements.

C) In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Purchaser, who shall then instruct the Contractor thereon. In the event of conflict regarding requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Purchaser in writing otherwise.

1.3) REGULATORY REQUIREMENTS

A) Conform to National Standards and Codes of Practice (India) for installing work.

B) Positioning of provisions for handicapped toilets shall conform to Authorities' regulations and requirements.

1.4) QUALITY ASSURANCE

A) Manufacturer Qualifications: Company specializing in toilet accessories with 5 years' minimum documented experience.

B) Installer Qualifications: Company with 5 years' minimum documented experience and approved by manufacturer.

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C) The installation shall be subject to inspection and shall be completed to the satisfaction of the Purchaser, failing which the works shall be rectified at the Contractor's expense.

D) Installed toilet and washroom accessories for handicapped shall comply with Authorities' requirements.

1.5) WARRANTY

A) The Contractor and the Supplier shall jointly provide a 2 (two) years warranty covering the performance of the material and installation against any defects and failure.

B) The guarantee shall cover the cost for damages, which include the cost of finishing materials and labor required replacing the entire defective installation, should the installation be proven defective.

1.6) DELIVERY, STORAGE, AND HANDLING

A) The Contractor shall be responsible for timely delivery, storage, protection and installation of all materials necessary for completion of the works.

B) Deliver materials to project site in manufacturer's original packaging, clearly identified as to type and location.

1.7) SEQUENCE AND SCHEDULING

A) Coordinate the work of this Section with the placement of internal wall, tiling, toilet partitions, etc. to receive anchor attachments.

1.8) SUBMITTALS

A) Provide the following in addition to the standard requirements:
   1) Product data on accessories describing size, finish, details of function and attachment methods.

   2) Two samples of each component illustrating color and finish.

1.9) MOCK UPS

A) Provide field samples when requested, illustrating installed accessories.

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B) Locate where directed.

C) Accepted sample may not remain as part of the work.

PART 2 - PRODUCTS

2.1) MATERIALS

A) Products quality for accessories shall conform to the following:

1) Sheet Steel: ASTM A366.

2) Stainless Steel Sheet: ASTM A167, Type 304.

3) Tubing: ASTM A269, stainless steel, Type SS316.

4) Adhesive: two-component epoxy type, waterproof.

5) Fasteners, Screws, and Bolts: stainless steel.

2.2) FABRICATION

A) Weld and grind smooth joints of fabricated components.

B) Form exposed surfaces from single sheet of stock, free of joints.

C) Form surfaces flat without distortion. Maintain flat surfaces without scratches or dents.

D) Paint back of components where contact is made with building finishes to prevent electrolysis.

E) Shop-assemble components and package complete with anchors and fittings.

F) Provide steel anchor plates, adapters, and anchor components for installation.

G) Hot-dip galvanizes exposed and painted ferrous metal and fastening devices.

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2.3) FACTORY FINISHING

A) Galvanizing: ASTM A123 to 45g/m2 (1.25 ounce per square yard) or other equivalent standard.

B) Shop-Primed Ferrous Metals: Pre-treat and clean; spray apply one coat primer and bake.

C) Enamel: Pre-treat to clean condition; apply one coat primer, and minimum two coats epoxy electrostatic baked enamel.

D) Chrome/Nickel Plating: ASTM B456, Type SC 2 satin and/or polished finish as required.

E) Stainless Steel: No. 4 satin luster and polished finish as required.

2.4) KEYING

A) Supply 3 keys for each accessory to Owner where applicable.

B) Master-key all accessories where applicable.

PART 3 - EXECUTION

3.1) EXAMINATION

A) Verify that site conditions are ready to receive work and dimensions are as indicated on shop drawings.

B) Beginning of installation means acceptance of existing conditions.

3.2) PREPARATION

A) Deliver inserts and rough-in frames to site at appropriate time for installation.

B) Provide templates and rough-in measurements as required.

C) Verify exact location of accessories for installation.

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3.3) INSTALLATION

A) Install fixtures, accessories, and items in accordance with manufacturer's instructions.

B) Install plumb and level, securely and rigidly anchored to substrate.

3.4) ADJUSTING AND CLEANING

A) Remove all protective masking and clean surfaces, leaving them free of soil and imperfections.

B) Fill all units final acceptance with necessary supplies just prior to of building.

C) Deliver to Owner all keys or other devices required to service units.

3.5) PROTECTION

A) The Contractor is to ensure that all completed toilet accessories are fully protected until full completion of construction.

LOCKERS

PART 1 – GENERAL

1.1 WORK INCLUDED

This Section specifies the requirements necessary to furnish and install the following:

Lockers

1.1 RELATED WORK

This Section shall be used in conjunction with, but not limited to, the other relevant specifications, drawings & Contract Documents to establish the total requirements.

CAUTION: Use of this Section without including all of the above-listed items will result in omission of basic requirements.

In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Architect, who shall then instruct the Contractor thereon. In the event of conflict regarding requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Architect in writing otherwise.

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1.2 QUALITY ASSURANCE

Manufacturer Qualifications: Company which has been in the business for at least 10 years and which has successfully produced products of a scope similar to this project.

Installer Qualifications: Company which is approved by manufacturer and which has successfully installed products of a scope similar to this project.

The installation will be subject to inspection and shall be completed to the satisfaction of the Purchaser. In case the requirements are not followed. The Purchaser can request the works to be amended up to complete satisfaction at Contractor's expenses.

The materials use shall be of the type and standard acceptable by the local authorities. The materials and the installation shall comply with the relevant local standards and code of practice.

1.3 WARRANTY

The Contractor and Supplier shall provide a one (1) year warranty on work of this Section for its performance against any defects and failure.

1.4 DELIVERY, HANDLING, AND STORAGE

Deliver products in manufacturer's original, unopened, protective wrapping with original, legible label intact.

Protect against damage and discoloration.

1.5 SUBMITTALS

Provide the following within 2 weeks of Contract award:

- Product data describing product type, size, configuration, layout, accessories, and finish color when applicable.
- Samples - Submit samples of materials to be used; colour and pattern selected for verification.
- Shop Drawings - Submit shop drawings indicating fastenings, details of construction, hardware, and other related items and installation details.
- Proposed Work Programme.

PART 2 – PRODUCTS

1.6 MANUFACTURER

- Godrej.
- Manufacturers that can meet the requirements specified will be considered.

1.7 MATERIALS

B) Materials used shall meet the following or other equivalent standards.

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A. Aluminum – ASTM B 221, alloy 6063-T5 for extrusions; ASTM B 209, alloy 6061-T6, sheet and plate. Protect aluminum surfaces in contact with cementitious materials with zinc chromate primer or chromate conversion coating.

B. Stainless Steel – SS 316 with hairline finish, unless indicated otherwise, for plates, sheet and strips.

C. Structural Steel Shapes – ASTM36

D. Steel Plates – ASTM A283 Grade C

E. Scratch Resistance Plastic Laminate for counter and cabinet – The plastic laminate shall be of the type and standard acceptable by the Purchaser/Architect. Preferred laminates are Formica / Greenlam / Ventura / approved equivalent manufacturers.

PART 3 -- EXECUTION

1.8 INSPECTION

- Verify adequacy of backing and support framing and property, prepared, sized, and located.
- Verify that surfaces and openings are ready to receive work and field measurements are as shown on shop drawings.
- Beginning of installation means acceptance of existing conditions.

1.9 PREPARATION

- Protect other materials against damage and discoloration caused by work of this Section.

1.10 INSTALLATION

General:

Follow manufacturer's instructions and reviewed shop drawings.

Secure specialties plumb, level, square, and true as applicable.

1.11 ADJUSTING AND CLEANING

- Adjust the specialties to function correctly and satisfactorily at the time of substantial completion and during warranty period.
- Remove debris from project site upon work completion or sooner, if directed.
- Including work of other sections, clean, repair and touch up, or replace when directed products which have been soiled, discolored, or damaged by work of this Section.
- Leave installation clean and free of defects on completion.

CEILING SURFACES

1.16 PART 1 - GENERAL

1.17 RELATED WORK

This Section shall be used in conjunction with the other relevant

specifications, the Drawings and Contract Documents to establish the total requirement for the installation of the ceiling works.

B) CAUTION: Use of this Section without including the above mentioned will result in omission of basic requirements.

1.2) ***DESIGN CRITERIA***

A) The location and the type of ceiling panels and the location of the lighting points are shown in the architectural drawings.

B) The work in this Section shall include all accessories, control joints, end trims, which may not be expressly indicated on the drawings, but which are necessary to provide a total ceiling systems package, which interfaces in a complete manner with the adjacent construction.

1.3) ***QUALITY ASSURANCE***

A) The installed ceiling shall have a sound transmission class of minimum STC40 for areas specified to have acoustic ceilings. The ceiling shall be free of any asbestos and shall be unaffected by moisture.

B) The installer shall be a company specializing in applying the work of this Section with a minimum of 5 years' documented experience and approved by the manufacturer.

1.4) ***WARRANTY***

A) The Contractor and the Specialist Sub-contractor shall jointly provide a two (2) years warranty for the completed works on its performance against any defects and failure.

B) The guarantee shall cover the cost for damages, which include the cost of finishing materials and labor required replacing the entire defective installation.

1.5) ***SUBMITTALS***

A) Provide the following with bid:

(i) Manufacturer's Data: installation literature for all ceiling systems and materials.

(ii) Certificates: copy of Certificate of License issued to system installer by manufacturer.

(iii) Submit evidence that the materials and systems have been tested, and that the fire rated systems have been approved by the Authorities. Submit environmentally friendly approval for suspended ceiling material.

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B) The contractor shall submit the following to the Purchaser for approval before any work in this trade commences on site:

(i) Samples of ceiling panels, fixing systems of appropriate size and types of sound insulation and thermal insulation shall be submitted to the Purchaser for review and approval, before ordering materials.

(ii) Shop drawings: The Contractor shall submit typical installation details for the ceiling systems for Purchaser approval. The shop drawings shall provide complete details of the system. Shop drawings shall be drawn using AutoCad-2008 and soft copies made available upon request without charge.

(iii) Installation schedule: The Contractor shall submit proposed delivery and work installation programmed for approval.

(iv) As built drawings: During construction, the Contractor shall keep accurate records of the contract works, "as built", on AutoCad-2008 construction drawings and details. Prior to the issue of the final acceptance certificate, the Contractor shall hand over to the Purchaser transparencies and AutoCad-2008 files of all as-built drawings, and all other documents related to the Contract work, which will be required for the application for the occupation permit.

1.6) *MOCK UPS*

A) Provide field sample panels of specified systems, minimum 2 meter long by 2 meter wide, showing ceiling panels and suspension systems.

B) Locate where directed.

C) The accepted samples shall not remain as part of the completed permanent works.

1.7) DELIVERY, STORAGE, AND HANDLING

The Contractor shall be responsible for timely ordering, scheduling, delivery, receiving, protection and installation of all materials necessary for completion of the works, on site or in transit.

A) Deliver materials to project site in manufacturer's original packaging, clearly identified as to type and location.

B) Materials shall be transported, handled and stored on the site or elsewhere in such a manner as to prevent damage, deterioration or contamination all to the satisfaction of the Purchaser. The Purchaser reserves the right to inspect any materials to be used on the works at any time and at any place of storage.

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1.8) SEQUENCING

A) Coordinate work under provisions of Conditions of Contract.

B) Coordinate work with installation of dry wall partitions, masonry works, blinds, other interior works and M&E services.

PART 2 - PRODUCTS

2.1) *MATERIALS*

2.1.1 ACOUSTICAL MINERAL FIBRE CEILING PANELS SUSPENDED CEILING AS SHOWN ON SCHEDULE

A) Acoustical mineral fiber or stone wool ceiling panels indicated in the Room Finish Matrix shall be 600x600x15mm/1200x600x15mm thick with recessed edges (Color: white). The panels shall be able to withstand temperatures above 1000 degrees Celsius without melting. Thermal conductivity of panel may not exceed 0.034 λ W/m degrees Celsius.

B) Sound Absorption:

Frequency, Hz	100	250	500	1000	2000	4000
Absorption		0.55	0.70	0.75	0.70	0.80	0.75

C) Supporting steelwork: Galvanized steel plate profiles

D) Surface: white finish with recessed edge installation.

E) Suspension: With spring or vernier hangers.

F) Fastening: With approved metal expansion anchor or other approved fasteners and associated screws.

G) Panels: Make, Rockon or equivalent recessed edges, Fire protection class O

H) Wall Joints: Shadow angle for recessed edge panels with white enamel finis.

I) Substructure: Vertical blinds flush with the ceiling. Vertical blinds shall be fitted to all office windows.

J) The acoustical ceiling panel shall be 100% moisture resistant when exposed between temperatures of 1 to 45 degrees Celsius and will not show any

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visible sagging or warping. The light reflectance shall be minimum 87% with surface and edges of the acoustical ceiling panel painted originally by the manufacturer to safeguard acoustical properties.

K) The acoustical panel must be inorganic and shall not be able to disintegrate and not sustain growth of bacteria, fungus and mould. The surface colour shall be white. The panel shall have a maximum density of 120kg/m3.

L) The acoustical ceiling panel shall be easily cleaned with ordinary cleaning agents dissolved in water.

M) The suspension system shall be exposed type grid in 600x600/1200x600 (Colour: white). Suspension member shall be double web design and pre-finished in manufacturer's standard baked enamel paint finish.

N) The main tee shall have an integral reversible splice piece, with connection values for basic loads of 90kg pull out tension, and 215kg compression. The cross tee shall have a high tensile steel locking tab. Its connection values shall be for basic loads of 155kg pull out tension, and 65kg compression.

O) Grid members shall be manufactured from hot-dipped galvanized steel. The system shall be either suspended or directly fastened to the structural slab soffit above by hangers. Main tee sections shall be suspended by means of 4mm galvanized rod. Perimeter panels shall be cut on site to suit the profile of the perimeter walls.

2.1.2 <u>ACOUSTICAL CLEANROOM CEILING PANELS (MYLAR BOARD) AS SHOWN ON SCHEDULE</u>

A) Shall be Thermaclean, laminated foil-faced ceiling panel made from new generation bio-soluble mineral wool, clay and starch indicated in the Room Finish Matrix shall be 1200x600x19mm thick with square edge (Color: white).

B) Sound Absorption: As per BS EN 20354: 1993

C) Sound attenuation : As per BS EN 20140-9: 1994 Dn,c,w = 34 dB (thickness 15mm)

D) Humidity resistance panels : up to 95% RH

E) Fire Resistance : Class A

F) Weight : 4.3 kg/m2

G) Thermal conductivity : λ = 0.052 – 0.057 W/mk

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H) Fire protection up to 1hr in accordance with BS476: Parts 20-23; 1987. Fire resistance F30-F120 to DIN 4102, Part 2.

I) BIO-PRUF – Surface treatment

J) Clean room standard – in accordance with ISO 14644-1, U.S. Fed. Std. 209E, VDI Guidelines 2083 Page 1.

K) Dimension Stability : Shall withstand 40 °C and 95% RH without visible sag.

L) Supporting steelwork: Galvanized steel plate profiles

M) Surface: white finish. Exposed grid installation with notched panels.

N) Suspension: With spring or vernier hangers.

O) Fastening: With approved metal expansion anchor or other approved fasteners and associated screws.

P) Panels: Make, AMF or equivalent square edges with Fire protection at BS 476 Part 6/7 Class 'O'

Q) Wall Joints: Corresponding angle for notched panels with white enamel finis.

R) Substructure: Vertical blinds flush with the ceiling. Vertical blinds shall be fitted to all office windows.

S) The light reflectance shall be minimum 90% with surface and edges of the acoustical ceiling panel painted originally by the manufacturer to safeguard acoustical properties.

T) The acoustical panel must be inorganic and shall not be able to disintegrate and not sustain growth of bacteria, fungus and mould. The surface colour shall be white.

U) The acoustical ceiling panel shall be easily cleaned with ordinary cleaning agents dissolved in water.

V) The suspension system shall be exposed type grid in 1200x600 (Colour: white). Suspension member shall be double web design and pre-finished in manufacturer's standard baked enamel paint finish.

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W) The main tee shall have an integral reversible splice piece, with connection values for basic loads of 90kg pull out tension, and 215kg compression. The cross tee shall have a high tensile steel locking tab. Its connection values shall be for basic loads of 155kg pull out tension, and 65kg compression.

X) Grid members shall be manufactured from hot-dipped galvanized steel. The system shall be either suspended or directly fastened to the structural slab soffit above by hangers. Main tee sections shall be suspended by means of 4mm galvanized rod. Perimeter panels shall be cut on site to suit the profile of the perimeter walls.

2.1.3 ALUMINIUM/METAL CEILING PANELS, CLIP-0N SYSTEM AS SHOWN ON SCHEDULE

A) Supporting steel work: Galvanized steel white capped interlocking tees in 24 mm (w).

B) Surface: White finish

C) Suspension: Rigid suspension with 3mm rod hangers with adjustable clips.

D) Fastening: with approved metal expansion anchors or other approved fasteners and associated screws

E) Panels: Durlum make or equivalent

F) System: Durlum S3F flush lay-on tiles ceiling

G) Material: Galvanised steel plate approximately 0.5mm thk.

H) Grid dimension: 600 x 600

I) Edges: Panels flush recess tegular on all 4 sides

J) Design: Plain without perforation

K) Surface: Polyester powder costing in excess of 60 microns paint thickness on the surface and edges.

L) Building material raiting: A2

M) Miscellaneous: Perforated panels should be used if acoustical insulation are required. Soundtex tissue shall be laminated at the back of perforated surface panels.

N) Wall Joint: F025 aluminium wall angles with white polyester powder coated surface.

2.1.4 METAL TILE CEILING PANELS, Clip-in System

A) Supporting steel work: Galvanized steel white capped interlocking tees in 24mm(w).

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B) Suspension: Rigid suspension with 3mm rod hangers with adjustable clips.

C) Fastening: with approved metal expansion anchors or other approved fasteners and associated screws

D) Panels: Durlum make or equivalent

E) System: Durlum S3F flush lay-on tiles ceiling

F) Material: Galvanised steel plate approximately 0.5mm thk.

G) Edges: Panels flush recess tegular on all 4 sides

H) Design: Plain without perforation

I) Grid dimensions: 600 x 600

J) Surface: Polyester powder costing in excess of 60 microns paint thickness on the surface and edges

K) Building material rating: A2

O) Miscellaneous: Perforated panels should be used if acoustical insulation are required. Soundtex tissue shall be laminated at the back of perforated surface panels.

L) Wall joints: F025 aluminium wall angles with white polyester powder coated surface.

2.1.5 GYPSUM PLASTER CEILING

A) The dry wall ceiling board in the Room Finish Matrix shall be 12mm thick recessed edge gypsum plasterboard. The 1.5mm deep recess on face side of the plasterboard shall allow formation of shallow channel for joint reinforcement. The thermal co-efficient of linear expansion shall not exceed $16.2x10^{-6}$mm in the temperature range 4° to 38°C.

B) Install the ceiling plasterboard and framing in accordance with the manufacturer's instructions and in accordance with to the National Standards and Authorities' requirements.

C) Incorporate control joints for the gypsum plaster ceiling to permit movement and to prevent deformation and damage. Provide control joints for plaster ceilings abutting any structural element or dissimilar wall or ceiling assembly.

D) Fire rated double layer ceiling to be provided in protected corridors, the ceiling system must be walk able for maintenance of services above the ceiling system.

PART 3 : EXECUTION

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3.1) *EXAMINATION*

The Contractor is to examine and satisfy himself of other related-trades site conditions under which, the ceiling is to be installed. Do not proceed until unsatisfactory conditions have been rectified. Beginning of installation means installer accepts existing surfaces and substrate.

3.2) *INSTALLATION*

A) During installation of acoustical mineral fibre ceiling panels and gypsum plasterboard the temperature shall remain stable within a range of 11 to 35°C. If there is a noticeable drop in temperature there will be a consequent increase in relative humidity (RH%) which harms the ceilings, whether already installed or not. At lower temperatures, especially lower than 11°C, slight drops in temperature cause an excessive increase in relative humidity (RH%).

B) GENERAL

(i) LIGHT FITTINGS: If the light fittings are held up by the support structure, the maximum load is 20 kg for two bearing sections and 6 kg for one or more cross-ties. Ceiling panels to be cut by Ceiling installer contractor to allow the light fittings installation by others.

(ii) CONTINUOUS LUMINOUS GROOVES: The bearing and intermediate sections shall have protruding ties without taking the presence of the luminous grooves into account, making sure to keep the minimum recommended distance between the ties.

(iii) LIGHT FITTINGS TO BE AFFIXED TO THE FALSE CEILING: The light fittings shall be affixed to the bearing sections by means of suitable fixing accessories.

(iv) AIR GRILLES: The air grilles shall always be independently fixed to the soffit, unless there are to be special installations. Ceiling panels to be cut by Ceiling installation contractor to allow the grille installation by others.

(v) CONTINUOUS VENTILATION GRILLES: See note on continuous luminous grooves.

(vi) SPRINKLER HEADS: The ceilings shall be designed for integration with fire sprinklers.

(vii) FITTING OF SMOKE DETECTORS: The smoke detectors must fit easily into all the ceilings.

(viii) SUPPORT OF SIGNS: The maximum load for signs is the same as that indicated for the light fittings.

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C) Suspended ceilings shall have openings (requirements of lighting equipment and installation equipment). The Ceiling Contractor shall be responsible for providing openings.

3.3) *ERECTION TOLERANCES*

A) Maximum Variation from Dimensioned Position: 5mm.

B) Maximum Variation from Flat Plane: 3mm in 3m.

3.4) *INSPECTION*

The Contractor shall carry out the ceiling works to meet the requirements as specified in the contract documents and the drawings, failing which the works shall be rectified at the Contractor's expense.

3.5) *ADDITIONAL MATERIALS*

For future repairing works, the Contractor shall supply for 10% of same materials for the suspended ceiling systems used herein.

IRONMONGERY & DOOR HARDWARE

PART 1 – GENERAL

1.1 SCOPE OVERVIEW

1.1.1 The works in this scope includes, but are not limited to, the design, supply, delivery, installation, supervision, co-ordination, testing, commissioning, and handover in approved conditions of the Ironmongery. All labor and material, transport, plant and necessary equipment for supply and installation of the ironmongery shall be included.

1.1.2 Manufacturer/approved material indicated in the specifications are included only for reference of quality and performance required and should not be read as pertaining to any particular preference or prejudice. Alternative proposal complying or exceeding the specifications are acceptable meeting the latest standards of appropriate installation. The drawings and door schedule depict the performance requirement and the Subcontractor shall review the details against his own system and propose solutions to meet technical requirements of the project.

1.1.3 Qualifications and exceptions to this specification shall be listed and specifically and included at the time of tender. Without such exceptions, tenders shall be deemed to fully comply with the specification.

1.1.4 The Ironmongery Supplier is to coordinate with door manufacturer to provide drawings, samples, and specifications for approval. The contractor shall assume full responsibility in ensuring that the assemblies meet the performance requirements of the specifications.

1.2 PROJECT/SITE CONDITIONS OR SPECIAL CONDITION

1.2.1 Hardware shall be complete with all necessary screws, bolts, anchors or other fastenings for proper application of suitable size and type, and match hardware as to materials and finish.

1.2.2 Regulatory Requirements

1.2.2.1 Conform to applicable building code for requirements applicable to fire rated doors and frames.

1.2.2.2 Conform to the applicable sections of Chapter 5 of NFPA 101, NFPA 80, and NFPA 252.

1.2.2.3 Provide hardware which has been tested and listed by UL or FM for fire rated assemblies of types which comply with requirements of door and frame labels.

1.2.3 Certification

1.2.3.1 Ironmongery Supplier/Manufacturer and Door Contractor shall jointly inspect complete installation and certify that ironmongeries & hardware installation has been furnished and installed in accordance with manufacturer's standard & instructions.

1.2.3.2 Provide two copies of certifications to Architect.

1.2.4 The contractor shall co-ordinate with other relevant trades and is responsible for obtaining all information required to achieve good and coordinated installation.

1.2.5 The Contractor shall carry out the following obligations and duties

1.2.5.1 Obtain field measurements and setting-out of areas before commencement of works.

1.2.5.2 Make enquiry if there are any discrepancies between site conditions and approved construction drawings prior to proceeding with work.

1.2.5.3 Provide/arrange necessary evidence/documentation as may be required by the relevant authorities to demonstrate compliance with relevant codes, regulations and standards.

1.2.5.4 Allow protection to completed works including all fixings and accessories.

1.3 REFERENCES/PROJECT REQUIREMENTS

1.3.1 Tender Drawings, Door Schedule and general provisions of Contract, including General and Supplementary Conditions and Scope Description & Specifications,

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apply to this Section. This section shall be used in conjunction with the above documents to establish the full requirement of the project.

1.3.2 The contractor to note that client is not an approving authority for the purposes of authority requirements. client will comment on drawings and proposal by the contractor it is the sole responsibility of the contractor to meet the performance requirements and the requirements of applicable statutory institutes or standards.

1.3.3 The contractor shall comply with all relevant local codes and regulations that may apply to the works. Equivalent standard in India in cases where they exist, with prior approval can replace the standards referred to in this document. The more stringent standard always applies.

1.3.4 Additional project requirements and references:

- Latest India Code on Barrier Free Accessibility in Buildings
- ANSI/NFPA 80 - Fire Doors and Windows.
- AWI - Architectural Woodwork Institute.
- BHMA - Builders' Hardware Manufacturers Association.
- DHI - Door Hardware Institute.
- NAAMM - National Association of Architectural Metal Manufacturers.
- NFPA 101 - Life Safety Code.
- SDI - Steel Door Institute.
- NFPA 101 - Code for Safety to Life from Fire in Buildings and Structures.
- NFPA 252 - Fire Tests of Door Assemblies.
- UL 10B - Fire Tests of Door Assemblies.
- UL 305 - Panic Hardware.
- Code of Practice – CP96
- All Related India Standards and Code of Practice.

1.4 SUBMITTALS & TECHNICAL REQUIREMENTS

1.4.1 Product Data Sheet & Samples:

1.4.1.1 Provide product data on specified hardware. Include each hardware item cut sheet bound in each hardware schedule. Identify item on sheet.

1.4.1.2 Data sheet shall include information to show compliance with technical, physical and performance requirements.

1.4.1.3 Data sheet shall include instructions for installation and maintenance of operating parts and finish.

1.4.1.4 Submit sample for **each** type of ironmongeries properly labeled and tagged mounted on standard sample boards including all accessories, attachments, and fixings.

1.4.1.5 All approved sample shall be retained by client/Architect for future reference of ironmongery types.

1.4.2 Certifications:

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Submit all other relevant certificates on quality conformance form local or international testing authority.

1.4.2.1 Ironmongery Schedule:

Submit schedule at earliest possible date, particularly where acceptance of ironmongery schedule must precede fabrication of other work that is critical in project construction schedule. Include in the schedule product data, samples, shop drawings of other work that is affected by finish ironmongery and other information essential for coordinated review of ironmongery schedule.

Ironmongery Schedule should contain the following information in an organized format:

- Type, style, function and finish of each ironmongery item
- Name, model number, and manufacturer of each item
- Fastening, fixing, and other pertinent information.
- Mounting locations for ironmongery with dimensions I reference to approved shop drawings.
- Door Frame size and material
- Keying information
- System and wiring diagram for all electronic ironmongery.

1.4.2.2 Keying Schedule

- THE CONTRACTOR and approved ironmongery supplier shall co-ordinate with to develop comprehensive keying schedule for the entire project.
- The keying schedule shall contain information with regard to keying system, master keying, numbering of keys and placement of cylinders.
- Comprehensive layout drawing showing cylinder tagging and numbering in relation to keying schedule shall be submitted by THE CONTRACTOR and approved ironmongery supplier.
- The keying/cylinder system shall be of highest security level and latest technology design.
- The keying system shall have the capacity to expand for the subsequent phases of the development without having to re-key the existing locks.
- The keying system shall be submitted to client for approval including all system information and required lead time for production and replacement.
- Cylinders shall be of removable core type, and shall conform to additional client requirements.
- Submit templates of finish ironmongery for door and frames as required by the various trades involve in the work.
- Ironmongery supplier will be required to meet with client to establish quantity and types of core required.
- Coordinate the ironmongery work required with the specialty door manufacturer / suppliers, the card reader, security alarm, and fire alarm Subcontractors.

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1.5 QUALITY ASSURANCE

1.5.1 Manufacturers & Suppliers: Companies specializing in manufacturing door hardware, ironmongery and security systems with minimum ten (10) years experience with a record of successful service performance for similar quantity, type, and quality to that indicated project.

1.5.2 The Manufacturer/Supplier shall be available at reasonable times during course of the work for consultation about the project ironmongery requirements to the client and the Contractor.

1.5.3 Hardware installer: Employ a qualified carpentry person to perform the work of this Section.

1.5.4 Single Source Responsibility: each type of ironmongery shall be supplied from single manufacturer without substitution unless noted otherwise "or approved equivalent" which means "or equal is approved by client".

1.5.5 Manufacturers: Items of other manufacturers than those scheduled will be considered for acceptance providing they meet the specified criteria and that the substitution requests are made in accordance with the specifications, no exceptions.

1.6 WARRANTY

1.6.1 Provide 5-year full warranty for all ironmongery. Door closers shall have 10 year full warranty. Warranty shall be signed by the Contractor and Ironmongery supplier and installer agreeing to repair or replace defective parts or workmanship.

1.6.2 Warranties to cover the cost of dismantling, removing, making new parts, making good to adjacent/surrounding surfaces, finishing and re-fixing to match existing.

PART 2 – PRODUCTS

2.1 HINGES

2.1.1 Hinges: All hinges shall be ball bearing with sufficient throw to clear door trim or wall construction, but no more than necessary. High frequency type, full mortice template butt hinge.

2.1.2 Hinges for exterior doors and security areas shall have pins held in place by a set screw which can only be removed while the door is open.

2.1.1 Provide additional hinges as required by door height in accordance with manufacturing recommendations

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2.1.2 All hinges supplied shall be of the same manufacturer and available in low, medium and high frequency.

2.1.3 Unless otherwise specified, all hinges shall be of satin stainless steel Grade 304/316, full mortice template ball bearing hinges.

2.1.4 All hinges shall be supplied with wood screw for timber doors and machine screw for metal doors.

2.1.5 The centre pin of the hinges shall be fixed so that it will not be moved out-of-place from the hinges due to door misalignment.

2.2 LOCK SETS

2.2.1 Cylindrical type of weight, design, function and materials as specified. Faces shall be rabbeted, beveled or rounded as required.

2.2.2 They shall pass the fire tests of BS476 Part. Manufactured according requirements to EN12209, dimensions according to DIN 18251-1, class 3, classification 3H110B2KC20.

2.2.3 Locks shall have all functions available in one size case, manufactured from heavy gauge steel.

2.2.4 The mortice lockcases are to be tested in overseas or locally to be suitable for usage on fire-rated doors up to 4-hours irregardless of the function of the locks.

2.2.5 Detailed specification of locksets are as follows :-

- Heavy duty able to withstand heavy usages.
- Heavy duty spring follower for lever handles to prevent any form of sagging. The force exerting on the lever handle in order to activate the latch must be at least 1.5kg.
- Available in 60mm backset.
- 8mm square follower.
- Minimum 22mm throw (Double throw) for deadbolt.
- Single sided lever handle fixing if necessary.
- 17mm profile or 22mm profile cylinder hole, 72mm centre-to-centre distance from lever to cylinder.
- As for high security mortise lock, the latch must be non-reversible and should be complete in one piece latch. Reversible latch is to be use in low security area.
- Forend to be in single piece of thickness 3.4mm and material in stainless steel Grade 316.
- Gauged case to be welded directly onto forend of lockcase for security purposes.
- Forend shall be in modular size for all lock functions for easy maintenance.

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2.2.6 Locksets shall be supplied complete with strike plate, cylinder escutcheon and roses, in stainless steel Grade 316, as required for the function requirement.

2.2.7 Stainless steel materials of the forend of the lockcases and lever handle must be of Grade 316 and tested accordingly to the standards DIN 50021/ASTM/B 117/JIS Z2371. The tests are to be tested by local test laboratory for the corrosion resistance of the stainless steel Grade 316 for the period of 4 years. The stainless steel materials must not rust or corrode during the first 4 years after completed installation. Proof of the test for corrosion resistance to be submitted.

2.2.8 The follower and latch of the proposed lockcase shall be tested for at least 600,000 cyclic movements, and proof of testings by independent institution shall be submitted as proof.

2.2.9 Rebated kits and striking plates shall be provided for all double leaves doors.

2.2.10 The possible functions of the locksets are :-

- ❖ Mortice Night Latch (Silent Action)
- ❖ Mortice Deadbolt
- ❖ Mortice Sashlock (A Lock With Deadbolt And A Latch)
- ❖ Mortice Nightlatch With Anti-Thrust Bolt
- ❖ Mortice Bicentric Lockset
- ❖ Narrow Mortice Deadlock
- ❖ Narrow Mortice Sashlock
- ❖ Mortice Panic Lock

2.2.11 Curved Strike Lips: Length to protect jamb trim.

2.2.12 All lock-strikes shall be with box, stainless steel dust covers and a lip of sufficient length to protect door trim and jamb.

2.2.13 Locksets shall have removable core keying and cylinder.

2.2.14 Material: All levers and handles must be of stainless steel; finish to be selected from manufacturer standard range.

2.3 DOOR CLOSERS

2.3.1 Closer Construction shall be heavy-duty type available in regular slide arm and channel. All parallel arm brackets shall be provided for door swings towards the opposite direction.

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2.3.2 Door closers must not install on the outside of any exterior door.

2.3.3 Door Closer shall be fully intelligent back-check feature providing a cushion effect to prevent uncontrolled opening of the door beyond 70° with adjustable closing speed control and latching action function from 180-70° to allow easy access to handicapped person, electromagnetic hold open device, smoke detectors and concealed sequence door selector.

2.3.4 Door closer shall have an adjustable latching force to ensure that door is properly closed and latched. Door Closer and door coordinator/selector shall be approved by relevant authority

2.3.5 Door Closer shall be totally reversible without adjustment.

2.3.6 Door Closer shall match the lever/pull handle/push plate finishes of the door.

2.3.7 Provide surface units which have been independently certified to a minimum of 10,000,000 cycles, in accordance with ANSI testing procedures.

2.3.8 Conforms to most recognized International Standards such as EN 1154 and certified to ISO9001.

2.3.9 The closer shall be approved by FSSB and PSB to be used on fire doors and certified to PSB SS 332 standard.

2.3.10 Fasten all closers with through bolts

2.4 EXIT DEVICES

2.4.1 Exit Devices: UL listed for purpose intended. Operating device shall be touchbar style. Finish, function, design, lever, and trim as indicated in Hardware Sets.

2.4.2 Provide extended rods as required for each particular opening.

2.4.3 Material: Device body and components must be of stainless steel; finish to be selected from manufacturer standard range.

2.5 FLUSH BOLTS & DUST PROOF STRIKE SOCKET

2.5.1 Flush Bolt shall be of lever action type or self latching PSB approved type.

2.5.2 Provide extended rods as required for each particular opening.

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2.5.3 Dust proof spring loaded strikes shall be used when the door locks into floor, except where metal threshold is used.

2.5.4 Material: Flush Bolts and Dust Proof Strikes must be of stainless steel; finish to be selected from manufacturer standard range.

2.6 DOOR STOPS

2.6.1 Door stop for doors adjacent to drywall shall be floor mounted type.

2.6.2 Door stop for doors adjacent to masonry/concrete wall shall be wall mounted type.

2.6.3 Material: door stop body must be of stainless steel; finish to be selected from manufacturer standard range. Bumper shall be of approved neoprene or rubber component.

2.7 DOOR SELECTOR

2.7.1 Door selector shall be on a non-handed type, fully automatic and available in vrying lengths.

2.7.2 Proprietary stainless steel strike plate shall be provided.

2.7.3 Material: door selector arm and body must be of stainless steel; finish to be selected from manufacturer standard range. Roller shall be of approved neoprene type.

2.8 FLOOR SPRING & GLASS DOOR IRONMONGERY

2.8.1 Floor Spring shall be of double action type.

2.8.2 All patch fittings and accessories shall come from single-supply source as the floor spring.

2.8.3 Lockset shall allow for the same cylinder profile as the rest of the whole project and form part of the master - keying schedule.

2.8.4 Stainless steel handle shall be designed and coordinated with door/curtainwall contractor.

2.8.5 Depth of floor spring shall not be more than 60mm. The Contractor shall ensure that the top level of floor spring completed is of the same level as the adjacent finished floor level (with finished).

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2.8.6 All floor spring shall be provided with pressure relief valve to prevent over-loading and oil leaking.

2.8.7 Floor spring shall be provided with adjustable hold open/back check from 75 degree to 175 degree.

2.8.8 Floor spring shall have delayed closing up to 45 seconds.

2.8.9 Floor spring shall be available in closing force of 53NM, 35NM or 15NM.

2.8.10 Floor spring shall be available with interchangeable spindle from 5mm to 50mm suitable for timber, metal and glass doors.

2.9 CYLINDER & MASTERKEY SYSTEM

2.9.1 Provide "Kaba" keyway or equivalent to match Owners requirements. Furnish all locks construction. Master keyed. Provide core type as required by owners system.

2.9.2 Cylinders shall comply with ANSI A156.6 and conform to DIN 18252 or its equivalent.

2.9.3 All cylinders proposed shall meet the degree of security desired for the installation.

2.9.4 The plug shall be made of solid brass. Cylinder shell shall be made of solid brass and finish to match the appearance of the lock which the cylinder is fitted.

2.9.5 All cylinders shall be available in at least 22 or more pins with tumblers. Each of the 22 positions consists of a security pin, a security tumbler and a spring. For added security the cylinder shall possess multi-part construction of the pin mechanism coupled with the rotation factor and off centre pin to key alignment features, and in 4 multiple rows for security reasons. Single row of pin is not acceptable.

2.9.6 The cylinders shall have detainer pins to protect against picking.

2.9.7 Cylinders shall be designed for tensile loading of 12800 Newton against wrenching and pulling of the plug within the cylinder.

2.9.8 The cylinder shall suit regular door thickness of 40 - 45mm but incremental increases shall be available for doors of thickness more than 60mm.

2.9.9 The cylinder's bodies and plugs are machined from extruded brass to a diameter of 17mm or 22mm round profile unique as compared to the conventional cylinder.

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2.9.10 It is finished in nickel silver plating as standard to match most door furniture, however, other finishes are available upon request.

2.9.11 The standard length of a double cylinder with both sides keyed is 65mm which suits most doors up to 50mm thick. Extended length is available upon request for extra thick doors.

2.9.12 Where external security is vital, cylinder can be surface hardened to prevent drilling. The pins in such cylinders are also hardened.

2.9.13 The range of cylinders must be very wide. A cylinder can be found to suit most applications from door locks, roller shutter locks, furniture locks, key switches, or in certain cases special application.

2.9.14 All cylinders are factory sealed making it impossible to tamper with the permutation inside the cylinder.

2.9.15 Since a cylinder could be found to suit most applications, it is possible to master key systems comprising a variety of cylinder locks, eg. mortice locks, roller shutter locks, knobsets, padlocks, furniture locks, key switches and others being integrated into a master key system.

2.9.16 All cylinders supplied shall be under grand masterkey complete with optional construction key system. The Contractor shall liaise with his sub-contractor responsible for producing a key chart in master key system for S.O.'s approval prior to installation.

2.9.17 Cylinders shall be available in construction key system, which is incorporated into the permanent cylinder, if requested. The construction key system can be invalidated by using a special U-key or change code key and only the mastered keys will be able to activate the cylinder. Alternatively, temporary cylinders should be supplied at no costs. The main contractor shall resume the responsibility to change the temporary cylinder to the actual cylinders during handling-over stage.

2.9.18 The inserts of the master keyed cylinders should be interchangeable for replacement and security purposes.

2.9.19 The inserts of the master keyed cylinders must be suited to other cylinder types, namely rim cylinder, 17 mm profile cylinder, 22 mm profile cylinder, 36 mm profile cylinder, etc.

2.9.20 The housing of the cylinder shall be recyclable and interchangeable. These as well as other components could be kept by the user for maintenance purposes.

2.9.21 The listed security patented cylinders and padlock would be:

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- ❖ Security patented thumb turn cylinder in nickel plated, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies.

- ❖ Security patented double cylinder in nickel plated, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies
- ❖ Security patented single cylinder in nickel plated, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies
- ❖ Security patented padlock, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies

2.9.22 The Subcontractor shall rekey construction cylinders as required to secure portions of the project for his use.

2.9.23 Provide 40 construction master keys for distribution to other trades during course of work.

2.9.24 Provide 3 change keys per lockset / cylinder.

2.9.25 Provide wall mounted key cabinet with hooks, labels, and index.

2.9.26 Provide stainless steel tamper proof key rings for each set of keys with 25% additional rings and required fastening tool.

2.10 KEYING AND MASTERKEYING (MECHANICAL LOCKSETS)

2.10.1 All cylinders shall be able to be furnished with built-in construction key system, individual key, sub-master key, master key, grand master key, great grand master key under the same system, with minimum 5 levels of master key hierarchy.

2.10.2 All keys are to be made of nickel silver, are flat, reversible and can be inserted both ways.

2.10.3 Keys shall have special key blanks and keyways for difficult unauthorised reproduction and shall have copyright for the period 2021. Patent protection shall be registered both worldwide and locally in India and the region.

2.10.4 Keys production can only be executed through authorised request from owner and the indentations on the keys are produced by CNC machine.

2.10.5 All cylinders shall be finished with 3 keys sealed with a tagged special chastity clip to be handed over to client/architect.

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2.10.6 Key alike cylinders shall be furnished with 12 keys sealed with a special chastity clip.

2.10.7 6 nos each of the sub-master keys, master keys and grand master keys are to be provided in a sealed chastity clip and tagged.

2.10.8 It shall be deemed that the contractor has priced for the provision of keys and master keying system specified (minimum 5 hierarchy) in the unit rates for cylinders.

2.10.9 Each key shall have the option of including various different colours, up to 12 different colours, to the key bow as means of identification by the client. The colour to the key bow shall be able to be interchangeable with special tooling by the client themselves. The supplier shall made provision to supply the fixture to change the colour coding on the key bow.

2.10.10 The key duplication method must be by special milling method with special and controlled tool bits by the supplier. Drilling method and any other methods of key duplication is not acceptable and will be rejected. The supplier must submit samples and proof of the required key milling method in the duplication the security key.

2.10.11 Provision must be made to allow an intelligent SMART RFID chip to be incorporated into the key bow of all keys supplied.

2.10.12 The keys to the mechanical locking system should be able to be upgraded in future to incorporate and integrate with mechatronic locking system or a full electronic access control system that make use of RFID or Legic technology, without changing the existing mechanical master key system and locking hardwares, except cylinders.

2.10.13 The listed security key system to the master keyed cylinders would be:

- Security patented thumbturn cylinder in nickel plated, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies
- Security patented double cylinder in nickel plated, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies
- Security patented single cylinder in nickel plated, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies
- Security patented padlock, come in minimum 22 individual pins with tumblers positions, suited to the overall master keyed system with minimum 5 levels of hierarchies

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2.11 HANDLING/DUPLICATION OF KEYS (MECHANICAL)

2.11.1 The Contractor shall maintain an updated record on site of keys issued and a copy of such record shall be submitted to client/architect. The cylinder lock shall be replaced prior to handing over for anyone of those keys reported lost at the Contractor's expense. No duplication of keys shall be permitted without prior approval of client/architect.

2.11.2 The supplier must be present to hand over the sealed keys to the owner's representative in the presence of the main contractor, owner's representative and S.O. All documentation of the handing over process must be properly recorded.

2.11.3 Temporary or construction keys should be properly controlled by the main contractor to be issued to sub-contractors, and proper records of key withdrawals are to be maintained. These records would be requested and inspected by the end-users at any time.

2.11.4 If temporary or construction cylinders are used during the construction phase(s) of the building, the main contractor are to be solely responsible and accountable for the proper changing over of the temporary or construction cylinders to the actual master keyed cylinders. The costs of the change-over of cylinders are deemed to be part of the costs and scope of works under the main contractor. The end-user's keys are to be handed over to the end-user directly by the supplier of the master keyed system.

2.12 HANDLES

2.12.1 All levers/pull handles and accessories shall be of the same manufacturer and supplier.

2.12.2 All roses and escutcheon shall have a snap on cover of more than 8 mm in height.

2.12.3 All levers/pull handles, roses and escutcheon shall be provided with a bolt through fixing and shall be supplied with a special fixing system. This is to prevent from becoming loose after prolong usages.

2.12.4 Approved level handles bolted to rose or backplate shall open smoothly, softly and silently and yet be strong enough to prevent any form of sagging.

2.12.5 All backplates, roses and escutcheons shall be concealed fixings and squarely aligned with door leaf. The fixing screws shall be installed from behind the door or from inside the room.

2.12.6 All lever handles shall be available with the option of incorporating with radial needle bearings and not ball bearings, which is in the roses itself, for heavy duty door and excellent handle operation. The needle-bearings, integrated in the lever

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handles, is fixed rotating on a ground plate in stainless steel and provided with the special fixing system.

2.12.7 Wherever required, lever handle and knobs can be intermixed for inside/outside trim.

2.12.8 Specified lever handles is able to withstand very heavy weight and pressure exerting on the handles.

2.12.9 Stainless steel materials of the forend of the lockcases and lever handle must be of Grade 316 and tested accordingly to the standards DIN 50021/B 117/JIS Z2371. The tests are to be tested for the corrosion resistance of the stainless steel Grade 304 shall simulate the corrosion environment within the period of 4 years. The test certificate of the test by an independent institution shall be submitted a proof of the test. The stainless steel materials must not rust or corrode during the first 4 years after completed installation.

2.12.10 More than 5 designs of the handles should be made available for customer's selection. Designer hollow and solid handles shall be made available for the client's final selection.

2.13 PRODUCT AND FINISH

2.13.1 All appropriate hardware shall be of satin **stainless steel grade 316** uniform throughout.

2.13.2 Finish hardware shall be tarnish resistance.

2.13.3 All mortise locksets, high security cylinders, handles, exit devices, door closers, floor springs and other accessories and components shall be from the same approved supplier.

2.14 MANUFACTURER/SUPPLIER

2.14.1 Ebco

2.14.2 Godrej

PART 3 – EXECUTION

3.1 PREPARATION & INSPECTION

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3.1.1 Verify that doors and frames are ready to receive work and dimensions are as instructed by the manufacturer.

3.1.2 Do not commence installation until unsatisfactory conditions have been rectified

3.1.3 Beginning of installation means acceptance of existing conditions.

3.2 DELIVERY, STORAGE, AND HANDLING

3.2.1 Deliver products to site, store and protect products in storage until installed.

3.2.2 Each individual item must be individually labeled and identify package with door number code to match hardware schedule.

3.2.3 Deliver permanent keys to client/architect direct form lock manufacturer.

3.2.4 Protect hardware from theft by cataloging and storing in secure area.

3.2.5 Install hardware only upon approval of client/architect.

3.3 SEQUENCING

Coordinate order of installation for all hardware items to eliminate conflicts of operating mechanisms. Provide general notes as to the order of installation.

3.4 INSTALLATION

3.4.1 Mount all Ironmongery units at height indicated in the drawings, except if shown or specified otherwise or to comply with requirements of governing regulations & handicapped requirements.

3.4.2 Install each ironmongery item in compliance with manufacturer's instructions, recommendations, and templates. Securely fasten all parts to be attached. Fit faces of mortised items snug and flush. Make sure all operating parts move freely and smoothly without binding, sticking, or excessive clearance.

3.4.3 Whenever cutting and fitting is required to install ironmongery onto or into surfaces which are later to be painted or finished in other way, remove and store ironmongery prior to painting or finishing. Reinstall item only when the finishes have been completed on the surface to which the ironmongery is to be installed. All buts, locks, plates, strikes, etc., shall be neatly and accurately mortised flush, properly placed and accurately aligned for smooth and quiet operation without sticking, binding, hanging, or ratting. All doors shall be hung with equal clearance at jambs and heads. Adjust all hardware properly and leave in smooth operating condition.

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3.5 ADJUSTING AND CLEANING

3.5.1 Adjust and check each operating ironmongery item to ensure correct operation and function.

3.5.2 Replace units that can not be adjusted to operate as intended for the installation made.

3.5.3 Final Adjustments:

- Where ironmongery is installation is made more than 1 month prior to building acceptance or occupancy of room or area, the supplier/installer shall return to work area 1 week prior to acceptance or occupancy and make final check and adjustment of all ironmongery items.
- Clean grease, dirt or item marks and as necessary restore correct operation, function and finish.
- Adjust door control device to compensate for final balancing of the heating and ventilating equipments and difference in room air pressure.

3.6 MAINTENANCE & TRAINING

3.6.1 Prior to handing over for inspection, all projected parts and surfaces such as door levers, pull handles and others shall be properly wrapped and sealed. Should any serious scratches or other defects on the surfaces of the ironmongery be found, THE Contractor shall replace the ironmongery at his own cost.

3.6.2 Submit operation and maintenance data, Include data on operating hardware, adjustments, lubrication requirements, inspection procedures related to preventative maintenance and cleaning procedures of finishes.

3.6.3 Provide special wrenches and tools applicable to each different or special hardware components.

3.6.4 Provide maintenance tools and accessories supplied by hardware component manufacturer.

3.6.5 Training Program: The Ironmongery supplier/installer shall conduct a training program to client technical/maintenance staff within 3 months of the application of Temporary Occupation Permit. The training program should be hands-on oriented with appropriate reference to operations and maintenance training manuals to be provided. The training shall focus on the following items

- To assemble and disassemble all items supplied
- To replace faulty parts within all parts supplied

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- To configure lock cylinder pinning for keys supplied
- To perform routine maintenance on all items supplied

3.6.6 This training requirement does not relieve the supplier/installer and the contractor from any warranty obligations already provided in the contract.

ROLLER SHUTTERS

1.0 PART 1 - GENERAL

1.1 SECTION INCLUDES: This section includes

- ❖ Fire rated roller shutters, motorised, powder coated.
- ❖ Non fire rated roller shutters, motorised, powder coated.

1.2 REFERENCES/PROJECT REQUIREMENTS:

- ❖ Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 specification sections, apply to this section.
- ❖ Requirements of the following Project Specification Sections apply to this section:
  - Section 09900 - Painting
  - M&W/EES/0021 – General Electrical Materials & Workmanships

- ❖ Additional project requirements:
  - ANSI/ASTM B221 - Aluminum-Alloy Extruded Bar, Rod, Wire, Shape, and Tube.
  - ANSI/UL 325 - Door, Drapery, Gate, Louver, and Window Operators and Systems.
- ❖ Design Requirements: Design door assembly to withstand wind / suction load of 30 psf (1.44 kpa), without undue deflection or damage to door or assembly components.

1.3 SYSTEM DESCRIPTION

Electric motor operated unit with manual override in case of power failure. Fire rated doors with fusible link activated with automatically governed closing speed.

1.4 SUBMITTALS: Submit the following in accordance with Conditions of Contract and Section 01340, Shop Drawings:

- ❖ Submit shop drawings and product data under provisions of DIVISION 1.

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- Provide pertinent dimensioning, general construction, component connections and details, anchorage methods, hardware location, and installation details.
- Submit manufacturer's installation instructions under provisions of DIV. 1.
- Samples: Submit two, 6" (15 cm) long samples of each type slat specified showing each type finish specified.
- Shop Drawings
  - Submit shop drawings showing elevations, locations, jamb conditions, methods of assembling and clearances required.
  - Indicate hardware installation data, thickness of materials, methods of anchoring and details of construction.
  - Note and mark sufficiently to indicate compliance with requirements of these Specifications.
  - Indicate location of motor, switches and controls.
- Operations and Maintenance Data
  - Submit manufacturer's operation and maintenance data under provisions of DIVISION 1.
  - Maintenance Data: Indicate lubrication requirements and frequency, periodic adjustments required.

1.5 QUALITY ASSURANCE:

- Verify that field measurements are as indicated on shop drawings.
- Furnish roller shutters by one manufacturer for entire project.
- Manufactures warranty: Furnish manufactures 5 years warranty against defect in product workmanship and materials.

1.6 PROJECT/SITE CONDITIONS OR SPECIAL CONDITION:

Regulatory Requirements:

- Provide SIRIM label / rated frame and assembly. Conform to applicable code for indicated hourly fire rated opening.
- Electrical Components: ULI listed.

1.7 SEQUENCING: Coordinate the work with installation of electric power, locations and size of conduit, and locations of devices.

2.1 MATERIALS

2.2.1 Curtain

- Slats: Minimum 20 gage (1.0 mm) thick slats of steel, ANSI/ASTM A526; for fire rated shutters and 1.4 mm thick Alum slats for non-fire rated shutters.

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- ❖ Slat Ends: Ends of alternate slat fitted with end locks to act as wearing surface in guides and to prevent lateral movement.
- ❖ Curtain Bottom: Bottom fitted with 2 mild steel angles (not less than 38X38X3 mm) bolted together as T-shape section to provide reinforcement and positive contact with floor in closed position.

2.2.2 Side Guides: Formed steel angles for required sizes and configurations with groove 75 mm depth minimum complying with JIS G3141 SPCC-SD slot bolt holes for track adjustment.

2.2.3 DRIVE BARREL: Steel pipe complying with BS 1387 or JIS 63452 and helical steel spring system capable of producing sufficient torque to assure easy operation of curtain from any position; adjustable spring tension.

2.2.4 Housing: Min 22 gage (0.85 mm) powder coated m.s. internally reinforced to maintain rigidity and form. Provide closed end for surface mounted hoods and any portion of jamb projecting beyond wall face. Provide intermediate support brackets as required to prevent sag. Galvanised self driving screws applied for easy access maintenance.

2.2.5 Hardware

- ❖ Handle: Inside side mounted, adjustable keeper, spring activated latch bar with feature to keep in locked or retracted position, interior handle.
- ❖ Cylinder: Furnished in DIVISION 8.
- ❖ Weather-stripping: Water and rot proof, resilient type; located along jamb edges, bottom of curtain, and within housing.
- ❖ Provide fire fly release mechanism and fusible link at rated doors.

2.2 MANUFACTURED UNITS

2.3.1 Electric Operator:

- ❖ Descriptions: UL approved in accordance with ANSI/UL 325; wall mounted.
- ❖ Electrical Requirements: Non-Fire rated doors: 230 volt, single phase, 50 Hz supply to 1/2 hp electric motor. 415 Volts, three phase, 50 Hz supplying for fire rated shutters. 24 v dc solenoid release for fire rated roller shutters to close upon receiving fire signal when there is a power failure.
- ❖ Brake: Adjustable friction clutch, double shoe brake system actuated by independent full line voltage solenoid controlled by motor starter.
- ❖ Limit Switch: Fully enclosed positive gear driven limit switch.
- ❖ Motor Controller: Fully enclosed magnetic cross line reversing starter.
- ❖ Control Station: Standard three button (open-close-stop) control for each operator; 24 volt circuit; surface mounted.
- ❖ Safety Device: Located at bottom of doors, full width; wired to reverse door upon striking object; neoprene covered to provide weather seal.
- ❖ Provide wall mounted bracket.
- ❖ Operating speed of 3m per minute (2" per second).
- ❖ Safety standard to IP54, IP55 and insulation class A.
- ❖ Manual override chain for emergency manual operation.

2.3 FINISHES:

- Curtain Slats: Powder coated.
- Steel Guides and Hood Enclosure: Powder coated.

2.0 PART 3 – EXECUTION

3.1 EXAMINATION:

- Verify surfaces and conditions are ready to receive work of this section.
- Notify Architect of any existing conditions which will adversely affect execution.
- Beginning of execution will constitute acceptance of existing conditions.

3.2 INSTALLATION:

- Install door unit assembly in accordance with manufacturer's instructions.
- Use anchorage devices to securely fasten assembly to wall construction and building framing without distortion or stress.
- Secure guides to structural members only.
- Fit, align, and adjust door assemblies' level and plumb; provide smooth operation.
- Coordinate installation of electrical service.
- Coordinate installation of sealants and backing materials at frame perimeter.
- Install perimeter trim and closures.

3.3 FIELD QUALITY CONTROL: Tolerances

- Maintain dimensional tolerances and alignment with adjacent work.
- Maximum Variation From Plumb: 1/16 inch (0.16 mm).
- Maximum Variation From Level: 1/16 inch (0.16 mm).
- Longitudinal or Diagonal Warp: Plus or minus 1/8 inch (3.2 mm) per 10 ft. (3 m) straight edge.

3.4 ADJUSTING:

- Adjust work under provisions of DIVISION 1.
- Adjust door hardware and operating assemblies.

3.5 CLEANING:

- Clean work under provisions of DIVISION 1
- Clean door and components.

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- Remove labels and visible markings.

SANITARY FIXTURES

1.0 PART 1 - GENERAL

1.1 WORK INCLUDED:

- Water closets.
- Urinals.
- Wash basins.
- Sinks.
- Mop basins.
- Electric water coolers
- Shower

1.2 RELATED WORK:

- This Section shall be used in conjunction with, but not limited to, the other relevant specifications, drawings and Contract Documents to establish the total requirements.
- CAUTION: Use of this Section without including all of the above-listed items will result in omission of basic requirements.
- In accordance with the General Conditions of Contract, the aforesaid documents shall be taken as mutually explanatory, and any ambiguities or discrepancies shall be resolved by the Purchaser, who shall then instruct the Contractor thereon. In the event of conflict regarding requirements between this Section and any other document, the more stringent requirement shall apply unless specifically instructed by the Purchaser in writing otherwise.

1.3 REFERENCES:

- ANSI A112.6.1 - Supports for Off-the-Floor Plumbing Fixtures for Public Use.
- ANSI A112.18.1 - Finished and Rough Brass Plumbing Fixture Fittings.
- ANSI A112.19.1 - Enameled Cast Iron Plumbing Fixtures.
- ANSI A112.19.2 - Vitreous China Plumbing Fixtures.
- ANSI A112.19.3 - Stainless Steel Plumbing Fixtures (Designed for Residential Use).
- ANSI A112.19.5 - Trim for Water-Closet Bowls, Tanks and Urinals.
- ANSI Z358.1 - Emergency Eye Wash and Shower Equipment.
- ARI 1010 - Drinking Fountains and Self-Contained Mechanically Refrigerated Drinking Water Coolers.
- ANSI A117.1 - Requirements for the Physically Challenged.

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- Americans with Disabilities Act Guidelines.

1.4 QUALITY ASSURANCE

- Refer to General Conditions.
- Comply with product data.
- Fixtures: By same manufacturer for each product specified throughout.
- Trim: By same manufacturer for each product specified throughout.

1.5 SUBMITTALS

- Refer to General Conditions.
- Submit shop drawings and product data.
- Product Data: Submit manufacturer's technical product data, including rated capacities of selected model clearly indicated, furnished specialties and accessories; and installation instructions. Include fixtures, sizes, utility sizes, trim and finishes.
- Shop Drawings: Submit manufacturer's assembly-type shop drawings indicating dimensions, roughing-in requirement, required clearances and methods of assembly of components and anchorages.

1.6 OPERATION AND MAINTENANCE DATA

- Refer to General Conditions.
- Submit operation and maintenance data.
- Maintenance Data: Submit maintenance data for each type of plumbing fixture and accessory; including troubleshooting maintenance guide. Include this data, product data and shop drawings in maintenance manual.
- Include fixture trim exploded view and replacement parts lists.

1.7 DELIVERY, STORAGE AND HANDLING

- Refer to General Conditions.
- Deliver products to site.
- Deliver plumbing fixtures individually wrapped in factory-fabricated containers.
- Handle plumbing fixtures carefully to prevent breakage, chipping and scoring fixture finish. Do not install damaged plumbing fixtures; replace and return damaged units to equipment manufacturer.

1.8 WARRANTY

- Refer to General Conditions.
- Provide five year manufacturer's warranty.
- Warranty: Include coverage of electric water cooler compressor.

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2.0 PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS - FIXTURES

1.1.1 Water closets, Urinals, Wash basins, Sinks (vitreous china/enameled cast iron).

- ❖ As Per BOQ

1.1.2 Sinks, Wash basins (stainless steel).

- ❖ As Per BOQ

2.2 ACCEPTABLE MANUFACTURERS - FAUCETS AND DRAINS (INSTITUTIONAL)

- ❖ AS Per BOQ

2.3 ACCEPTABLE MANUFACTURERS - WATER CLOSET SEATS

- ❖ As per BOQ

2.4 ACCEPTABLE MANUFACTURERS - MOP BASINS, SHOWER RECEPTORS

- ❖ Not Used

2.5 ACCEPTABLE MANUFACTURERS - ELECTRIC WATER COOLERS

- ❖ As per BOQ

2.6 WATER CLOSET (WC-1)

- ❖ Bowl: ANSI A112.19.2; wall hung siphon jet vitreous china closet bowl, with elongated rim, 1-1/2" top spud, china bolt caps; white. Model as per BOQ/Approved brand.
- ❖ Flush System: Dual flush system; Concealed Cistern with Flush Panel; Model as per BOQ/Approved brand.
- ❖ Seat: Solid white plastic, open front, extended back, self-sustaining hinge, stainless steel bolts, with cover Manufactured by approved brand. Anti-microbial plastic.
- ❖ Wall Mounted Carrier: ANSI A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud. Lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

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2.7 WATER CLOSET (WC-2) - FOR THE PHYSICALLY CHALLENGED:

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- Bowl: ANSI A112.19.2; wall hung siphon jet vitreous china closet bowl, with elongated rim, 1-1/2" top spud, china bolt caps; white. Model as per BOQ/Approved brand.
- Flush System: Dual flush system; Concealed Cistern with Flush Panel; Model WH003/MB001 Manufactured by approved brand.
- Seat: Solid white plastic, open front, extended back, self-sustaining hinge, stainless steel bolts, with cover Manufactured by approved brand. Anti-microbial plastic.
- Wall Mounted Carrier: ANSI A112.6.1; adjustable cast iron frame, integral drain hub and vent, adjustable spud. Lugs for floor and wall attachment, threaded fixture studs with nuts and washers.

2.8 URINAL (UR):

- Urinal: ANSI A112.19.2; vitreous china, wall hung syphon jet urinal with shields, integral trap, removable stainless steel strainer, 3/4" top spud, steel supporting hangers; white color. Model as per BOQ/Approved brand.
- Flush Valve: ANSI A112.18.1; exposed, battery powered, sensor operated flush meter, escutcheon, integral screwdriver stop, vacuum breaker, metal cover. Model as per BOQ/Approved brand.
- Wall Mounted Carrier: ANSI A112.6.1; cast iron and steel frame with tubular legs, lugs for floor and wall attachment, threaded fixture studs for fixture hanger, bearing studs

2.9 WASH BASIN (WB):

- Basin: ANSI A112.19.2; vitreous china Counter top WASH BASIN 650mm x 455mm x 200mm minimum, with single hole, D-shaped basin with front overflow, Model LW909KS Manufactured by approved Company.
- Grid strainer; provide chrome plated grid strainer and tail piece.
- P-Trap: Adjustable chrome plates 17 gauge 1-1/4" x 1-1/2" brass with cleanout plug and deep escutcheon. P-trap is pre-insulated. Manufactured by approved Company.
- Supply Fittings: Chrome plated rigid supplies with loose key angle stops.

2.10 LABORATORY SINKS (LS):

- Basin: To be supplied by others.
- Faucet: Deck mounted laboratory mixing faucet with rigid/ swing gooseneck with wrist blade handle. .
- Drain: Type 316 stainless steel with flat strainer and 4" tail piece.
- Trap: Chrome plated 17 gauge 1-1/2" x 1-1/2" brass with cleanout plug and deep escutcheon.
- Supply Fittings: Chrome plated rigid supplies with loose key angle stops.

2.11 SINK (Break Room):

- Double compartment 36" x 20" O.D ,depth 7.5", 18 gauge , stainless steel, self-rimming with undercoating, 1-1/2" side flanges, 4-1/2" faucet ledge, punched with three holes 1-1/2" diameter @ 4" O.C. Model Elegance Unique manufactured by Nirali.
- Faucet: ANSI A112.18.1; chrome plated brass supply with rigid/swing spout, water economy aerator 4" wrist blade handles. Model Z-831C4 manufactured by Nirali.
- Drain: stainless steel with removable crumb cup strainer, rubber seat stopper, 4" long tail piece and double compartment chrome plated continuous waste with center outlet.
- Trap: Chrome plated 17 gauge 1-1/2" x 1-1/2" brass with cleanout plug and deep escutcheon.
- Supply Fittings: Chrome plated rigid supplies with loose key angle stops. Frame: Provide mounting kit for counter top with seals.

2.12 SHOWER (SH-1)

- Base: Tiled walls and floor.
- Showerhead and valve: ANSI A112.18.1; Nickel Chrome finished hand and wall shower with 69" of flexible rubber-lined metal hose, hand spray and 48" chrome adjusting bar with hand shower slide bracket, wall spout with vacuum-breaker 2.5 gpm flow restrictor, internal check stops. Model Fixed shower head: GB 101C, Mixing valve with diverter: GB 204, Bath Spout: GB 101"Temptrol" manufactured by approved Company.
- MOP BASIN (MB-1) – Provide a Mop basin at every Janitor Closet as shown on drawings.
- Bowl: 36" x 24" x 10" white molded stone, floor mounted, with 1" wide shoulders, vinyl bumper guard and stainless steel strainer.
- Faucet: ANSI A112.18.1; built-in exposed wall type supply with 3" diameter cross handles, wall brace, riser supports pail hook 3/4" hose end spout, vacuum breaker.
- P-Trap: Cast iron deep seal where buried below floor slabs.
- Stops: Two chrome plated straight way valves with loose key, 1/2" I.P.S. inlet and outlet and wall escutcheon plates.
- Accessories: 2'-6" long flexible heavy duty 5/8" rubber hose, cloth reinforced with 3/4" chrome coupling at one end. Hose bracket shall be stainless steel with rubber grip. Stainless steel mop hanger with three rubber tool grips and stainless steel splash catcher.

2.13 ELECTRIC WATER COOLER (EWC-1)-FOR THE PHYSICALLY CHALLENGED

Water cooler with full stainless steel body, of size 460x580 height 1215, weight without water 50kg refrigerated with integral air cooled condenser; capacity of 40 ltrs/hr, Max. Current 3.1 amps. Refrigerant R-22, condenser: propeller type(quiet type), with thermo stat , inlet: 12.7mm BSP connection, Drain:25.4, 12.7mm BSP connection, CFC free refrigerant by Voltas

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3.0 PART 3 - EXECUTION

3.1 INSPECTION

- Review millwork shop drawings. Confirm location and size of fixtures and openings before rough-in and installation. Special attention shall be given to cabinet recessed openings for foot valve faucets. Coordinate these openings with Millwork Contractor by providing exact dimensions for proper mounting.
- Verify adjacent construction is ready to receive rough-in work of this Section.
- Examine floors and substrates and conditions under which fixture work is to be accomplished. Correct any incorrect locations of piping and other unsatisfactory conditions for installation of plumbing fixtures. Do not proceed with work until unsatisfactory conditions have been corrected in manner acceptable to installer.
- Inspect fixtures and accessories that are to be removed and relocated. Damaged or blemished items shall be brought to Construction Manager's attention before reinstalling.

3.2 INSTALLATION

- Install each fixture with trap, easily removable for servicing and cleaning.
- Provide chrome plated rigid or flexible supplies to fixtures with loose key stops reducers and escutcheons.
- Piping exposed to view shall be chrome plated.
- Install components level and plumb.
- Install and secure fixtures in place with wall supports or wall carriers and bolts.
- Seal fixtures to wall and floor surfaces with sealant, color to match fixture.
- Mount fixtures to the following heights above finished floor: Refer to Architectural Drawings.
- Protect installed fixtures from damage during remainder of construction period.

3.3 ADJUSTING AND CLEANING

- Adjust stops or valves for intended water flow rate to fixtures without splashing, noise or overflow.
- At completion clean plumbing fixtures and equipment.
- Adjust or replace washers to prevent leaks at faucets and stops.
- Solidly attach water closets to floor with lag screws. Lead flashing is not intended hold fixture in place.

3.4 FIELD QUALITY CONTROL

- Upon completion of installation of plumbing fixtures and after units are water pressurized, test fixtures to demonstrate capability and compliance with requirements. When possible, correct malfunctioning units at site, then retest to

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demonstrate compliance; otherwise, remove and replace with new units and proceed with retesting.

- ❖ Inspect each installed unit for damage to finish. If feasible, restore and match finish to original at site; otherwise, remove fixture and replace with new unit. Feasibility and match to be judged by the Construction Manager. Remove cracked or dented units and replace with new units.

3.5 FIELD INSPECTION AND REPORT

- ❖ Provide report, in accordance with Section 01400, prepared by manufacturer=s representative, stating that systems installed and services provided under this Section are in accordance with manufacturer=s recommendations and are properly operating.

3.6 FIXTURE ROUGH-IN SCHEDULE

- ❖ Refer to schedule on Drawings.

- **Appointment of agencies for execution of works:**

Contractor shall submit credentials of the agencies proposed to be engaged by him/them for execution of sub heads e to i above of works mentioned in Para 2 above to the Client. Particular agency shall be approved by Client and only such agencies shall be allowed to execute the work on behalf of the contractor.

In addition to above, the contractor shall get the specialized works including the following works executed through a particular agency approved by Client and only such agencies shall be allowed to execute such works on behalf of the contractor.

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1. Water proofing treatment works
2. UPVC door & windows
3. Aluminum door and windows, aluminum partition etc.
4. Aluminum composite panel & Structural glazing work
5. Anti-termite chemical treatment
6. HT & LT switch gear
7. Elevator
8. Transformers
10. Diesel Generating sets
11. EPABX system
12. Firefighting

Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and Technical Specifications included in the tender documents, wherever applicable.

- The work shall, in general, conform to the Latest CPWD Specifications for Civil, Electrical and all other works with up to date correction slips for all sub heads of work as applicable, and, Technical Specifications included in the tender documents, wherever applicable. Wherever any aspect of design/ construction/ material standards is not covered under the above mentioned specification, relevant standards shall be referred to in the order of precedence which shall be as follows. In the case of discrepancy between the Bill of Quantities, the Specifications and/ or the Drawings, the following order of preference shall be observed –

a. Description of Bill of Quantities (BOQ)
b. Particular specification and Specific Condition, if any
c. Drawings
d. CPWD Specifications
e. Indian Standard Specifications of BIS/ NBC/ IRC/ MORTH/ BS/ ASTM/ DIN
f. For items not covered by any of the above, the work shall be done, as per sound engineering practices and as directed by the Engineer-in-charge.

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CHAPTER B - TECHNICAL SPECIFICATIONS AND CONDITIONS- CIVIL WORKS

1. EARTH WORK: As per relevant CPWD specifications.

1. Irrespective of the stipulations in the relevant CPWD Specifications or elsewhere in the Contract, the excavated earth shall be disposed of by the contractor at his own cost to the place as directed by Engineer – in-charge and/or permitted by the local authority after obtaining written permission of the Engineer – in-charge and no payment will be made by the Client for disposal of this excavated earth.
2. The Contractor shall, at his own expense and without extra charges, make provision for all shoring, pumping, dredging or bailing out water, encountered from any sources such as rains, floods, springs, subsoil water table being high or due to any other cause whatsoever. The foundation trenches shall be kept free from water while all the works below ground level are in progress without any extra payment.
3. Filling in plinth shall be consolidated with water and compacted with pneumatic rammers, to achieve 90% relative density on testing. One test is to be carried out for 1000 sq.ms. of compacted area.

2. PLAIN CEMENT CONCRETE AND REINFORCED CEMENT CONCRETE WORK:

A. STONE AGGREGATE:

i. Stone aggregate used in the work shall be of hard broken stone to be obtained from approved source and shall conform to relevant provision in the Latest CPWD Specifications for works.

B. SAND/ M Sand

i. Sand/ M Sand to be used for the work shall be of as specified in CPWD Specifications 2019. Sand/ M Sand shall be obtained from the source to be got approved by the Engineer in charge and washed if required, with appropriate equipment to bring down the chemical, inorganic and organic impurities within the permissible limits as per the direction of the Engineer in charge. The same shall consist of hard siliceous materials.

Note: Where only one variety of sand is available the sand will be sieved for use in finishing work as directed by the Engineer – in – charge in order to obtain smooth surface and nothing extra will be paid on this account.

ii. Nothing extra shall be paid for screening or washing the sand/M Sand as prescribed above.

C. FLY ASH (GRIHA POINTS)

Fly Ash conforming to grade 1 of IS 3812 (Part 1) may be used as part replacement of OPC provided uniform blending with cement is ensured in accordance with clauses 5.2and 5.2.1 of I.S.456-2000 in the items of BMC and RMC. However this shall not override the provisions of the respective items.

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D. CENTERING, SHUTTERING AND SCAFFOLDING:

i. All Scaffolding centering for RCC shall be with properly designed system and brought to site well in advance so that the progress of the work is not hampered for non-availability of the same.

ii. All shuttering for RCC work except soffits of slab shall be in water proof shuttering Ply (marine ply). Shuttering for slab and soffits shall be in water proof shuttering ply or in good quality mild steel plates free of dents, bends or warping and rusting as approved by the Engineer in charge.

iii. Contractor should deploy complete one set of shuttering materials for minimum one complete floor and the shuttering material for beam bottom shall be minimum for two complete floors.

iv. Scaffolding works for all levels for the facade works including aluminium works, brick facade works, painting works etc., complete are inclusive in the quoted rates. no additional charges shall be paid for scaffolding works

E. REINFORCEMENT:

i. TMT reinforcement steel shall be used as per design and conforming to IS: 1786 pertaining to Fe 500/Fe 500D grade of steel.

ii. TMT steel bars manufactured by main producers, as per list of makes, shall be allowed in the work. Contractor shall produce manufacturer Test Report for each dia and each lot Tests. Nothing extra will be paid for "straightening of bars" received from market in coils or with bends. All incidental charges of any kind whatsoever including cartage, storage, safe custody of materials, cutting and wastage etc. shall be borne by the contractor.

iii. The actual average sectional weight for dia up to 10 mm shall be arrived at from one meter long samples (minimum 3 from each dia) taken from each lot of steel. The discretion of the Engineer – in – charge shall be final for the procedure to be followed for determining the average sectional weight of each lot. Quantity of each diameter of steel received at site of work each day will constitute the single lot for this purpose.

iv. The weight of each lot of a particular diameter of 10mm and below shall be reckoned as the weight as per actual issue multiplied by a factor equal to the standard sectional weight of the particular diameter divided by the average sectional weight of the particular dia in a particular lot worked out as per above para. Adjustment for the steel shall be effected on the basis of the weight as modified above for quantity payable.

v. Measurement of all diameters of steel be on linear basis and will be converted into weight on the basis of standard sectional weight coefficients given in relevant CPWD specifications mentioned in schedule 'F' of General Conditions of Contract.

vi. Measurement of reinforcement shall be as per procedure described in the relevant CPWD specifications mentioned in schedule 'F' of General Conditions of Contract.

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F. CEMENT

1. The contractor shall procure 43/ 53 grade ordinary Portland cement [grade as per design/ drawings/ decision of Engineer-in-charge] conforming to IS 8112 as required in the work, from approved manufacturers of cement having a production capacity not less than one million tonnes per annum as approved by the Engineer-in-charge. (Modified vide OM DG/MAN/270 dt. 1.5.2013)) The tenderers may also submit a list of names of cement manufacturers which they propose to use in the work. The tender accepting

   authority reserves right to accept or reject name(s) of cement manufacturer(s) which the tenderer proposes to use in the work. No change in the tendered rates will be accepted if the tender accepting authority does not accept the list of cement manufacturers, given by the tenderer, fully or partially. The supply of cement shall be taken in 50 kg. bags bearing manufacturer's name and ISI marking. Samples of cement arranged by the contractor shall be taken by the Engineer-in- charge and got tested in accordance with provisions of relevant BIS codes. In case the test results indicate that the cement arranged by the contractor does not conform to the relevant BIS codes, the same shall stand rejected, and it shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer- in-charge to do so.

2. The cement shall be brought at site in bulk supply as decided by the Engineer- in-charge. The cement godown of the capacity to store a minimum of 500 bags of cement shall be constructed by the contractor at site of work for which no extra payment shall be made.

3. Double lock provision shall be made to the door of the cement godown. The keys of one lock shall remain with the Engineer-in-Charge or his authorized representative and the keys of the other lock shall remain with the contractor. The contractor shall be responsible for the watch and ward and safety of the cement godown. The contractor shall facilitate the inspection of the cement godown by the Engineer-in-Charge at any time.

4. The cement shall be got tested by the Engineer-in-charge and shall be used on the work only after satisfactory test results have been received. The contractor shall supply free of charge the cement required for testing including its transportation cost to testing laboratories. The cost of tests shall be borne by the contractor/Department in the manner indicated below: (a) By the contractor, if the results show that the cement does not conform to relevant BIS codes. (b) By the Department, if the results show that the cement conforms to relevant BIS codes.

5. The actual issue and consumption of cement on work shall be regulated and proper accounts maintained as provided in clause10 of the contract. The theoretical consumption of cement shall be worked out as per procedure prescribed in clause 42 of the contract and shall be governed by conditions laid therein. In case the cement consumption is less than theoretical consumption including permissible variation, recovery at the rate so prescribed shall be made. In case of excess consumption no adjustment need to made.

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6. The cement brought to the site and the cement remaining unused after completion of the work shall not be removed from site without the written permission of the Engineer-in- charge.

7. The damaged cement shall be removed from the site immediately by the contractor on receipt of a notice in writing from the Engineer-in-charge. If he does not do so within 3 days of receipt of such notice, the Engineer-in charge shall get it remove at the cost of the contractor. Engineer –in- charge may change the brand of Cement depending upon availability in local market, if needed. Instructions in this respect can be issued by them at regular intervals.

G. CONCRETE MIX DESIGN

The mix design shall be for MODERATE exposure and GOOD degree of quality control, unless otherwise specified.

H. CONCRETE BATCHING PLANT (DESIGN MIX)

Not Applicable

I. READY MIX CONCRETE (RMC)

i. The contractor shall engage Ready Mix Concrete (RMC) producing plants (Distance of plant from site to be approved by Engineer in Charge) to supply RMC for the work. The RMC plant proposed to be engaged by the contractor shall fulfill the following requirements.

a) It shall be fully computerized.

b) It should have supplied RMC for Govt. projects of similar magnitude.

c) It should have facility for providing printed advice showing ingredients of concrete carried by each mixer.

ii. The Ready Mix Concrete (RMC) producing plants of the main Cement producers shall be preferred.

iii. The contractor shall, within 10 days of award of the work submit list of at least three reputed RMC plant companies along with details of such plants Including details of transit mixer, pumps etc. to be deployed indicating name of company, its location, capacity, technical establishment, past experience for approval by Engineer-in-charge.

iv. The Engineer-in-Charge reserves the right to exercise check over the:-

a) Ingredients, water and admixtures purchased, stored and to be used in the concrete including conducting of tests for checking quality of materials recordings of test results and declaring the material fit or unfit for use in production of mix.

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b) Calibration check of the RMC.

c) Weight and quality check on the ingredient, water and admixture added for batch mixing.

d) Time of mixing of concrete.

e) Testing of fresh concrete, recordings of results and declaring the mix fit or unfit for use. This will include continuous control on the workability during production and taking corrective action.

For exercising such control, the Engineer shall periodically depute his authorized representative at the RMC plant. It shall be the responsibility of the contractor to ensure that the necessary equipment manpower & facilities are made available to Engineer and/or his authorized representative at RMC plant

v. Ingredients, admixtures & water declared unfit for use in production of mix shall not be used. A batch mix found unfit for use shall not be loaded into the truck for transportation.

vi. All required relevant records of RMC shall be made available to the Engineer or his authorized representative. Engineer shall, as required, specify guidelines & additional procedures for quality control & other parameters in respect of materials, production and transportation of concrete mix which shall be binding on the contractor & the RMC plant.

vii. It shall be the responsibility of the Contractor to ensure that the RMC producer provides all necessary testing equipment and takes all necessary measures to ensure Quality control of ready -mixed concrete. In general the required measures shall be:-

a) CONTROL OF PURCHASED MATERIAL QUALITY

RMC producer shall ensure that the materials purchased and used in the production of concrete conform to the stipulation of the relevant agreed standards with the material Supplier and the requirement of the product mix design and quality control producer's. This shall be accomplished by visual checks, sampling and testing, certification from materials suppliers and information /data from material supplier. Necessary equipment for the testing of all material shall be provided and maintained in calibration condition at the plant by the RMC producer.

b) CONTROL OF MATERIAL STORAGE

Adequate and effective storage arrangement shall be provided by RMC producer at RMC plant for prevention of contamination, reliable transfer and feed system, drainage of aggregates, prevention of freeing or excessive solar heating of Aggregate etc,

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c) RECORD OF MIX DESIGN AND MIX DESIGN MODIFICATION

RMC producer shall ensure that record of mix design and mix design modification is available in his computer at RMC plant for inspection of Engineer or his representative at any time.

d) COMPUTER PRINT OUTS OF EACH TRUCK LOAD

Each truckload / transit mixer dispatched to site shall carry computer printout of the ingredients of the concrete it is carrying. The printout shall be produced to Engineer or his representative at site before RMC issued in work.

e) TRANSFER AND WEIGHING EOUIPMENT RMC

Producer shall ensure that a documented calibration is in place. Proper calibration records shall be made available indicating date of next calibration due, corrective action taken etc. RMC producer shall ensure additional calibration checks whenever required by the Engineer in writing to contractor. RMC producer shall also maintain a daily production record including details of mixes supplied. Record shall be maintained of what materials were used for that day's production including water and admixtures.

f) MAINTENANCE OF PLANT, TRUCK Mixers AND PUMPS

Plant, Truck Mixers and Pumps should be well maintained so that it does not hamper any operation of production, transportation and placement.

g) PRODUCTION OF CONCRETE

The following precautions shall be taken during the production of RMC at the plant

i) Weighing (correct reading of batch data and accurate weighing):- For each load, written, printed or graphical records shall be made of the weights of the materials batched, the estimated slump, the total amount of water added to load the delivery tickets number for that load and the time of loading the concrete into the truck.

ii) Visual observation of concrete during production and delivery or during sampling and testing of fresh concrete assessment of uniformity, cohesion, workability adjustment to water content. The workability of the concrete shall be controlled on a continuous basis during production. The batch mix found unfit shall not be loaded into the truck for transportation. Necessary corrective action shall be taken in the production of mix as required for further batches.

iii) Use of adequate equipment at the plant to measure surface moisture content of aggregates, particularly fine aggregates or the workability of the concrete, cube tests etc. shall also be ensured.

iv) Making corresponding adjustment at the plant automatically or manually to batched quantities to allow for observed, measured or reported changes in materials or concrete qualities.

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v) Sampling of concrete, testing monitoring of results.

vi) Diagnosis and correction of faults identified from observations /complaints. The RMC plant produced concrete shall be accepted by Engineer at site after receipt of the same after fulfilling all the requirements of mix mentioned in the tender documents.

viii. The rate for the Item of design mix cement concrete shall be inclusive of all the ingredients including admixtures, if required, labour, machinery T&P etc. required for a design mix concrete of required strength and workability. The rate quoted by the agency shall be net & nothing extra shall be payable on account of change in quantities of concrete, ingredients like cement and aggregates and admixtures etc. as per the approved mix design.

ix. Ready mix concrete shall be arranged in quantity as required at site of work. The ready mix concrete shall be supplied as per the pre-agreed schedule approved by Engineer.

x. Frequency of sampling and standards of acceptance shall be as per CPWD specifications.

i) No addition of water or other ingredients shall be permitted in the RMC at site or during transit.

ii) The RMC shall be placed by pump of suitable capacity end the contractor shall arrange sufficient length of pipe at site to place the RMC in the minimum required time. The contractor shall co-ordinate with RMC supplier and pumps hirer to have effective concrete placement.

iii) Pre-paid delivery tickets shall be produced with each truck load of RMC.

iv) The representative of RMC supplier shall attend the site meeting as and when decided by the Engineer

xi. i) The contractor shall assess the quantity of RMC requirement at site well in advance and order accordingly to the RMC supplier. In case excess RMC is received at site, the department shall not be under any obligation to get extra quantities utilized and no payment for such RMC shall be made.

ii) The contractor shall have to employ labour in shifts to ensure continuous casting of raft and other RCC members. No extra payment on this account shall be made.

3. BRICK WORK/ BLOCK WORK (AAC)

A. BRICK WORK

a) Bricks used in the work shall be obtained from kilns to be got approved from the Engineer in charge and shall be best quality well burnt ground moulded bricks as available in the vicinity. They shall have a compressive strength of not less than 75Kgs/sq.cm and an absorption percentage of not more than 15 (Fifteen) % of its dry weight when immersed in water for 24 hours. In all other

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respects they shall conform to the provision in Latest CPWD Specifications for works.

b) Both the face of wall of thickness more than 23cm shall be kept in the proper plane. Walls of half brick thickness or less shall be measured separately and paid in sqm.

c) Bricks wall beyond half brick thickness shall be measured in multiple of half brick (i.e. more than 115mm or equivalent) which shall be deemed to be inclusive of mortar joints. In all other respects they shall conform to the provision in relevant specifications of the work.

d) For mortar, use of PP Cement shall be preferred.

B. BLOCK WORK

i. Precast CC blocks shall be procured from approved manufactures or manufactured at site. Nothing extra shall be payable on account of adding any admixture for making pre- cast blocks or for steam curing.

ii. The CC blocks shall have nominal size of 400mm x 200mm x 100m and 400mm x200mm x 200mm respectively for 100mm and 200mm thick masonry wall, and shall confirm to IS 2185.

iii. The samples of CC blocks (each sample consisting of 6 specimens) shall be chosen randomly from the lot and tested for various parameters specified below. One sample shall be tested for every 100 cum or part thereof.

iv. Following parameters shall be tested.

a) Compressive strength.

b) Water absorption

c)
Density

d)Dimensional Tolerances

The material shall meet following parameters :

a) Compressive strength shall be no less than 5.0 N/sq. mm.

b) Water absorption shall not be more than 5% in 24 hours of immersed water.

c) Density shall be not less than 1500 kg/cum.

d) Dimensional tolerance in the size shall be not more than + 5mm for length and + 3mm for height and width.

Top course of all plinth, parapets, steps and top of walls below floor and roofs shall be laid with solid blocks, properly radiated and keyed into position to form cut (meru) corner. Where blocks cannot be cut to meru corners, cement concrete 1:2:4 (1 cement : 2 coarse sand : 4

graded stone aggregate 20 mm nominal size) equal to thickness of the coarse shall be provided in lieu of cut blocks. No additional payment shall be made on this account.

Nothing extra shall be payable on account of chasing the CC block masonry work for embedding pipes, electrical boards/ boxes etc. and also filling the chases with cement mortar 1:4 (1 Cement : 4 Coarse sand). The chasing shall however be carried out using machine cutters so as not to disturb the joints in the masonry and without any cracks being developed in the masonry.

All other specifications for 100 mm thick and 200 thick block work shall be as describes for full brick and half brick masonry work respectively.

For unsupported lengths of 100 mm thick walls exceeding 3.5 m, 100 x 200 mm wide R.C. mullions shall be provided at 3.5 m centre, tied to the lintels at door height. Similarly, continuous R.C. beam of size 100 x 150 mm shall be provided at door height for 100 mm thick wall. Such RC mullion/ bands shall be measured and paid separately.

4. CEMENT PLASTER: - The use of PP Cement shall be preferred.

5. WOOD WORK:

a. Timber required for shutters of doors, windows, ventilators, partitions etc shall be as per Bill of Quantities and CPWD Specification.

b. The moisture contents of the wood used in the work shall not be more than that stipulated in the relevant clause of Latest CPWD Specifications for works. The rate quoted for various items shall be inclusive of kiln seasoning and preservative treatment of wood. In all other respects the wood used in the work shall conform to the provision in latest CPWD specification for works.

c. The sample of species to be used shall be deposited by the contractor with the Engineer-in – charge before commencement of the work. The contractor shall produce cash voucher and certificate from standard kiln seasoning plant operator about the timber section to be used on the work having been kiln seasoned by them failing which it would not be so accepted as kiln seasoned.

d. <u>Glass :-</u>

i. Transparent sheet glass (Float glass) conforming to IS 1761 – 1970 shall be used.

ii. Minimum thickness shall be governed as under, unless otherwise specified in the item.

AREA of Glazing	Max. Unsupported length	Thickness
For glazing area up to 0.5 sqm	120 cm	6.0 mm
For glazing area more than 0.5Sqm	120 cm (200 cm)	6.0 mm / 8 mm

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iii. Glazing for toilet and in fixed ventilators shall be of frosted type.

e. Shutters:-

i. Factory made shutters, as specified shall be obtained from factories to be approved by the Engineer – in - charge and shall conform to IS 2202 (Part –I) 1977. The contractor shall inform well in advance to the Engineer – in – charge the name address of the factory from where the contractor intends to get the shutters manufactured.

ii. The contractor will place order for manufacture of shutters only after written approval of Engineer – in – charge in this regard is obtained. The contractor is bound to abide by the decision of the Engineer – in-charge. In case the factory already proposed by the contractor is not found competent to manufacture quality shutters, the Engineer – in – charge will recommend the name of another factory from the approved list.

iii. The contractor will also arrange stage wise inspection of the shutters at factory with the Engineer in charge or his subordinate authorized representatives. Contractor will have no claim, if the shutters brought at site are rejected by the Engineer in charge in part or in full lot due to bad workmanship/ quality or damages caused during their shifting from factory to site. Such shutters will not be measured and paid and the contractor shall remove the same from the site of work within 7 days after the written instruction in this regards are issued by the Engineer in charge or his authorized representatives.

6. STEEL GRILL WORK:

a. All steel grills shall be according to the detailed drawings and obtained from approved suppliers. These shall conform to Latest CPWD Specifications for works.

b. In case of grills an approved quality priming coat of zinc chromate shall be applied over and above a shop coat of primer. Nothing extra shall be payable for providing shop coat primer, but the zinc chromate primer, if additionally required, will be paid for separately.

7. ALUMINIUM WORKS/ UPVC WORKS

a. The scope of the work is the fabrication, supply and erection at site of all types of Aluminium/ UPVC glazed doors, windows and ventilators in accordance with the drawings and specifications.

b. The supply and erection will include all parts such as but not restricted to frames, tracks, guides, mullions, styles, rails, couplers, transoms, rails, plates glazing bars, glass, hinges, arrangement, spring catches, cord and pulley arrangements, spring catches, cord and pulley arrangements door closers floor springs etc., required for the whole work whether the parts/ items are individually and specifically referred to in

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the schedules/ specifications/drawings or not provided that the supply and installation of such parts can be inferred there from and are necessary to make the work complete, unless separate provision is made in the bills of quantities for supply to such parts/items.

c. The doors, windows, ventilators, will be fabricated to suit the finished clear openings in the building/structure which the tenderer will himself measure.

d. Materials:-

(a). The members will be made out of aluminum alloy corresponding to IS:733 and will consist of extruded sections and of other shapes, and to sized gauges as shown in the drawings/ described in accordance with the relevant IS codes. The members shall be chosen to provide strength/ stability and maximum resistance to wear and tear.
(b). UPVC members shall be made of PVC material conforming to IS: 10151.
(c). The Sections will be as per approved makes, extruded sections. As indicated in the drawings the tenderer should specifically mention which sections he is using.
(d). The weight of sections and the corresponding catalogue numbers are mentioned.The IS specifications are to be strictly adhered.
(e). The extruder using recycled materials may be preferred.
(f). The alloy of extruded aluminum should be BS or IS old HE9, Alcon 50 SWP. to this effect test certificate has to be provided for the extruder.

e. Finishing:

i. The extruded aluminum section has to be mechanically finished to remove all scratches; extrusion marks etc and subsequently thoroughly cleared in all alkali baths prior to anodizing.

ii. The polyester powder coating, as required, as per item of work, shall be of desired shade with minimum average thickness to 50 microns or other shades as required and to this effect the tenderer must have to produce test certificate from authorized institutions Bureau of Indian Standard.

iii. The polyester powder coated material should be properly wrapped in gummed tape before fabrication to avoid scratches during fabricated and erection shall be kept protected till handing over.

f. Fabrication:

i. Before commencing the fabrication the contractor shall submit to the Engineer – in - charge for their approval detailed shop drawings, based on the Architectural drawings and corresponding specification showing junctions, fittings, accessories such as hinges flush bolts, locks, latches, latching arrangements, peg stays, rotor arms, anodize pivots gaskets rubber packing door felts, mastic, sealant etc., including fixing and sealing arrangements . Type and method of scaffolding he intends to use, Fabrication is to be taken up only after approval by the Engineer – in - charge and in accordance with the approved drawings. Sections for fabrication of door/ window/ventilators

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etc shall be as per architectural drawings or as approved by the Engineer – in - charge.

ii. A sample of finished door / windows/ ventilator railing etc. shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication,

iii. The doors, window, ventilators and partitions shall be as per thickness given in the approved shop drawings, Polyester Powder coating shall be as specified in the item specifications.

iv. All materials shall conform to relevant IS. Codes and in the absence of IS code, they should correspond to the best engineering practice; decision of the the Engineer – in - charge shall be final and binding on the contractor.

v. Fabrication shall be done true to the drawing/ sample approved and in correspondence to the finished openings at the site. All joints shall be mitered at the corners, true right angles, and joints to be finished neatly to hairlines, with concealed fasteners, wherever possible joints shall be made in concealed locations.

vi. All fabricated/ finished items shall be packed and carted properly to site to prevent any damage in transit. On receipt at site they shall be carefully stacked in protected storage to avoid distortion/damage.

vii. Site installation shall be with concealed screws, self-tapping or other approved fasteners or may be by welding, due precautions shall be taken to avoid any distortion/ discoloration /damage to the finished items.

viii. Wood work faces /parts coming in contact with masonry shall before shifting to the site be given a heavy coat of alkali resistance bitumen paint. Steel items coming in contact with other incompatible materials shall be given a thick coat of zinc chromate primer.

g. Glazing:

Glazing shall be done with flawless sheet glass of best approved quality without waviness, distortion, coloration / discoloration, of specified thickness in sizes as shown in the drawings, fixed as required with special glazing clips, putty, neoprene/PVC gaskets. All glass shall be cleaned thoroughly before they are fixed in position. Unless otherwise specified the minimum thickness shall be 5 mm thick.

8. FIRE CHECK

DOORS:-

a. General:-

i. The door shall be procured from approved manufacturer of CPWD / CBRI. The fire and smoke / hot gases check door shall be conforming to IS-3614

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(Part-II)). The manufacturer shall have a prototype door tested and certified by CBRI Roorkee, of120 minutes fire rating confirming to BS : 476 part 22 & IS : 3614 Part II .

ii. The fire and smoke / hot gases check door shall not collapse during the rated period of the fire under the specified fire conditions.

iii. The fire and smoke / hot gases check door shall not allow the passage of hot gases or the flames through the rebate of the gap between the door frame and shutter or through the holes, developed in the shutter during fire.

iv. **Material: -**Door frames and shutter shall be made from materials specified in the bill of quantities.

v. **Shop drawing:-** The contractor shall submit including required designing shop drawing for doorframes, shutters complete with

a. Plan, elevation with relative position of adjacent works

b. Glazing details with type size and fixing

c. Fitting and fixtures with type size, brand and fixing details.

d. Finishing details.

vi. **Sample Approval:-** A sample of fire check door including fittings and fixtures, shall be fabricated as per the shop drawings approved by the Engineer – in - charge for final approval before under taking mass production/ fabrication

b. **Metal Fire Doors & Frames: -** These shall conform to the BOQ and CPWD specifications.

9. GLASS ENTRANCES AND GLAZING WITH PATCH FITTING

a. GENERAL

i. The contractor shall be responsible for design, fabrication, supply, installation, test and guarantee of all items including taking all measures that may be required to complete the work as per Architectural concept drawings and specifications details.

ii. The specialist agency engaged to carry out the external glazing installation and supply shall have at least 5 years of relevant experience and have completed external glazing systems of similar nature and equivalent scale of works as shown in the tender documents.

iii. The specialist contractor shall submit an outline of recent comparable works (illustrated by appropriate drawings, sketches, photographs, brochures) by the firm/ its technical partner to illustrate the competence, experience and suitability of the firm.

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b. The scope of work shall include:

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i. Design, preparation of shop drawings, calculations, engineering data and test reports.

ii. Fabrication and installation of Glass Entrances and Glazing with Patch Fittings system.

iii. All anchors, fixings, attachments, reinforcements, steel reinforcing for mullions and transoms required for a complete installation, except those specifically indicated as being provided by other trades.

iv. Exposed Architectural mullions and other support members.

v. Finishes, protection coatings and treatments.

vi. Sealing with approved sealants within and around the perimeter.

vii. All thermal insulation, fire safing etc. including supports and/or backing.

viii. All caulking, sealing, electrometric and metal flashing, and gaskets including sealing at junctions with roof, ground-floor waterproofing and building expansion joints between structures.

ix. Electrical bonding and ear thing of all metal cladding elements.

x. Provisions to receive electrical outlets and cutouts for conduits and other electrical work.

xi. Glass and glazing.

xii. Transportation, storage, handling, protection and cleaning.

c. SUBMITTALS

i. Product Data: Include construction details, material descriptions, dimensions of individual components, profiles and finishes.

ii. Shop Drawings

d. Fabrication and installation details, including followings

i. Plans, elevations and sections.

ii. Details of fittings and glazing.

iii. Hardware quantities, locations and installation requirements.

iv. Sample for verification, for each type of exposed finish required for

1. Metal finish: 150mm long section of patch fittings, rails and other items.

2. Glass: 150mm square, showing exposed edge finish.

e. MATERIALS

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i. Glass

1. Glass shall be as specified in drawing or BOQ or as per design requirement. It shall be Indian/ imported hard coated reflective bronze and heat strengthened glass. It shall be of approved make.

2. In toughening of Glass, rolling direction shall be parallel to the width of the glass panel such that waviness if any is parallel to the horizontal and no waviness parallel to the vertical and to ensure that such waviness is of negligible order.

DGU

Option 1 : Guardian Glass (Neutral 70)

U- Value = 1.87 W/Sqm. K

SHGC = 0.52

VLT = 69%

Option 2 : SKN 144 II (Envision)

U- Value = 1.6 W/Sqm. K

SHGC = 0.24

VLT = 40%

ii. Components

1. Patch fittings: Stainless steel

2. Floating Transom Bar: Steel cladded in metal matching fittings and in sizes recommended by manufacturer for application indicated. Include stainless steel support rods, lateral adjustment and ceiling channel. Support fins to be metal, finished to match transom bar.

3. Rails: Stainless steel

4. Accessory Fittings : Matching with patch fittings and rails metal and finish for overhead door stop, Centre hosing lock, glass support fin brackets and other as shown in drawing.

5. Anchors and fastenings: Concealed

6. Weather stripping: Sweep type

iii. Hardware

1. Hardware should be heavy duty in matching finish

2. Concealed Floor Closer and Top Pivots

a. Centre hung; BHMA A156.4, Grade 1; including cases, bottom arm, top walking beam pivots, plates, and accessories required for complete installation.

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b. Swing : Double acting; Positive dead stop, concealed with hold open angle c. Delayed action closing

d. Concealed Overhead Holder: Grade 1, with dead stop setting coordinated with concealed floor closer.

e. Push-pull set : Stainless steel finish

3. Lock set of approved make.

f. FABRICATION

1. Provide holes and cutouts in glass to receive hardware, fittings, rails and accessories before tampering glass. Fully temper glass using horizontal (roller-hearth) process and fabricate so, when installed, roll wave distortion is parallel with bottom edge of door or tile.

2. Factory assembled components and factory installed hardware to greatest extent possible.

g. EXECUTION

1. Examine areas and condition for compliance with requirements for installation tolerances and other conditions affecting performance of work.

2. Install all glass system and associated components according to manufacturer's written instructions.

3. Set units in level and plumb.

4. Maintain uniform clearances between adjacent components.

5. Lubricate hardware and other moving parts according to manufacturer's written instructions.

6. Set, seal and grout floor closer cases as required suiting hardware and substrate indicated.

h. CLEANING

1. The Contractor shall ensure that all actions are taken during installation to eliminate the effects of corrosive substances on the finishes.

2. The Contractor shall clean both internal and external surfaces to remove corrosive substances, dust or cement / mortar dropping during the installation as may be directed and instructed by the Engineer – in - charge.

3. The internal surfaces of glass and aluminum frame are to be cleaned with compatible cleaning agents prior to the installation of the internal protective sheeting.

4. The Contractor shall provide written verification that cleaning agents are compatible with aluminum, stainless steel, glass coatings, granite, glazing materials and

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sealants. In no case shall alkaline or abrasive agent be used to clean the surface. Care shall be taken during cleaning to avoid scratching of the surface by grit particles.

5. Prior to snagging inspections the Contractor shall, remove the internal protection sheets and carry out a thorough cleaning of all glass and aluminum.

6. The Contractor shall also make good any physical damage to the structure including scratches, dents, abrasions, pitting, etc. to the satisfaction of the Engineer–in - charge.

7. Manufacturer's delivery or job markings on glass and adhesive for manufacturer's labels shall be either a neutral or slightly acidic material. In no case shall such material be alkaline; any staining of glass by alkaline material will be cause for rejection of the glass.

8. After the installation of each pane of glass all markings and labels shall be carefully and completely removed from the panes. Thereafter no markings or labels of any sort shall be placed on the glass.

9. Glazed openings shall be identified by suitable warning tapes or flags attached with a non-staining adhesive or other suitable means to the framing of the opening. Tapes or flags shall not be in contact with glass.

10. As soon as it is practically possible after the issuance of the occupation Permit for the Building, the Contractor is to carry out a complete cleaning of the external face.

i. PERFORMANCE GUARANTEE: The contractor shall offer a minimum of 10 year

Performance Warranty for the entire installation carried out.

j. MEASUREMENTS: - Measurements shall be in Sq.m of actual area covered.

k. RATE: - Rate shall include all required labour, material, designing, drawing conveyance, testing at approved laboratory breakage, wastage, supervision, protection till handing over etc. complete.

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10. FLOORING:

a. The flooring in the building shall be as per the approved floor finish drawings and laid in such a way that limits in floor levels would not exceed the limits provided in the latest CPWD specifications or manufactures specifications.

b. Wherever Vitrified Tile flooring is done, it shall be with multy grade/range 1st Quality tiles.

c. Slope in floors shall be provided as per architectural drawings, else the levels at any place when checked over a distance of one meters in any direction should not show variation in floor level more than 3 mm.

d. Rate for the items of flooring is inclusive of provision of sunken flooring and finishing edges of the same in bath kitchen, toilets, cutting holes for traps/ pipes etc., and nothing extra shall be paid on this account unless otherwise specified.

e. Protective layer to be provided of any type of flooring and nothing extra shall be paid on this account.

11. FALSE CEILING: -

NOT Applicable

12. UNDER DECK INSULATION

a. **Material:-**The under deck insulation shall be in accordance with Bill of Quantities and CPWD Specification.

13. STAINLESS STEEL RAILINGS

Stainless steel shall be austenitic chromium-nickel steel, possessing rust, acid and heat resistant properties conforming to IS:6603 and IS:6911. Mechanical properties/grade for such stainless steel shall be as specified by the accepting authority, but in no case be inferior to mild steel. Generally, stainless steel is available as per AISI grades. AISI 304 which is equivalent to grade 04Crl8NillO of IS:6911 satisfies the requirements of mechanical properties of structural steel. Other grades of stainless steel for specific purposes may be provided as per specific requirements. For application in adverse/ corrosive environment, stainless steel shall conform to AISI 316L or 02G17 Ni Mo2 of IS:6911.

4. GLASS:

a. All glass and glazing material shall be verified and coordinate with the applicable Performance requirement.

b. All glass shall be cut to require size and ready for glazing. All glass shall be accurate sizes with clear undamaged edges and surfaces which are not disfigured. Any panel which does not fit any section of the curtain wall and shop front will be rejected and a replacement made at the Contractor's expense.

c. Glass shall conform to the quality, thickness and dimensional requirement specified in Bill of Quantities/ CPWD Specification.

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d. Heat strengthened glass shall not deviate in surface flatness by more than 0.23 mm with in 260mm of leading or trailing edge, or 0.076 mm in centre. Direction of ripple shall be consistent and is acceptable to Engineer-in-charge. Distortion of glass shall be controlled as much as possible during heat strengthening. Sag distortion shall be unidirectional and surface compression shall be in the range of 320-450 Kg/cm². All glass shall be delivered to site with the manufacturer's label of identification attached.

e. The glass glazed panel/ structural glazing frames for the structural glazing system shall be designed to withstand lateral imposed loads and comply with requirement of local building codes.

f. Glass shall be free from defect or impurities detrimental to its performance. Defects such as bubbles, waves, spots scratches, spalls, discoloration, visibly imperfect coating, chipping, and bubbles delaminating of opacifier film shall be limited in accordance with the Manufacturer's / trade guidelines. The glass is to be produced in such a way that the rollers will be parallel to what will be the horizontal position of the glass. Glass should be consistent in colour.

g. Double glazed units shall be procured only from approved manufacturer. Quality control tests shall be performed for mixing, curing, adhesion and dew point. The unit shall be guaranteed against condensation and dirt between the panes, failure of seal and damage to internal coating.

h. All glass breakage caused by the Contractor or his sub-contractor because of negligence or caused by the installation of faulty work by him shall be replaced by the Contractor at his own expense without delay to the project completion.

15. WATER PROOFING TREATMENT:

All the items for water proofing treatment with cement based water proofing treatment for roof slab and sunken portion in schedule of quantities shall be guaranteed for TEN YEARS the case of cement based treatment by the contractor as per Performa prescribed. The water proofing treatment work should be got done through specialized agency approved by EIC.

16. WATER PROOFING TREATMENT FOR ROOF /SUNKEN FLOORS OF W.C`S ETC.

a. Water proofing treatment for roof/ sunken floor has to be carried out as per the respective Bill of Quantities/ CPWD Specification.

b. The finished surface after water proofing treatment shall have required slope.

c. While treatment of sunken floors is done it shall be ensured that the 'S' or 'P' traps as the case may be have been fixed / eased and rounded off properly the work shall be carried out as per relevant CPWD specifications.

d. GUARANTEE: The above waterproofing, treatment shall be guaranteed for TEN YEARS against any leakage etc. the contractor shall have to execute a bond, 10 % of cost of items executed for waterproofing shall be retained for 10 years as security

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(Refer GCC provisions for (BANK GUARANTEE TO A VALUE OF 5% OF WORK DONE FOR 10 YEARS)).

17. **EXPANSION JOINTS**

a. The work shall be carried out as per CPWD specifications and directions of Engineer-in-charge.

b. The work shall be carried out as per site requirement. The contractor shall submit detailed drawing/shop drawing for each type of joint within three days from the date of award and shall be got approved from Engineer-in-charge before execution of the work.

c. The contractor shall make minor modification in the samples as per site requirement with the approval of Engineer-in-charge if required and nothing extra shall be paid for this modification.

d. The contractor shall submit the test reports of the product of the manufacturers.

e. Guarantee:- All the joints shall be guaranteed at least for the period of 5years when installed by the certified applicator in the prescribed proforma.

f. Installation:- Installation shall be in strict accordance with manufacture's technical specifications, details and installation instructions. The work shall be carried out through the specialised agencies as approved by the Engineer-in-charge.

g. Protection:- The system and its component should be protected during construction and after work is complete, the exposed surface and adjacent areas should be cleaned by suitable cleaner to the satisfaction of Engineer-in-charge.

h. Rates: - The rate shall include the cost of material inclusive all taxes except VAT, excise and custom duty, fright charges, landing charges, insurance, transportation up to site and fixing of expansion joints including all screws, bolts, adhesive, scaffolding etc. as per requirements on all the floors.

i. Sample for joints:-The agency shall supply sample of minimum one meter length of all types of expansion joints and the same shall be fixed at site at appropriate location and the same shall be approved by the competent authority which shall be duly intimated by Engineer–in–Charge. The agency shall place the order for procurement of mechanical expansion joint from the parent company for supply only after obtaining approval from Engineer-in-Charge.

j. Materials:-Materials to be followed as per the Bill of quantities/ CPWD Specifications.

18. **SAMPLES OF MATERIALS**:

a. Sample of all materials/ fittings and fixture to be used in the work such as doors, windows, tiles, sanitary, water supply, drainage fittings and fixtures shall be submitted well in advance by the contractor for approval from the Engineer-in charge of work in writing before placing orders for the entire quantity required for completion

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of work. Samples approved by the EIC shall be kept in Sample Room under the charge of Engineer-in-Charge and shall retain till completion of work.

b. Finished items in respect of typical portion of works of repetitive nature such as typical room, toilet, railing, door, window or any other work desired by the engineer- in- charge shall be prepared by the contractor to the satisfaction of Engineer-in –charge and got approved from him in writing before the commencement of these items for the entire work.

c. The requirements for preparation of samples shall be observed and fulfilled by the contractor well in advance to avoid any detriment to the general progress of work. In other words, this will not be allowed to have any effects on the general progress of work or on any of the terms and conditions of the contract. No claims of any kind whatsoever including the claims of extension of time will be entertained due to the incorporation of this requirement.

19. VARIATION IN CONSUMPTION OF MATERIALS:

The variation in consumption of material shall be governed as per CPWD specification and clauses of the contract to the extent applicable.

20. MISCELLANEOUS:

Materials manufacture by reputed firms and approved by Engineer – in charge shall only be used. Only articles classified as "First Quality" by the manufactures shall be used unless otherwise specified. Preference shall be given to those articles which bear ISI certification marks. In case articles bearing ISI certification marks are not available the quality of sample brought by the contractor shall be judged by the standards laid down in the latest CPWD specifications. For items not covered by the latest CPWD specification, relevant ISI standards shall apply.

21. TESTS:

a. Materials brought at site of work shall not be used in the work before getting satisfactory test results for Mandatory tests as per relevant provisions in Latest CPWD Specifications for works. Normally, part rate payment shall be allowed in the running account bills only if the materials are tested and test results are found to be satisfactory to by the Engineer-in-charge. These tests shall be got done from laboratories approved by Engineer-in - charge or the laboratory set up by the contractor at site as per directions of Engineer-in - charge.

b. The Engineer-in - charge of work shall check the test results and satisfy himself before allowing any payment in the running/ final bill.

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CHAPTER C -TECHNICALSPECIFICATIONS OF PLUMBING & SANITARY WORKS

SECTION 1 GENERAL REQUIREMENT

1. Scope of work

The work shall in general conform to the Latest CPWD Specifications for works as mentioned in Schedule 'F' of the GCC. Work under this Contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the plumbing and other specialized services as described hereinafter and as specified in the schedule of quantities and/ or shown on the plumbing drawings.

SECTION 2 PLUMBING FIXTURES

1. Scope of work

a. Work under this Part shall consist of furnishing all materials & labour necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories as required by the drawings and specified in the Bill of Quantities.

b. Without restricting to the generality of the foregoing the sanitary fixtures shall include the following:-

i. Sanitary fixtures

ii. Chromium plated fittings

iii. Porcelain or stainless steel sinks

iv. Accessories e.g. towel rods, toilet paper holders, soap dish, mirrors etc.

v. Whether specifically mentioned or not, the rates quoted for the installation of the fixtures, appliances and accessories shall be provided with allfixing devices, nuts, bolts, screws, hangers, fasteners as required.

vi. All exposed pipes within toilets and near fixtures shall be chromium plated brass or copper unless otherwise specified.

2. General

a. All sanitary fixtures, CP Fittings and CP/SS accessories shall be supplied at site of work as per manufacturers' standard supply.

b. All fixtures and fittings shall be provided with all such accessories and fixing devices as are required to complete the item in working condition, even if the same is not specifically

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mentioned the Bill of Quantities, Specifications or shown on the drawings. The rate quoted will include all devices for proper fixing arrangement, nuts, bolts, screws and required connection pieces etc.

c. Fixing screws shall be half round head stainless steel wood screws or bolts withStainless Steel washers. Iron screws rust and will not be permitted.

d. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at Contractor's cost.

e. Contractor shall provide poly-sulphide sealant appropriate for its use for all fixtures fixed near wall, marble core seal and edges.

3. Water Closets

a. European W.C.

i. W.C. shall be any one of the following types:

a. Wall hung wash down or

b. single or double siphon type or

c. As per BOQ

ii. Each W.C. set shall be provided with an approved type of plastic/wooden seat of approved finish compatible and fitting appropriately with the WC set with rubber buffers and hinges. The WC seat shall be those approved and accepted for fixing on a particular type of WC.

iii. The seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

iv. The edge between the fixture and the wall shall be sealed with approved type of poly-sulphide sealant.

b. Health faucet/spray (Optional)

A chromium plated spray with integral hand control valve and connected to a flexible pipe and angle valve with wall flange and hook are fixed as shown on the drawings or directed by the Engineer-in-charge. The angle valve and flange shall be paid under relevant item with tabulation tap.

4. **Wash Basins**

a. Wash basins shall wall mounted type or for under over/counter installation as specified in the BOQ.

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b. Each basin shall be supported on **MS galvanized** or painted brackets and the basin securely fixed to wall or under/ above counter installation. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.

c. Each basin shall be provided with 32 mm dia. C.P. waste with overflow/ pop-up or standard waste with rubber plug and chain, 32 mm dia. C.P. brass bottle trap with CP pipe to wall and flange as specified in the BOQ.

d. Each basin shall be provided with a single tap for cold water or two taps for hot & cold water as per requirements and as per the direction of the Engineer –in – charge, waste fittings, wall flange etc.

e. The edge between the fixture and the wall or the counter shall be sealed with approved type of poly-sulphide sealant

f. Washbasins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cm or as directed by Engineer-in-charge.

g. Each washbasin connection (separately for hot and cold) shall be provided with angle valves with CP wall flange and CP connecting pipe and of required length.

5. Sinks

a. Sinks used shall be of any of the following types:

b. For kitchens, pantries, and designated utility rooms the sinks shall be stainless steel sinks conforming to SS 304 with or without drain boards.

c. Each sink shall be supported by **MS galvanized** or painted brackets and clips and the basin securely fixed to wall or on the counter. The design of the brackets shall suit the basin selected and as recommended by the manufacturer.

d. Stainless steel sinks shall be provided with 40mm dia. C.P (as supplied by manufacturer), 40mm dia. C.P. brass "P" trap with CP pipe to wall and flange.

e. Each sink shall be provided with individual taps for hot & cold with approved type as directed by the Engineer-In-Charge.

6. Shower set

a. Shower set shall be C.P. shower arm with wall flange and shower head adjustable type.

7. Accessories

a. Accessories shall be of any of the following types:

i. Towel rails

ii. Towel rings

iii. Coat hooks

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iv. Soap dishes

v. Paper holder

vi. Mirrors

b. Accessories shall be fixed with stainless steel half round head screws and cup washers in wall with raw plugs or nylon sleeves and shall include cutting and making good.

c. Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand) and fixed in relation to the tiling work. The flange of the recessed fixture shall cover the recess in the wall fully.

8. Measurement & Rates

a. Sanitary fixtures shall be measured by numbers or as specified in BOQ.

b. Rates for all items mentioned above shall be inclusive of cutting holes and chases and making good the same, stainless steel screws, nuts, bolts, fastener and any fixing arrangements required and recommended by manufacturers, testing and commissioning

SECTION 3 SOILS, WASTE, VENT & RAINWATER PIPES & FITTINGS

1. Scope of work

a. Work under this Part shall consist of furnishing all labour, materials, equipment's and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.

b. Without restricting to the generality of the foregoing, the system shall include the following:-

i. Vertical and horizontal soil, waste, vent and rain water pipes, and fittings, joints, clamps and connections to fixtures.

ii. PVC SWR. Pipes soil & uPVC rainwater pipes.

iii. Connection of all pipes to sewer lines as shown on the drawings at ground floor levels.

iv. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads/ Khurras.

v. Testing of all pipe lines.

2. General requirements

a. All materials shall be new of the best quality conforming to specifications and subject to the approval of Engineer-in-charge.

b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner.

c. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

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d. Pipes shall be securely fixed to walls and ceilings by suitable clamps intervals specified.

e. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance.

3. Piping System

a. Soil, Waste & Vent Pipes

i. The Soil & Waste pipe system above ground has been planned as a "two pipe system" as defined in BIS: having separate pipes for waste for kitchen sinks, showers, washbasins, AHU's condensate drains and floor drains and is approved by Engineer-in-charge.

ii. All waste water from AHU's plant and pump rooms, floor channels in basements will be provided with a deep seal trap before connecting to the main drain or vertical stack.

iii. Vertical soil & waste stacks shall be connected to a common horizontal drain pipe at basement ceiling or to an external manhole directly where feasible and shown on the drawings.

b. Rainwater Pipes

i. All terraces shall be drained by providing down-takes rainwater pipes.

ii. Rainwater pipes are separate and independent and connected to the storm water drainage system as shown on the drawings.

iii. Rainwater in enclosed courtyards shall be collected in catch-basins and connected to storm water harvesting chambers as shown in drawings..

iv. Any dry weather flow from waste appliances, AHU's pump rooms, shall not be connected to the sewerage system.

v. Materials as specified in the BOQ.

c. Balcony/Planter drainage

NOT Applicable

d. uPVC pipes & fittings (For Rain Water Pipes etc.)

i. Where specified, Polythene pipes shall be uPVC pipes confirming to I.S:4985-1988. The details of the nominal outer diameter, weight and working pressure shall be as per the standards, for the respective pressure ratingas specified in the B.O.Q.

ii. Polythene pipes may be cold bending to a radius of not less than eight times of their external diameter. Pipes bent for a smaller radius may be made by hot bending.

iii. Fittings used for Polythene pipes shall be compression moulded fittings matching to the above specifications.

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e. Jointing

i. All Polythene pipes shall be Drip seal/Sealant and jointed as per manufacturer's specifications and relevant I.S codes.

ii. All pipes shall be tested after installation for a pressure equal to twice the maximum working pressure in the line as per manufacturer's specifications.

f. Fittings

1. Fittings shall conform to the same Indian Standard as for pipes. Pipes and fittings must be of matching IS Specification. Interchange of pipes of one standard with fittings on the other standard will not be permitted.

2. Fittings shall be of the required degree of curvature with or without access door.

3. Access door shall be made up with 3 mm thick insertion rubber washer and white lead. The bolts shall be lubricated with grease or white lead for easy removal later. The fixing shall be air and water tight.

g. Fixing

1. All vertical pipes shall be fixed by structural support clamps truly vertical.

Branch pipes shall be connected to the stack at the same angle as that of the fittings. No collars shall be used on vertical stacks. Each stack shallbe terminated at top with a cowl (terminal guard).

2. Horizontal pipes running along ceiling shall be fixed on structural adjustable clamps (Clevis clamps) of special design shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them.

3. Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the Engineer- In-Charge/ Building Contractor for making such provisions in the structure as necessary. All damages shall be made good to restore the surfaces.

4. Traps

a. <u>Floor traps</u>

Floor traps shall be siphon type full bore P or S type PVC having a minimum 50 mm deep seal. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement :2 coarse sand : 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor level. Contractor shall provide all necessary shuttering and centring for the blocks. Size of the block shall be30x30 cm of the required depth.

b. <u>Urinal traps</u>

Urinal traps/horn shall be PVC P or S traps with or without vent and set in cement concrete block specified for floor traps.

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c. Floor trap inlet

Bath room traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type inlet fitting fabricated from G.I. pipe without, with one, two or three inlet sockets welded on side to connect the waste pipe. Joint between waste and hopper inlet socket shall be Drip Seal. Inlet shall be connected to a PVC P or S trap. Floor trap inlet hoppers and the traps shall be set in cement concrete blocks as specified in para above without extra charge.

d. Gratings for traps

Floor and urinal traps shall be provided with 100-150mm square or round C.P./ Stainless steel grating/ PTMT, with rim of approved design and shape as per BOQ.

e. Jointing

Soil, waste, vent and anti-siphonage pipes shall be jointed with Lead joint/ Drip seal joint as mentioned in the BOQ. The following minimum procedures shall be complied with while making the pipe joints:-

i. Ensure that the pipes are clean internally and undamaged.

ii. The pipes shall be cut square with sharp tools.

iii. The cut ends of the pipes shall be filed/ reamed and finished smooth.

iv. Any deformed ends shall be re-rounded.

v. It shall be ensured that the pipe ends shall enter the fittings and sockets to full depth of the jointing area.

vi. The pipe work shall be assembled in a manner such that it does not entail making of joints in restricted locations.

vii. Each metal pipe spigot shall be centered with three lightly wedged pieces of hardwood or folded lead.

viii. The jointing surfaces shall be cleaned to remove any coatings or cutting oils, etc.

f. Floor Trap Inlet/ GI Inlet Fitting:

Traps and connections shall ensure free and silent flow of discharging water. Where specified, Contractor shall provide a special type PVC or G.I. inlet hopper without or with one or two or three inlet sockets to receive the waste pipe. Joint between G.I. waste pipe and hopper inlet socket shall be Drip seal joint. Hopper shall be connected to a CI 'P' or 'S' trap with at least 50mm seal (hopper and traps shall be paid for separately). Floor trap inlet hoppers and the traps shall be set in cement concrete blocks/ and supports as required for Floor trap above shall be provided without any extra charge.

5. Cleanout Plugs

a. Cleanout Plug on soil pipes

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Clean out plug for Soil, Waste or Rainwater pipes laid under floors shall be provided near pipe junctions bends, tees, "Ys" and on straight runs at such intervals as required as per site conditions. Cleanout plugs shall terminate flush with the floor levels. They shall be threaded and provided with key holes for opening. Cleanout plugs shall be Cast Brass suitable for the Pipe dia. With screwed to a G.I. socket. The socket shall be Drip seal caulked to the drain pipes.

b. Cleanout Plug on Drainage Pipes

i. Cleanout plugs shall be provided on starting point of each drain and in between at locations indicated on plans or directed by the Engineer-in- charge. Cleanout plugs shall be of size matching the full bore of the pipe but not exceeding 150 mm dia. Cleanout Plugs on drains of greater diameters shall be 150 mm dia. Fixed with a suitable reducing adapter.

ii. Cleanout Plug at Ceiling Pipes: - Cleanouts provided at ceiling level pipe shall be fixed to a CI flanged tail piece. The cleanout doors shall be specially fabricated from light weight galvanised sheets and angles with hinged type doors with fly nuts, gasket etc., as per drawing.

6. Waste pipe from appliances

a. General

i. Waste pipe from appliances e.g. washbasins, sinks and urinals shall be of heavy galvanized steel /CPVC as given in the Schedule of Quantities or shown on the drawings.

ii. All pipes shall be fixed in gradient towards the outfalls of drains. Pipes inside a toilet room shall be in chase unless otherwise shown on drawings. Where required pipes may be run at ceiling level in suitable gradient and supported on galvanized structural clamps. Spacing for clamps for such pipes shall be as per good engineering practice approved by the Engineer-In-Charge.

b. Galvanized pipes

Waste pipes from appliances shall be galvanized steel tubes conforming to I.S.1239 (Heavy class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. tees, couplings, bends, elbows, unions, reducers, nipples, plugs. All G.I. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Pipes inchase shall be wrapped with bitumen tape and then painted with two coats of black bitumen paint. Exposed pipes with one coat of Zinc cromate with etch coating primer and two or more coats of synthetic enamel paint or as given in the Schedule of Quantities. Colour shall be as per the approved colour code.

7. **PVC/ SWR/ RCC pipes for drainage**

a. All drainage lines passing under building, in exposed position above ground e.g. basement ceiling etc. shall be PVC/ SWR/ RCC pipes. Position of such pipes shall generally be shown on the drawings.

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Fittings

Fittings used for S.W/ RCC drainage pipe shall conform to I.S. 1538 (Heavy class). Wherever possible, junction from branch pipes shall be made by a Y- tee.

Joints

i. Joints between pipes shall be made with pre-moulded rubber joints (Tyton Joints) supplied by the manufacturer to ensure compatibility and water tightness.

ii. Joints between pipes and fittings shall be made by caulked spun yarn dipped in tar and molten drip seal 45 mm deep by hammering with caulking tools.

8. Encasing pipe in Cement Concrete

Soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand :4 stone aggregate 12 mm size) 75 mm in bed and all-round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8 m. Rate for concrete round pipes shall be inclusive of pillars, supports, shuttering and centring.

9. Painting

a. All cast iron, soil, waste vent, anti-siphon age and rainwater pipes in exposed location in shafts and pipe spaces shall be painted with two or more coats of synthetic enamel paint to over a priming coat to give an even shade.

b. Paint shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe colour code.

c. G.I. waste pipes in chase shall be painted with two coats of bitumen paint, covered with polythene tape and a final coat of bitumen paint. Exposed pipes shall be painted with two or more coats of synthetic enamel paint over each priming coat.

d. Soil and waste pipes below ground and covered in cement concrete or lead pipes shall not be painted.

10. Cutting and making good

a. Pipes shall be fixed and tested as building proceeds.

b. Contractor shall provide all necessary holes cut outs and chases in structural members as building work proceeds. Wherever holes are cut or left originally, they shall be made good with cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 stone aggregate 20 mm nominal size) or brick work in cement mortar1:2 (1 cement: 2 coarse sand) and the surface restored as in original condition.

11. Testing

a. Testing procedure specified below apply to all soil, waste and vent pipes above ground including pipes laid in basement ceiling.

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b. Entire drainage system shall be tested for water tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber/bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests. All testing shall be certified for its calibration by an approved laboratory.

c. All materials obtained and used on site must have manufacturer's hydraulic test certificate for each batch of materials used on the site. All testing equipment must be calibrated and shall carry certificate from an approved laboratory.

d. Testing soil, waste and rainwater pipes

i. Apart from factory test all pipes and fittings shall be hydraulically tested for a head of 3 m preferably on a specially set up work bench. After applying pressure, strike the pipe with a wooden pallet and inspect for blow holes and cracks. Pressure may be applied for about 2 minutes. Reject and remove all defective pipes.

ii. After installation all connections from fixtures, vertical stacks and horizontal drains including pipes shall be tested to a hydraulic pressure not exceeding 3 m. Such tests shall be conducted for each floor separately by suitable plugs.

iii. The entire installation shall be tested by smoke testing machine. The test can be conducted after the plumbing fixtures are installed and all traps have water seal or by plugging all inlets by bellow plugs. Apply dense smoke keeping the top of stack open an observe for leakages. Rectify or replace defective sections.

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

e. Contractor shall maintain a test register identifying date and time of each area.

All tests shall be conducted in presence of Engineer-in-charge and signed by both.

12. Measurements

a. General

i. Rates for all items quoted shall be inclusive of all work and items given in the specifications and Bill of Quantities.

ii. Rates are applicable for the work under floors, in shafts at ceiling level area for all heights and depths.

iii. Rates are inclusive of cutting holes and chase in RCC and masonry work and making good the same.

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iv. Rates are inclusive of pre testing, on site testing, of the installations, materials and commissioning of the works.

v. Pipes (Unit of measurement, linear meter to the nearest Centimetre) or as specified in CPWD specifications.

b. All SWR/ RCC Soil, waste, vent, anti-syphonage and rain water pipes shall be measured net when fixed correct to a centimetre including all fittings along its length. No allowance shall be made for the portions of pipe lengths entering the sockets of the adjacent pipes or fittings. The above will apply to both case i.e. whether pipes are fixed on wall face or pillars or embedded in masonry or pipes running at ceiling level.

c. Pipes shall be measured per running meter correct to a centimeter for the finished work which shall include fittings e.g. bends, tees, elbows, reducers, crosses, sockets, nipples and nuts. The length shall be taken along centre line of the pipes and fittings. All pipes and fittings shall be classified according to their diameter, method of jointing and fixing substance, quality, and finish. The diameters shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of unequal bore, the largest bore shall be measured.

d. Cement concrete around pipes shall be measured along the centre of the pipe line measured per linear metre and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications.

e. Slotted angles/channels shall include support bolts, nuts and clamps embedded in masonry walls with cement concrete blocks and nothing extra will be paid for making good the same.

f. Fittings

Unit of measurement shall be the number of pieces. Pipe fittings are included in the rate for pipes. Urinal traps, trap gratings, hoppers, cleanout plugs shall be measured by number per piece and shall include all items described in the relevant specifications and Schedule of Quantities.

g. Painting

Painting of pipes shall be measured per running metre and shall be inclusive of all fittings and clamps. No deduction for fittings shall be made.

h. Excavation for soil pipes

No payment shall be admissible with respect to excavation, refilling and disposal of surplus earth for soil and waste pipes laid below ground, in sunken slabs.

i. Engineer-in-charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

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SECTION 4 - WATER SUPPLY SYSTEMS

1. Scope of work

a. Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

b. Without restricting to the generality of the foregoing, the water supply system shall include the following:-

i. Rising main from water supply pumps to all overhead tanks.

ii. Distribution system from overhead tank to all fixtures and appliances for cold & hot water.

iii. Insulation to hot water pipes within toilets.

iv. Connections to all plumbing fixtures, and appliances.

2. General requirements

a. All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer-in-charge.

b. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

c. Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.

d. As far as possible all bends shall be formed by means of a hydraulic pipe bending machine for pipes up to 25 mm dia. Bends and elbows may be used for pipe dia. greater than 32 mm.

e. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

f. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals approved by the Engineer-In-Charge.

g. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

3. Water Supply System

a. Contractor should study the site plan and water supply system diagram for overviews of the system.

b. Source

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i. Water supply will be acquired from Client's mains line (water report enclosed).

ii. The rising mains will be connected to the main fire static tank and then overflow into the main domestic water tank located in basement.

c. Water supply piping for garden hydrant and sprinkler and irrigation system will be separate and independent connected to a different pumping system.

4. G.I/ CPVC Pipes & Fittings

a. All pipe inside the building and where specified, outside the building shall be galvanized / CPVC steel tubes conforming to I.S. 1239 of class specified. When class is not specified they shall be heavy class.

b. Fittings shall be malleable iron galvanized /CPVC of approved make. Each fitting shall have manufacturer's trade mark stamped on it. Fittings for G.I./CPVC pipe shall include couplings, bends tees, reducers, nipples, union and bushes. Fittings shall conform to I.S. 1879-(Section I to X).

c. Pipe and fittings shall be joined with screwed joints, after cutting a pipe with a hacksaw or a cutting machine care shall be taken to remove burr from the end of the pipe after reaming with a proper file.

d. Pipe threaded joints will be made by applying suitable grade of TEFLON tape used for drinking water supply.(Use of red and white lead sutli will not be permitted for screwed joints)

e. All pipes shall be fixed in accordance with layout and alignment shown on the drawings. Care shall be taken to avoid air pockets. G.I./CPVC pipes inside shall be fixed in wall chases well above the floor. No floor shall be run inside a sunken floor as far as possible. Pipes may be run under the ceiling or floors and other areas as shown on drawings.

f. Clamps

i. G.I/CPVC pipes in the shaft and other locations shall be supported by clamps of design approved by Engineer-In-Charge. Pipes in wall chases shall be anchored by hooks. Pipes at ceiling level shall be supported on structural clamps.

ii. Spacing of clamps, hooks etc. Shall be as per good engineering practice approved by the Engineer-in-charge

g. Unions

Contractor shall provide adequate number of unions on pipes 50mm and below to enable easy dismantling later when required Unions shall be provided near each gunmetal valve, stop clock, or check valve and go on straight runs as necessary at appropriate locations as required and /or direct by Engineer-In- Charge.

h. Flanges

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i. Flanged connections shall be provided on pipes 65 mm and above as required or where shown on the drawings generally as follows:

1. On straight runs not exceeding 30 m, near bends and at connections to main branch lines.

2. On all valves ends

3. On equipment /pump connections as necessary and required or as directed by Engineer – in - charge.

j. Flanged connections shall be made by the correct number and size of the bolts and made with 3 mm thick insertion neoprene gaskets Bolt hole dia. for flanges shall conform to match the specification for sluice valve and butterfly valve.

k. Trenches

i. All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

Dia. of pipe	Width of trench	Depth of trench
15 mm to 50 mm	30 cm	75 cm
65 mm to 100 mm	45 cm	100 cm

ii. Sand filling

Where specified in the Schedule of Quantities all G.I. pipes in trenches shall be protected with fine sand 15 cm all around before filling in the trenches.

l. Where shown on the drawings, main pipe lines may be run in masonry trenches from the pump house to the buildings in phase I & II , filled up with sand and buried in ground as per architectural /landscape details.

m. painting

All pipes above ground shall be painted with one coat Zinc with each coating and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code specified by Engineer-in-charge.

n. Pipe protection

i. Where specified in the Schedule of Quantities all pipes in chase or below floor shall be protected against corrosion by the application of two coats of bitumen paint covered with bitumen tape and a final coat of bitumen paint before covering up the pipe.

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ii. All G.I. / CPVC water supply pipes below ground shall be protected against corrosion by applying one layer of 4 mm thick multilayer anticorrosive polymeric mix tape applied over a coat of primer as per recommendations of the manufacturers. (Pypcoat)

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o. Insulation

Hot water pipes within a toilet /kitchen from hot water header shall be insulated with fire resistance closed cell chemically cross linked polyethene is used in the forms of rolls, sheets and tubes. The thickness of insulation is 13mm on all sizes of pipes. Density of insulation is 30 ± 2 kg/cum.

5. Valves

a. Ball valves

i. Valves 50 mm dia. and below shall be screwed type ball valves with stainless steel balls spindle Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying couplings and steel handles to B.S. 5351.

b. Butterfly Valves

i. Valves 65 mm dia. and above shall be butterfly valve to be used for isolation and/or flow regulation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction. Valves shall be provided with matching flanges with neoprene insertion gasket 3 mm thick .P.N 1.6

ii. Butterfly valve shall be of best quality conforming to IS: 13095.

c. Non Return Valve

i. Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only, It shall be single door swing check type of best quality conforming to IS: 5312.P.N1.6

ii. Each butterfly and slim type swing check valves shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanized nuts, bolts and double washers of correct length.

iii. Sluice valve shall be of approved makes conforming to I.S.:780 of class as specified.

6. Storage Tanks

a. Overhead Tanks

Overhead water storage tanks for water supply shall be reinforced cement concrete.

b. Tank connection and accessories

i. Contractor shall provide the following to each tanks:

1. Inlet and outlet connections to pumps, equipment and main pipe lines.
2. Tank overflows with mosquito proof gratings
3. Scour drain and valve as per drawings

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4. Water level gauge with approved type of brass gauges, plastic tube, a wooden board with level marking.

ii. Electronic level controllers, cabling, sequence controllers and all related equipment shall be provided by agency executing the pumping system work. Plumbing contractor shall provide necessary G.I. sleeves and co- operate with the contractor to ensure that the work is successfully executed.

7. Testing

a. All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 10 kg /cm^2 whichever is more. Pressure shall be maintained for a period of at least 12 hours without any drop& withstand for 8 hrs.

b. A test register shall be maintained and all entries shall be counter-signed byContractor(s) in the presence of Engineer-in-charge.

c. In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the Contractor during the defects liability period without any cost.

d. After commissioning of the water supply system, Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

8. Measurements

a. G.I./CPVC pipes

i. G.I./CPVC pipes above ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of all fittings e.g. couplings, tees, bends, elbows, unions, and flanges. Deduction for valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chases and making good the same and all items mentioned in the specifications and Schedule of Quantities.

ii. G.I./CPVC pipes below ground shall be measured per linear metre (to the nearest cm) and shall be inclusive of fittings, e.g. couplings, tees, bends, elbows, unions. Deduction for valves shall be made. Rates quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chases and making good and all other items mentioned in the specifications and Schedule of Quantities.

b. Gunmetal/ cast iron/ brass, butterfly and non-return valves puddle flanges, level indicators and meters shall be measured by numbers.

c. Brick masonry chamber for valves and meters shall be measured by number and include all items given in the Bill of quantities.

d. Painting/pipe protection

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Painting/pipe protection for pipes shall be measured per linear metre over finished surface and shall include all valves and fittings for which no deduction shall be made.

e. Engineer-In-Charge's decision with respect to the correct interpretation regarding mode of measurement shall be final and binding on the contractor.

SECTION – 5 WATER SUPPLY PUMPING SYSTEM & ALLIED SERVICES

1. Scope of work

a. Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required for the satisfactory supply, installation, completion and commissioning of water supply pumping system and allied works as described hereinafter, as specified in the schedule of quantities and/or shown on the plumbing drawings and described in the scope of work .

2. The System

a. The system described below is for the contractors bidding for the works to understand the extent and scope of work and the intent in the manner in which the water supply system is planned and shall be executed. This does not form a part of the contractor's scope of work with respect to the various elements that are described in this paragraph.

b. Sources of supply

Local water supply for which a water main from the main road to the underground water tank will be laid by contractor.

c. Underground water tanks

i. Static fire water storage tanks in compartments .Connections from the tube well water supply lines will be made into these tanks. Water will overflow into the raw water tanks

ii. Raw Water Tank to hold the tube well as well as CWS Supply water will be made to:

1. A set of pumps will be connected to and water filter and chlorination system and the filtered water stored in the Treated Water Tanks (in three compartments. All piping and connections for this system are a part of this contract, if required.

2. Domestic Water Pumping Systems

iii. Water supply to the various buildings will be made from a set of pumping sets to the overhead water and supplementary fire tanks located on the terrace of each building.

3. Rising Mains & level control system

a. Water from the pumps described above will fill each tank by a rising main to each tower.

b. To control the level in each tank and enable it to fill as the water demand so requires, each tank will be provided with a ball cock to shut off the water supply when the tank is full.

c. A set of electronic level sensing probes will be installed in each tank. The probes installed in each pumping system will be wired to a central electronic panel which will activate the

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pump when any one of the tank probe signals low water conditions and top up all tanks. No excess flow will occur due to the ball cock in the tank.

4. Level Controllers

a. Level controllers shall be electronic magnetic type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications:-

i. Provide a audible high water alarm when water level in the sump reaches a pre-determined high level in the sump location at MCC panel installed in wall near sump location

b. Overhead tank level controller cum indicators

i. Each OHT to be provided with required number of stainless steel electronically operated probes (housed in a stainless steel protective housing) and connected by a control cable to a central junction box connected to MCC panel located in the pump house at basement. Acommon multi-core cable from each group of buildings will be laid to the pump room in basement. The probes will function as follows:

ii. To cut off the water supply pumps when all the OHT is full and to start the pump if any OHT level reaches at pre-determined low level.

iii. Provision shall be made to enable the operation of the second duty pump in case the water level does not rise above a pre-determined level in the tank due to water demand which is higher than capacity of duty pump no.1 to meet.

iv. Indicate the water level in each OHT in the level indicating panel installed in the pump room

v. Each OHT are also provided with a float valve to stop the supply in individual OHT when level reaches a cut off high level.

c. Control & Indicating Panel (For overhead and underground water tanks)

i. A centralized indicating stand–alone wall mounted panel fabricated from14 g. with seven tank process MS sheet and painted inside and outside with stove enamelled finish with clear vertical panels for each group ofbuildings & tanks shall indicate water level in each tank by means ofdigital display unit to indicate water level in each tank in four levels(¼th, ½, ¾ and full). The panel shall be installed on the control console panel located in the pump room or as directed by the Project Engineer. The panel shall have:

ii. Digital level indicator panel meter for each water tank.

iii. Etched plate identification plates.

iv. Control cabling from MCC to the panel installed in the control room as directed by the Engineer-In-Charge.

v. Cabling from PHT sensing probes to the panel

5. **Pressure filters for Water Supply System**, if required.

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a. Specification shall apply for water filtration system

i. Pressure filters shall be manufactured with factory made bobbin wound polyester fibre glass multilayer filters fitted with internal GI distribution pipe with polypropylene diffusers on top, collector pipes and arms, inlet and outlet header vertical water pressure dished ends complete with initial charge of filter media, G.I. face piping, accessories testing and commissioning complete, Working Pressure 2.4 kg/cm^2 (Test pressure3.75 kg/cm^2). Along with bfv & nrv & gauge, prv etc.

ii. Each vessel will be provided with suitable pressure tight manhole cover appropriately located for inspection and repairs.

iii. The diameter and height of each vessel shall be as per the design requirement and given in the BOQ and as per site conditions.

b. Multi-Port Valves

i. Each vessel will be provided with multi-port valves to operate and regulate the normal flow, backwash and rinsing, rapid washing, on the face piping.

ii. Provide suitable sampling cocks to draw water samples for raw water and treated water.

c. Face Piping

i. Each vessel shall be provided with non-corrosive face piping from the inlet to the outlet. Face piping shall be CPVC (IS 4985) 10 kg/cm^2 all CPVC fittings are heavy grade to pipe and solvent weld and flanged joints

ii. All valves shall be butterfly valves as specified in the piping section over65 mm dia. and for pipe dia. below 50 mm dia. shall be provided with ball valves.

d.Water Filtration Plant (For Domestic Water)

i. Design parameters for the proposed filter shall be as follows:

1. Filter media: - Graded aggregate of required size selected coarse and fine silica sand as per latest water treatment practice. Aggregate and sand to be acid washed and having purity of99.9%.

2. Depth of filter media:- Approx. 750-900 mm deep (as per manufacturer's design)

3. Back washing :- By air scouring through air blower (approx. 5.1 lpm/m^2 of filter surface area and water supply from raw water pumps by reverse flow

4. Output Water Quality for Domestic Filters: To conform to IS10500 for the relevant design criteria

e. Chemical Dosing Pumps

i. Pump applications

1. Chlorination of raw water from tube wells,

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ii. Dosing system comprising of an electronic metering pump with, 100 lit capacity uPVC/HDPE solution tank with level gauge and lid on top.

iii. Electronic driven metering pumps with mechanically actuated diaphragm with oil lubricated gear mechanism. The output of the pump should be adjustable for operation from 10-100%. Pump construction shall be corrosion resistant polypropylene or similar material. Pump electrical circuit shall be interlocked with the main raw water /pool recirculation pumps so that they operate only when the pumps are operating.

f. Air Blower for Back Washing

i. Low pressure air blower with TEFC electrical motor, belt driven or direct drive, all mounted on a common structural based plate with oil and water separator.

ii. Air blowers will be used for back washing operations. The air blower shall be designed for operation of one filter at a time. Blowers will be designed for air flow of approx 5.1 lpm/m^2 air capacity at 0.5 kg/cm^2 pressure. (This may be modified to suit manufacturer's requirement for filters offered.)

iii. The electrical switchgear shall be included in the respective MCC panel of the system

SECTION 6 - PIPES & FITTINGS

1. **Headers, piping and connections**

a. All pipes within the plant room building in exposed locations and shafts including connections buried under floor and for suction and delivery headers shall be G.I. / CPVC pipes (medium class) and thickness specified. Pipes up to 150 mm dia. shall conform to I.S. 1239.

b. Pipe 200 mm dia. and above shall be G.I. ERW tubes to IS 3589. If black pipes are available they shall be galvanized before use.

c. Fittings for G.I. pipes shall be approved type malleable iron or wrought iron screwed galvanized fittings for screwed joints. Fittings 200 mm dia. may be shop fabricated but shall be shop galvanized after fabrication.

d. All M.S. structural supports and clamps shall be galvanised. All the pipe work within plant room shall be adequately supported with G.I. structural supports from floor or ceiling as required and directed by Engineer-In-Charge.

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2. Jointing

a. G.I. Pipes (Screwed joints)

Pipe shall be provided with metal to metal threaded joints. Teflon tape shall be used for lubrication and rust prevention. (USE OF LEAD /ZINC BASED JOINTING COMPOUND ARE NOT PERMITTED)

b. Flanged joints / Dead Joints

a. Flanges shall be provided on:

i. Straight runs not exceeding 12-15 m on pipe lines 80 mm dia and above.

ii. Both ends of any fabricated fittings e.g. bends, tees etc. of 50 mm dia orlarger diameter. (When Permitted)

iii. Both end of all suction delivery and other headers.

iv. For jointing valves, appurtenances, pumps, connections with pipes, to water tanks and other places necessary and required as good for engineering practice.

v. Flanges shall be as per applicable I.S. with appropriate number of G.I. nuts and bolts, 3 mm insertion rubber gasket complete.

vi. The cost of flanges is included in the rates of pipes along with fittings.

c. Unions

Provide approved type of dismountable unions on pipes lines 50 mm and below near valves or inspector test/drain and assemblies and as required as per site conditions.

d. Vibration Eliminators

All suction and delivery lines and as shown on the drawings double flanged reinforced neoprene bellow type flexible pipe connectors shall be provided.Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer's details.

3. Valves

a. Sluice valves

i. Full way Sluice Valves shall be used on the suction connection to pumps and headers.

ii. Sluice valves (80 mm dia. and above) shall be double flanged sluice valves with rising stem. Each sluice valve shall be provided with wheel in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for sluice valves with cap tops.

iii. Sluice valves shall be of approved makes conforming to I.S.780 PN1.6 class

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b. Butterfly Valves (PN 1.6 rating)

i. Butterfly Valves shall be used in all other locations as required conforming to IS13095.PN 1.6

ii. Disc shall be CI heavy duty electrolysis nickel plated abrasion resistant.

iii. The shaft to be EN-8 Carbon Steel with low friction nylon bearings.

iv. The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.

v. Built in flanged rubber seals.

vi. Actuator to level operated for valves above ground and T Key operated for valves below Ground.

vii. Built in flanges for screwed on flanged connections. Manufacturer's details on fixing and Installation will be followed.

c. Non Return Valves (NRV PN 1.6 rating))

i. Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

ii. NRV shall be cast iron/ gunmetal/ brass slim type with cast iron gunmetal/ brass body and gunmetal internal parts and accompanying flanges. Valves shall conform relevant IS or match the butterfly valves.PN 1.6

iii. Built in flanges for screwed on flanged connections.

d. Ball Valves

Ball Valves up to 40 mm dia. shall be screwed type ball valves with stainless steel balls, spindle, Teflon seating and gland packing tested to a hydraulic pressure of 20 kg/cm^2 and accompanying coupling and steel handles (to B.S. 5351.

4. 'Y' Strainers (PN 1.6 rating)

Provide cast iron/ gunmetal/ brass 'Y' type strainers with gunmetal internal strainers, CI screwed plug to be provided on all water tank suction connections to pumps.

5. Measurements (Part 1, 2 & 3)

a. General

i. Unit rate for individual items, e.g., pressure tanks, MCC, level controller, water tank are for purposes of payments only. Piping, headers, valves, accessories, cabling and MCC to measured separately in this contract only.

ii. All items must include all accessories fittings as described in the specifications, BOQ and shown on the drawings.

b. Drainage Pumps & Sewage Pumps

Drainage pumps shall be measured by numbers and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

c. Level controllers & Alarms

Level controllers for each set of pumps shall be measured by number and inclusive of probes, cabling up to surface box near the pump and shall include all items as given in the specifications and schedule of quantities to provide a complete working system.

d. Piping Work

i. Suction and delivery headers for each pumping system shall be measured per set with required length and shall include all items as given in the schedule of quantities. Painting shall be included in rate of headers.

ii. CPVC pipes between various filters and units shall be measured per linear meter of the finished length and shall include all fittings, flanges, jointing, clamps for fixing to walls or hangers and testing. Flanges shall include 3 mm thick insertion rubber gasket, nuts, bolts and testing.

iii. Vibration eliminators, "Y" strainers, butterfly valves, slim non return valves, ball valves shall be measured by numbers and shall include all items as given in the schedule of quantities and specifications except from pump room.

a. The warranty shall expressly include replacement of all defective or under capacity equipment. Engineer-In-Charge may allow repair of certain equipment if the same is found to meet the requirement for efficient functioning of the system.

b. The warranty shall include replacement of any equipment found to have capacity lesser that the rated capacity as accepted in the contract. The replacement equipment shall be approved by the Engineer-In-Charge.

c. The contractor shall separately submit with this offer his charges per month for operation of mechanical equipment(s) after commissioning and handing over.

Section 7: 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

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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.

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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)

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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

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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.

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11.3 The point at the change in level of the fencing top/bottom, necessary links shall be adjusted suitably as per the manufacturers 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.

Section 8 . 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.

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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.

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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.

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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.

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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.

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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

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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.

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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

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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.

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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)

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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

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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.

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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:

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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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CHAPTER D - TECHNICAL SPECIFICATION FOR ELECTRICAL WORKS

SPECIAL CONDITIONSFOR ELECTRICAL SERVICES

1.0 GENERAL

The design and workmanship shall be in accordance with the best engineering practices, to ensure satisfactory performance and service life. The requirement offered by the contractor shall be complete in all respects. Any materials or accessories which may not have been specifically mentioned, but which are usual and necessary for the satisfactory and trouble free operation and maintenance of the equipment shall be provided without any extra cost of the purchaser. This shall also include spares for commissioning of the equipment.

2.0 The contractor shall obtain all sanctions (electrical loads, approval of drawing/ ESS/D.G.'s estimator/approval of meter room etc. from the concerned authorities and permits required for the electrical installation work. All actual fee payable in this regard will be reimbursed against receipt/documentary evidence. On completion of work, the contractor shall obtain NOC from TNEB & Director of Safety of the concerned state; a copy of the same shall be delivered to CLIENT. Contractor shall be responsible for handing over to TNEB and other authorities shall be responsibility of contractor till commissioning and getting electricity in the complex.

The CLIENT shall have full power regarding the materials or work got tested by independent agency at the electrical contractor's expenses in order to prove their soundness and adequacy. The contractor will rectify the defects/suggestions pointed out by CLIENT/ independent agency at his own expenses.

The installation shall comply in all respects with the requirements of Indian Electricity Act 2003, Indian Electricity Rules (IER) 1956 and other related Laws and Regulations as amended up to date, there under and special requirements ,if any, of the State Electricity Board set c. The bidder is liable to furnish the list of authorized licensed persons/ employed/deputed to carry out the works/perform the assigned duties to fulfill the requirement of Rule No.3 of IER1956 as amended up to date.

3.0 DRAWINGS

i) The list of drawings along with these specifications is given in Annexure. These drawings are meant to give general idea to bidder regarding the nature of work covered by these specifications.

ii)Any information/data shown/not shown in these drawings shall not relieve the contractor of his responsibility to carry out the work as per the specifications. Additional information required by the bidder/tenderer for successfully completing the work shall be obtained by him.

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iii) Shop Drawings

The contractor shall prepare detailed coordinated electrical shop drawing indicating lighting/lightingfixtures,convenienceoutlets,D.G.'s,H.T.,Transformer,M.V. Panel Boards/Relay Panel, PCC, DB's, Rising Mains, Cable Schedule with other relevant services and submit to the CLIENT for approval or the Engineer-in-Charge before commencing the work. The shop drawings shall indicate all setting out details and physical dimension so fall components with wiring and cable details including system operating write up in the system i.e.11KV Panel Board, Control and Relay Panel Package Substation, D.G.'s, PCC's, MCC's, cable schedule and routes, manhole trap and fixing details as well as for conduit indicating run and size of wire/cables outlet/pull/junction boxes etc .with fixing details etc. for the above mentioned work. All work shall be carried out on the approval of these drawings. However, approval of these drawings do not relieve the contractor of his responsibility for providing maintenance free and fool proof system including any missing component/accessories to meet with the intent of the specifications. Contractor will submit 2 prints for preliminary approval and finally six prints for distribution.

iv) Completion Drawings/As Built Drawings

On completion of the work and before issue of certificate of virtual completion, the contractor shall submit to the CLIENT 4 sets along with soft copy of' As Built 'drawings (in Auto CAD & PDFformat) of the work along with 01Nos. cloth tracing originals including write up (trouble shooting, installation, operation and maintenance manual with instructions) in corporating all such changes and modifications during engineering and execution along with warrantee & guarantee certificates from manufacturers.

These drawings must provide:

Run and size of conduit, inspection and pull boxes including routing and locations.

Number and size of conductor in each conduit.

Locations and rating of sockets and switches controlling the light and power outlet.

A complete wiring diagram as installed and schematic drawings showing all connections in the complete electrical system.

Location of outlets of various services, junction boxes, light fixtures.

Location of all earthing stations route and size of all earthing conductors.

Layout and particulars of allcables.

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Location and details of PCC's, MCC's, Feeder Pillars, capacitor control panels, PLC D.G. set panel, UPS panel, and relay panels with description detailed control wiring diagram.

Location of transformer and its details and control wiring diagram.

Location of Hume pipe and manhole including HT/LT cable layout and scheduling.

Location of D.G.'s, exhaust and auxiliary equipment with schematic drawings.

Layout of cable trays with support and their fixing details.

Location of all earthing station, route and size of all earthing conductor.

Layout and particulars of rising mains with fixing details.

v)Position of HT/LT Switch Boards/Transformer & D.G.'S

The recommended position of the switch boards, transformer & D.G.'s as shown on the layout drawings will be adhered to as far as practicable.

The contractor shall submit 2 sets of samples of each type of accessories and apparatus, proposed to be used in the installation at site for approval (drawings or samples) as required shall be submitted by contractor and the choice of selection out of the approved list lies with the CLIENT. For all non-specified items, approval of the CLIENT shall be obtained prior to procurement of the same. CLIENT shall in no way be liable for rejection of the any material due to poor quality, poor workmanship, poor material etc.

4.0 MANUFACTURER'SINSTRUCTIONS

Where manufacturers have furnished specific instructions, relating to the material/equipment to be used on this job, covering points not specifically mentioned in this document, manufacturers' instructions should be followed.

5.0 MATERIALS AND EQUIPMENT

All the materials and equipment shall be of the approved make and design. Unless otherwise called for any approval by CLIENT's Engineer-in-Charge, only the best quality materials and equipment shall be used.

The contractor shall fill in the data sheet for capital equipment as attached elsewhere in this document. The Material/Equipment shall be rejected due to not giving/filling in the details of the said equipment.

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6.0 GENERAL DETAILS

6.01 Space Heaters & Lighting.

One of more adequately rated heaters thermostatically controlled with On-Off switch and fuse shall be provided to prevent condensation in any panel compartment. The heaters shall be installed in the lower portion of the compartment and electrical connections shall be made from below the heaters to minimize deterioration of supply wire insulation. The heaters shall be suitable to maintain the compartment temperature to prevent condensation. CFL lamp shall be provided in any panel compartment.

6.02 Fungistatic Varnish

Besides the space heaters, special moisture and fungus resistant varnish shall be applied on parts, which may be subjected or predisposed to the formation of fungi due to the presence or deposit of nutrient substances. The varnish shall not be applied to any surface of part where the treatment will interfere with the operation or performance of the equipment. Such surfaces or parts shall be protected against the application of the varnish.

6.03 Ventilation Opening

In order to ensure adequate ventilation, compartments shall have ventilation openings provided with fine wire mesh of brass to prevent the entry of insects and to reduce to a minimum the entry of dirt and dust. Outdoor compartment openings shall be provided with shutter type blinds.

6.04 Degree of Protection

The enclosures of the Control Cabinets, Junction Boxes and Marshalling Boxes, Panels etc. to be installed shall provide degree of protection as called for in specification / BOQ whenever it is not mentioned it shall be as given below.

Installed out door: IP-55.

Installed indoor in air-conditioned area: IP-52.

Installed in covered area: IP-52.

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Installed indoor in non-air-conditioned area where possibility of entry of water is limited: IP-42.

For L.T. switchgear (AC and DC distribution boards): IP-52.

The degree of protection shall be in accordance with IS: 13947 (Part-I)/IEC-947 (Part-I). Type test report for degree of protection test, on each type of the box shall be submitted for approval.

6.05 Rating Plates, Name Plates and Labels

Main PCC, PCC's, MDB and auxiliaries items installed in the building are to permanently attach to it in a conspicuous position. A rating plate of non-corrosive material with engraved manufacturer's name, year of manufacture, equipment name, type or serial number together with details of the loading conditions of equipment in question has been designed to operate and such diagram plates as may be required by the purchaser. The rating plate of each equipment shall be according to IEC requirement.

All such nameplates, instruction plates, rating plates shall be trilingual including local language with Hindi inscription first followed by English. Alternatively two separate plates one with Hindi and the other with English inscriptions may be provided.

6.06 First Fill of Consumables, Oil and Lubricants

All the first fill of consumables such as oils, lubricants, filling compounds, touch up paints, welding/soldering/brazing material for all copper/G.I. earthing and essential chemicals etc. which will be required to put the equipment/scheme covered under the scope of the specifications, into successful operation, shall be furnished by the Contractor unless specifically excluded under the exclusions in these specifications and documents.

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7.0 DESIGN IMPROVEMENTS

The bidder shall note that the equipment offered by him in the bid only shall be accepted for supply. If for any reason, Contractor wishes to deviate from specification, prior permission from CLIENT will be sought.

If any such agreed upon change is such that if affects the price and schedule of completion, the parties shall agree in writing as to the extent of any change in the price and/or schedule of completion before the Contractor proceeds with the change. Following such agreement, the provision thereof, shall be deemed to have been amended accordingly in the specification.

8.0 QUALITY ASSURANCE PROGRAMME

To ensure that the equipment and services under the scope of this Contract whether manufactured or performed within the Contractor's works or at his sub-contractor's premises or at the Purchaser's site or at any other place of work are in accordance with the specifications, the Contractor shall adopt suitable quality assurance programme to control such activities at all points necessary. Such programme shall be outlined by the Contractor and shall be finally accepted by the Purchaser after discussions before the award of Contract. A quality assurance programme of the contractor shall generally cover the following:

His organization structure for the management and implementation of the proposed quality assurance programme.

Documentation control system.

Qualification data for bidder's key personnel.

The procedure for purchases of materials, parts components and selection of sub-contractor's services including vendor analysis, source inspection, incoming raw material inspection, verification of material purchases etc.

System for shop manufacturing and site erection controls including process controls and fabrication and assembly control.

Control of non-conforming items and system for corrective actions.

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Inspection and test procedure both for manufacture and field activities.

Control of calibration and testing of measuring instruments and field activities.

System for indication and appraisal of inspection status.

System for quality audits.

System for authorizing release of manufactured product to the Purchaser.

System for maintenance of records.

System for handling storage and delivery.

A quality plan-detailing out the specific quality control measures and procedures adopted for controlling the quality characteristics relevant to each item of equipment furnished and/or services rendered.

The Purchaser or his duly authorized representative reserves the right to carry out quality audit and quality surveillance of the system and procedure of the Contractor/his Vendor's quality management and control activities.

9.0 QUALITY ASSURANCE DOCUMENTS

The Contractor shall be required to submit the following Quality Assurance Documents within three weeks after dispatch of the equipment.

All Non-Destructive Examination procedures, stress relief and weld repair procedure actually used during fabrication and reports including radiography interpretation reports.

Welder and welding operator qualification certificates.

Welder's identification list, listing welders and welding operator's qualification procedure and welding identification symbols.

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Raw material test reports on components as specified by the specification and/or agreed to in the quality plan.

Stress relief time temperature charts/oil impregnation time temperature charts.

Factory test results for testing required as per applicable codes/mutually agreed quality plan/standards referred in the technical specification.

The quality plan with verification of various customer inspection points (CIP) as mutually and methods used to verify the inspection and testing points in the quality plan were performed satisfactorily.

10.0 INSPECTION, TESTING AND INSPECTION CERTIFICATE

The CLIENT or duly authorized representative shall have at all reasonable times free access to the Contractor/ Manufacturer's premises or works and shall have the power at all reasonable times to inspect and examine the materials and workmanship of the works during its manufacture or erection, if part of the works is being manufactured or assembled at other premises or works, the Contractor shall obtain permission to inspect as if the works were manufactured or assembled on the Contractor's own premises or works. Inspection may be made at any stage of manufacture, dispatch or at site at the option of the Purchaser and the equipment if found unsatisfactory due to bad workmanship or quality, material is liable to be rejected.

All equipment being supplied shall conform to type tests and shall be subject to routine tests in accordance with requirements stipulated under respective sections. Bidder shall submit the type tests reports for approval. The Contractor shall intimate the CLIENT the detailed programme about the tests at least three (3) weeks in advance in case of domestic supplies. If for any item type test is pending payment would be made on successful completion of type/routine test(s) actually carried out as per CLIENT instructions.

The Contractor shall give the CLIENT thirty (30) days written notice of any material being ready for testing. Such tests shall be to the Contractor's account. The CLIENT, unless witnessing of the tests is virtually waived off, will attend such tests within thirty (30) days of the date of which the equipment is notified as being ready for test/inspection, failing which the Contractor may proceed with the test which shall be deemed to have been made in the presence of CLIENT and he shall forthwith forward to the CLIENT duly certified copies of tests in triplicate.

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The CLIENT shall within fifteen (15) days from the date of inspection as defined shall inform in writing to the Contractor of any objection to any drawings and all or any equipment and workmanship which in his opinion is not in accordance with the Contract. The Contractor shall give due consideration to such objections and make the necessary modifications accordingly.

When the factory tests have been completed at the Contractor's or Sub-contractor's works, the CLIENT shall issue a certificate to this effect within fifteen (15) days after completion of tests but if the tests are not witnessed by the CLIENT, the certificate shall be issued within fifteen (15) days of receipt of the Contractor's Test certificate by the CLIENT. Failure of the issue such a certificate shall not prevent the Contractor from proceeding with the works. The completion of these tests or the issue of the certificate shall not bind the CLIENT to accept the equipment should, it, on further tests after erection, is found not to comply with the Specification. The equipment shall be dispatched to site only after approval of test reports and issuance of clearance by the CLIENT.

The contractor shall arrange all necessary instruction and testing facilities free of cost for this purpose including air travel, lodging and boarding expenses.

For tests whether at the premises or at the works of the Contractor or of any Sub-Contractor, the Contractor except where otherwise specified shall provide free of charge such items as labour, materials, electricity, fuel, water, stores, apparatus and instruments as may be required by CLIENT or this authorized representative to carry out effectively such tests of the equipment in accordance with the Specification.

The inspection by CLIENT and issue of Inspection Certificate thereon shall in no way limit the liabilities and responsibilities of the Contractor in respect of the agreed quality assurance programme forming a part of the Contract.

The CLIENT will have the right of having at his own expenses any other tests(s) of reasonable nature carried out at Contractor's premises or at site or in any other place in addition of aforesaid type and routine tests to satisfy that the material comply with the specifications.

The CLIENT reserves the right for getting any field tests not specified in respective sections of the technical specification conducted on the completely assembled equipment at site. The testing equipment for these tests shall be provided by the Contractor.

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11.0 TESTS

11.01 Charging

On completion of erection of the equipment and before charging, each item of the equipment shall be thoroughly cleaned and then inspected jointly by the CLIENT and the Contractor for correctness and completeness of installation and acceptability for charging, leading to initial pre-commissioning tests at Site. The pre-commissioning tests to be performed as per relevant I.S. given and shall be included in the Contractor's quality assurance programme.

11.02 Commissioning Tests

The available instrumentation and control equipment will be used during such tests and the Contractor will calibrate all such measuring equipment and devices as far as practicable. However, unmeasurable parameters shall be taken into account in a reasonable manner by the Contractor for the requirement of these tests. The tests will be conducted at the specified load points and as near the specified cycle condition as practicable. The Contractor will apply proper corrections in calculation, to take into account conditions, which do not correspond to the specified conditions.

All instruments, tools and tackles required for the successful completion of the

Commissioning Tests shall be provided by the Contractor, free of cost.

Pre-commissioning test shall be carried out as per relevant IS and/or as specified in the relevant clause.

The Contractor shall be responsible for obtaining statutory clearances from the concerned authorities for commissioning of the equipment. However necessary fee shall be reimbursed by CLIENT on production of requisite documents.

12.0 PACKAGING

All the equipment shall be suitably protected, coated, covered or boxed and crated to prevent damage or deterioration during transit, handling and storage at Site till the time of erection. While packing all the materials, the limitation from the point of view of availability of Railway wagon/truck/trailer sizes in India should be taken account of the Contractor shall be responsible for any loss or damage during transportation, handling and storage due to improper packing. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor. CLIENT

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takes no responsibility of the availability of any special packaging/transporting arrangement.

13.0 PROTECTION

All coated surfaces shall be protected against abrasion, impact, discoloration and any other damages. All exposed threaded portions shall be suitably protected with either a metallic or a non-metallic protecting device. All ends of all valves and pipings and conduit equipment connections shall be properly sealed with suitable devices to protect them from damage.

The parts which are likely to get rusted, due to exposure to weather should also be properly treated and protected in a suitable manner.

14.0 FINISHING OF METAL SURFACES

14.01 General

All metal surfaces shall be subjected to treatment for anti-corrosion protection. All ferrous surfaces for external use unless otherwise stated elsewhere in the specification or specifically agreed, shall be hot-dip galvanized after fabrication. High tensile steel nuts and bolts and spring washers shall be electro galvanized. All steel conductors used for earthing/grounding (above ground level) shall be galvanized according to IS: 2629.

14.02 Hot Dip Galvanizing

The minimum weight of the zinc coating shall be 700 gm/sq.m and minimum thickness of coating shall be 85 microns.

The galvanized surfaces shall consist of a continuous and uniform thick coating of zinc, firmly adhering to the surface of steel. The finished surface shall be clean and smooth and shall be free from defects like discolored patches, bare spots, unevenness of coating, spelter which is loosely attached to the steel globules, spiky deposits, blistered surface, flaking or peeling off etc. The presence of any of these defects noticed on visual or microscopic inspection shall render the material liable to rejection.

After galvanizing drilling or welding shall be performed on the galvanized parts of the earthing materials. Sodium dichromate treatment shall be provided to avoid formation of white rust after hot dip galvanization.

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The galvanized steel shall be subjected to six one minute dips in copper sulphate solution as per IS-2633.

Sharp edges with radii less than 2.5mm shall be able to withstand four immersions of the Standard Preece test. All other coatings shall withstand six immersions. The following galvanizing tests should essentially be performed as per relevant Indian Standards.

- Coating thickness,
- Uniformity of zinc,
- Adhesion test,
- Mass of zinc coating.

Galvanized material must be transported properly to ensure that galvanized surfaces are not damaged during transit. Application of zinc rich paint at site shall not be allowed.

14.03 Painting

All sheet steel work shall be degreased, pickled, phosphate in accordance with the IS-6005 "Code of practice for phosphating iron and sheet". All surfaces which will not be easily accessible after shop assembly shall beforehand be treated and protected for the life of the equipment. The surfaces, which are to be finished painted after installation or require corrosion protection until installation, shall be shop painted with at least two coats of primer. Oil, grease, dirt and swaf shall be thoroughly removed by emulsion cleaning. Rust and scale shall be removed by pickling with dilute acid followed by washing with running water, rinsing with slightly alkaline hot water and drying.

After phosphating, thorough rinsing shall be carried out with clean water followed by final rinsing with dilute dichromate solution and oven drying. The phosphatecoating shall be sealed with application of two coats of ready mixed, staving type zinc chromate primer. The first coat may be "flash dried" while the second coat shall be shoved.

Powder coating/electrostatic painting of approved shade shall be applied.

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The exterior color of the paint shall be as per shade no.697 of IS-5 or as approved by Engineer-in-charge and inside shall be white or as approved by Engineer-in- charge. A small quantity of finishing paint shall be supplied for minor touching up required at site after installation of the equipments, if required.

In case the Bidder proposes to follow his own standard surface finish and protection procedures or any other established painting procedures like electrostatic painting etc. the procedure shall be submitted along with the Bids for CLIENT's review and approval.

15.0 HANDLING, STORING AND INSTALLATION

In accordance with the specific installation instructions as shown on manufacturer's drawings or as directed by the Purchaser or his representative, the Contractor shall unload, store, erect, install, wire, test and place into commercial use all the equipment included in the contract. Equipment shall be installed in a neat, workmanlike manner so that it is level, plumb, square and properly aligned and oriented.

Contractor shall follow the unloading and transporting procedure at site, as well as storing, testing and commissioning of the various equipment being procured by him separately. Contractor shall unload, transport, store, erect, test and commission the equipment as per instructions of the manufacturer's Engineer(s) and shall extend full co-operation to them.

In case of any doubt/ misunderstanding as to the correct interpretation of manufacturer's drawings or instructions, necessary clarifications shall be obtained from the CLIENT. Contractor shall be held responsible for any damage to the equipment consequent for not following manufacturer's drawings/instructions correctly.

Where assemblies are supplied in more than the one section, Contractor shall make all necessary connections between sections. All components shall be protected against damage during unloading, transportation, storage, installation, testing and commissioning. Any equipment damaged due to negligence or carelessness or otherwise shall be replaced by the Contractor at his own expense.

The Contractor shall submit to the CLIENT every week, a report detailing all the receipts during the weeks. However, the Contractor shall be solely responsible for any shortages or damages in transit, handling and/or in storage and erection of the equipment at Site. Any demurrage, wharfage and other such charges claimed by the transporters, railways etc. shall be to the account of the Contractor.

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The Contractor shall be fully responsible for the equipment/material until the same is handed over to the CLIENT in an operating condition after commissioning. Contractor shall be responsible for the maintenance of the equipment/material while in storage as well as after erection until taken over by CLIENT, as well as protection of the same against theft, element of nature, corrosion, damages etc.

The Contractor shall be responsible for making suitable indoor storage facilities, to store all equipment, which require indoor storage.

The words 'erection' and 'installation' used in the specification are synonymous.

Exposed live parts shall be placed high enough above ground to meet the requirements of electrical and other statutory safety codes.

The minimum phase to earth, phase to phase and section clearance along with other technical parameters for the various voltage levels shall be maintained as per relevant IS.

16.0 PROTECTIVE GUARDS

Suitable guards shall be provided for protection of personnel on all exposed rotating and/or moving machine parts. All such guards with necessary spares and accessories shall be designed for easy installation and removal for maintenance purpose.

17.0 DESIGN CO-ORDINATION

The Contractor shall be responsible for the selection and design of appropriate equipments to provide the best co-ordinated performance of the entire system. The basic design requirements are detailed out in this Specification. The design of various components, sub-assemblies and assemblies shall be so done that it facilitates easy field assembly and maintenance.

18.0 DESIGN COORDINATION MEETING

The Contractor will be called upon to attend design co-ordination meetings with the Engineer, and the CLIENT/ CLIENT during the period of Contract. The Contractor shall attend such meetings at his own cost at New Delhi or at mutually agreed venue as and when required and fully co-operate with such persons and agencies involved during those discussions.

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19.0 TOOLS AND TACKLES

The Contractor shall supply with the equipment one complete set of all special tools and tackles for the erection, assembly, dis-assembly and maintenance of the equipments.

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TECHNICAL SPECIFICATIONS FOR ELECTRICAL SERVICES- GENERAL REQUIREMENTS

1 GENERAL

To provide a complete electrical system for the distribution of electric power from the point of supply (TNEB), D.G.s to the utilization equipment, all as shown in the drawings and described in these specifications. The quantities mentioned in BOQ are tentative. It will be the bidder's responsibility to work out the exact quantities from drawings or from worksite, which trade provides said equipment, materials, tools and labour.

2 SCOPE

The bidder shall supply, install and commission along with requisite spare, maintenance tool sand tackles the following equipment and system in the Project. The scope also covers the detailed engineering and calculations of the various equipment/system mentioned here under and the same shall be approved by the CLIENT/Engineer-in-charge prior to execution of the job.

11 KV Transformers

11 KV H.T. Switch boards.

Medium voltage switch gear.

Battery and battery charger.

Earthing.

Lightning protection system.

Capacitor with control panels.

Synchronization and AMF pane.

Laying and termination of H.T. cables.

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Laying and termination of L.T. cables.

Conduiting for Fire Alarm and Public Address System

Bus duct / Rising Main / Distribution Boards / Sub-Distribution Board.

Complete internal building wiring as per specification.

Safety to personnel and equipment during both operation and maintenance.

Reliability of Service.

Minimum fire risk.

Ease of maintenance and convenience of operation.

Automatic protection of all electrical equipment through selective relaying system.

Electrical supply to equipment and machinery within the design operating limits.

Adequate provision for future expansion and modification.

Maximum interchange ability of equipment.

Fail-safe feature.

Suitability for applicable environmental factors.

This specification defines the basic guidelines to develop a suitable electrical system as necessary for the Hospital. All data required in this regard shall be taken into consideration to develop a detailed engineering of the system. Site conditions as applicable are mentioned elsewhere.

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Compliance with these specifications and/or approval of any of the Contractor's documents shall in no case relieve the Contractor of his contractual obligations.

All work to be performed and supplies shall be affected as a part of contract requires specific approval/ review of CLIENT or his authorized representative. Major activities requiring approval/ review shall include but not be limited to the following:

The engineering activities shall comprise the submission for approval of the following:

Basic engineering documents e.g. overall single line diagram, area classification drawing, overall cable layout, testing, type test report, guaranteed particulars of all equipment and maintenance manuals.

Quality assurance procedures.

Field testing and commissioning procedures.

Basic engineering calculations viz. load analysis; load flow, fault level calculations, and voltage drop calculations during motor start-up/re-acceleration etc.

Control and protection schemes.

Load sharing and annunciation scheme,

Sizing calculation for cable trays/cable trenches.

Area-wise illumination level calculation and preparation of power supply distribution drawing.

Calculation for earthing system and lightning protection.

The Contractor shall be responsible for:

Detailed co-ordination with other services, shop drawings for various electrical layouts such as equipment layout, lighting layouts, cabling layouts, earthing and lightning

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protection layouts, including equipment installation and cable termination details etc. prior to start of work.

Preparation of bill of materials for cabling, lighting, earthing and miscellaneous items etc.

Cable schedule.

Lighting/power panel schedule.

Interconnection drawing.

Protection co-ordination drawings/tables for complete power system.

Shop inspection and testing procedures.

Field testing and commissioning procedures.

Preparation of as built drawings for all services.

Any other work/activity which is not listed above however is necessary for completeness of electrical system.

3 CODES & STANDARDS

The design engineering manufacturing and the installation shall be in accordance with established codes, sound engineering practices, and specifications and shall conform to the statutory regulations applicable in the country. Contractor shall obtain all approvals from statutory authorities' e.g. Electrical inspector, pollution control boards, TNEB as applicable before commissioning of electrical/DGs.

Indian Electricity Act.

Indian Electricity Rules.

Factory Act.

Pollution Control Act.

IS-732: Code of practice for electrical wiring installation system voltage not exceeding 650V.

IS-3043: Earthing.

IS-2309: Code of practice for the protection of buildings and allied structure against Lightning

IS-7689: Guide for control of undesirable static electricity. IS-3716: Insulation co-ordination application guide.

IS-8130: Conductors for insulated electrical cables and flexible cords. IS-5831: PVC insulation and sheath of electric cables.

IS-3975: Mild steel wire, strips & tapes for armouring cable. IS-3961: Current rating of cables

IS-694:PVC insulated (heavy duty) electric cables for working. Voltage up to and including 1100 volts.

IS-424-1475 (F-3): Power cable flexibility test.

IEC-439/IS-7098: Specification for cross linked polyethylene insulated PVC sheathed cable for working voltage up to 1.1KV.

IS-1554: PVC insulated cables up to 1100 volts.

IS-10810: Test procedures for cables.

IS-6121: Cable glands.

IS-10418: Cable drums.

IEC-754(1): FRLSPVC insulated cable.

ASTM-D-2863: Standard method for measuring minimum oxygen concentration to support candle-like combustion of plastic(oxygen index).

ASTM-D-2843: Standard test method for measuring the density of smoke from burning or decomposition.

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ASTME-662/IEC754(A) Standard test method for specific optical density of smoke generated by solid materials.

IEEE-383: Standard for type test class-IE, electric cables, field splicers and connections for power generation station.

IS13947/IEC947: Air circuit breaker/moulded case circuit breaker.

IS-8623: Specification for factory built assemblies of switch gear and controlgearforvoltageuptoandincluding1000vac/1200vdc

IS1018: Switchgear and control gear selection/installation and maintenance

IS-1248: Direct acting indicating analogue electrical measuring instruments and testing accessories.

IS-13779: Digital measuring instruments and testing accessories. IS-3156: Voltage transformer

IS-2705: Current transformer for metering and protection with classification burden and insulation.

IS-2147: Degree of protection provided by enclosures for low voltage.

PARTI,II,III Switch gear and control gear

IS-3427: Metal enclosed switch gear and control gear

BS-162: Safety clearance

IS-3202: Code of practice for climate proofing of electrical equipment.

IS-375: Marking and arrangement for switchgear, bus bars, main connections and auxiliary wiring.

IS-722: Ac electric meters

IS-3231/IEC-255: Electrical relays for power system protection.

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IS-5082: Electrolytic copper/aluminium bus bars

IS-2834: Capacitors

IS-2713: Steel tubular pole

IS-335: Specification for insulating oil

IS-3837: Specifications for accessories for rigid steel conduit for electrical wiring.

IS-2026&335: Distribution transformer

(PARTI,II,III) GI /STEEL / PVC conduit pipe for electrical wiring.

IS-2274: Code of practice for electrical wiring installation system voltages exceeding 650 volts.

IS-6665: Code of practice for industrial lighting

IS-3646: Interior insulation part 1&2

IS-1944: Code of practice for lighting of public through fares.

IS-7752: Guide for improvement of power factor consumer's installation.

IS-13346: General requirement for electrical for explosive gas atmosphere.

IS-13408: Code of practice for the selection, installation and maintenance of electrical apparatus for use in potentially explosive atmospheres

IS-12360: Voltage and frequency for ac transmission & distribution system.

IS-5572: Classification of hazardous area for electrical installations.

IS-5571: Guide for selection of electrical equipment for hazardous area.

IS-4201: Application guide for Current Transformer

IS-4146: Application guide for Voltage Transformer

IS-10028: Code of practice for installation and maintenance of transformer

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IS-8478: Application guide for on load tap changer

IS-10561: Application guide for power transformer

IS-1646: Code of practice for fire safety of buildings electrical installation

IS-3034: Code of practice for fire safety of industrial building-electrical generating and distribution station

IP-30: National electrical code(NEC) BIS publication.

IS-4722: Rotating electrical machines.

IS-4889: Method of determination of efficiency of rotating electrical machines.

IS-325: Three phase induction motors.

IS-4729: Measurement and evaluation of vibration of rotating electrical machines.

IS-900: Installation and maintenance of induction motors.

IS-4029: Air break switches.

IS-2208-9224: HRC cartridge fuses.

IS-2959: Contactors.

IS-9537: Rigid steel conduit.

IS-1030-1982: Specification for carbon steel castings for general engineering purpose.

IS-1601/BS-649: Performance & testing of Internal Combustion(IC) engines for general purpose.

AIEE-606(1959): Recommended specification for speed governing of I.C. engine generator units.

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BS-5514/IS-30468528(Part-2): Reciprocating IC engine driven A.C. generators.

Any other standard may be followed provided it is equivalent or more stringent than the standards specified above.

Incase of any deviation/conflict of this specification with the codes & standards, the following order of precedence shall govern.

a) Specification, particular specification if any, and drawings. b) Indian regulations/code sand standards.

4 SITE CONDITIONS

i)	Design ambient	50Deg.C. Maximum,2Deg.C.minimum
ii)	Relative Humidity	85%maximum
iii)	Site environment	Normal

5 DESIGN CRITERIA

I	**Electrical Details of Incoming Supply**	
a	Supply Voltage	11 KV as per TNEB approved.
b	Fault level (sym.) at supply of point (designed)	350 MVA (to be confirmed from State Electricity Board by Tenderer).
c	Neutral Earthing	Solid Earthing
d	Voltage Regulation	10%
e	Frequency Regulations	3%
f	Combined	10%
II	**L.T. Power Distribution Systems**	
a	Voltage	415 V / 240 V
b	Frequency	50 Hz
c	Neutral Earthing	Grounded
d	Short Circuit Fault withstand Capacity	10 KA - 50 KA (1 Sec.) as per B.O.Q. and specification.
III	**Emergency Lighting (Battery Operated With Self Charger)**	
a	Voltage	12 V, DC

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b	Source	Mains/D.G. Set
IV	**Control Supply for Electrical System:-**	
	The various supply voltage to be used in the control panels for main equipment are	
a	Spring Charge Motor	230 Volt A/C
b	Closing/Trip Coil	24 V DC / 230V AC
c	Alarm/ Indication/ Relay	24 V DC/ 230 V AC
d	Heaters	230 V AC
V	**Power Supply Load Control / Distribution Panel**	433 V TPN / 240 V 1 phase A.C. (other supply if required shall be derived by package vendor
VI	**Painting of Panel**	Powder coating of approved shade
VII	**Painting of Cable Tray & Structure Steel**	Powder coated of approved shade

6 CABLE DETAILS

i.	Internal Wiring	CopperconductorPVCinsulated1.1KVgradeascalled for in BOQ
ii.	Power Cables (L.T.).	XLPE insulated Al. Armoured Cable as per BOQ.
iii.	11 KV.	Aluminium conductor XLPE insulated armoured cable.
iv.	Grounding Conductor.	Copper/G.I. strip as per BOQ.
v.	Lightning Conductor.	G.I. Strip.

7 ACCURACY CLASS OF METERS

a	Revenue Metres.	Class-0.5 or as per TNEB approved
b	Ammeter, Voltmeter and Other Instruments.	Class – I Digital / Analogue as per BOQ

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TECHNICAL SPECIFICATIONS - ELECTRIFICATION

SECTION –1: 11KV VCB SWITCHGEAR

1. SCOPE

All the necessary Approvals & Liasoning for Load enhancement from present approved load to the required load shall be in the scope of the contractor. Only fee paid to the authority shall be reimbursed against the submission of the receipt and nothing shall be paid extra.

Manufacturing and supplying of integrated cubicle type metal clad, form 3 a, floor mounted and draw out type free standing, front operated indoor type 11 KV switchgear as per specifications given below:

The switchgear enclosure shall conform to degree of protection IP 4 X. The switchgear shall be made from MS sheet steel 2 mm thick (CRGO) and shall be folded and braced as necessary to provide a rigid support for all components.

The switchgear assembly shall form a continuous dead front line up of free standing vertical cubicles. Each cubicle shall have a lockable front hinged door and a removable bolted back cover. All covers and doors shall be provided with neoprene gaskets. Suitable arrangement for lifting of each cubicle shall be provided. Design and construction of the switchgear shall be such as to permit extension at either end.

Vacuum Circuit breaker shall be provided with surge arresting device for protection against lightning and switching over voltage. Two separate and distinct connections to earth shall be provided for each surge arrestor.

2. STANDARDS AND CODES

Updated and current Indian Standard Specifications and Codes of Practice will apply to the equipment and the work covered by the scope of this contract. In addition the relevant clauses of the Indian Electricity Act 2003, Indian Electricity Rules 1956, National Building Code 2005, National Electric Code 2008, Code of Practice for Fire Safety of Building (general): General Principal and Fire Grading – IS 1641 - 1988 as amended upto date shall also apply. Wherever appropriate Indian Standards are not available, relevant British and/or IEC Standards shall be applicable.

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11000 volt Circuit Breaker:	IS 13118; 1991
Metal Enclosed Switchgear and Control gear for voltages above 1000 volts: IS 3427: 1969	
Electrical Relays for Power System Protection	IS 3231: 1986
Voltage Transformers	IS 3156: 1978
Current Transformers	IS 2705: 1981
Rubber Mats for Electrical Works	IS 5424: 1983
Danger Notice Plate	IS 2551: 1982
AC isolators and earthing switches	IEC 129
AC metal enclosed Switchgear	IEC 298
HT AC contactors	

3. BREAKER COMPARTMENT

Vacuum Circuit Breaker shall be mounted in draw out truck with front plate which covers the cubicle when the breaker is in service position. This front plate shall be provided with view glass to facilitate observation of mechanical ON/OFF indication of Circuit breaker, Spring charged / discharged indication and operation counter.

Necessary orifice shall be provided for manual charging of the springs. ON/OFF push button for opening and closing of the circuit breaker shall also be provided. The draw out truck shall have two positions for the circuit breaker VIZ isolated / Test & Service.

4. BUS BAR COMPARTMENT

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Bus bars of rectangular cross section of copper conductor supported by cast epoxy insulator to withstand full short circuit currents up to 18.4 KA / as per BOQ specification for one second shall be provided at the rear. Bus bar chamber shall be provided with inter panel barriers with epoxy cast seal off bushings.

5. CT AND CABLE COMPARTMENTS

At the rear of the panel sufficient space shall be available to accommodate three numbers epoxy CT's of double core and two numbers three core cable termination. The cable entry shall be from the top / bottom.

6. SEPARATE COMPARTMENTS

Circuit breakers, instrument transformer, bus bars, cable etc shall be housed in a district different compartments as required for form 3 a, compartmentalization. All relays, switches, lamps, etc. comprising the control, indication and protective devices shall be housed in a separate compartment on the front of the cubicle.

7. TECHNICAL PARTICULARS OF VCB CIRCUIT BREAKER Rated Current

630 A Rated Voltage - 11 KV Rated Frequency - 50 Hz

Rated Short Circuit breaking Current - 18.4 KA for 1 Sec. Rated short circuit making current - 50 KA

Insulation Level (KV rms/KVP) - 28KV / 75 KV

8. EARTHING SWITCH

Cable earthing switch shall be provided in the cable chamber and shall be operated from the front of the panel. The ON/OFF position of switch shall be indicated by mechanical indicator. The Earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

Earthing switch shall also be provided on bus bar side. The ON/OFF Switch shall be indicated by mechanical indicator. The earthing switch shall be suitably interlocked with the breaker, so that it can be operated only when the breaker is in OFF position.

9. ISOLATING CONTACTS

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The breaker isolating contacts shall consist of two parallel flat silver plated copper bars with ball point contacts to give a vertical tolerance of ±10 mm.

10. LOW VOLTAGE PLUG AND SOCKET CONNECTOR

A twenty pin plug and socket connection along with flexible leads shall be provided to connect control instrumentation and interlock circuits on the breaker truck and in the panel. The plug and socket assembly shall be suitably interlocked with the truck positions like service and test/isolated position

11. INTERLOCKS

The following interlocks shall be provided:

1. The truck cannot be moved from either test to service position or vice versa, when the circuit breaker is' ON'.
2. The circuit breaker can not be switched 'ON' when the truck is in any position between test and service position.
3. Front part of the truck cannot be removed when the breaker in 'ON' position.
4. The low voltage plug and socket cannot be disconnected in any position except test/isolated position.
5. The truck cannot be moved inside the panel, when the LT plug and socket is disconnected.
6. Earthing switch cannot be switched 'ON' when the truck is inside the panel.
7. The truck cannot be inserted when the earthing switch is 'ON'.

12. SAFETY DEVICES

The following Safety devices shall be provided for the safety of the operating personnel:

1. Individual explosion vents shall be provided for breaker/bus bar/cable chambers on the top of the panel to let out the gases under pressure generated in case of fault inside the panel.

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2. Cubicle with front plate to withstand the pressure for internal arc fault as per PEHLA recommendation.

3. Circuit breaker and sheet metal enclosure shall be fully earthed.

4. Self-locking shutters shall be provided which shall close automatically when the truck is withdrawn to 'Test position' and no separate padlocking of the shutter shall be required.

13. PROTECTIVE EARTHING

The earthing connection between the truck and the cubicle shall be by means of sliding contacts so that the truck is earthed in the isolated position when inserted and remains earthed when the truck is pushed further into the connected position or when the truck is being withdrawn until the truck has moved part the isolated position.

14. CURRENT TRANSFORMER

I. GENERAL REQUIREMENTS

Accommodation shall be provided in the circuit breaker panel, to mount one set of duel ratio CT. Access to the CTS for cleaning, testing or changing shall be from the front, back or top of the panel.

II. RATING

Duel ratio CTS of suitable burden(but each not less than15 VA) shall be preferred with 5amps secondary's.

Instrument Security Factor(ISF) of each CT shall not be more than 5.

The CT's shall conform to relevant Indian Standards. The design and construction shall be dry type, epoxy resin cast robust to with stand thermal and dynamic stresses during short circuits. CT terminals shall be shorting type. Current &voltage circuits shall be laid in separate wire ways. Secondary terminals of CTS shall be brought out to a suitable terminal block which will be easily accessible for terminal connections. Test terminal block shall be provided in the front side of the panel for testing purpose.

CT'S shall have 2 Nos. of cores for following application:

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Core-1for metering

Core-2for over current & earth fault protection. Class of accuracy of each winding Metering class 1/ as per BOQ specification

Protection class 5P10

15. POTENTIALTRANSFORMERS

The potential transformers shall be confirmingtoIS3156/ IEC185. The primary windings of the potential transformers shall be insulated and shall be of the castrestin type.

Potential transformer(PT'S)shall be mounted on a draw out trolley and housed in separate metal compartment and shall have control fuses on the H.V.s ide and a miniaturecircuitbreakerontheL.V.sideofthewindings.HTHRCControlfusesshallbe confirmingtoIS–609385/IEC–282.MiniatureCircuitbreakershallcomply withIS–608828/IEC – 898.

Pad locking facilities shall be provided for both service and isolated position. The potential transformer shall be as specified below:

Ratio	:	11000/V3/110/V3/110V
VABurden	:	100VAfor100/V3and110Vwinding
Class	:	CL –1 for both the windings /as per BOQ specification
Basic Insulation level	:	28/75KV
Overvoltage factor	:	1.2Continuous

Single phase PT'S shall be used and shall be connected in Star/Star.

16. PROTECTIONANDTRIPPINGARRANGEMENT PROTECTION

The protection and tripping arrangement of circuit breaker shall be:

1. Numeric Type Instantaneous short circuit protection Device No.50 Range 500 –

2. 2000% shall be provided on all phases.

3. Numeric Type Back up over current protection for Phase faults Device No.51
4. Range 50 – 200% shall be provided on all phases.

5. Numeric Type Ground fault protection Device No.50G with stabilizing resistor.
6. CT's. Range 20 – 80% shall be provided.

7. Lockout and trip supervisory relays etc shall be provided with manual reset facility.

8. Auxiliary relay for transformer fault.

9. Surge Arrestor

17. CONTROL WIRING

The control wiring shall be carried out with minimum 1.5 / 2.5 sq. mm. PVC insulated copper conductor cables. The wiring shall be securely fixed and neatly arranged to enable easy tracing of wires. Identification PVC ferrules shall be fitted to all wire terminals to render easy identification and facilitate checking in accordance with IS

5578 and 11353.

18. METERING INSTRUMENT PANEL ACCESSORIES METERING

Digital type Trivector meter of approved make shall be provided on the incomer feeder. Specification of the meter shall be as follows:

Accuracy : Class 0.2, compliant to revenue class certification / as per

BOQ specification

ANS I – C 12.20 – 1998 on all measurements.: Real time measurement per phase & average

V, I, PF, KW, KVAR, KVA: Peak demand, sliding window. Protected.

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: V & I unbalance, Phase reversal

: Time of Use (TOU) Power Quality Measurement : Total Harmonics

Logging & recordings for all measurement: Interval or event-based, 32 channel measurement & recording

: Event logging

: "Bust" data recording

: Min/ Max recording

Alarming functions. : Over & under measurement detection by24 set point

Multiport Communication : One each of RS 485 and RS 232 ports.

II. INSTRUMENT PANELS

The instrument panel shall be part of the housing. Relays, meters and instruments shall be mounted as per general arrangement drawings to be submitted by the vendors. They shall be of flush mounting type.

III. INSTRUMENTATIONS

Digital type Power factor meter of class of 1.0 accuracy conforming to IS : 1248 shall be provided at incomer panel.

Digital type Ammeter of specified range to class 1.0 accuracy and 96 x 96 sq mm in size as per IS - 1248 shall be provided at both incomer and outgoing panels along with necessary selector switches.

Digital type frequency meter class of 1.0 accuracy conforming to IS:1248 shall be provided at incomer panel.

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IV. The following minimum indication lamps shall be provided in the front of cubicle.

Breaker open / closed / tripped, spring charged, trip circuit healthy and control supply healthy. Lamps shall be clustered LED type and trip circuit supervision scheme shall be of continuous supervision type.

V. After meeting all necessary control and indication requirements 2 nos. NO and 2 nos.. NC auxiliary of the breaker shall be made available for the CLIENT, wired up to terminal block (if required).

VI. Separate MCB's shall be provided for lamps, heaters and other instrumentation etc. on each panel.

VII Anti-condensation space heaters suitable for operation on 240 V single phase, 50 Hz A.C. for each cubicle and with thermostat control one incandescent lamp with switch and 3 pin 5 amps plug socket.

19. DRAWINGS/DOCUMENTS REQUIRED FOR REVIEW/APPROVAL

Following drawings documents shall be submitted by the manufacturer for approval.

- General arrangement(GA) of equipment layout.
- Equipment list.
- Relay and metering system schematics.
- Supply and erection schedule.
- Catalogue and specification sheets.

20. QUALITYASSURANCE

Vendor shall submit in substantial detail a quality assurance plan indicating all activities step by step at various manufacturing/fabrication stages to meet the requirement of this specification and various standards/regulations/practices to enable comprehensive assessment of its merits and reliability.

21. TESTATMANUFACTURERSWORKS

Copies of type tests and of routine tests carried out at manufacturer's works shall be furnished along with the delivery of the switch boards. Engineer-in-charges/CLIENTs reserves the right to get the switch board inspected by their representative at manufacturer's works prior to dispatch to site to witness the routine tests, for which purpose the contractor shall provide the necessary facilities and also give due notice.

22. TESTS AT SITE

Pre-commissioning tests as per manufacturer's recommendations shall be carried out on the switch board at site after installation including but not restricted to the following.

- Physical checking of the switch board including checking for damage or cracks in components, bolt tightness, gasketting etc.
- Checking of vacuum bottles to ensure leak tightness
- Insulation testing of Busbar supports by 2.5 kV megger
- Insulation testing of Control wiring by 1.1 kV megger.
- Testing of relays and CT swith secondary injection kit.
- Checking of breaker operation.
- Checking of earth continuity.
- High potential test/Pressure testing

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SECTION 3 - TECHNICAL SPECIFICATIONS FOR D.G.SETS

General

All items of work under this Contract shall be executed strictly to fulfill the requirements laid down in the specifications. Type of equipment, material specification, methods of installation and testing and type of control shall be in accordance with the specifications, approved shop drawings and the relevant Indian Standards, however capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

The unit rate for all equipments or materials shall include cost in RUPEES for equipment and materials including all taxes and duties and also including forwarding, freight, insurance and transport into Contractor's store at site, storage, installation, testing, balancing, commissioning and other works required.

The rate for each item of work included in the Schedule of Quantities shall, unless expressly stated otherwise, include cost of :

a. All materials, fixing materials, accessories, appliances tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of work called for in the item and as per Specifications and Drawings.

b. Wastage on materials and labour.

c. Loading, transporting, unloading, handling/ double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and for the job in accordance with the contract documents, good practice and recognize principles.

d. Liabilities, obligations and risks arising out of Conditions of Contract.

e. All requirements of Specifications, whether such requirements are mentioned in the item or not. The Specifications and Drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

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f. In the event of conflict between Schedule of Quantities and other documents including the Specifications, the most stringent shall apply. The interpretation of the CLIENT/ Engineer-In-Chargeshall be final and binding.

All equipments, quantities and technical data indicated in this Schedule are for the

Contractor's guidance only, these are based on the documents prepared by the CLIENT.

This schedule must be read in conjunction with other documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved Shop Drawings at the contract rates.

This Schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK including NIL items.

No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorised in writing by CLIENT. Any such alterations, notes or additions shall, unless authorized in writing, be disregarded when tender documents are considered.

In the event of an error occurring in the amount of the Schedule, as a result of wrong mention of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the amount shall be amended on the basis of rates.

Any error in totalling in the amount column and in carrying forward total shall be corrected. Any error, in description or in quantity, omission of items from this Schedule shall not vitiate this Contract but shall be corrected and deemed to be variation required by the Engineer –In-Charge / CLIENT.

Rates have been called for a number of items of works, as alternatives which, for the present do not form part of the total value of tender. However the rates for these items shall be quoted, with due care so that in the event of choice of an alternative item of work, said rate shall form part of the contract and shall not violate the contract any way.

The Contractor shall procure and bring Materials/ Equipment to the site only on the basis of drawings approved for construction and shop drawings and not on the basis of Schedule of Quantities which are provisional only. This also applies to the Contractor's requisition for CLIENT's supplied materials. Choice of make shall be as per approved makes

DRAWINGS

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The drawings, specifications and bill of quantities shall be considered, as a part of this contract and any work or materials shown on the drawings and not called for in the specifications or vice-versa, shall be executed as if specification called for in both. The contract drawings indicate the extent and general arrangement of various equipments and their wiring, etc. and are essentially diagrammatic. The drawings indicate the point of termination for conduit runs and broadly suggest the routes to be followed. The work shall be done as indicated on the drawings. However, any minor change if found essential to co-ordinate the installation of this work with other traders shall be made without any additional cost to the CLIENTs. The data given herein and on the drawings is as could be secured but its complete accuracy is not guaranteed. The drawings and specifications are for the assistance and guidance of the contractor. The exact location, distances and levels etc. will be governed by the space conditions. The contractor shall examine all Architectural, structural, Plumbing and Sanitary, Air-conditioning and electrical drawings before starting the work and report to the Engineer-in-charge any discrepancies, which in his opinion appear, on them, and get them clarified. He shall not be entitled to any extras, for omissions or defects in electrical drawings or when they conflict with other works.

SHOP DRAWINGS

The Contractor shall prepare and submit to the CLIENTs/Engineer-in-charge/ CLIENT for their approval detailed shop drawings within 30 days of signing of the contact or before

7 days of particular work or whichever is earlier. The shop drawings shall clearly indicate.

a) The general arrangement and schematic diagram of main D.G Panel, PLC Panel, clearly stipulating the material, size of sheet steel, bus bar, inter connections detail, make and rating of switchgear and other equipment etc.

b) Number, size and route of the Cable Tray, and fixing details.

c) Total number of cable runs, size make, material and type of cables with clear routing, trenches / treys detail, installation mode, starting and termination point of each and individual cable etc.

d) The shop drawings shall also show all setting out details and physical dimensions of all equipments components used in the system, location of manholes fixing, cutout details etc.

QUALITY

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The CLIENT's decision with regard to the quality of the material and workmanship will be final and binding, any material rejected by the CLIENT shall be immediately removed by

the Contractor from the site. The CLIENT or their representative shall at all reasonable times have free access to the works and / or to the workshops, factories or other places where materials are being prepared or constructed for the contract and also to any place where the material lying or form which they are being obtained, and the contractor shall give every facility necessary for inspection and examinations and test of the material and workmanship free of cost.

COST OF SAMPLES AND TESTS

The Contractor at his own cost shall supply all samples and the cost of making any test as per specifications shall be borne by the contractor. The Contractor shall submit four copies of all brochures, manufacturers' description data and similar literature. One copy will be returned to the Contractor after approval.

COMPLETION DRAWINGS

The Contractors shall submit to the CLIENT / CLIENT, layout drawings drawn at approved scale in six sets and a reproductive (original) copy clearly showing.

a) Location of distribution and PLC Panel

b) All types of cables (L.T. / Control etc.) layout.

c) Layout of DG Room and switchgears and associated equipments. d) Layout of Diesel Generator Sets.

e) Location of Fuel Tank, Cooling Towers, Pumps and fuel and water piping layout.

f) As built drawing with equipments operation and maintenance literature. - After the completion of the work and before issuance of certificate of virtual completion.

FOREMAN / SUPERVISOR

The Contractor shall employ a competent, licensed qualified full time electrical engg./ foreman/ supervisors to direct the work of electrical installations in accordance with the

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drawings and specifications. The foreman / supervisor shall be available at all times on the site to receive instructions from the Engineer-in-charge / Engineer in the day to day activities throughout the duration of the Contract and as long as there after as the CLIENTs may consider necessary until the expiration of the "Defect Liability Period". The Foreman / Supervisor shall correlate the progress of the work in conjunction with all the relevant requirements of the supply authority. The skilled workers employed for the work should have requisite qualifications and should possess competency certificate from the Electrical Inspectorate of the Local Government. The Contractor shall on the request of the CLIENTs immediately dismiss from the works any person employed there on who may, in the opinion of the CLIENTs, be unsuitable or incompetent or who may misconduct himself and such person shall not be again employed or allowed on the work without the permission of CLIENTs/Employee.

INSPECTION AND TESTING

Contractor shall employ a full time qualified Engineer who shall be available at all working hours at site for taking instructions and to look after the quality of the work. Instructions given to the Engineer of the contractor shall be construed as issued to the contractor.

Contractor shall maintain at site the following tools and instruments, but not limited to the list below in working conditions.

a) Clip-on Ammeter and voltmeter

b) 1000 V Meggar and 5 KV Meggar

c) Steel tapes of various lengths

d) Sprit Level

e) Hydraulic Crimping Tool

f) Earth Testing Meggar

g) Pipe bending Tool, thread-cutting die, bench vice etc.

h) Cable jointing kit

The contractor shall provide at least four permanent benchmark at site, which shall be preserved till the completion of works. These are essential for laying of cables at correct levels.

CLEARANCE FROM LOCAL AUTHORITIES

The Contractor shall get the entire installation tested inspected and approved by Local Authorities like Electrical Inspectorate pollution control explosive clearance and any other

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agency required to take permission for commissioning of the installation. He will also undertake the Liaison work with local Electricity Supply Company for obtaining the Electrical Service Connection.

SCOPE

In general, the contractor shall supply, store, erect test and commission all the equipment required for electrical installation. The contractor shall furnish all the materials, labour, tools and equipment for electrical work, as shown in the accompanying drawings and in the bill of quantities and specifications hereinafter described.

CONTRACTOR

The contractor shall be a licensed electrical contractor, possessing a valid electrical contractor's in the state, employing licensed supervisors and skilled workers having valid permits as per the regulation of Indian Electricity Rules and Local Electrical Inspector's requirements.

2.0 Preamble to BOQ for D.G. Set:

1. All items of work under this Contract shall be executed strictly to fulfil the requirements laid down under the specifications. Type of equipment, material specifications, methods of installation and testing, and type of controls shall be in accordance with the Specifications, approved shop Drawings and the relevant Indian Standards, however, capacity of each component and their quantities shall be such as to fulfill the above mentioned requirement.

2. The rate for each item of work included in the Bill of Quantities shall, unless expressly stated otherwise, include cost of:

a. All materials, fixing materials, accessories, appliances, tools, plants, equipment, transport, labour and incidentals required in preparation for and in the full and entire execution, testing, balancing, commissioning and completion of the work called for in the item and as per Specifications and Drawings.

b. Wastage on materials and labour.

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c. Loading, transporting, unloading, handling / double handling, hoisting to all levels, setting, fitting and fixing in position, protecting, disposal of debris and all other labour necessary in and for the full and entire execution and to fully complete the job in accordance with the contract documents, good practice and recognized principles.

d. Liabilities, obligations and risks arising out of Conditions of Contract.

e. All requirements of specifications, whether such requirements are mentioned in the item or not. The specifications and drawings where available, are to be read as complimentary to and part of the Schedule of Quantities and any work called for in one shall be taken as required for all.

f. In the event of conflict between Bill of Quantities and other documents including the specifications, the most stringent shall apply and the interpretation of the CLIENT's shall be final and binding.

3. The unit rate for each equipment or materials shall include cost in Rupees for equipment and material including the excise duty, and also including forwarding, freight and insurance up to Contractor's store at site, storage, installation, testing balancing, commissioning and other works required.

The extension for (total) amounts against each item shall be based on the quantities indicated in this Schedule.

4. All equipment, quantities and technical data indicated in this Schedule are for the Contractors guidance only; these are based on the documents prepared by the CLIENTs. The contractor shall assess the required quantity of cables, cable trays, piping etc that are required for completion of the work. This schedule must be read in conjunction with these documents. The Contractor shall be paid for the actual quantity of work executed by him in accordance with the approved shop drawings at the contract rates.

5. The quantities given in this schedule are provisional, the CLIENT reserves the right to increase or decrease the quantities of work or to totally omit any items of work and the Contractor shall not be entitled to claim any extras or damages on these grounds. These variations shall be permitted until such time Contractors shop drawings are approved.

6. This schedule shall be fully priced and the extensions and totals duly checked. The rates for all items shall be filled in INK.

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7. No alteration whatsoever is to be made to the text or quantities of this Schedule unless such alteration is authorized in writing by the CLIENT. Any such alterations, notes or additions shall unless authorized in writing be disregarded when tender documents are considered.

8. In the event of an error occurring in the amount column of the Schedule, as a result of wrong extension of the unit rate and quantity, the unit rate quoted by the tenderer shall be regarded as firm and the extensions shall be amended on the basis of the rates.

9. Any errors in totalling in the amount column and in carrying forwarded totals shall be corrected. Any error, in description or in quantity or commission of items from this schedule shall not vitiate this contract but shall be corrected and deemed to be a variation required by the CLIENTs.

3.0 D.G. SET- 200 KVA / As specified in the BOQ

The D.G. set shall be provided with Diesel Engine of Model no. & no. of Cylinder as given below, vertical 4 stroke cycle, Air cooled radiator having turbo charged after cooled Engine at 1500 RPM under NTP conditions of BS: 5514. The D.G. set shall be provided with electrical starting arrangement and shall give the electrical output of as given below at 0.8 power factor, 415 Volts at the alternator terminal.

ELECTRICAL OUTPUT	No. of Cylinder
200 KVA / as specified in the BOQ	12 or as per approved manufacturer

Other accessories of the engine would be as under:

COOLING SYSTEM

- Thermostat
- Corrosion Inhibitor
- Self contained piping

FUEL SYSTEM

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- PT fuel pump
- Injectors
- Fuel filters
- Self contained piping

LUBRICATING SYSTEM

- Oil pump
- Strainer
- Lub oil cooler
- Oil filter
- Bypass filter
- Self contained piping

AIR INTAKE SYSTEM

- Dry type filter
- Air intake manifold with necessary connections
- Turbo charged after Cooled

EXHAUST SYSTEM

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- Exhaust manifold
- Flexible piping
- Silencer (Hospital) GOVERNING SYSTEM
- Electronic Governor

STARTING SYSTEM

- Starter, 24V, DC
- Battery charging Alternator
- With in-built Regulator

ENGINE CONTROL PANEL (ECP) (it will display)

- Lub oil pressure
- Jacket water temperature
- Engine RPM
- Battery voltage
- Engine Running Hours

SAFETY SYSTEM

- Low lub oil pressure

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- High water temperature
- Over speed

OTHER SYSTEM

- Flywheel
- Flywheel housing

ALTERNATOR:

Output

i) 200 KVA / As specified in the BOQ Power factor : 0.8

Rated Generating Voltage Volts

Voltage regulation : +/- 1% all load between no load to full load & factor 0.8 to unity

Frequency : 50 Hz Speed : 1500 RPM Class of insulation : H

Winding connection : Star connection (all six leads will be brought out of stator frame)

Overload capacity : The Generator offered by the Tenderer should be tested for 24 hours at the factory at 100% load conditions and 110% load for one hour in every 12 hours of test run as per BS 5514 standard and CPWD Norms.

Bearings : Long life single bearing

Enclosures : Drip proof & screen protected IP-23

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Parallel operations : All machines shall be suitable for operation in parallel. Damper winding shall be provided to facilitate parallel operation

Power Command Paralleling Genset Controls (PCC3.3 of Cummins or equivalent)

The features shall be given as below:-

- Digital governing
- Digital Voltage regulation
- AmpSentry Protection for true alternator O/C protection on PCC 3.3 for solo / paralleling applications.
- Analog/ Bargraph/ Digital AC output Metering
- Battery Monitoring System to sense and warn against a weak battery condition
- Digital Alarm and Status Message Display
- Genset Monitoring : Displays status of all critical engine and generator set functions
- Smart Starting Control System : Integrated fuel ramping to limit black smoke and frequency over shoot
- Advanced serviceability
- Synchronizers and load sharing controls
- KVAR and power factor controls
- Import / Export controls for paralleling with utility / main bus.

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The alternator shall be of self-excited, self-regulated, self-ventilated in brush less design, provided with suitable automatic voltage regulator and shall conform to BS:2613 or BS :

5000 and shall give rated output at NTP conditions.

ESSENTIAL ACCESSORIES:

One set of essential accessories shall be supplied with each D.G. Set. This set of accessories shall comprise of the following:

BASE FRAME:

One no. MS Fabricated adequately machine Channel Common Base Frame with lifting facility, pre-drilled foundation holes suitable for permanent installation on concrete foundation for direct grouting or on anti-vibration mountings which will be suitable to receive the offered engine and alternator duly coupled through a flexible coupling. A suitable coupling guard shall also be provided.

FUEL TANK:

One no. Daily fuel tank of 990 LITRES capacity / or as per OEM Supplier Specification for each DG set made out of 3 mm thick MS sheet complete with inlet and outlet connections, drain plug, manhole, etc. & suitable for mounting on floor with mounting pedestals. Wire-braided hoses shall also be supplied with fuel tank.

BATTERIES:

For electrical control circuit of 24 volt DC, 2 Nos. batteries of 12 volts 180 AH for each set respectively (dry and uncharged) of approved make with battery leads for electrical starting of each DG Set.

4.0 DIESEL GENERATING SET DESIGN

1.1 The engine alternation set shall be capable of working at ambient temperature between 0°C to 50°C and relative humidity upto 95%.

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The operating capacity of each set shall be arrived at after considering a load with power factor of 0.8 lagging, and after taking into consideration suitable de-rating on account of above parameters of the station.

Performance Load Test Procedure

1.2 The Generator offered by the Tenderer should be tested for 24 hours at the factory at 100% load conditions and 110% load for one hour in every 12 hours of test run (total 24 Hours) as per BS 5514 standard and CPWD Norms. The Performance load test should be done at factory in the presence of PMC / Bidder / Client. Incidental, to and fro charges and boarding and lodging expenses should be borne by the bidder.

1.3 Nominal output voltage of engine/alternator set shall be 415 volts 50 Hz AC Supply with manual adjustment at all conditions of load with coarse and fine controls with a range of ± 5%.

The frequency shall be maintained at 50 Hz ± 2% for the set.

1.4 The output wave-form shall be sinusoidal at all load conditions.

1.5 The engine/alternator set shall be selected for a high degree of performance with over all low fuel consumption for the normal life of the alternator set.

1.6 The engine/alternator set shall meet the requirements of all linear & non-linear loads, but over-sizing of the alternator in order to meet the non-liner characteristics of loads in not envisaged.

1.7 The Engine shall be capable to minimum 60% bulk load of the rating during transfer of the load from NO Load position without tripping.

SYSTEM OPERATION

The set may be idle for a long time except for periodical test whenever there is a electrical supply failure, the set may required to run continuously for period even exceeding 24 hours.

SYSTEM FEATURE

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The entire work shall confirm to Bureau of Indian Standards safety standards; British Standards, and C.P.W.D. specifications.

DETAILS OF ENGINE/ALTERNATOR

Scope

The scope of this section covers general requirement for reciprocating diesel engine and alternator complete with drive, safety controls, lubricating system, cooling system, instruments etc., including erection, testing and successful commissioning on load.

Diesel Engine

Diesel engine shall be multi-cylinder, 1500 RPM reciprocating, 4-stroke internal combustion conforming to BS 649 and shall be of welded construction or of fine grain cast iron. The crank case shall be of iron alloy, casting, crank shaft shall be of high tensile forging corresponding to medium carbon steel of 1045 (AISI) grade, Main B.E bearing shall be of high grade bearing material, connecting rod shall be of 1 beam high grade of drop forged steel corresponding to carbon steel of 1139 grade, cylinder liner shall be wet type cast alloy iron with specially machined groomed in the bores to serve as oil retaining surfaces, piston shall be of low expansion aluminium alloy with machined surfaces.

The engine shall be equipped with all required standard accessories:

- Fly wheel & housing
- Oil bath air cleaner
- Exhaust turbo charger & after coolers as called for.
- Flexible coupling and coupling guard
- Flexible connection between heat Exchanger and water pipe.
- Lubricating pump and fuel injection pump
- Nozzles

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Electronic / hydraulic Governor as called for in BOQ.

- Oil pressure gauge and water temp gauge
- Fuel filter, fuel tank and fuel lines
- Turbo charged aspiration
- Water-cooled radiator/ Heat Exchanger as called for in BoQ.

12 cylinders or as required.

Other fittings as recommended by the manufacturer.

The lubricating system shall be positive pressure type for all moving parts. No moving parts shall require lubricating by hand, either prior to starting or while in operation.

The lubricating system shall consist of following major components.

- Oil pan
- Oil pump
- Oil filter
- Oil pipe/hose
- Oil cooler
- Piston cooling nozzle
- Oil temperature & gauge

- Oil pressure gauge

- By-pass filters.

Lubricating oil filter shall be provided for operation of 500 hour without any necessity of replacement or cleaning.

The engine shall be water cooled with Heat Exchanger. All standard accessories like inlet, outlet connection, fuel connection, drain plug etc. shall be provided.

Engines shall be suitable for running at 1500 RPM the speed of the engine shall be controlled by means of a governor which may sense the actual speed and make adjustment to the fuel system when required. The speed governing system shall be Class A hydraulic type as per BS 649. The maximum change in speed of engine shall be not more than 10% or 4% when the full load is either taken off or thrown ON temporary or permanently as the case may be. The engine/alternator set shall be able to attain the steady speed within a time period of 3 seconds from the time load change takes place.

Engine Starting

The engine shall be self starting type. The starter motor shall conform to BS-2613-1970. Time required for starting of engine from cold conditions shall be 10-20 secs maximum.

Fuel Tanks

Fuel tank(s) shall be fabricated from 3 mm thick MS sheet and of 990 litres capacity. Fuel lines shall be of MS "C" class welded pipe & standard hose pipes. The fuel tank shall have all standard fittings like outlet, fuel return, drain & vent connection. The fuel tank shall also level indicator so as to indicate the quantity of fuel present in litres with calibration chart. It shall be provided with high & low level switches having potential free contacts for annunciation and also for auto control of fuel oil pump.

Exhaust System

Industrial type Air intake filter shall be provided in the turbo charger assembly of the engine unit. The exhaust system shall consist of turbo charger with cladded pipe inter connecting

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it with the cylinder head inlet. The exhaust manifold shall be suitably lagged and covered as well. The exhaust pipe shall discharge the exhaustible smoke at the top of the building.

The exhaust system, which carries away the products of combustion from the engine to the atmosphere, shall be such as to restrict the backpressure within prescribed limit (below 75 mm of Hg) to ensure proper engine operation. The exhaust system shall consist exhaust pipe, flexible pipe of minimum 30 cm length, and exhaust noise suppressor silencer, and catalytic converter.

The silencer shall be of hospital type, which can provide suppression in noise as per specifications. A test certificate to this effect shall be furnished.

The exhaust piping system shall have a provision of condensate trap with drain plug valves. Exhaust piping shall be insulated with a layer of 75 mm dia glass wool with aluminium cladding rope to minimize the heat radiated to the room.

DETAILS OF D.G.SET

Engine Instrumentation on Engine

- Speedometer with time totalizer.
- Lub oil pressure gauge.
- Lub oil temperature gauge.
- Cooling water temperature gauge.
- Battery Charger (Separate).
- Starting switch with key.
- Over speed relays.
- Run/Idle toggle switch

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Alarms/Trip (Audio and Visual)

- Over speed.
- High Cooling water temperature.
- Low lub oil pressure.

Alternator

Screen protected, drip proof, 3 phase 415 Volts, 4 wire, 50 Hz, 0.8 p.f., 1500 RPM, self regulated, class H insulation, brushless alternator; continuous rating as per relevant Indian Standards, A removable gland plate shall be provided for the cables. Also an automatic voltage regulator at 415 Volts ± 2.5% shall be provided. Enclosure shall be as per IP-23. Rated voltage shall be 415 V suitable for 50° ambient temperature and overload capacity shall be 10% for one hour during 24 hours continuous running must have droop characteristics and others for synchronizing system and fine adjustment of voltages.

Exciter

Self excited, self regulated, providing alternator output regulation at plus or minus 2.5%, from no load to full load along P.F. between unity to 0.8 lagging, with 4% speed variable, of the engine. Solid state excitation system is preferred.

BATTERY CHARGING EQUIPMENT

Battery charging equipment should be incorporated in the generator control panel and shall comprise of:

- AC and DC "ON" and "OFF" switches with HRC fuses.
- Indicating lamps for indicating mains "ON" and battery charging.
- Ballast to give charging.

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- Single phase double wound (copper conductor) impregnated natural air cooled mains transformer for rectifier stock.

- Rotary switch to give step control.

- Single phase full wave bridge connected silicon rectifier stack.

- Moving coil ammeter to indicate charging current.

- Moving coil Voltmeter with a selector switch to measure the battery/charger voltage.

- Silicon blocking diodes connected to a suitable tap to maintain continuity of DC supply. Trickle and boost arrangement must be there.

- AC and DC contactors of suitable rating as required

SPECIFICATION OF MATERIALS

Exhaust Silencer Piping

The exhaust silencer piping system shall be of heavy duty MS pipes confirming to Class C. Suitable length of flexible piping shall be used for connecting the exhaust piping to the engine as per the recommendations of the manufacturer. MS screwed flanges and bends shall be used as per site requirements.

Exhaust pipe inside the building shall be lagged with 75 mm dia glass wool with aluminium cladding and suitably bonded with asbestos cloth.

Water Piping and Oil Piping

Water Piping shall be of C class MS pipe. Oil piping shall be of MS or braided flexible type only. Cooling water and oil piping shall be tested in accordance with ASA-B

31.1 pressure piping code. Wiring

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All the wiring outside the panel shall be drawn to 16 gauge MS conduits.

The minimum size of wires outside the panel shall be 2.5 sq. mm stranded copper conductor.

The minimum size of control cables inside the panel shall be 1.5 sq. mm stranded copper conductor.

All the wires and cables suitable for 650/1100 Volts. As per IS-694-1990 latest amendment.

INSTALLATION OF GENERATING SET

The engine and alternator shall be mounted on specially designed common MS base plate and frame of extremely rigid welded construction, so as to provide no deflection.

The engine/alternator set shall be installed over the Dunlop-make, S-type anti-vibration cushy base in order to isolate the transmission of vibrations to the floor or building structures.

The exhaust system shall be designed and installed in such a manner that it avoids excessive stresses on the exhaust manifold of turbocharger, washing spray or any other source.

The exhaust pipe shall pass through an oversized collar, filled with glass wool when crossing floor/wall.

All exposed metal parts shall be suitably painted to prohibit corrosion under the climatic conditions at site.

The installation of fuel piping, power distribution and control panels shall be carried out in accordance with the specification of respective items.

PRELIMINARY TRIALS

After completion of erection of generating sets and before carrying out main trials, preliminary trials shall be conducted in the presence of the Engineer-In- Charge and the results shall be recorded in the test sheet at 30 minutes intervals. Alternator efficiencies

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as determined in works test shall be used as the basis of calculation for fuel consumption rate. A tolerance of 15% shall be allowed on the fuel oil consumption to cover possible errors of measurement.

Tests providing the satisfactory performance of all safety and operating controls shall be carried out. Governor trials shall be carried out as laid down in BS: 639. Alternator insulation resistance and commutation check shall be as per BS 2613/BS 5000. Starting time of sets shall be tested at least five times the sufficient time integral to allow for cold start. On completion of tests, inspection doors shall be removed and running gears inspected and alignment has to be checked. A further reasonable trial as suggested by the CLIENT shall be carried out with no extra charges. All instruments, materials and labour required for carrying out the trials shall be provided by the Contractor. Test sheets of trials shall be forwarded in quadruplicate to Engineer-In-Charge. The successful bidder has to submit a list of recommended spares to CLIENT for purchasing the same. A set of tools and tackles has to be supplied alongwith each set. List of recommended spares shall be indicated to CLIENT.

DAY SERVICE TANK

Day service tank shall be of 3mm thick MS sheet fuel oil storage tank of capacity 990 litres or OEM Vendor specification for each set with all accessories such as oil level indicator, inlet pipe connection. Outlet pipe connection, with gun metal valve through to collect split oil, air vent pipe, manhole with cover, low level and full level float valve arrangements and interconnections between tanks and painting. The tank shall be provided with Suitable calibration scale. The tank shall be fabricated from 3mm thick MS sheet.

FOUNDATION

Foundation shall be casted as per the recommendations of the manufacturer in consultation with the Supplier and as per the requirements of the site. The successful bidder shall submit detailed foundation drawings within 7 days of award of work.

PAINTING

The Contractor shall paint all exposed metal parts and equipment supplied by him. All sheet metal work shall undergo a process of phosphating, passivating and then sprayed with high corrosion treatment of two coats of synthetic enamel paint of approved colour. All piping shall be colour coded.

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5.0 VOLTS DC BATTERIES & BATTERY CHARGER

Lead acid type batteries, 2 x 12V - 25 plates: 180AH as required conforming to IS shall be provided for each set for starting purposes as per requirements. These batteries shall be fitted with electrolyte (specific gravity 1.280) and initially charged, discharged and recharged and placed in suitable enclosure, in ready to use shape.

SHOCK TREATMENT CHART

Shock treatment chart explaining the method of shock treatment in English, Hindi and local language shall be provided dully framed in glass in the diesel generating station.

WIRING

Providing conduits and drawing wires for the following: -

- Control wiring between diesel generating set and the automatic mains failure panel.
- All wiring associated with the fuel oil transfer pump and including level controllers and circulating water pumps.
- All wiring associated with DC supply.
- All earthing conductors associated with this installation.
- All wiring and cables shall be PVC insulated stranded copper conductor wires and cables suitable for 660/1100 volts minimum size of wires for control wiring shall be

2.5 sq. mm and minimum size of wire for pumps shall be 4 sq.mm. The wires would be as per IS.

CABLES

MV cables shall be XLPE aluminium conductor armoured cables, laid in trenches between diesel generating set and DG panel. All power & control cables will be rated for

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1.1 KV grade. Storing, laying, jointing procedures as same as that for the LT cables stated elsewhere.

TEST PERFORMANCE

Scope

This section lay down the procedure for conducting test on the installation. In general the procedure laid down here shall be followed. However, if manufacturer of the equipment has prescribed different procedure which is at variance, the same may be adopted. All required artificial load, testing equipment other required material required for testing purpose shall be supplied by agency.

Physical Test

- Particulars such as name plate details of all major component equipment shall be recorded and compared with what has been offered by the contractor as per agreement.
- Level of foundation.
- Firmness of mounting.
- Verticality of installed set.
- Tightness of nuts & bolts.
- Proper installation of exhaust pipe.
- Insulation of exhaust pipe with 75 mm dia glass wool with aluminium cladding.
- Provision of guard on engine/alternator set coupling joints.
- Termination of various cables.

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- Rating of various fuses.

- Termination of earth leads on neutral & body.

Earth Resistance

The resistance shall be measured by isolating the connecting earth lead in respect of all earth stations.

Run Test

The engine shall be given a test run continuously for at least six hours with alternator supplying full rated load. During this run following observation shall be recorded.

1. Lubricating oil pressure

2. Exhaust gas colour
3. Speed engine

4. Output voltage

5. Load current

6. Load (KW)

7. Noise Level (DB)

Stator Temperature Rise Test

The alternator shall be loaded of full rated load and stator (alternator) body temperature be recorded as under at intervals of 30 minutes till such time that there consecutive readings are the same.

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S.No.	TIME	AMBIENT TEMP	STATOR TEMP
(Hr)		(°C)	(°C)

a. The temperature rise shall be maintained within 60°C above the ambient. Fuel Consumption Test

. Fuel consumption for half an hour shall be measured after the full load operation condition have stabilized.

. During this measurement the load shall be maintained unchanged.

. The fuel consumption shall be compared with values given in the technical particulars.

Over Load

- Over load test to the extent of 10% over the rated load shall be conducted immediately after the full load run test.

- The various parameters as in the case of run test shall regularly be monitored and recorded.

- After the over load test, the load shall be normalized to rated value and all parameters recorded.

Insulation Test

- Insulation test shall be conducted after testing the engine/alternator set at overload.

- The insulation resistance between the starter coil and from shall be measure with 5000 volts meggar.

- The insulation resistance of alternator winding shall be not below: Rated output voltage + 1 Mega Ohms

1000 + Rated output in KVA

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- Insulation resistance of control wiring with 500 volts meggar shall be measure, which shall not be less than one mega ohms.

Regulation Test

- The voltage regulation from no laid to full rated load at 0.8 p.f. and from no load to half the rated load at 0.8 p.f. shall be measured between phase & neutral under automatic and manual regulation mode, which shall not exceed 0.5% of the nominal rated output voltage.

- In automatic regulation mode, the recovery line shall be noted which shall not exceed 3 seconds.

- The frequency of output supply of various load conditions shall be noted and recorded.

- The variation shall be compared with the accuracy standards specified.

- Change in speed of engine with change in load shall be observed and compared with standard reading for the speed governor.

Data Sheet:

Vendors shall fill in the performance data in the block columns of the attached Data sheets.

6.0 ACCOUSTIC ENCLOSURE

Construction Details

The Structure is fabricated using CRCA sheets of 14/16 SWG Thickness and steel members. The enclosure is fabricated on a MS Channel Frame work further strengthened by suitable cross members to make it robust and sturdy. Rock wool / Mineral wool of suitable thickness and density conforming to IS 8183 is used for acoustic insulation to reduce the sound level to 68 – 70 d b from the original sound level of

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105 – 110 d b, when measured at 1mtr.distance from the D.G. Set. The acoustic enclosure consists of following:

a) Acoustic Insulation :

High density Fireproof Acoustic Enclosure Material i.e. resin bonded rock wool / fiber glass wool (75 – 100mm thick of 64Kg/m3 density) conforming to IS:8183 is provided on all doors and roof to absorb noise. The insulation material used is fire retardant. The insulation is covered with fiber glass cloth and is supported by perforated sheet. Sound attenuators / down stream silencers are provided at all openings for air inlet/outlet to facilitate free air flow but to absorb sound resulting in extremely low noise level. Detachable partitions are provided inside the enclosure to attain further noise attenuation of the engine.

b) Noise Suppressor :

A suitably designed absorption type Hospital noise suppressor is provided which minimize the exhaust noise of the engine.

c) Exhaust System :

The exhaust gas is taken out through a specially designed flexible pipe, which prevents any back pressure on the engine.

d) Thermal Insulation :

The exhaust system and noise suppressor is provided thermal insulation by using glass wool & covering it with Aluminum sheet. This prevents it from radiating excess heat on the engine, makes it safe for the operator and enhances aesthetics.

e) Surface Treatment :

The enclosure is surface treated and painted with high quality polyurethane epoxy paint with prior zinc oxide primer base, which makes it weather proof and suitable for outdoor application. The paint is highly resistant to acids, alkaline, salt sprays, halogens, solvents, lubricants etc and has very good dielectric properties and is resistant to abrasion and cracking.

f) Air Circulation & Ventilation System:

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A suitable forced air circulation and ventilation system is designed to maintain safe operating temperatures inside the enclosure. Requisite air circulation for engine aspiration combustion and cooling is provided by means of Exhaust fans or tube axial fan driven by a 3 phase squirrel cage induction motor according to need of engine.

g) Vibration Isolation:

The engine and alternator is mounted on Anti-Vibration Mounting pads to eliminate engine vibration.

h) Hardware:

Inlet and Outlet for cable, draining of lube oil and diesel etc. are provided. The doors are gasketed with high quality EPDN gaskets to avoid leakage of sound. All doors are lockable.

i) Testing / R&D:

The Gen set shall be thoroughly tested on load before it is dispatched from factory.

Technical DataSheet DieselGenerator(Alternator) 200KVA(As perBOQ)		Name oftheProject:
		Date:
S.No.	Item	Data
1	Serial	
2	Type	
3	Make	
4	Voltage,Phase,Frequency	415V,3PHASE,50Hz
5	NormalContinuousRating	KVAasperBOQ
6	StartingKVA	(PLEASESPECIFY)
7	Manufacturer	
8	MAXIMUM VALUE OFMOTORLOAD WHICH DOESNOTAFFECT STARTING	(PLEASESPECIFY-minm.60%
9	PowerFactor	0.8
10	Classofinsulation	H
11	Efficiency&lossesat0.8p.f.and	AS REQUIRED/PERIS.
a)	1/4thFullload	
b)	½thFullload	
c)	¾Fullload	
d)	fullload	
12	OVERLOADCAPACITY	10%
13	Build up timeforvoltagefromno load tofull load	20secMaximum

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14	NO.of hoursalternatorcan be runwithno increaseintempunder10%overload	2 hrsMinimum	
Preparedby:	Name:	Date:	

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SECTION 4 : L.T. PANELS & SWITCHGEARS GENERAL

Technical specifications and make of materials should be get approved before the procurement of the materials. All panels / equipments approval shall be taken in the form of GA Diagrams before fabrication.

PERFORMANCE TEST

The Performance test should be done at factory in the presence of PMC / Bidder / Client. Incidental, to and fro charges and boarding & lodging expenses should be borne by the bidder.

The contractor shall consider the following details in their scope of works no additional cost shall be paid, wherever required:

1. Supporting rigid steel framework.
2. Cubicle type, 14 gauge CRCA sheet steel enclosed.
3. Complete with interconnections and distribution bus bars.
4. Proper bonding to earth.
5. Painting/ lettering on Breakers and distribution boards, the location they serve, providing on each panel its circuit diagram.
6. Providing cable clamps / supports within distribution boards cable alley.
7. TPN ACB's / MCCB's shall mean 3 pole ACB's / MCCB's with adequate size of neutral link.
8. All MCB's /MCCB shall be of minimum KA breaking capacity as per CPWD General Specification Part-IV Substation
9. All motor feeders MCCBs shall be of motor duty.

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10. Distribution panels shall be Powder Coated with Siemens gray paint shade no. RAL-7032 of IS-5 or as pwer direction of EIC.

11. Degree of protection for following type of distribution panel enclosure shall be as per IS: 13947-1993.

12. All MCCB's shall be provided with operating mechanism for door interlock.

13. Bus bars shall be of sufficient cross-section so that a current density of 130A/sq.cm (800A/sq.inch) is not exceeded at nominal current rating foraluminium bus bars, and 160A/sq.cm (1000A/sq.inch) for copper bus bars.

14. Tinned copper earth bus shall be provided through out the length of each board.

15. All measuring instruments (Meters) shall be of digital electronic with LED of approved make and compatible with BAS.

16. All hinged door shall be earthed through 2.5 sq mm tinned braided copper wire.

17. All panels shall have provision of the following:

18. Pad locking of Switch board doors.

19. Pad locking of MCCB's handles in "OFF" Position.

20. Additional set of C.T.s, potential free contacts, connectors, contactors with wiring etc are to be provided for BAS including space required for various transducers in Main Switch Board sections. Only transducers shall be supplied by BAS contractor.

21. All MCB's used for protection of resistive and lightly inductive load shall be type "B" characteristic and inductive (motor) load shall be of type "C" characteristic and discharge lamps and UPS etc. shall be of type D characteristic.

22. All incoming and outgoing air circuit breakers shall be placed on middle portion of the vertical in single tier formation.

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23. All PTs / control transformer shall be provided with centre tap earth secondary.

24. All DOL & Star-Delta Starters shall be provided with SPPR (single phase preventor relay) and 2 nos. of Aux.Contacts for Remote operation/monitor.

25. The Panel fabricator shall provide Al./ Copper Bus-bars link from Breakers wherever more than two nos. of cables are terminated in the breakers.

26. Readymade 16SWG Sheet steel Enclosure with cut out For MCBs

27. The breakingcapacityofMCCB'saremention edpanel wise.AllMCCB'sshallbe withthermalmagneticreleasesupto 200amps andmicroprocessorbasedabove200 amps capacity,unlessspecifiedotherwise.

Medium voltage switch boards/distribution boards, the combination of both these and components shall conform to the equipments of the latest revision including amendments of the following codes and standards.

The drawings, specification and BOQ complement each other and which is shown or called for one shall be interpreted as being called for on both. Material, if any, which may not have been specified but fairly required to make a complete assembly of switch gear as shown on the drawing, specifications shall be construed as being required and no extra charges shall be payable on this account.

CODES&STANDARDS

The design, manufacture and performance of equipmentshall comply withall the currentlyapplicable statues,safetycodes, relevantBureauofIndianStandards(BIS), BritishStandards(B.S.),International DutroTechnical Commission(IEC)Publication, NEMA,IDE&DEMAstandardasamendeduptodate.

1. IS: 13947- 1993/IEC 60947-1989: Air circuit breaker/moulded case circuit breaker. IS:3156 Voltage transformers.
2. IS:2705 Current transformers for metering and protection with classification
3. Part-I, II burden and insulation & III 1964
4. IS:9224 Low voltage fuse and protection.
5. IS:3231 Specification for electrical relays for power system protection.
6. IS:8623 Specification for factory built assemblies of switchgear and control gear for voltage upto and including 1000-V AC/1200 V-DC.
7. IS:4237 General requirements for switch gear and control gear for voltage not exceeding gear.

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8. IS:2147 Degree of protection provided by enclosures for low voltage switch gear and control gear.
9. IS:1018 Switchgear and control gear selection/installation and maintenance.
   IS:1248 Direct acting electrical indicating instruments.
10. IS:375 Arrangement for switchgear, bus bars, main connections, auxiliary wiring and marking.
11. IS:2959 AC contactors for voltage not exceeding 1000V.
12. IS:5578 Guide for marking of insulated conductors.
13. IS:11050 Guide for forming system of marking and identification of conductors
14. & apparatus terminal.
15. IS:1248 Direct acting indicating analogue electrical measuring instruments andTesting ccessories.
16. IS:600 Code of practice for phosphating of iron & steel.

The board shall be metal enclosed single front, indoor, floor mounted, free standing type or wall mounting type as mentioned in BOQ. The panel shall be designed for a degree of protection of IP-55. However bus bar chamber shall have IP: 42 degree of protection incase bus bar rating exceed 1600 Amps. Keeping in view the operating height of the top switch 1750mm from finish floor. 400mm clear space shall be left throughout the panel at bottom. The cold rolled sheet steel will be of 2mm thick. The structure shall be mounted on a rigid base frame of folded sheet steel of minimum 3mm thickness and

50mm height.

All cutouts and covers shall be provided with synthetic rubber gaskets (preferably neoprene).

The panel shall be divided into distinct vertical sections each comprising of:

i) Complete enclosed bus bar compartment for running horizontal and vertical bus bars.

ii) Complete enclosed switchgear compartment one for each circuit for housing air circuit breaker, MCCB/MPCB with starters etc.

iii) Compartment for power and control cables of at least 300mm width covering entire height provided.

iv) The panel shall have sufficient space at least 20% of outgoing feeders for future use. The front of each compartment shall be provided with hinged single leaf door with

locking facilities. Panel shall be provided with suitable lifting facilities. Isolators and

MCCB/ACBs and accessories shall be of fixed/drawout type as per BOQ.

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Each feeder shall have compartmentalized or non-compartmentalized for MCB feeders only. Ri-tall type with separate construction cable entry shall be from top/bottom (3mm thick gland plate with suitable numbers & sizes of knockout holes (as called for in schematic/ fabrication drawings) shall be provided.

The panel shall be provided with three phase buses & neutral bus bars of high conductivity electrolytic copper/Aluminium sections throughout the length of the panel& shall be adequately supported and braced to withstand the stressed due to the short circuit current of 35 KA rms. for 1 sec. as called for in BOQ/Data Sheet. Maximum temperature rise of bus bars and bus bar connection while carrying rated current shall not exceed 40 Deg.C over an ambient temperature of 50 Deg.C. Bus bars shall be of sufficient cross-section so that a current density of 130A/sq.cm (800A/sq.inch) is not exceeded at nominal current rating foraluminium bus bars, and 160A/sq.cm (1000A/sq.inch) for copper bus bars.

The minimum clearance in air between phases and between phases and earth for the entire run of the bus bar connections shall be 32mm minimum. Bus bars support insulators shall be made of non-hydroscopic non-combustible track resistant and high strength SMC or polyester fiberglass moulded material.

All bus bars shall be colour coded as per IS: 375.

Copper /G.I./Aluminium earth bus of suitable size shall be provided at the bottom of the panel throughout the length. Similarly suitable size of strip in each vertical section for earthing the individual equipment/accessories shall be provided and connected to main horizontal bus.

Sheet steel hinged lockable doors shall be interlocked with MCCB to prevent opening of the panel when MCCB is on position. Safety interlock with operating handle shall be provided.

Contactors shall be electromagnetic type with interrupted duty as per IS: 2959. The main contacts shall be of silver or silver alloy, provided with minimum 2 NO and 2 NC auxiliary contacts. The push button should be of shrouded type and each should be provided with 1 NO and 1 NC contact. Colour coding shall be as per IS: 6875 (Part-II).

General Note for ACBs/MCCBs/MCBs

Preferred Specification/Selection of Air Circuit Breaker and Moulded Case CircuitBreakers;

These should be confirmed entering into the agreements:-

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(I) MCCBs: MCCBs should preferably be used for loads below 800 Amperes.

(1) Upto 160 A MCCBs shall be of > 20 Ka (Ics=Icu) at 433 V Short CKt. Current rating and should be Thermal Magnetic.

(2) From 200 A- 250 A MCCBs shall be of > 35 Ka (Ics= Icu) at 433 V Short Ckt.

Current rating and should be Thermal Magnetic.

(3) From 300A0 onwards MCCBs shall be of > 50 Ka (Ics=Icu) at 433 V Short Ckt.

Current rating and should be microprocessor based having over load and short

circuit protection. If used as incomer should also have earth fault protection

&time delay. Earth leakage modules are not acceptable.

(II) ACBs: From 800 A onwards ACBs shall normally (MCCBs should be used judiciously for such loads) be used. These should have 50 Ka (Icu=Ics) Short Ckt. Current rating with microprocessor based overload, short circuit and earth fault protection at 415 volts, 50 HzACB (IEC 60947-2; IS 13947)

The circuit breaker shall be of air break type in order to eliminate fire and explosion risk and shall comply with the IEC with a rupturing capacity of not less than 35 MVA at 415 volts or as specified elsewhere (The service short circuit breaking capacity shall be as specified and equal to the short circuit with stand value Ics = Icu). The breaker shall be provided with variable microprocessor based releases within built fault differentiation for integral over load, short circuit and earth fault & other protection as called for in BOQ, LED indication for type of fault, CT's for protection and measurement class as called for in BOQ, and LCD display of curves and parameters. Electrical endurance without maintenance shall be greater than 2000 cycles.

Mechanical & electrical anti pumping devices shall be provided in breaker, as required.

The breaker shall have memory for logging history for type of fault, load, time & date and the Vendor shall mention in the data sheet for no. of loggings available in the breaker memory.

The breaker shall consist of a horizontal draw out pattern triple/four pole, fully interlocked, independent manual/motorized spring operated mechanism. The mechanism should be such that the circuit breaker is at all times free to open immediately. The trip coil is energized. Current carrying parts should be silver plated and suitable arcing contacts

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shall be provided to protect the main contact arc-chutes for each pole shall be provided and shall be lifted out for the inspection of main and arching contact.

Self-aligning cluster type isolating contacts shall be provided on breaker for interlocking protection metering and for any other purposes. The breaker should have 3 distinct positions - SERVICE/TEST/ISOLATED within the cubicle.

The ACB shall be with molded housing class II front fuse and shall be suitable for Isolation as per the annexure 7.1.2 in the standard.

Breaker shall be provided with automatic safety shutters to screen the main live contact when the breaker is withdrawn. The frame of the circuit breaker could be positively earthed when the breaker is racked into the cubicle.

The following safety arrangements shall be provided for the safety of the personnel to prevent mal-operation.

i) Interlock to prevent the truck from being withdrawn or replaced except in the fully isolated position.

ii) Interlock to prevent earth connection from being made by the earthing device except breaker is open.

iii) Interlock to prevent the breaker being closed unless it is fully raised.

iv) Interlock to prevent the breaker from being made alive without its rack in position.

Protection Releases

Self-powered & true RMS sensing microprocessor based release with following features.

a) Incomer ACB of Panels:

Long time short circuit protection with time delay. Instantaneous and earth fault protection with LCD display to show RMS current in all three phases, neutral (for 4pole) simultaneously. The other features of the release to be as under.

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• The release should display distinct fault indication for each type of tripping for faster fault diagnosis and reduce down time & should protect ACB from over temperature and Phase unbalance.

• Release should provide contact wear indication in display no. of operation seen by the breaker for case of maintenance.

• The release shall be self-diagnosis & should provide fault history including cause of fault as well as level of fault current. It should be possible to store minimum 20 last trip data with nonvolatile memory.

• The protection setting of release should be accessible to change locally.

• LCD display should be at least 4 line display and should be able to display current is all the 3 phases and neutral (4 pole) simultaneously.

b) For Outgoing ACB feeder:

Long time Short circuit protection with time delay (for discrimination), instantaneous. The other features of the release to be as under.

The release should have distinct fault indication for each type of tripping for faster fault diagnosis and reduced down time and shall protect ACB from over temperature and phase unbalance.

• Operation counter

• Alarm and warning indication

Type test certificate : The ACB's shall be type tested ad certified for coplion is to IS 13947/equivalent / EC standard from Indian / Internation testing authority, supplier to submit certificate of the same.

MOULDED CASE CIRCUIT BREAKER (MCCB)

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MCCB shall confirm to the latest IS13947-1993/IEC 60947. The Service Short CircuitBreaking Capacity (Ics at 415 VAC) should be as specified.

MCCB shall be Current Limiting and comprise of Quick Make – Quick Break switching mechanism & Double Break Contact system. The arc extinguishing device and the tripping unit contained in a compact, high strength, heat resistant, flame retardant, insulating molded case with high withstand capability against thermal and mechanical stresses. All MCCBs shall be capable of defined variable overload short circuit and earth fault adjustment with thermo- magnetic releases upto 250A and with electronic release above

250A onwards.

The Service Short Circuit Breaking Capacity (Ics at 415 VAC) should be as called for in BOQ and is the required minimum value for that feeders/ panel, however if the rating of feeder mentioned is not available, the contractor shall used next higher rating without any extra charges. The service short circuit breaking capacity shall be equal to ultimate breaking capacity of MCCB, i.e. Ics= 100%Icu

The trip command shall over ride all other commands. MCCB shall employ maintenance free double break contact system to minimize the let thru' energies and capable of achieving discrimination upto the full short circuit capacity of downstream MCCB. The

manufacturer shall provide both the discrimination tables and let thru' energy curves. The MCCB shall not be restricted to Line/Load connections.

The handle position shall give positive indication of 'ON', 'OFF' or 'Tripped' thus qualifying to disconnection as per the IS/IEC indicating the true position of all the contacts. In case of

4 pole MCCB the neutral shall be defined and capable of offering protection upto full rating. The remote tripping coil should be of continuous duty. The general-purpose control switch shall be provided for ON/OFF Auto/Manual. The switch shall be provided with engraving plates on the front with the complete inscription.

The switch shall be normally a fixed control box type heavy-duty unit.

Indicating lamps shall be of the panel mounting, LED type and shall have execution plates marked with its function wherever necessary. The color of the lamp cover shall be red for

'ON' and green for 'OFF' indicating lamps shall be provided with series resistor. MCCB

shall be provided with interlocking devise for interlocking the door of switchboard. Following shall be included if specified in the drawing or in the schedule of quantities:

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o Under voltage trip

o Shunt trip

o Alarm Switch

o Auxiliary switch

CONTACTORS

The contactors should comply with the latest IEC947-4 and the corresponding IS13947-4 standards. They shall have UL and CSA approval. The contactors should be rated for AC3 duty at 415V and 50Hz. The contacts should be fast closing and fast opening type. The making and breaking capacity values of the contactors should be as follows (as per IEC947-4):

For AC3 Duty

- Making Capacity equal to or more than 10 Ie
- Breaking Capacity equal to or more than 8 Ie

For AC4 Duty

- Making Capacity equal to or more than 12 Ie
- Breaking Capacity equal to or more than 10 Ie

The contactors should be capable of frequent switching and should operate without derating at 600C for AC3 applications. They should be climate proof as standard .The coil of the contactor should have class H insulation to support frequent switching.

The rated voltage of the contactor shall be equal or superior at 690 V, and rated insulation voltage shall be 690 V. The rated impluse voltage of the contactor should be 8 KV.

The contactor should be modular in design with minimum inventory requirements and built in mechanically interlocked 1NO 1NC auxiliary contact up to 32A. They should be suitable for the addition of auxiliary contacts and other electrical auxiliaries without any compromise on the performance or the operation of the contactors .The contactors from 4 KW to 400 KW will be associated with the same auxiliary contact block range.

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Wherever D.C control is required, the contactor should have wide range (0.7 to 1.25Uc) D.C coil with built in interference suppression as standard.

The control and power terminals should be at separate layers preferably with colour coding (black for power and white for control)

All contactors power connection will be finger safe (IP2X) as standard.

They should be capable of being integrated into automated system (PLCs etc.) without any interposing components in minimum operating conditions.

The thermal over load relay if used will be directly mounting under the contactor without any specific connections.

NAME PLATES & LABELS

i) Panel and all modules shall be provided with prominent engraved identification plates. The module identification designation. For single front switchboards, similar panel and board identification labels shall be provided at the rear also.

ii) All nameplates shall be of non-rusting metal or 3-ply lamicold, with white engraved lettering on black background. Inscription and lettering sizes shall be subject to CLIENT's approval.

iii) Suitable stenticilled paint marks shall be provided inside the panel/module identification of all equipments in addition to the plastic sticker labels. These labels shall be partitioned so as to be clearly visible and shall have the device number, as mentioned in the module wiring design.

PAINTING

All steel work shall be pretreated in tanks and finally powder coated of approved shade.

WIRING

Control and protective wiring shall be done with copper conductor PVC insulated 1100 volts grade multi-stranded flexible wire of 1.5 / 2.5sq.mm cross section. The colour coding shall be as per latest edition of IS: 375.

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Each wire shall be identified by plastic ferrule. All wire termination shall be made with type connection. Wire shall not be taped or splied between terminal points.

Terminal blocks shall preferably by grouped according to circuit function and each terminal block group shall have at least 20% spare capacity.

Not more than one wire shall be connected to any terminal block. All doorframe of L.T. switchboard shall be earthed with bare braided copper wire.

TESTING & INSPECTION

After completion of all work at the manufacturer's works the switchboards shall be inspected and tested in presence of Purchaser's representative. However, stage inspection may be carried out from time to time to check progress of work and workmanship. The following tests shall be carried out:

i) All routine tests specified in relevant Indian/British Standards shall be carried out on all circuit breakers.

ii) Test for protective relay operation by primary or secondary injection method. iii) Operation of all meters.

iv) Secondary wiring continuity test.

v) Insulation test with 1000 Volts megger, before and after voltage test.

vi) HV test on secondary wiring and components on which such test is permissible (2 KV for one minute)

vii) Simulating external circuits for remote operation of breaker, remote indicating lights and other remote operations, if any.

viii) Measurement of power required for closing/trip coil of the breaker.

ix) Pick up and drop out voltages for shunt trip and closing coils. x) CT Polarity test.

Vendor shall provide all facilities such as power supply, testing instruments and apparatus required for carrying out the tests. Required copies of test certificates for all the tests carried

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out alongwith copies of type test certificates and certificates from Sub-Vendor for the components procured from them are to be submitted before despatch of switchboards.

DRAWINGS AND INFORMATION

The Vendor shall furnish following drawings/documents in accordance with enclosed requirements:

i) General Arrangement drawing of the Switchboard, showing front view, plan, foundation plan, floor cutouts/trenches for external cables and elevations, transport sections and weights.

ii) Sectional drawings of the circuit breaker panels, showing general constructional features, mounting details of various devices, bus bars, current transformers, cable boxes, terminal boxes for control cables etc.

iii) Schematic and control wiring diagram for circuit breaker and protection including indicating devices, metering instruments, alarms, space heaters etc.

iv) Terminal plans showing terminal numbers, ferrules markings, device terminal numbers, function etc.

v) Relay wiring diagrams. vi) Equipment List.

Vendor shall furnish required number of copies of above drawings for Purchaser's review, fabrication of switch boards shall start only after Purchaser's clearance for the same. After final review, required number of copies and reproducible shall be furnished as final certified drawings.

The information furnished shall include the following:

i) Technical literature giving complete information of the equipment.

ii) Erection, Operation and Maintenance Manual complete with all relevant information, drawings and literature for auxiliary equipment and accessories, characteristics curves for relays etc.

iii) A comprehensive spare parts catalogue.

TOOLS

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One complete set of all special or non-standard tools required for installation, operation and maintenance of the switchboard shall be provided. The manufacturer shall provide a list of such tools with his quotation.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

QUALITY ASSURANCE

Quality Assurance shall follow the requirements of CLIENT as applicable.

Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

DEVIATIONS

Deviation from specification must be stated in writing at the quotation stage.

In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

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SECTION 5 : HT CABLES AND LT CABLES

H.T. CABLE (XLPE) (33 KV & 11 KV)

The cross-linked polyethylene (XLPE) cable shall be aluminium conductor PVC outer sheath steel strip armoured over inner sheath construction. XLPE cable shall conform to testing in accordance with IS: 7098 (Part-I) 1977 and (Part-II) 1973. The screening shall be done on individual cover. The armouring applied over the common covering shall be flat steel wires. Each and every length of cable shall be subjected to routine test.

The termination and jointing techniques for XLPE cables shall be by using heat shrinkable or push on cable jointing kits.

While laying underground cables in ducts care should be taken so that any underground structures such as water pipes, sewerage lines etc. are not damaged. Any telephone or other cable coming in the way shall be properly protected as per instructions of the Engineer-in-charge. The H.T. cable shall be laid at least 900mm for cable upto 33 KV (E) below the ground level in a trench 450mm wide.

Insulation tests shall be done before and after laying of cables.

After laying and jointing work is completed a high POT test shall be performed in presence of Engineer and test results submitted for approval in order to ensure that they have not been damaged during or after the laying operation. In case, the test results are unsatisfactory, the cost of all repairs and replacement and all extra work of removal and relaying will be made good by the contractor without any extra cost.

L.T. CABLES & WIRE

a) Wires

The design manufacture, testing and supply of single core LEAD FREE FRLS PVC insulated 1.1 KV grade multi-stranded twisted wires under this specification shall comply with latest edition of following standards.

IS : 3961 Current rating for cables.

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IS: 5831 PVC insulation and sheath of electric cables.

IS : 694 PVC insulated cables for working voltage upto and including 1100 volts.
IEC: 754(i) FRLS PVC insulated cable.

Copper multi-stranded twisted conductor FRLS PVC insulated wires shall be used in conduit as per item of work.

The wires shall be colour coded R Y B, for phases, Black for neutral and Green for earth. Progressive automatic in line indelible, legible and sequential marking of the length of

cable in metres at every one metre shall be provided on the outer sheath of wire.

The material & insulation of wires shall be ROHS compliant (Reduction Of Hazardous

Substance) and shall comply the following directives:

- EU Directive 2002/95/EC Issued Jan 2003
- EU Directive 94/62/EC and 2004/12/EC (amendment)
- EU Directive 91/338/EEC
- EU Directive 91/157/EEC & 98/101/EC (amendement)

Summary on related directives

Directive Ref.	Date	Objective	Remarks
2002/95/EC	27Jan03	Restriction of the use of certain hazardous	6 banned materials included Pb (Lead), Hg (mercury), Cr6+

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		substances in electrical and electronic equipment (EEE) and to contribute to the protection of human health and the environmentally sound recovery and disposal of waste EEE.	(Hexavalent Chromium), Cd (Cadmium) and Flame Retardants- Polybrominated Biphenyls – PBB 1000ppm & Polybrominated Diphenyls Esters- PBDE 1000ppm.
94/62/EC 2004/12/EC (amendment)	20Dec94 2Nov04	Amending directive 94/62/EC, on Packaging and Packaging Waste is to prevent packaging waste by encouraging packaging re-use and recycling while at the same time avoid distortions in the internal market.	The targets defined are the following: • Recovery of minimum 60% by weight • of the packaging waste Recycling of at least 55% and a maximum 80% by weight of the totally of packaging materials, with a material-specific minimum recycling rate for plastic of 22.5% • Max. sum of concentration levels of Pb, Cd, Hg and Cr6+ > 100 ppm
		Restriction on the use of Cadmium pigment (amending for the 10th time Directive	The cadmium content (expressed as Cd metal) exceeds 0,01 % by mass is prohibited in the finished products or components of products manufactured from polymers or copolymers of vinyl

b) Cables

The design, manufacture, testing and supply of the cable under this specification shall comply with latest edition of following standards:

IS: 8130 Conductors for insulated electric cables and flexible cords. IS: 7098 XLPE insulation and sheath of electric cables.

IS: 3975 Mild steel wires, strips and tapes for armouring cables. IS: 7098 Current rating of cables.

IS: 7098 XLPE insulated (heavy duty) electric cables for working voltage upto and including 1100 volts.

IS: 424-1475(F-3) Power cable-flammability test.

Specification for cross-linked polyethylene insulated XLPE sheathed cable for working voltage upto 1.1 KV.

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Specification for XLPE insulated (heavy duty) electric cables for working voltages upto and including 1100 volts.

ASTM-D: 2863 Standard method for measuring the minimum oxygen concentration to support candle-like combustion of plastics (Oxygen Index).

ASTM-D: 2843 Standard test method for measuring the density of smoke from the burning or decomposition.

IEEE : 383 Standard for type of test Class-IE, Electric cables, feild splicers and connections for power generation station.

ASTME:662IEC:754(x) Standard test method for specific optical density of smoke generated by solid materials.

IS : 10418 Cable drums.

c) Technical Requirements:

i. The cables shall be suitable for laying in racks, ducts, trenches conduits and under-ground buried installation with uncontrolled back fill and chances of flooding by water.

ii. They shall be designed to withstand all mechanical, electrical and thermal stresses under steady state and transient operating condition.

iii. The aluminium/copper wires used for manufacturing the cables shall be true circular/sector in shape before stranding and shall be of uniformally good quality, free from defects. The conductor used in manufacture of the cable shall be of H2 grade.

iv. The cable should withstand 25 KA for 0.5 sec with insulation armour insulated at one end. Bidder shall furnish calculation in support of capability to withstand the earth fault currents. The current carrying capacity of armour and screen (as applicable) shall not be less than the earth fault current values and duration.

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v. The fillers and inner sheath shall be of non-hygroscopic fire retardant materials and shall be suitable for the operating temperature of the cable. Filler and inner sheath shall not stick to insulation and outer sheath.

vi. Progressive automatic in line indelible, legible and sequential marking of the length of the cable in metres at every one metres shall be provided on the outer sheath of all cables and at every 5 metre 'FRLS' marking in case of 'FRLS' cables.

vii. Strip/Wire armouring following method (b) mentioned in IS: 3975 shall only be acceptable. For single core cable aluminium wire armouring shall be used.

viii. Allowable tolerance on the overall diameter of the cables shall be + 2mm.

ix. The normal current rating of all XLPE insulated cables shall be as per IS: 7098.

x. A distinct inner sheath shall be provided by pressure extrusion process for all multicore armoured and unarmoured cables as per IS: 5831.

xi. Outer sheath shall be provided by extrusion process as per IS: 5831

xii. The breaking load of armour joint shall not be less than 95% of that armour wire.

Zinc rich paint shall be applied on armoured joint surface. xiii. In plant repairs to the cables shall not be accepted.

xiv. All the cables shall be supplied in non-returnable drums as per IS: 10418.

d) In Case of FRLS Cables

i) The outer sheath of cables shall have an oxygen index of not less than 29 as per ASIMD: 2863.

ii) The maximum acid gas generation by weight as per IEC: 754 (i) shall not be more than 20% for outer sheath material of all cables. Bidder shall also guarantee the maximum theoretical acid gas generation with 20% by weight of outer sheath.

iii) The cables outer sheath shall meet the requirement of light transmission of 40% (minimum and shall be tested as per ISTMD: 2843). In case the test for light transmission

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is conducted as per ASTME: 662. The bidder shall furnish smoke density values as per this standard and shall co-relate the anticipated light transmission when tested as per ASTMD: 2843.

iv) The cable shall pass the fire resistance test as per SS: 42, 41, 475 (I) and flammability test as per EEE: 383.

e) Inspection:

All cables shall be inspected on receipt of the same at site and checked for any damage during transit.

f) Joint in Cables

The contractor shall take care that the cables received at site are distributed to various locations in such a manner as to ensure maximum utilisation and avoidance of cable jointing. Cable shall be rechecked before cutting in lengths, where the joints are unavoidable, and the location of such joints shall be got approved from the CLIENT/CLIENT. The joints shall be done by qualified jointer strictly in accordance with manufacturer's instruction/drawings.

g) Joint Boxes for Cables

The cable joint boxes shall be of appropriate size suitable for type of cable of particular voltage rating.

h) Jointing of Cables

All straight through joints shall be done in epoxy mould boxes with epoxy resins. Straight through joints shall not be permitted unless the length of run is in excess of cable drum.

End terminations of cables more than 1.1 KV grade shall be done with epoxy mould boxed and epoxy resin. Cable glands shall be 1.1KV grade double compression type and made to tin plated heavy-duty brass casting and machine finished. Glands shall be of robust construction capable of clamping cable and cable armour, firmly without injury of cable.

All washers and hardwares shall be made of brass tinned. Rubber components used in the glands shall be made of neoprene of tested quality.

Cable lugs shall be tinned copper/aluminium solderless crimping type conforming to IS: 8309 suitable for aluminium or copper conductor.

Crimping of terminals shall be done by using Corrosion inhabitory compound, with crimping tool.

Fire resistant paint has to be applied 1 Metre on either side of cable joint.

The contractor shall liaise fully with all other contractors to achieve an efficient and properly coordinated installation where equipment has to be re-positioned due to lack of site liaison; no extra cost shall be incurred by the CLIENT.

i) Testing of Cables

Cables shall be tested at factory as per requirement of IS: 7098 Part-I. The tests shall incorporate routine tests, type tests and acceptance tests. Prior to laying of cables, following tests shall be carried out:

i) Insulation test between phases and phase to earth for each length of cable before and after jointing.

On completion of cable laying work, the following test shall be conducted in the presence of Engineer-in-charge/CLIENT/PMC.

ii) Insulation resistance test (Sectional and overall) 1000/5000V depending upon the voltage grade of cable.

iii) Continuity resistance test.

iv) Sheathing continuity test.

v) Earth test.

j) Laying of Cable

The cable drum shall be placed on jacks before unwinding the cable. Great care shall be exercised in laying cables to avoid forming links. At all changes in directions in horizontal

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& vertical places, the cable shall be bent with a radius of bend not less than 8 times the diameter of cable.

The cable of 1.1KV grade shall be laid not less than 750mm below ground level in a 375mm wide trench (throughout), where more than one cable is to be laid in the same trench, the width of the trench shall be increased such that the interaxial spacing between the cables except where otherwise specified shall at least be 150mm minimum or as per site requirements or as approved by the Engineer-in-charge. Where single core cables are used in multiphase systems, the cables shall be installed in trefoil where possible.

In case the cables are laid in vertical formation due to unavoidable circumstance the depth per tier shall be increased by 200mm (minimum). Cable shall be laid in reasonably straight line, where a change in direction takes place a suitable cur- vature shall be i.e. either 12 times the dia meter of the cable or the radius of the bend shall not be less than twice the diameter of the cable drum or whichever is less. Minimum 3-meter long loop shall be provided at both sides of every straight through joint & 3 meters at each end of cable or as directed at site.

Greater care shall be exercised in handling the cable in order to avoid forming

'Kinks'. The cable drum shall in-verbally convey on wheels and the cable unrolled in right direction as indicated on the drum by the manufacturer. The cable shall be pulled over rollers in the trench steadily and uniformly without jerks and strains.

Cables laid in trenches in single tier formation, 10 cms. All around sand cushioning is provided below and above the cable before a protective cover is laid. For every additional vertical tier. The 30cm of sand cushion are provided over the initial tier. The cable shall be protected by 2nd class bricks of size not less than 230x115x75mm, stone tiles/RCC curved channel be placed on top of the sand breadth wise for the full length of the cable and where more than one cable is to be laid in the same trench the brick shall cover all cables and project at least 8 cms. Over the outer sides of the end cables.

Filling of trenches shall be done after the sand cushioning and laying of tilesor bricks are carried out to the satisfaction of the Engineer-in-charge (Refer drawing). Back fill for trenches shall be filled in layer not exceeding 150 mm. Each layer shall be properly rammed & consolidate before laying the next layer.

GI / Hume pipe shall be provided for all road crossing. The size of the pipe shall be according to the cable and a minimum 100mm dia. pipe shall be provided. The pipe shall be laid in ground with special arrangement and shall be cement jointed and concreting with 1:5:10 shall be made as per relevant IS with latest amendment. Location of cables laid directly underground shall be indicated by cable marker at an interval of 30 meters &

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with change of direction. Aluminium strip cable tag of 20mm wide with engraved tag no. shall be provided at both ends of cable.

Where the cables are to be laid in ducts (pucca trenches) in side the building, they will have to be laid on MS rack/ on MS cable trays grouted in walls trenches. Cables sizing through floors shall be protected from mechanical damage by a

steel channel to a height of one meter above the floor where cable pass through wall they shall be sleeved with PVC/steel conduit.

Where the cables are laid in open (in building) along walls, ceiling or above false ceiling, cable rack (ladder type) or cable tray shall be provided. The size of the cable tray or rack shall depend on the number of cables to pass over that rack. Cable tray/rack shall be properly supported through wall/ceiling according to the site conditions. Cable laid on tray & riser shall be neatly dressed &clamped at an interval of 1000 mm & 750mm for horizontal & vertical cable run respectively either side at each bend of cable. All power cables shall be clamped individually & control cables shall be clamped in groups of three or four cables. Clamps for multicore cables shall be fabricated of 25x3 GI flats. Single core power cable shall be laid in trefoil formation & clamped with trefoil clamps made of PVC/fibre glass.

Cable openings in wall/floor shall be sealed by the contractor suitably by hession tape & bitumen compound or by any other proven to prevent ingress of water.

After the cables are laid, these shall be tested as per IS and the results submitted to Engineer-in-charges/Engineer and in case the results found unsatisfactory, all the repairing/ replacing of cables will be done by the contractor free of charge.

k) Fire Seal System

i) All the floor/wall opening provided for cable crossing shall be sealed by fire seal system.

ii) The fire proof sealing system shall fully comply with the requirements of relevant IS/BS: 476 Part-B. The fireproof seal system shall have minimum one hour fire resistance rating.

iii) The fire proof seal system shall be physically, chemically, thermally stable and shall be mechanically secured to the masonary concrete members. The system shall be completely gas and smoke tight, antirodent and anti-termite.

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iv) The material used in fireproof seal system shall be non-toxic and harmless to the working personnel.

v) Type of fireproof seal system shall be foaming type or flamemastic type compound or approved equivalent.

After laying and jointing work is completed, high voltage test should be applied to all cables to ensure that they have not been damaged during or after the laying operation and that there is not fault in the jointing.

Cables for use on low and medium voltage system (1.1KV grade cables) should withstand for 15 minutes a pressure of 3000V DC applied between conductors and also between each conductor and sheaths. In the absence of pressure testing facilities it is sufficient to test for one minute with a 1000V insulation tester In case the test results are unsatisfactory the cost of repairs and replacements and extra work of removal & laying will be made good by the contractor.

Cable shall be installed so that separation shown in the table below are observed. HV Cable (11 KV/ 33 KV) - HV Cable (11 KV/ 33 KV) 50 mm

ELV & LV 230 V/433 V - ELV & LV cable 230 V/433 V Equal to the diameter of the bigger cable.

HV cables (11 KV/33 KV) - ELV & LV cables 230 V/433 V 300 mm LV cables 433 V - Telephone/Instrument cable 350 mm All cables - All hot pipe work 200 mm

l) Quality Assurance

Quality Assurance shall follow the requirements of CLIENT/ CLIENT as applicable. Quality Assurance involvement will commence at enquiry and follow through to completion and acceptance thus ensuring total conformity to Purchaser's requirements.

m) Deviations

Deviation from specification must be stated in writing at the quotation stage.

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In absence of such a statement, it will be assumed that the requirements of the specifications are met without exception.

n) Spares for Commissioning Including Consumables

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools and consumables. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

CABLE TRAYS

a. Ladder type Cable tray – for Power Cables only

Cable trays shall be ladder type fabricated out of mild steel/slotted angles and flats of required width as per design. Bends shall be prefabricated. The cable tray shall be hot dip galvanized or primed and painted with powder coating as asked for in BoQ or as approved by CLIENT/ CLIENT. The minimum weight of the zinc coating shall be 460 gm/sq.m and minimum thickness of coating shall not be less than 75 microns.

b. Perforated Cable tray – for Power Cables & Low current service both

The perforated cable trays are fabricated out of 1.6mm thick CRCA sheet steel having minimum 50mm depth or as called for in BOQ, hot dip galvanized or epoxy coated of approved shade. Perforations are maximum 10mm spaced at maximum 20mm distance. The cables shall be tied with the cable tray with nylon strip/ aluminium clamps/M.S. clamps as per requirements.

Suitable provision shall be made where a tray crosses expansion joints. The width of the tray shall allow for a suitable separation between cables the design shall allow for adequate bending radius for the sizes of cables. No sharp bend to be allowed in cable tray. Joints between sections shall be bolted.

The tray shall be suspended from the surface of the concrete slab by means of approved steel hangers spaced at a distance of not more than 125cms. Suitable bushes shall be provided where cables pass through apertures in the tray. Cables must be securely fixed to the tray with clamps or cable ties. In routing necessary barrier and spacing shall be maintained for cables of different voltages in case they lie side by side. Telephone cables shall cross the power cables only at about right angle and these two shall not run in close proximity. Full details of the tray shall be approved by the CLIENT/Engineer-in-charge

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before fabrication. Earth continuity shall be maintained between each section of cable tray and each total run of tray shall be effectively bonded to the nearest earth continuity 0conductor. All nuts and bolts used shall be of galvanised steel.

Depending on the size of cable trays space of 20-33% has to be maintained for future expansion.

Cable tray is manufactured to comply with the specifications of National Electrical Code (NEC) and National Electrical Manufacturer's Association (NEMA).

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SECTION 6 : DISTRIBUTION BOARDS & MCBs

General

Distribution boards shall be of standard make with MCBs as per approved make given. Distribution boards shall be constructed out of steel sheet all weld enclosure with double door IP42 protection and shall be powder coated. Ample clearance between the conductors of opposite pole, between conductors and sheet steel body shall be maintained in order to obviate any chance of short circuit. Removable conduits entry or knockouts plates shall be provided at top and bottom to facilitate drilling holes at site to suit individual requirements. Also on additional/separate adopter box of suitable length and size shall be provided to accommodate wires and cables. No. of conduits etc. and nothing shall be payable on this account. The MCBs shall be mounted on high-grade rigid insulating support and connected by electrolytic copper bus bars. Each incoming MCB isolator shall be provided with solderless cable sockets for crimping. Phase separation barriers made out of arc resistant materials shall be provided between the phases. Bus bars shall be colour coded for phase identification.

Distribution boards shall be recessed in wall nitch or if required mounted on the surface of the wall with necessary clamp bolts etc. The mounting height shall not exceed

1200mm from finished floor level. Distribution board shall be provided with proper circuit identification nameplate and danger sticker/plate as per requirements.

All the distribution boards shall be provided with engraved nameplates with 'lighting',

'power' or 'UPS' with DB Nos., as the case may be. Each DB shall be provided with a circuit list giving details of each circuit. All the outgoing circuit wiring shall be provided with identification ferrules giving the circuit number & phase.

Each distribution board shall have a separate neutral connection bar and a separate earth connection bar mounted within the DB each having the same number of terminals as the total number of outgoing individual circuits from the distribution board. Conduit

& cable armouring shall be bonded together & connected to the distribution board earth bar.

Where oversized cables are specified due to voltage drop problems, it shall be contractors responsibility to ensure that satisfactory terminal arrangements are provided without an extra cost.

Earth Leakage Circuit Breaker

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ELCB shall be 4 pole 415 volts 50Hz, 30-300mA sensitivity. These shall be of approved make. The rating of the ELCB shall be as specified in BOQ. These shall be suitable for manual closing and opening and automatic tripping under earth fault circuit of 30-

300mA as specified in item of work. The enclosure of the ELCB shall be moulded from high quality insulating material. The material shall be fire retardent, anti-tracking, non-hygroscopic, impact resistant and shall with stand high temperature. All parts of switching mechanism shall be non-greasing, self-lubricating material so as to provide consistent and trouble free operation. Operation of ELCB shall be independent of mounting position and shall be trip free type. The RCCB shall be protected against nuisance tripping by protective device.

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Miniature Circuit Breaker

1. The MCB shall be current limiting type and suitable for manual closing and opening and automatic tripping under overcurrent and short circuit. The MCB shall also be trip free type.

2. Single pole/three pole versions shall be furnished as required.

3. The MCB shall be rated for 10 KA/15 KA fault level.

4. The MCB shall be suitable for its housing in the distribution boards and shall be suitable for connection at the outgoing side by tinned cable lugs and for bus-bars connection on the incoming side.

5. The terminal of the MCBs and the open and close conditions shall be clearly and indelibly marked.

6. The MCB shall generally conform to IS: 8828. -1996

7. The MCB shall have 20,000 electrical operation upto 63A.

8. The MCB shall have minimum power loss (Watts) as per I.S./ IEC.

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INTERNAL ELECTRICAL WORKS

A. Conducting (M.S Conduit)

All conduits shall be of heavy gauge solid drawn ERW welded manufactured out of 16 (1.6mm) gauge MS Sheet up to 32mm dia and of 14 (2 mm) gauge for sizes higher than this. Both inner and outer surfaces shall be smooth without burrs, dents and kinks. Conduits shall be black stove enameled inside and outside. The cross section of conduit shall be uniform throughout. The welding shall be uniform such that welded joints do not yield when subjected to flattening test. Welded joint shall not break when threaded or bent at an angle. Conduit shall conform to specifications of IS: 9537 (Part-II) and the capacity of conduits shall be in accordance with the standards and shall never be exceeded. The minimum size of the conduit shall be 20mm dia. Care shall be taken to ensure that all conduits are adequately protected while stored at site prior to erection and no damaged conduit shall be used.

B. PVC Conduit

All conduits shall be high impact rigid 2mm thickness PVC heavy duty type and shall comply with I.E.E. regulations for non-metallic conduit 2mm thick as per IS-

9537/1983 (Part-III). All sections of conduit and relevant boxes shall be

properly cleaned and glued by using epoxy resin glue and the proper connecting pieces. Inspection type conduit fittings such as inspection boxes, drawn boxes, fan boxes and outlet boxes shall be M.S. or otherwise mentioned. Conduit shall be terminated with adopter/PVC glands as required.

Accessories

Conduit accessories such as normal bends, unions, circular junction boxes and pull boxes, locknuts etc. shall be heavy gauge type and approved make. Conduit accessories shall conform in all respects to IS: 3837-1966 with latest amendment. Wherever several conduits are running together, adequately sized adoptable boxes common to all runs shall be used to avoid inserting inspection boxes in the individual run. Where it is necessary to segregate wiring metal filler shall be fixed with in the box.

Conduits shall be laid before casting in the upper portion of a slab or otherwise, as may be instructed or in accordance with approved drawings, so as to conceal the entire run of conduits and ceiling outlet boxes. Vertical drops shall be buried in columns or walls. Wherever necessary, chases will be cut by the contractor with the help of chase cutting m/c or by hand. Nothing extra shall be paid to the contractor on this account. In case of exposed brick/ rubble masonry work special care shall be taken to fix the conduit and

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accessories in position along with the building work. Sufficient depth of the chases will be made to accommodate the required number of conduits. The chase will be filled with cement, coarse sand mortar (1:3) and properly cured by watering for one week.

If a chase is cut in an already finished surface the contractor shall fill the chase and finish it to match the existing finish. Contractor must not cut any iron bars to fix conduits. Conduits shall be kept at a minimum distance of 100mm from the pipes of other non- electrical services. Where the conduit is to be embedded in a concrete member it shall be adequately tied to the reinforcement to prevent displacement during casting, conduits in chases shall be held by steel hooks of approved design at maximum of 100 cm centres. The embedding of conduits in walls shall be so arranged as to allow at least 12mm plaster cover the same. All threaded joints of conduit pipes shall be treated with some approved 'preservative compound' to secure protection against rust.

Suitable expansion joints fittings of approved make and design shall be provided at all the points where the conduit crosses the expansion joint in the building. (Preferably with Pilca metallic watertight conduits). Conduits shall cross at right angles of the joints only.

Separate conduit shall be used for:

1) Normal light, fan call bell

2) 16 A power outlets

3) Emergency Light Point

4) Fire alarm System

5) Computer Outlets

6) P.A System

7) Telephone system

8) TV Network

9) Or any other services not mentioned here.

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Wiring for short extensions to outlets in hung ceiling or to vibrating equipments, motors etc. shall be installed in flexible conduits. Flexible conduits shall be formed from a continuous length of spirally wound interlocked wire steel with a fused zinc coating on both sides. The conduit shall be provided with approved type adoptor. A separate and accessible earth connection shall bond across the flexible conduit.

Conduit runs on surfaces shall be supported with metal 1.2 mm thick saddles, which in turn are properly secured on to GI spacer to the wall or ceiling. Fixing screws shall be with round or cheese head and of rust proof materials. Exposed conduits shall be neatly run parallel or at right angles to the walls of the building and shall be painted in color matching the adjoining area. Unseemly conduit bends and offsets shall be avoided by using better appearance. Cross cover of conduits shall be minimum and entire conduit installation shall be clean and with good appearance. For surface work, the boxes shall be raised back pattern type, designed for use with distance saddles to give clearance of

6mm between the back of conduit and the fixing surface.

Where conduits are run on steel work, they will be fixed by means of purpose made GI Caddy clips in manner meeting with the approval of the Engineer prior to the installation being carried out. Other methods of fixing may be agreed in special circumstances, but approval must first be obtained from the site engineer.

The spacing of saddles shall be not more than 600mm centers for up to 32mm diameter conduits and at 750mm for conduit sizes of 40mm diameter and above in case of MS conduit and not more than 600 mm for PVC conduit. In addition, saddles shall be fixed at each side of any bend/Tee, or set at a distance of 200mm from the bend/Tee. The holes in the brickwork or concrete for fixing plugs shall be neatly drilled by means of a masonry drill of the appropriate size.

All the GI sheet steel /passivated boxes used for housing switches, plugs, fan regulator etc. shall be five sided conforming to IS: 5133 Part I-1969. Suitable size of boxes shall be provided a minimum of 2 adjustable fixing lugs on vertical sides. Suitable earth terminal inside each box shall be provided. All fixing lugs shall be threaded to receive standard machined chromium plated brass screws. Sufficient number of knockouts shall be provided for conduit entry. Conduits carrying wires of different circuit can terminate in common J.B having metal compartments. Necessary GI pull wires shall be inserted into the conduit for drawings wires. In case conduit pipe is required to cross any RCC beam special adopter boxes shall be provided for crossing & nothing shall be paid extra.

Where conduits are used for non-air-conditioned space to air-conditioned space or into a fan chamber or duct, a junction box shall be installed to break the continuity of such conduit at the point of entry or just outside and conduit shall be sealed around the conductors.

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Particular care shall be taken during the progress of the work to prevent the ingress of dirt and rubbish such as plaster droppings into erected conduits. Conduit which has become so clogged shall be entirely freed from these accumulations or will be replaced. Screwed plastic or metal caps or turned wooden plugs shall be employed to protect all open ends. Plugs of waste wood, paper, cotton or other fibrous matter shall not be used. All unused conduit entries shall be blanked off in an approved manner and where conduits terminate in adaptable boxes, all removable box covers shall be firmly secured to provide complete enclosure. If considered necessary by the Engineer-in-charge, the conduits shall be swabbed out by drawing swabs of rag through the conduit to remove moisture prior to any cables being drawn in.

All conduit installations must be completed and erected in their totality before they are wired and must be fully rewireable from outlets to distribution boards or trunking systems etc. to which they connect. No wiring of any part of the installation shall be commenced until instructions are received to do so by the Engineer-in-charge at such time as he is satisfied that the wiring will not be damaged due to building operations.

Conduits shall be installed so that they are self-draining in the event of ingress of moisture due to condensation or any other reason. A suitable drainage hole shall be drilled at the bottom of the lowest conduit box in every 9-meter of horizontal run.

PVC bush of good quality shall be used in each conduit termination in a switch box, draw box, lighting fixtures and circular junction boxes.

Exposed conduits running above false ceilings shall be suitably clamped independently along with the dropped ceiling. Perforated straphangers or twisted attachment shall not be acceptable. In no case shall raceways be supported or fastened to other pipe for repair and maintenance. They shall be arranged symmetrically and in the cost compact design, in no way unduly criss-crossing each other. Proper spacing shall be maintained when two or more conduits run side by side. The layout of the pipes shall be co- ordinated with other services if any. The junction boxes and conduits used in hazardous areas shall be flameproof type with cast iron construction complete with threaded covers. The conduit of each circuit or section shall be completed before conductors are drawn in. The entire system of conduit after erection shall be tested for mechanical and electrical continuity throughout and permanently connected to earth conforming to the requirements by means of special approved type of earthing clamp efficiently fastened to conduit pipe in a workman like manner for a perfect continuity between the earth and conduit.

The conduit system shall be so laid out that it will obviate the use of tees, elbows and sharp bends. No length of conduit shall have more than the equivalent of two-quarter bends from inlet to outlet. The conduit itself being given required smooth bend with radius of bends suiting to the site conditions but not less than 6 times overall diameter.

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Outlet boxes shall be of heavy-duty sheet steel installed as to maintain continuity throughout. These shall be so protected at the time of laying that no mortar finds its way inside during concrete filling or plastering. For fluorescent fittings, the outlet boxes heavy duty shall be provided 300mm off centre for a 1200mm fitting and 150mm off centre for a 600mm fittings or as per B.O.Q.

Draw boxes of ample dimensions shall be provided at convenient points to facilitate pulling of long runs of cables. They shall be completely concealed with MS covers flush with plasterwork painted to match the wall. These boxes will be as few as possible and located where found suitable by the CLIENT.

Switch Boxes

The switch boxes shall be zinc passivated & shall not be less than 18 SWG thick or shall be as called for in BOQ. It will be so designed that accessories could be mounted on integral pedestals or on adjustable flat iron mounting straps with tapped holes by brass machine screw. Leaving ample space at the back and on the sides for accommodating wires and check nuts at conduit entries. These shall be attached to conduits by means of check nuts on either side of their walls. These shall be completely concealed leaving edges flush with wall surfaces. Earthing terminal inside box shall be provided.

Moulded plate switches screw less as specified in item of work shall be provided. No timber shall be used for any supports. Boxes, which come within concrete, shall be installed at the time of casting. Care shall be taken to fix the box rigidly so that its position is not shifted while concreting.

Wiring

All the wiring installation shall be as per IS: 732 with latest amendment. PVC insulated copper conductor cables as specified in bills of quantity shall be used for sub-circuit runs from the distribution boards to the points and shall be pulled into conduits. They shall be twisted copper conductors with thermoplastic insulations of 660/1100 volts grade. Colour Code for wiring shall be followed.

Looping system of wiring shall be used, wires shall not be jointed. Where joints are unavoidable, they shall be made through approved mechanical connectors with prior permission of the CLIENT. No reduction of strands is permitted at terminations. No wire smaller than 1.5 sq.mm shall be used and shall be as per B.O.Q. Wherever wiring is run through trunkings or raceways, the wires emerging from individual distributions shall be bunched together with cable straps at required regular intervals. Identification ferrules indicating the circuit and DB number shall be used for submains sub-circuit wiring. The ferrules shall be provided at both end of each submain and sub-circuit.

Where single-phase circuits are supplied from a three phase and a neutral distribution board, no conduit shall contain the wiring fed from more than one phase. In any one room in the premises where all or part of the electrical load consists of lights, fans and/or other single phase current consuming devices, all shall be connected to the same phase of the supply. Circuits fed from distinct sources of supply or from different distribution boards or through switches or MCBs shall not be bunched in one conduit. In large areas and other situations where the load is divided between two or three phase, no two single-phase switches connected to different phase shall be mounted within one box.

All splicing shall be done by means of terminal blocks or connectors and no twisting connection between conductors shall be allowed.

Industrial sockets shall be of moulded plastic BoQ and deeply recessed contact tubes. Visible scraping type earth terminal shall be provided. Socket shall have self-adjustable spring loaded protective cap. Socket shall have MCB/ELCB/RCCB as specified in the schedule of work.

Maximum number of PVC insulated 650/1100 V grade/copper conductor cable conforming to IS: 694-1990.

Wire size in	S	B	S	B	S	B	S	B	S	B	S	B

Notes:

1) The above table shows the maximum capacity of conduits for a simultaneous drawing in of cables.

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2) The columns heads 'S' apply to runs of conduits which have distance not exceeding

4.25 m between draw in boxes and which do not deflect from the straight by an angle of more than 15 degrees. The columns heads 'B' apply to runs of conduit which deflect from the straight by an angle of more than 15 degrees.

3) Conduit sizes are the nominal external diametres.

TELEPHONE , DATA, TV& CCTV SYSTEM

A TELEPHONE SYSTEM

1.0 Scope of work

Supply, installation, testing ,commissioning and handing over of telephone system including all materials and manpower as per the specifications , bill of quantities , drawings, layout and schematic diagram to the satisfaction of client, consultant.

The contractor shall carry out the entire work of the system which consists of following devices/items/works:

Telephone outlets

2 pair telephone cable Terminal blocks Junction box

Multi pair telephone cable Main distribution box Cable containment system

Contractor shall follow CPWD specifications for installation works for the system.

The list of approved manufacturers for the products covered in the system is attached separately.

The detailed bill of quantities, scope of work, technical specifications of products to be used, installation method, testing, commissioning and handing over procedures are attached to the tender documents.

Contractor shall avail product approval before procurement of the materials.

Shop drawings shall be submitted and get approved before commencing the installation works at site.

Contractor must go through the above mentioned documents before submitting the estimate for the system.

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2.0. Standards and Codes

Following standards and codes are to be considered for the telephone system for the project.

CPWD standards for wiring installations

IEC 60364 -5 -523 conductors/cables	Installation method of electrical
Sec 54, Electricity Act 2003 & R36	Wiring in high rise buildings
IEC 732, IS 4648-1968(reaffirmed 1997)	Electrical wiring

3.0 Manufacturing standards

Cables – 2 pair/multi pair	
unarmoured & multi pair armoured	Code DOT GWIR06/02
C-DOT/VDE: 0815, 0816/IEC189/IS5608	
PVC conduits FRLS	BIS CODE: 4985 – 2000, IS 9537 part-3,
Telephone sockets	BS 6305, 6312
Cable trays/trunking	IS 4759, 2629, 2633
PVC Ducts	ASTM D1785 & D2665

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4.0. Technical specification

Telephone wires to be used must be one or more twisted pairs of copper wire as per UL

-444 & EIA/TIA 568 B for application up to 16MHz,with annealed bare high conductivity copper,PVC/PE/Cellular PE insulated overall sheathed cores, twisted to form a pair, individual or overall shielding using aluminium-mylar tape/copper tape. Armouring to be provided with an extruded inner PVC/PE sheath and overall sheath of PVC/PE flame retardant, wherever required.

2 pair, 0.5 mm dia cable must be used for wiring from each telephone outlets to the floor terminal box.2 pair telephone cable must be drawn in PVC conduit embedded in concrete slab or installed on surface of wall.

The PVC conduit shall be medium gauge rigid type of minimum 25mm dia.

Contractor must use standard fittings like bend, couplers etc. from the same manufacturer to ensure good workmanship.

Cable tray to be used shall be perforated pre-painted GI cable trays with perforation not

more than 17.5%, in convenient sections. Accessories like couplers, Tees, Bends, etc. must be from same manufacturer.

Telephone outlets shall be of modular type. Contractor must refer make list provided for wiring devices in electrical part of the specification for type and finish of the telephone socket.

5.0 Installation

For each floor, 2 pair wires from each telephone outlet must be taken to the terminal blocks fixed in lockable junction boxes. The junction boxes shall be suitably located in services room or in a convenient place located in each floor, preferably in the lobby at high level close to the false ceiling. 25 mm dia rigid medium gauge PVC conduit must be used to contain the 2 pair telephone cable. PVC conduit must be either embedded in concrete or installed below RCC slab on surface as per site condition. When conduits are to be taken open, it can be either installed on wall or beneath concrete slab by using GI saddle spaced at 60cm intervals.

When a bunch of PVC conduits are to be routed to the service room, cable containment system of appropriate size must be installed above false ceiling. GI back boxes of suitable size must be concealed in the block/RCC wall to accommodate telephone sockets. Type and finish of telephone sockets must match with other electrical wiring accessories of the project. Telephone socket and back box must be from same manufacturer.

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Telephone socket must be modular type matching with other electrical wiring devices. Cable tags must be provided at both ends to identify the cable.

Multi pair unarmoured telephone cable must be used for connecting floor terminal box to main distribution frame located in the main telephone room within the building Multi pair cable must be laid in a suitable sized containment system(cable tray/cable trunking) which runs between floor distribution frame & MDF. Tray/Trunking shall be pre-painted GI cable trays perforated type and installed on wall or hanged from RCC slab using proper support system/ anchor fasteners at regular intervals. Cable laid in the tray shall be neatly dressed using heavy gauge cable tie at regular intervals.

Multi pair armoured telephone cable must be used for interconnection of buildings if required. Heavy gauge PVC ducts of suitable size must be laid at specified depth in the excavated trench to contain externally laid telephone cables. Minimum size of PVC duct must be 100 mm. Inspection chambers at regular intervals must be provided in this route. Draw wires/Plastic rope must be provided to achieve hassle free cable pulling.

Floor distribution frame shall be located in the service room of each floor. It consists of multi pair terminal blocks located inside lockable type junction boxes. The work includes terminal blocks, cable manager, jumper wire etc.

Main distribution frame shall be consists of metal rack, terminal blocks, cable manager, jumper wires, power supply outlets etc.

6.0 Warranty

The contractor must submit written guarantee duly signed by the manufacturer and installer of the system for the period of 1 year from the date of substantial completion. The guarantee shall cover the repair and replacement of material with manufacturing defects and workmanship as directed by the engineer.

7.0 Contractor's responsibility

Shop drawings

Upon award of the job, the contractor shall submit a set of shop drawings for the approval of the consultant. The drawing shall clearly indicate position of telephone sockets, routing of conduit, cable tray, floor junction boxes, main distribution frame etc. etc.

A schematic diagram must be submitted to have an overall view of the system. Standard symbols of devices and its mounting height must be clearly marked in the layouts.

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The drawing must be submitted in hard copies of minimum A2 size.

Material Approval

The contractor shall submit technical data sheets of all components to be used for the system in the project for consultant's approval. The submittal shall include product's technical data sheets from the manufacturer, compliance statement, company profile, reference list etc.

All products to be proposed must be from a single manufacturer unless otherwise specified.

The material procurement may commence upon approval of material submittal and shop drawings.

8.0 As built drawings and Maintenance manuals

On successful completion of the work, contractor must submit three sets of hard copies and softcopy in DVD in AutoCAD format of latest version of as built drawings and operation & maintenance manual to the client. The document shall be submitted as directed by the consultant.

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BATTERY & BATTERY CHARGER

1. SCOPE

The specifications give details of the Battery Charger suitable for HT/ LT Panels. The batteries are housed in the Bottom Compartment of the Battery Charger. Sealed maintenance Free Batteries up to 24V – 200AH or Lead Acid Batteries up to 24V – 150AH can be housed in the Battery Compartment. The Battery Charger is a composite Battery Charger cum DC Distribution Board.

2. GENERAL

The Battery Charger shall be Float cum Boost type, Thyristor controlled. The Charger shall have selector switch for Auto Float – Boost/Manual Float/Manual Boost Mode of operation. During Auto Float – Boost Mode, Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa. This means that when the Batteries are fully charged the charging shall automatically change from Boost charge to Trickle charge.

Construction Feature

Float cum Boost Charger and DC Distribution Board shall be housed in Sheet Steel Cubicle with Panels of 1.6mm thickness, louvers for ventilation, gland plate will be provided for cable entry from bottom. The cubicle shall be painted in Siemens Grey Shade. The Battery Charger shall be divided into two Compartments. The Upper Compartment shall house the Battery Charger & DCDB with all the necessary controls. The Lower Compartment shall be suitable for housing the Batteries.

Performance

a. The D.C. Output Voltage of Float/Boost Charger shall be stabilized to within ± 2% for A.C. Input variation of 230V ± 10%, frequency variation of 50 Hz ± 5% and D.C. Load variation of 0 – 100%. The Voltage Regulation shall be achieved by a constant voltage regulator having fast response SCR controlled. The ripple content in output shall be within 3% of D.C. Output Nominal Voltage.

b. There shall be provision to select Auto Float/Manual Float /Manual Boost Modes. During Auto Float Mode the Battery Charging shall automatically changeover from Boost Mode to Float Mode and vice – versa. During Manual Float/Boost Modes it shall be possible to set the output volts by separate potentiometers.

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c. The Battery Charger shall have automatic output Current Limiting feature.

Components

The Battery Charger shall essentially comprise of the following:

a. 1 No. Double Pole ON/OFF MCB at A.C. Input.

b. 1 No. Pilot Lamp to indicate Charger ON.

c. 1 No. MAIN TRANSFORMER: Double Wound, naturally air – cooled, having Copper winding.

d. 1 Set Single Phase full wave Bridge Rectifier consisting of 2 nos. Diodes and 2 nos. SCR's, liberally rated, mounted on Heat Sinks and complete with Resistor/Condenser network for surge suppression.

e. 1 No. Rotary Switch to select AUTO FLOAT/MANUAL FLOAT/ MANUAL BOOST. During Auto Float Mode Automatic Changeover shall take place from Float Mode to Boost Mode and vice – versa.

f. 1 Set Solid state constant potential controller to stabilize the DC Output Voltage of the Float cum Boost Charger at ± 2% of the set value for AC Input Voltage variation of 230V ±10%, Frequency variation of ± 5% from 50Hz and simultaneous Load Variation of 0 - 100% and also complete with Current Limiting Circuit to drop the Float Charger Output Voltage upon overloads to enable the Battery to take over.

g. 1 No. Electronic Controller to automatically changeover Battery Charging from Boost to Float and vice – versa.

h. 1 No. DC Ammeter and Toggle Switch to read Charger Output Current and Battery Charge / discharge current.

i. 1 No. Moving Coil DC Voltmeter to read the DC Output Voltage.

j. 2 Set Potentiometer to adjust the output Voltage during Manual / Auto Float and Boost Modes.

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k. 1 No. Double Pole ON/OFF MCB at Charger Output. I. Dc Distribution Board :-

INCOMER : 1 No. 63A DP MCB, as called for in BOQ.

OUTGOING : Suitable No. 16A/20A DP MCB, as called for in BOQ.

Alarm Annunciation :

Visual and Audible Alarm with Manual Accept/Reset Facility shall be provided for the following:

a) A.C. Mains Fail.

b) Charger Fail.

c) Load/Output over volt.

RATING :

A C INPUT : 230V ±10% AC 50 Hz Single Phase

D C OUTPUT : To Float/Boost charge 24V / 100AH

Batteries and also supply a continuous load

CURRENT RATING : 15.0 Amps

FLOAT MODE : 27.0 V Nominal (Adj. between 24.0 – 28.0V)

BOOST MODE : 28.0 V Nominal (Adj. between 24.0 – 30.0 V) Voltage Regulation : ± 2% of the set value

RIPPLE : Less than 3%.

For 24V / 100 AH Batteries the Charger Rating is given in the Specification for

Batteries of other capacities refer to the Table as given below:

BATTERY CAPACITY CHARGING RATING

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24V / 40AH	10.0 Amp.
24V / 60AH	15.0 Amp.
24V / 100AH	15.0 Amp.
24V / 120AH	20.0 Amp.
24V / 150AH	25.0 Amp.
24V / 200AH	30.0 Amp.

Technical specifications and make of materials should be get approved before the procurement of the materials. All panels / equipments approval shall be taken in the form of GA Diagrams before fabrication.

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EARTHING

All electrical equipment is to be earthed by connecting two earth tapes from the frame of the equipment to a main earth ring. The earthing ring will be connected via several earth electrodes. The cable armour will be earthed through cable glands. Earthing shall be in conformity with provision of rules 32, 61, 62, 67 & 68 of Indian Electricity Rules 1956 and as per IS-3843-1966.

The following shall be earthed:

1. Transformer & D.G. Set neutrals.

2. Transformer Housing.

3. H.T. Panels.

4. Non-current carrying metallic parts of electrical equipment such as switchgear, bus ducts, rising mains, panel boards, motor control centres, power panels, distribution boards, cable trays, metal conduits, welding sockets etc.

5. Generator & motor frames.

6. All fixtures, sockets outlets, fans, switch boxes and junction boxes etc. shall be earthed with PVC insulated copper wire as specified in item of work. The earth wires ends shall be connected with solderless bottle type copper lugs.

7. The third pin of Outlets on UPS shall be provided with a separate PVC insulated Cu.

Wire (green with yellow stripe) as Isolated ground earth wire apart from the earthing of box.

The earth connections shall be properly made. A small copper loop to bridge the top cover of the transformer and the tank shall be provided to avoid earth fault current passing through fastened bolts, when there is a lightning surge, high voltage surge or failure of bushings.

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The shop drawing for earthing system shall be prepared by the contractor and be got approved by CLIENT/Engineer-in-charge. The work shall be done in accordance with approved drawings.

All earth electrodes shall be given to a depth sufficient to reach permanently moist soil. Their location shall be marked and approval taken from Engineer-in-Charge before excavation for the same.

The earth electrodes shall be tested for earth resistance by means of a standard earth test ohms meter. All tests shall take place during the dry months, preferably after a protected dry spell.

The resistance between earthing system and the general mass of earth shall not be greater than 1 ohm.

The earth loop resistance to any point in the electrical system shall not be in excess of 1 ohm in order to ensure satisfactory operation of protective devices.

The resistance to earth shall be measured at the following: -

a) At each electrical system ground or system neutral ground.

b) At one point on each grounding system used to ground electrical equipment enclosures.

c) At one point on each grounding system used to ground wiring system enclosures such as metal conduits and cable seaths or armoured.

All earthing conductors shall be of high conductivity copper/ G.I. as per B.O.Q. and shall be protected against mechanical damage. The cross-sectional area of earth conductors shall not be smaller than half that of the largest current carrying conductor. However, the contractor shall use the sizes specified in the bill of quantities of the Tender.

Pipe Earth Electrode

G.I. pipe shall be of medium class and of the size and dia as specified in BOQ. G.I. Pipe electrode shall be cut tapered at bottom and provided with holes of 12mm dia drilled not

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less than 7.5cm from each other up to 2m of length from bottom. The electrode shall be buried in the ground vertically with its top not less than 20cm below ground level.

Plate Earth Electrode

The plate earth electrode shall consist of copper plate or G.I. plate as per item of work. The plate electrode shall be buried in ground with its faces vertical and top not less than 2.5m below Ground level. The plate shall be filled with charcoal dust and common salt filling, extending 15cm around it on all sides.

A watering pipe as specified in BOQ, of medium class G.I pipe shall be provided. The top of the pipe shall be provided with a funnel and a G.I. mesh screen for watering the earth. In the case of pipe electrode a removable plug shall be provided as per drawing. This will be housed in a masonry sump (with cement plastering) of not less than 40 cm square and 40 cm deep. A C.I. frame with hinged cover of 10mm thickness and locking arrangement shall be suitably provided over the sump. The earthing lead from electrode onwards shall be suitably protected from mechanical injury by a suitable dia medium class PVC/ HDPE pipe. The overlapping in G.I. strips in joints shall be riveted with rivets and welded in approved manner. The protection pipe within ground shall be buried at least 30 cm deep (to be increased to 60cm in case of road crossing and pavements). The portion within the building shall be recessed in walls and floors to adequate depth. In the case of plate earth electrode, two nos. 50mm x 6mm GI/Cu. Strip the earthing lead shall be securely bolted to the plate with two zinc passivated bolts, nuts, check nuts and washers. In case of pipe electrode, it shall be connected by means of a through bolt, nuts and washers and cable socket. Main earthing conductor is taken from the earth electrode with which the connection is to be made.

No earth pit shall be fixed within 2.5M of a wall of foundation. The location of the earth electrode will be such where the soil has reasonable chance of remaining moist. Effort shall be made to locate them in grass lawns or near flowerbeds or water taps. The distance between two earthing stations shall be at least 3.0 meters.

Testing and Commissioning

Testing and commissioning shall be done as per the programme/ instructions to be given by CLIENT's authorized representative. All testing equipments necessary to carry out the tests shall be arranged by the electrical Contractor.

Before the electrical system is made live, the electrical Contractor shall carry out suitable tests to the satisfaction of CLIENT that all equipment wiring and connections have been correctly done and are in good working condition and will operate as intended.

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All tests shall be conducted in the presence of the CLIENT authorized representative by the electrical Contractor and shall be notified one week before tests are to take place.

All measurements shall conform to establish minimum acceptable test values. CLIENT's Engineer reserves the right to approve all test results before circuit or equipments are energized for the first time.

LIGHTNING PROTECTION SYSTEM

Protection of buildings against lightning shall generally be done in accordance with latest IS-Code. The installation shall be done as per routes and location of equipment indicated on the drawing and bill of quantities. The conductors and the earth electrode conductor shall be fixed so that they are free to expand and contract. Special care shall be taken in the fixing of support to allow free movement.

The materials of lightning conductors, down conductors, earth termination etc. shall be reliably resistant to corrosion or be adequately protected against corrosion. All air terminations shall be GI and the conductors shall be GI / as specified in the BOQ.

The entire lightning protection system should be mechanically strong to withstand the mechanical forces produced in case of a lightning strike. The system shall be installed such that it does not spoil the architectural or aesthetic beauty of the buildings but on other hand at should meet IS code/safety code.

Horizontal air terminations should be so interconnected that no part of the roof is more than 9 metres away from the nearest horizontal conductor. For a flat roof horizontal air termination along the outer perimeter of the roof is used. For a roof of larger area a network of parallel horizontal conductors shall be installed. Horizontal air terminations shall be laid along contours such as ridges, parapets and edges of flat roofs and where necessary area flat surfaces in such a way as to connect each air termination to the rest and shall, they form a closed network.

All metallic finials, chimneys, ducts, vent pipes, railings, gutters, metallic flag staff, on or above the main surface of the roof of the structure shall be bonded to and form part of the air termination network. All air terminations shall be effectively recessed against over turning either by attachment to the object to be protected or by means to substantial braces and fixing which shall be permanently and rigidly attached to the buildings.

Down conductors shall be distributed around the outside walls of the structure. They shall preferably be run along the corners and other projection, due considerations being given to the locations of air terminations and earth terminations. Lift shafts shall not be used for fixing

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down conductors. Metal pipes leading rainwater from the roof to the ground may be connected to the down conductors but cannot replace them. Such conductors shall have disconnecting joints. All vertical conductors shall be plumbed before fixing. Insulation shall be provided between down conductors and wall.

The lightning protective system shall have as few joints in it as possible. Wherever joints in the down conductor above ground level are necessary they shall be mechanically and electrically effective. The joint overlap shall not be less than the width of the tape. In the down conductor below ground level there shall be no joint. The joints may be clamped, screwed, bolted, revitted, sweated, braced or welded. The bonding of the external metal forming part of a structural or drain water pipe shall have a cross sectional area not less than that employed for the main conductors. Gas pipe, however, in no case shall be bonded to the earth termination system.

Conductors shall be securely attached to the building to be protected by fasteners, which shall be substantial in construction, not subject to breakage and shall be of steel. The conductors shall be secured at not more than 900mm apart for horizontal run and

750mm for vertical run.

Where tape are required to pass through roof asphalting or other waterproofing membranes, a special seal shall be used comprising a 38mm diameter plastic, copper or aluminium tube with 100mm diameter flange 50mm from the top of the tube. The tube length shall suit the thickness of the roof through which the conductor passes, allowing for the tube to protrude 50mm above the membrane. The seal is to be asphalted in position and the conductor shall be sealed in the tube by a setting waterproof compartment.

Each down conductor shall have an independent earth termination. The interconnection of all the earth termination shall be preferable. It should be capable of isolation for testing purpose by "testing joints" at position approchable easily for the meggar testing. The whole of the system could have a combined resistance to earth not exceeding 2 ohm before any bonding has been affected to metal in or on structure or two surfaces below ground.

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CAPACITORS & CAPACITOR CONTROL PANEL

Power factor correction capacitors shall conform in all respects to IS 2834-1964. The capacitors shall be suitable for 3 phases 415V at 50Hz. frequency and shall be available in units as per B.O.Q. to form a bank of capacitors of desired capacity. All these units shall be connected in parallel by means of high conductivity electrolytic copper busbars of adequate current carrying capacity having S.C rating of 25 KA for 1 sec. Each capacitor bank shall be for PVC insulated aluminium conductor armoured cables. Two separate earthing terminals shall be provided for each bank for earth connection. The capacitor bank shall be housed indoor.

The capacitor bank shall be subject to routine tests as specified in relevant Indian Standard and the test certificate shall be furnished. The capacitor shall be suitable for indoor use upto 45 Deg.C over and above ambient temperature of 50degree C. The permissible overloads shall be as given below:

a) Voltage overload shall be 10% for continuous operation and 15% for 6 hours in a 24 hours cycle.

b) Current overloads 15% for continuous operation and 50% for 6 hours in a 24 hours cycle.

c) Overload of 30% continuously and 45% for 6 hours in a 24 hours cycle.

The capacitor banks shall be floor mounting type indoor housing using minimum floor space with protective guard or fencing. The capacitor bank shall be provided with 7% Detuned reactor filter to compensate third harmonics from being generated.

Capacitors shall be of aluminium foil and craft paper. Hermetrically sealed in sturdy corrosion-proof sheet steel 2mm thick containers and impregnated with non-inflammable synthetic liquid and of low power loss version. Every element of each capacitor unit shall be provided with its own built in silvered fuse. The capacitor shall have suitable discharge device to reduce the residual voltage from crest value of the rated voltage to 50 V or less within one minute after capacitor is disconnected from the source of supply. The loss factor of capacitor shall not exceed 0.005 for capacitors with synthetic impregnants. The capacitors shall withstand voltage of 2500V AC supply for 1 minute.

The insulation resistance between capacitor terminals and containers when test voltage of 500V A.C. is applied shall not be less than 50 megohms.

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- Capacitor bank and switching equipments shall be housed in a cubicle having degree of protection IP-51 and constructed with sheet steel of minimum 2mm thickness.

- Capacitors shall be unit type having non-PCB, non-flammable non-toxic dielectric.

- Necessary discharge resistor shall be provided externally to reduce the terminal voltage to or less then 50V in 60 seconds of disconnection from supply.

- Testing shall be done as per applicable standards for shunt capacitors.

Capacitor Control Panel

The capacitor control panel shall general comprise of the following:

a) Automatic power factor correction relay. b) Step controller with reversing motor.

c) Time delay and no-volt relays.

d) Protection MCCB / MCB.

e) Contactor (AC-3 duty) for individual capacitors of suitable rating.

f) Change over switch for either automatic operation or manual operation with push button control.

g) C.T.s with ammeter and selector switch as asked for in BOQ.

h) Voltmeter with selector switch.

i) Indicating lights RYB.

All the capacitors and contactors shall be interconnected with PVC insulated copper conductor wires of adequate size in a neat and acceptable manner. Three phases and neutral bus bar shall be provided in panel as required.

The above control gear, P.F. meter, Digital Microprocessor based P.F. correction relay, push button station etc. shall be housed in a sheet steel metal enclosure cubical type, free standing front operated with lockable doors. The panel shall be fabricated from MS sheet steel 2mm thick and shall be folded and braced as necessary to provide a rigid support for all components. Joints of any kind in sheet steel shall be seam-welded. The panel shall be totally enclosed design completely dust tight and vermin proof. Gaskets between all adjacent units and beneath all covers shall be used to render the joints effectively.

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All sheet steel material used in the construction of capacitor control panel should have undergone a rigorous rust proofing process comprising Alkaline Degreasing, descaling in dilute sulphuric acid and recognised phosphating process. The steel work should then receive two coats of primer before applying final coat of epoxy paint of approved shade.

Quality Assurance

Quality Assurance shall follow the requirement of CLIENT. Q.A. documents as applicable. Q.A. involvement will commence at enquiry and follow through to composition and

acceptable thus ensuring total conformity to purchaser's requirement.

Deviations

Deviations from the specification must be stated in writing at the quotation stage.

In the absence of such a statement it will be assumed that the requirements of the specifications are met without exception.

SPARES

The manufacturer/tenderer shall also supply a complete list of commissioning spares and tools. The same shall be included in the bid price. No extra payment shall be made on account of non-availability of spares during commissioning.

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CHAPTER E - FIRE PROTECTION SYSTEM

1. SCOPE

The basic system requirement shall be as per National Building Code of India 2016 -Part 4

Type of Building Occupancy-**Group A : Residential (15m and above but not exceeding 35m).** The Tenderer shall be responsible for preparing the drawings and prior to execution the tenderer should get it approved from the client engineer in charge.

2. CODES AND STANDARDS

NBC: National Building Code 2016, Part 4, Fire and Life Safety TAC: TAC Protection Manual / 1998 (Guidance only) & as per the direction given by the local fire force department

Engineering Practices

IS-1239 / IS-3589: Specifications for GI Pipes

IS-778/14846: Specifications for Gun Metal gate, globe, and check Values for water supply.

IS-814: Specifications for covered electrodes for metal arc welding of structural steel.
BS-5155: Specifications for C.I. butterfly valve.

IS-1641: Specifications for C.I. screwed fittings.

IS-903: Specifications for Branch pipes (long Pattern)

IS-3844: Code of practice for installation of internal Fire Hydrant in Multi storied building IS-IS

5290: Specifications for hydrant landing values.

IS-903: Specifications for coupling double male double female instantaneous pattern for firefighting.

IS-1879: Malleable iron fittings (Parts I to X)

IS-4853: Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.

IS-636: Synthetic, jacketed hose pipes.

IS-1520: Electrically operated Centrifugal pump.

IS-5: Specification for painting

3. PUMPING SYSTEM(as per BOQ)

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Sl No	Pump Details
1	Booster pump 900 lpm @ 3.5 kg/sq.cm at terrace level, head 50 mtr

Positive suction arrangement is considered for firefighting pump sets.

4. DESIGN PARAMETERS

- The yard hydrants will be fixed on the stand post at 30 m intervals around the buildings.
- In each floor, in each riser, tapping will be taken for connecting a Single headed hydrant valve and a hose reel drum having 20mm dia rubber hose of 30m long with nozzle at one end.
- Each single headed hydrant valve will be provided with 2 Nos. of 15 m hose and 1No. of branch pipe.
- Pipes will be laid in ring form around the area protected. Isolating valves will be provided from maintenance point of view as will be provided from maintenance point of view as well as fire service requirements.
- The wet riser system piping will be as per relevant IS standards.
- The hydrant mains will be sized for the entire aggregate pumping capacity considering velocity of 5 m/s.
- Minimum pressure of 3.5 kg/cm^2 will be ensured at the remotest hydrant point.
- All the hydrants will be used oblique type with the outlet angle towards ground.
- All the outdoor hydrants will be provided with two (2) Nos. RRL hoses (63 mm size x15m long with couplings) and one (1) no. branch pipe with nozzle (20mm bore).
- At every internal hydrant location, one (1) no. of hose reel arrangement will be provided except for terrace level.
- In addition there shall be a set of fire department connections mounted on the external wall of the property near the main entrance. These shall comprise of 4 Nos. 63 mm dia male outlets capable of directly filling the complex's static fire storage tanks.
- The system will be automatic in operation.
- The power supply to MCC & control panel of the firewater pumps will be directly from the sub-station without any tapping.

Wrap coating of under ground MS pipes to be collected from ATE

8. PIPE SUPPORT

All pipes will be adequately supported from ceiling or walls from existing inserts by structural clamps fabricated from M.S. structural e.g. rods, channels, angles and flats or by

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using anchor fasteners type as per site conditions. All clamps will be painted with one coat of red oxide and two coats of black enamel paint.

9. PORTABLE FIRST-AID FIRE EXTINGUISHERS

The portable first-aid fire extinguishers shall be provided for all the buildings as per requirements of NBC 2016.

SYSTEM DESCRIPTION

The extinguishers are used to put-off small fires. The extinguishers will be used in the incipient stage of fire. Fire extinguishers are easy to handle. This is useful to put off the fire in the initial stage itself and thus avoiding major losses.

10. SAFETY SIGNAGES

Safety signage shall be provided for exits & fire escape route.

11. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS (Applicable if any)

The Tenderer shall be responsible for the submission of all necessary forms and drawings to the Statutory Authorities which shall conform to the latest architectural plans submitted to and kept by this Authorities. Tenderer shall be responsible for obtaining the initial and final NOC from Statutory Authorities. Statutory fees will be paid by the contractor as per the GO, which shall be reimbursed by Client on producing the original bill / receipt.

11. FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Tenderer shall carry out final inspection from fire and rescue department and obtaining the Final NOC.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Tenderer shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

12. REJECTION OF INSTALLATION

Any item of system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, and erection or on completion at site may be rejected by the in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect / Consultant/ Client/ Project Manager so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Tenderer at his own expense and to the satisfaction of the Authority/Architect/Consultant.

After works have been accepted, the Tenderer may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/Client/ Consultant/ Project Manager.

13. WARRANTY AND HANDOVER

The Tenderer shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

14. HANDING OVER OF DOCUMENTS All testing and commissioning shall be done by the Tenderer to the entire satisfaction of the Client. And all testing and commissioning documents shall be handed over to the Client

The Tenderer shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Client.

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Chapter F

TECHNICAL SPECIFICATION SOLAR POWER

WORK DESCRIPTION-GENERAL

This section specifies the engineering, supply, delivery to site, installation, testing, commissioning and maintenance of solar power plant as described in the Content.

Outline scheme of the project for 01 No of Location:

i. The array capacity of the proposed grid connected PV (Photo Voltaic) power plant shall be total

capacity of 10 kWp at Velachery.

ii. PV array should be installed as per the site condition and supported by concrete blocks to be prepared at site. The installation is at Indian Bank own premises Velachery

iii. The power plant shall be connected to the existing (Bank) HT/LT system through the grid tie string inverter of suitable capacity (as mention in the Technical Specification) and with output voltage of 415V 3-phase, 50 HZ AC. *This Inverter may also be used for future expansion of the power plant.*

iv. The inverters shall be located in the electrical room as directed by the Engineer in-charge.

v. The output of the grid tie inverters is to be terminated to a power evacuation panel (ACDB) which shall be fixed at suitable place.

vi. The output of ACDB will be connected to a 1no. 32A/64 Amps/100Amps (as mention in the Technical Specification) 4P MCCB with suitable enclosure (under scope of contract) fixed near the Invertor/Main EB Board at the supply mains and its associated termination with EB Mains.

vii. The energy meter (02 nos.) of suitable current rating will be fixed as per local electrical norms. Same shall be followed at different locations (2 sites)

viii. The SPV power plant to be installed should be robust, economic, efficient and type tested.

1. SOLAR PHOTOVOLTAIC MODULES:

The cell of the modules shall be Monocrystalline PERC of Minimum 540Wp or higher Rated panels. The PV modules shall qualify IEC-61215 or IS-14286 and IEC-61730 and should be certified under ISO 9001: 2008 & ISO 14001 or equivalent BIS standard and must 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 and included in the ALMM List published by MNRE.

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If higher capacity Solar Power Panel (540 Wp or more) is used, the quantity of solar panels should be such that the total power output (10 kWp) is maintained.

The PV module must conform to the latest edition of the following IEC / equivalent BIS standards for PV module design qualification and type approval

Sl No	Standard	Description
1	IEC: 61215	Crystalline silicon terrestrial photovoltaic modules – Design qualification and type approval
2	IEC: 61730 – I:2007	Photovoltaic module safety qualification – Requirement for Construction
3	IEC: 61730 – II:2007	Photovoltaic module safety qualification – Requirement for testing
4	IEC 61701	Salt mist corrosion test of the module
5	IEC 61853	Photovoltaic (PV) module performance testing and energy rating

Module efficiency shall be 19% or more at STC. (Measured at standard test conditions of solar radiation at 1000 W per sq meter at 25 deg. Celsius, spectrum AM 1.5)

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.

The quantity of solar panels should be such that the total power output (10 kWp) is maintained.

The bidder offering single module with highest wattage shall be given preference provided all other criteria are equal.

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& latest IEC/IS norms.
1.1	Test certificate issuing authority	NABL/ IEC Accredited Testing Laboratories or MNRE accredited test centres (preferably the

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		latest).
2.0	**PV cell**	
2.1	Type	Mono crystalline
2.2	Panel Dimensions	2272 mm(L) x 1133 mm (W) x 35 mm (T)/ As per Manufacturers recommendation
3.0	PV Module	
3.1	Rating at STC	540 Wp, 144 cells (without any negative tolerance)
3.2	Module Efficiency	Greater than 20 %.
3.3	Fill Factor	Greater than 70 %
3.4	Withstanding voltage	1500 V DC
3.5	Solar Cell Type & Size	Mono PERC, 91 x 182 mm.
3.6	Encapsulate	PID free & UV resistant
3.7	Front Glass	3.2 mm Low Iron (minimum) & Tempered glass with ARC coating. High transmission, low iron, tampered & textured glass with anti reflective coating.
3.8	Junction Box (Protection degree)/ material	IP 68 rated/Weatherproof PPO.
3.9	Cable & Connector (Protection degree)/ type	IP 68 rated/MC4 compatible.
4.0	Frame	Anodized Aluminium Alloy
4.1	Thermal Characteristics – Operating Temperature range (C)	-40 to 85
4.2	Series Fuse rating	25 Amps
4.3	Product	The solar panel supplied to be the latest & with the most recent technology.

2. ARRAY STRUCTURE:

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

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S.No	Item	Description
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 inverter
5	Number of Parallel String against each MPPT Channel	02 Nos (Maximum) / As Specified by manufacturer.

Array Structure

i. PV array shall be installed on the GI channel supports resting on the Concrete blocks on the terrace floor.

ii. PV array mounting channel shall be GI with combination of either I, C, L or as per structural design requirement. The structure shall be capable of withstanding a wind load of 180 Km/Hr after installation. (Structural design document to be submitted by the contractor.)

iii. The weight of the metallic part of the PV module.

iv. Structure shall be corrosion resistant and electrically compatible with the materials used in the module frame, fasteners, nuts and bolts.

v. The mounting channel shall be made of hot dip galvanized MS structure of minimum galvanizing thickness of 120 microns (Test certificate to be submitted by the contractor from standard testing lab to prove the thickness of galvanization).

vi. The channel shall be supplied complete with all members to be compatible for allowing easy installation.

vii. The module mounting channel shall have to be designed and fabricated with optimum tilting angle considering the site condition.

viii. The channel shall have to be designed for simple mechanical and electrical installation. It shall support solar photo Voltaic modules at a given orientation, absorb and transfer the mechanical loads to the building structure.

ix. All fasteners for supporting conduits, nuts and bolts shall be stainless steel of grade SS – 314. The same shall be supported on concrete blocks. No drilling on the terrace floor is allowed.

x. The module mounting structure shall have to be adequately protected against climate condition. The array support shall support SPV modules at a given orientation and absorb and transfer the mechanical load to the building properly.

xi. The channel shall be designed for simple mechanical and electrical installation. There are no requirement of welding or complex machinery at the installation site.

xii. The specification of GI section shall be as per IS-808.

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

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Standards applicable for Structures shall be the Mounting steel structure: BIS 2062 (amended up to date) Galvanisation of mounting structure: BIS 4759 (amended up to date).

Photovoltaic arrays must be mounted on a stable, durable structure that can support the array and withstand wind, rain, and other adverse conditions. The modules will be fixed on structures with fixed arrangement. The module mounting structures shall have adequate strength and appropriate design suitable to the locations which can withstand the load and high wind velocities.

The mechanical structure shall be made up of hot – dip galvanized steel and designed to withstand gusts of wind / cyclonic wind up to 140 km/hr from back side of the panel. Stationary structures shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the ground properly.

Wind Velocity withstanding capacity	140 km/hr (wind speed as specified in IS 875 Part 3)
Structure material	Hot dip Galvanized Steel with galvanization thickness as per BIS specifications 2062 & 4759. Minimum Galvanization thickness shall be of 80 microns.
Bolts, Nuts, fasteners, panel mounting clamps	Stainless Steel SS 304 or above
Mounting arrangement for RCC flat roofs Minimum distance between ground level and lower edge of PV panel	With fixed type concrete ballast 0.3 m
Access for panel cleaning and maintenance	Panel top and bottom shall be accessible for cleaning and from the bottom for access to the module junction box
Panel Tilt angle	North South Orientation with a fixed tilt angle of 10 – 13 degrees (depending on location) facing true south

The array will be installed on steel racking structures that are anchored in the ground. Racks will be laid out in parallel matrices allowing for individuals to access the area between the racks for cleaning and other maintenance needs. In between the row of solar panels sufficient gap need to be provided to avoid falling of shadow of previous row on the next row. Seismic factors for the site will be considered while making the design of the foundation.

Array support structure shall be fabricated using corrosion resistant GI or anodized aluminium or equivalent metal sections electrically compatible with the structural material. Array support structure welded joints and fasteners shall be adequately treated to resist corrosion.

3. Mechanical Specification

i. The tilt angle of the SPV panels shall be 10-13-degree latitude to the horizontal surface facing true south direction. However, the module alignment & tilt angle shall be calculated to provide the maximum annual energy output. This shall be decided based on the location of array installation and bidder shall clearly indicate the details in the Technical Bid.

ii. The min. Clearance between lower edge of PV panel and terrace ground level shall be 300 mm. (to allow ventilation for cooling, also ease of cleaning and maintenance of panels as well as cleaning of terrace). The minimum height should be increased according to the site conditions for each Roof Top.

iii. In between the row of solar panels sufficient gap need to be provided to avoid falling of shadow of previous row on the next row. Seismic factors for the site will be considered while making the design of the foundation.

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iv. The height of each PV panel structure shall not exceed 3m above the terrace level.
v. The PV array structure design shall be appropriate with a factor of safety of min 1.5.
vi. Array support structure shall be fabricated using corrosion resistant GI.
vii. Array support structure welded joints and fasteners shall be adequately treated to resist corrosion.
viii. The support structure shall be free from corrosion when installed.
ix. PV modules shall be secured to support structure using Stainless Steel screw fasteners and / or metal clamps. Screw fasteners shall use existing mounting holes provided by module manufacturer. No additional holes shall be drilled on module frames. Module fasteners / clamps shall be adequately treated to resist corrosion.
x. The support structure shall withstand wind loading of up to 140 km/hr. Photo – voltaic arrays must be mounted on a stable, durable structure that can support the array and withstand wind, rain, hail and other adverse conditions. Stationary structures shall support SPV modules at a given orientation, absorb and transfer the mechanical loads to the roof properly. Adequate spacing shall be provided between any two modules secured on PV panel for improved wind resistance.
xi. The structure shall be designed to withstand operating environmental conditions for a period of minimum 25 years.
xii. It is required to design the grid structure (on which PV module will be installed) in such a way that all load is transferred to the existing columns of the buildngs. Structure design should be provided for the same.
xiii. The bidder shall specify installation details of the PV modules and the support structures with appropriate diagram and drawings. The drawings along with detailed structure design and material selected and their standards should be submitted before starting the execution work.
xiv. Any modification in the equipment or installation that may be demanded by the inspecting authorities shall be carried out by the contractor at no additional cost.
xv. The grid structure should be installed in a manner to leave sufficient space for repair and maintenance of the rooftops, particularly for leakages. The rooftop structure shall not be altered for foundation structures and on any instance of damage to rooftop shall be rectified by the contractor at own expense.
xvi. Installation of grid structure for solar PV mounting should not tamper with the water proofing of roofs if provided.

4. String Combiner Box or Array Junction Box

Array Junction Box (AJB) shall have to be used for termination of string prior connecting array with inverter. There shall be two Arrays Junction Box incase, the inverter is located elsewhere away from PV array. The desired specification of the PV Array Junction Box and accessories shall include but not limited to the following:

S.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

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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	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
4.0	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

a) The String combiner box / Array junction box shall be dust, vermin, and waterproof and made of FRP / ABS Plastic. The terminal will be connected to copper bus – bar arrangement of proper size to be provided. The Junction boxes shall have suitable cable entry points fitted with cable glands of appropriate sizes for both incoming and outgoing cables. Suitable markings shall be provided on the bus-bars for easy identification and cable ferrules will be fitted at the cable termination points for identification.

b) The String combiner box / Array junction box shall be with protection class IP 65 for mounting outside in Open weather condition.

c) Each string combiner box / junction box will have suitable Reverse Blocking Diodes of maximum DC blocking voltage of 600 / 1000V with suitable arrangement for its connecting.

d) The string combiner box / Array Junction box will also have suitable surge protection devide. The Surge Protective Device shall be of Type 2 as per IEC 60364 – 5 -53.

e) The junction Boxes shall have suitable arrangement for the following (typical):
- Combine groups of modules into independent charging sub-arrays that will be wired into the controller.
- Provide arrangement for disconnection for each of the groups.
- Provide a test point for each sub – group for quick fault location

f) The current carrying ratings of the string combiner box / Array junction box shall be suitable with adequate safety factor, to inter connect the Solar PV array.

g) The string combiner box / Array junction boxes shall conform to IEC 60529 (Degrees of Protection provided by Enclosures (IP Code)).

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5. Grid Connected Inverter

The solar grid inverter converts the DC power of the solar PV modules to grid compatible AC power. The power generated from PV array shall be fed to the MPPT Tracker of

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Three phase grid tied solar string inverter of nominal capacity as per the individual solar PV system capacity through array junction box.

The proposed 10 kWp Plants shall be connected with the grid. As such, the inverters shall be compatible to operate with existing utility supply. The PV system shall comprise of 10 KVA (or higher 1 Nos) 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 & 3.4)	NABL / IEC Accredited Testing Laboratories or MNRE approved test centers.
4.0	Input (DC)	
4.1	PV array connectivity capacity	10 kWp
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 kWp
5.2	Number of Grip Ph	3
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%

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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 3. Over current
7.2	AC Side	1. DC inject protection to grid less than 1% 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 which can detect changes in ground current. Rating shall be as suitable for inverter	To be provided for transformer less inverter
8.0	Display	
8.1	Display type	LCD Display
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

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		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 60^0 C
11.3	Cooling	Natural / forced cooling

5. 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:

5.a- **Web based monitoring system:**

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

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7.0 ACDB Panel

Output of the Inverter shall be terminated in ACDB Panel (indoor wall mounting type) through 32/63/100 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 Amps 415V 4 pole MCCB. The set of AC surge suppressor (Surge protection Device) shall be connected at the outgoing bus.

8.0 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.

In the Event KSEB is unable to provide the Bi-directional Meter. Contractor shall proceed to procure the same. 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 KSEB to be submitted in this regard). For Procurement of Meters the distribution licensee (M/s KSEB) shall procure, test and install the meters. However, Liasoning with M/s KSEB 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 KSEB 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 byM/s KSEB) (Purchase Bill of the Energy Meter in the rate prescribed by M/s KSEB 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 KSEB 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).

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10.0 Cables & Wirings:

- Cables: All cables shall be supplied conforming to IEC 60227/ IS 694 & IEC 60502/ IS 1554 Voltage rating: 1,100V AC, 1,500V DC
- For the DC cabling, XLPE or XLPO insulated and sheathed, UV stabilized single core flexible copper cables shall be used; Multi-core cables shall not be used.
- For the AC cabling, PVC or XLPE insulated and PVC sheathed single or, multi-core flexible Aluminium cables shall be used, Outdoor Ac cables shall have a UV – stabilized outer sheath.
- All LT XLPE cables shall conform to IS: 7098 part I & II
- The total voltage drop on the cable segments from the solar PV modules to the solar grid inverter shall not exceed 2.0%
- The total voltage drop on the cable segments from the solar grid inverter to the building distribution board shall not exceed 2.0%.
- The DC cables from the SPV module array shall run through a UV-stabilized PVC conduit pipe of adequate diameter with a minimum wall thickness of 1.5mm.

- Cables and wires used for the interconnection of solar PV modules shall be provided with solar PV connectors (MC4) and couplers.
- All cables and conduit pipes shall be clamped to the rooftop, walls and ceilings with thermos-plastic clamps at intervals not exceeding 50cm; The minimum DC cables size shall be 4.0 mm2 copper; The minimum AC cable size shall be 4.0mm2 copper. In three phase systems, the size of the neutral wire shall be equal to the size of the phase wires.
- The following colour code shall be used for cable wires and shall confirm to IEC 69947 DC positive: red (the outer PVC sheath can be black with a red line marking)
- DC negative: black AC single phase: Phase: red; neutral: black AC three phase: phases: red, yellow, blue; neutral: black Earth wires: green.
- Cables and Conduits that have to pass through walls or ceilings shall be taken through PVC pipe sleeve.
- Cable conductors shall be terminated with tinned copper end ferrules to prevent fraying and breaking of individual wire strands. The termination of the DC and Ac cables at the Solar Grid Inverter shall be done as per instructions of the manufacturer, which in most cases will include the use of special connectors.
- Bending radii for cables shall be as per manufactures recommendations and IS: 1255. Cables shall also conform to IEC 60189 for test and measuring methods.
- For laying / termination of cables latest BIS/IEC Codes/standards shall be followed.

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 class 5

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1.2	Standard	PV-1F / 2 PfG 1169/08.2007 / VDE Standard E PV 01:2008-02/ Equivalent
1.3	Make	KEI, Polycab, Havells or Finolex
B	AC Cable	
2.1	Rated Voltage	1.1kV
2.2	Construction	
2.2.1	Type	Armored or unarmoured as per requirement mentioned in the price bid
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 / Finolex / Havell's
C	PVC Conduit tees, bends etc (Hard & flexible)	
3.0	Standard	ASTM D 1785 u PVC
3.1	Ambient Temperature	0^0 C to 50^0 C
3.2	Type	UV stabilized, temperatures, Shock proof chemical resistant
3.3	Make	Oriplast / Supreme or equivalent
D	GI Pipe	
2.0	Make	TATA B class with the thickness mentioned in the Price Bid.

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.

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10.0 Earthing System, Equipment, Array structure

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i. Array Structure must be earthed with GI Strip / Aluminium or Copper conductors as per Norms stipulated by the Electrical Inspectorate and conforming to IS - 3043

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 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.

11.0 Lightning Protection

The Building is not provided with Lightning protection. Hence new 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

- The SPV power plant should be provided with lightning and over voltage protection.
- The entire space occupying SPV array shall be suitably protected against lightning by deploying required number of lightning arresters. Lightning protection should be provided as per IEC 62305.
- The protection against induced high voltages shall be provided by the use of surge protection devices (SPDs) and the earthing terminal of the SPD shall be connected to the earth through the earthing system.
- Surge protection shall be provided on the DC side and AC side of the solar system.
- The DC surge protection device shall be installed in the DC distribution box adjacent to the solar grid inverter.

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- The AC surge protection devices shall be in the AC distribution box.
- The source of over voltage can be lightning or other atmospheric disturbance. The lightning conductors shall be made as per applicable Indian Standards in order to protect the entire array yard from lightning strike.

12.0 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 KSEB

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

WARNING – DUAL POWER SOURCE

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

13.0 Provision for Module Cleaning

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

14.0 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

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Body Thickness	1 mm

14a Fire Extinguisher:

A 2.5 KG dry powder fire extinguisher shall be provided in the lift machine room where the inverter and ACDB will be installed. The same shall be mounted to the wall and suitable brackets.

14b Rubber Mat:

A Rubber mat as per IS – 15623 -2006 with thickness of 2mm and tested for 3.3 KV shall be spread in front of the inverter and ACDB.

15.0 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.

16.0 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. (Monthly once)

v. Functional Checks of Protection Components and Switchgear: Monthly once.

vi. Inverter, transformer, data acquisition, energy meters and power evacuation checks: Monthly once.

vii. Support structure and terrace water-proofing checks: Monthly Once.

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.

xi. All recorded data (monthly & yearly) shall be preserved in both manual and computer format and submitted for the first 5 years (in addition to DLP).

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17. 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

18. 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

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	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

APPROVED MAKES

SNo:	Description	Make of material
01	Solar PV panels	Warre/Emmvee / HHV / TATA / Adani / REC /Sun Power /Panasonic/Trina Solar/Bosch/Q Cells./Vikram Solar.
02	Solar inverter	Delta/ABB/Schneider/ Growatt.
03	Array Junction box	Hensel/Spelsberg/ABB/Cooper busman.
04	ACDB panel	Local fabrication approved by Consultant/Engineer-

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		In-charge
05	MCB / MCCB	Legrand/ Schneider/Siemens/ L&T
06	Armoured cables 1.1 KV	Polycab/KEI/Havells/ RR Kabel/Finolex.
07	Energy Meter	L&T/Siemens/Schneider/Secure/HPL
08	Surge protection	OBO Betterman/ ABB/ Legrand
09	PV module interconnecting Connector	Tyco/ Cooper busman/Nordid
10	PVC Conduit tees, bends etc (Hard &flexible)	Oriplast /Supreme
11	Cables and Wires for AC	RR Cable/ Polycab/LAPP/ Havell's
12	Cables and Wires for DC	LAPP/Top Solar / Nexans / Siechem.
13	Surge Protecting Device (SPD)	OBO Betterman / ABB/ Legrand
14	GI Pipe	TATA-B class- 3 mm thick.

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15	Lightning Arrestors	Indelec / Star / Erico
16	Data logging System	Delta/ABB/Schneider/Growatt.
17	Fire Extinguisher	Alert / Tyco / Minimax / Newage / Ceasefire
18	Indication lamps LED type, Pushbutton	Schneider electric, L&T, Siemens, Vaishno
19	Fasteners	Hilti / Fisher
20	Paints	ICI/Asian / Berger / Kansai Nerolac

GUARANTEED TECHNICAL PARTICULARS (GTP)

(TO BE COMPLETELY FILLED AND SUBMITTED ALONG WITH TECHNICAL BID)

PV MODULE (GPT)

Sl. No	Item	Specification (as per tender)	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	Mono crystalline	

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2.2	Size	2272x1133x35	
3	PV Module		
3.1	Rating at STC	540Wp, 144 cells (without any negative tolerance)	
3.2	Efficiency	Minimum 20%	
3.3	Fill Factor	Minimum 70%	
3.4	Withstanding voltage	1500V DC Toughened	
3.5	Glass	3.2 mm (minimum)	
3.5.1	Thickness		
3.5.2	Type	High transmission, low iron, tampered & textured glass with anti-reflective coating	
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)	1500 V dc	
3.7.2	Number	3 numbers	
3.8	Module Frame		
3.8.1	Type	Anodized aluminum frame	
4	**PV Module : MAKE Offered**	As per the list mentioned	

PV ARRAY (GTP)

For 10 kWp 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 inverter	

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5	Number of Parallel String against each MPPT Channel	03 Nos.	

PV ARRAY JUNCTION BOX (GTP)

S.No	Item Description	Specification(As per Tender)	As Offered
1	Enclosure		
1.1	Degree of Protection	IP 65 with UV protected	
1.2	Material	Polycorbonate	
1.3	Withstanding voltage	1500V 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	
1.7	Approved make	Hensel / Spelsberg / ABB / Cooper busman.As per the list mentioned in page 57,58	
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 (SPD)		
3.1	Type	DC	
3.2	Approved make	OBO Betterman / ABB / Legrand. As per the list mentioned in page	

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		57,58	
3.3	Protection class	Type 2	
3.4	Number of set	As may be required as per string Design	
3.5	System Voltage	Matched with System Voltage 1500 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 1500 V DC.	

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GRID CONNECTED INVERTER (GTP)

C) 10 KVA INVERTOR:

S.No	Operating Parameter	Specification (As per tender)	As offered
1	Type	Grid connected String Inverter	
2	Usage	Specially used for PV system	
3	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 & 3.4)	NABL / IEC Accredited Testing Laboratories or MNRE approved Test centers.	
4	Input(DC)		
4.1	PV array connectivity capacity	10 kWp	
4.2	MPPT Voltage range	Compatible with the array voltage	
4.3	Number of MPPT channel	3 nos (minimum)	
5	Output (AC)		
5.1	Nominal AC Power Output	10 KVA	
5.2	Number of Grid Ph	3	
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 /	

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		transformer less	
6	General Electrical data		
6.1	Efficiency (Maximum)	95%	
6.2	Sleep mode consumption	Less than 5%	
7	Protection		
7.1	DC side	1. Reverse – polarity protection 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 than 1% 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 for inverter	To be provided for transformer less inverter	
8	Display		
8.1	Display type	LCD Display	
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	

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		iii) Web based remote monitoring system	
10	Web monitoring	Matched with the monitoring and data logging system	
11	Mechanical Data		
11.1	Protection Class	IP 65 or higher	
11.2	Operating ambient temperature	0^0 C to 60^0 C	
11.3	Cooling	Natural / forced cooling	
12	MAKE offered	As per the list mentioned in page 57,58.	

WEB BASED REMOTE MONITORING SYSTEM (GTP)

S.No	Operating Parameter	Specification (As per Tender)	As Offered
1	Input Data	PV Power PV Energy	
2	Meteorological Data	Insolation 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. As per the list mentioned in page 57,58	
B	AC Cable		
2.1	Rated Voltage	1.1kV	
2.2	Construction		
2.2.1	Type	Armoured or unarmoured as per	

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		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	0^0 C to 50^0 C	
3.2	Type	UV stabilized, temperatures, Shock proof chemical resistant	
3.3	Make D	Oriplast,/ Supreme.As per the list mentioned in page 57,58	
	GI Pipe		
	Make	B Class – 3 mm thickness	

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 march 2017r. 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 Chennai city. The maintenance setup of the proposed inverter manufacturer may be inspected by authority, if required.

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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.

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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**

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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

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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.

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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.

Th

e 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 projects site

vi. Completion certificate as per prescribed format provided by authority

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13.0 CEA 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 / KSEB / 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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CHAPTER G - TECHNICAL SPECIFICATIONS FOR ELEVATORS

1.1 This section deals with technical requirement of Electric Traction Type & Passenger Elevator, its components, and safety devices. All features shall be of latest International standards such as EN81, European standards, American standards or IS 14665 (part -1 to 5) and amended up to date. The technical specifications given below are for general guidance only and standard specifications of manufactures are acceptable subject to the condition that these specifications meet the technical / functional requirement specified below.

The contractor shall be responsible to check and ensure dimensions of hoist way, before tendering those requirements of statutory laws and local codes of Electrical / elevator inspector are met with and the equipment offered are suitable for the space available and getting the approval from inspectorate. The scope of work also includes minor civil works and providing necessary channel supports etc for making lift shaft suitable for erection of Elevator.

1.2 POWER SUPPLY

Client shall provide 415 V±10%, 3 phases, 50 Hz AC power supply for the elevator at suitable location in top landing. Elevator shall be suitable for operation on 415 V±10%, 3 phases, 50 Hz AC power supply. Wiring shaft lighting, earthing and required electrical panel with all switches and connections shall be carried out by the elevator contractor which shall be included in his quoted rates and nothing extra shall be paid on this account. All power required for erection, testing and handing over the elevator shall be in the scope of the contractor.

LIFT LICENSE :

CEIG / Lift Electrical Inspectorate license should be obtained by Bidder. Statutory fees will be paid by the contractor as per the GO, which shall be reimbursed by Client on producing the original bill / receipt.

The Performance test should be done at factory in the presence of PMC / Bidder / Client. Incidental, to and fro charges and boarding & lodging expenses should be borne by the bidder.

1.3 CODES & STANDARDS

1.3.1 Work carried out shall in general be in conformity with following:

(i) CPWD specification for electrical work.

(ii) IS 14665 (part -1 to 5) and amended up to date or international specifications which ever is superior shall be applicable and in accordance with regulations of local codes which govern the requirements of the elevator.

(iii) In addition, Indian Electricity Rules 1956 and Indian Electricity Act 1910 and the rules issued there under with amendments issued from time to time shall also apply.

(iv) All the codes and standards mean the latest publication. Unless specified otherwise, the installation shall generally follow the Indian Standard code of practice/the relevant British Standard code of Practice.

1.3.2 All designs, materials, manufacturing techniques and workmanship shall be in accordance with accepted National or international standards/ practices for this type of equipment.

1.3.3 The tenderer shall also state, where applicable, the National or other International Standard (s) to which the whole or any specific part, of the equipment or system complies. In addition, any other information/ description, the tenderers may wish to provide, the features/ performance figures specified/indicated shall be with supporting documents/calculations.

1.4 TECHNICAL REQUIREMENT

Sl.No.	Items	Technical requirement
1	Type of Elevator	Passenger Lift
2	Capacity	**8 passengers (Minimum) capacity (minimum 544 Kgs)**
3	Speed	1.20 Mtr/sec (1.50Mtr / Sec)
4	Serving Floors	Stilt floor to 5th floor (checking)
5	Travel in meters	Approx. 18.0 M (check)
6	Stops & Opening	6 stops & 6 Openings.
7	Machine	Machine Room less Gearless traction machine with electro-magnetic brake placed in the hoist way on top.
8	Control system	Micro-processor based control with variable voltage variable frequency technology.
9	Operation	Simplex full collective.
10	Car Enclosure	Mat finish stainless steel panel on all the four sides &

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		Ceiling.
11	Flooring	Granite flooring
12	Number of Entrance	Entrance at front side on all the serving floors (All stops – Center opening). (Refer drawings attached to this document)
13	Car & Hoist way Entrance (landing) Doors.	Automatic center opening automatic mirror finish stainless steel door.
14	Safety Feature	(i) All safety feature required as per IS / International Standards.
		(ii) Additional features.
		a) Reverse phase relay on controller.
		b) Single Phasing power supply protection.
		c) Overload warning indicator on car (visual and audio)
		d) Fireman's switch
		e) Battery operated alarm bell & emergency light with battery and charger.
		f) Infra red rays sensing device along the edge of the car door for full height.
15	Signals	a) LED Hall buttons/ landing call registered indicator at all landings.
		b) Digital car position indicator in car and at all landings.
		c) Up/ Down pre-announcing indicator at all landings
		d) Integral car operating panel with aesthetic luminous switches, emergency stop switch, key switch for auto/ attendant mode.
		e) Annunciator in car
16	Fixtures (In car)	a) Matt finish stainless steel fixtures four sides.

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		b) Concealed decorative luminaries with LED lights complete with housing, reflector and accessories.
		c) Axial pressure fan suitable design to suit the ceiling.
17	Inter com (In car)	Suitable to hook to EPABX system.
18	Automatic rescue device.	Solid state battery operated device to automatically rescue passengers trapped in the elevator car in between floors in the event of power failure.
19	Manual Rescue Device	Manual rescue device shall also be provided so as to bring the elevator car to the nearest floor in the event of failure of battery operated automatic rescue device.
20	Handrail	3 sides SS handrail to be provided
21	Shaft Lighting	LED Bulk head fittings and 6/16 AMPS modular power switched sockets for each floor

1.5 CONTROLLER

1.5.1 The control system shall be of microprocessor controller type, incorporating variable voltage variable frequency drive for elevators of 1.0 m/s speed. It shall be suitable for site programmability and shall have field test mechanism for quick fault diagnosis. The elevator motor shall be fed through this controller for smooth & silent operation of elevator.

1.6 ELEVATOR HOISTING MACHINE

1.6.1 Manufacturer's standard design/constructional features are acceptable. The elevator hoisting machine shall be compact, energy efficient and proven design. The hoisting machinery shall be gearless type with 3 Phase AC motor. The drive shall be of variable voltage variable frequency type.

1.7 MOTOR

1.7.1 The elevator hoisting motor shall be as per manufacturer's selection. Motor shall be dynamically balanced and shall have high starting torque and low starting current, suitable for elevator duty and equipped with required protection. Motor shall be part of drive unit.

1.8 INSTALLATION OF ELEVATOR HOISTING MACHINE

1.8.1 The required arrangement for installation of elevator hoisting machine shall be provided by the contractor. Necessary scaffolding, channels, load hooks, buffer spring, cutouts on slab and all related civil works shall be in the scope of the contractor.

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1.9 GUIDE

1.9.1 Machined steel guides shall be provided for the car and counterweight. The guide rails shall have tongued and grooved joints, sliding clips shall be used for fastening the guides to allow building settlement without distorting the guide. The flanges shall be mechanical for the fish plate mounting so that rail alignments at joints almost remain constant. To keep down the noises level and to reduce wear and tear of sections, only Nylon ribs shall be used in the guide shoes. However, initially cast iron ribs shall be provided for smoothening of guide rails which shall later be replaced free of cost by Nylon ribs.

1.10 DRIVING MACHINE BRAKE

1.10.1 Electric elevator machine shall be equipped with brakes which shall be applied automatically by means of springs in compression only or by gravity when the operating device is in the 'off' position or in the event of power failure. The brake shall be designed to have a capacity sufficient to hold the car at rest with 125% of its rated load.

1.11 ROPES / FLAT BELTS

1.11.1 The elevator shall be provided with round stranded steel wire ropes or flat belts having tensile strength not less than 12.5 tone/ cm^2. Lubricants between the strands shall be achieved by providing impregnated hemp core. The rope shall conform to IS – 2365 – 1963 amended up to date.

1.12 LEVELING

1.12.1 Leveling with floors should be exact virtually independent of passenger load. This is to be achieved by self adaptive load compensation.

1.13 SELECTOR

Selector shall be as per OEM, however selector shall be microprocessor based.

1.14 CAR DETAILS

1.14.1 CAR FRAME

The car frame shall be made of structural steel of rigid construction to withstand without permanent deformation the operation of safety gear. The car shall be so mounted on the frame that vibration and noise transmitted to the passengers inside is minimized.

1.15 CAR PLATFORM

1.15.1 The car platform shall be of framed construction and designed on the basis of rated load evenly distributed. The dimensions shall conform to IS – 3534 – 1968 amended up to date unless otherwise specified. The flooring shall be finished with antiskid wooden material (sample shall be got approved).

1.16 CAR BODY

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1.16.1 The side walls of the car shall be as per BOQ.

1.17 CAR ROOF

1.17.1 The roof of the car shall be solid type with extra supporting arrangement capable of taking load of maintenance team (at least 140 Kg weight) and also have a fan and light fittings.

1.18 CAR DOOR

1.18.1 The car entrance doors shall be as per BOQ. Doors shall be automatic side/centre opening horizontal sliding and power operated type.

1.19 HOIST WAY (LANDING) DOORS

1.19.1 Doors shall be as per BOQ. It shall be fitted with a locking device which shall comply with clause 21 of IS –3-4666-1980 amended up to date.

1.20 CAR DOOR & HOIST WAY DOOR OPERATORS

1.20.1 (i) Each hoist way door shall be provided with an interlock which shall prevent movement of the car away from the landing unless the door is in the closed position as defined in the IS codes.

(ii) Door system should have the following features:

(a) Reliable robust construction, linear drive door gear with electronically controlled closing and opening for trouble free operation under adverse duty conditions.

(b) Door system interface compatible with modern micro-contactor control system for optimum performance.

(c) Proven door safety devices for maximum safety of users.

1.21 SAFETY GEARS & GOVERNORS

(a) Elevator shall be provided with car safety devices attached to the elevator car-frame and placed beneath the car. The safety device shall be capable of stopping and sustaining the elevator car with full rated load.

(b) The elevator shall be provided with over speed monitoring & tripping safety device and its operation shall be independent of power.

(c) The car safety is provided to stop the car whenever excessive descending speed is attained. The safety shall be operated by a centrifugal speed governor located at the top of hoist way and connected to the governor through a continuous steel rope. The governor shall be provided with ropes in proper tension. Even after ropes stretch, suitable means shall be applied to cut off power from motor and apply the brakes on applications of the safety.

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(d) Temper proof infrared rays sensing device shall be provided through out the height of door or upto 1.8m above sill as per OEM to ensure the door reopens till the obstruction exits in case obstruction comes while the door is closing.

1.22 COUNTER BALANCE

1.22.1 A suitable guided structural steel frame with appropriate CI weights shall be furnished to promote smooth and economical operation.

1.23 TERMINAL SWITCHES

1.23.1 Elevator shall be provided with proximity switches arranged to stop the car automatically within the limits of top car clearance and bottom run by over travel from any speed attained in normal operation. Such switches shall Act independently of the operating device, the ultimate or final limit switches and the buffers.

Proximity switches may be fitted in the elevator car or in the elevator well or in the machine room and such switches shall be brought in to operation by the movement of elevator car.

An automatic safety switch shall be provided to stop the machine should the chain, rope or other similar device mechanically connecting the stopping device to the car, fail.

1.24 ULTIMATE OR FINAL SWITCHES

1.24.1 Elevator shall be provided with ultimate or final switches arranged to stop the car automatically within the top and bottom clearance independently of the normal operating device and the terminal switches.

Final switches shall act to prevent movement of the elevator car under power in both directions of travel and shall after operating remains open until the elevator car has been moved by a hand winding to a position within the limits of normal travel.

All ultimate or final switches shall be of enclosed type and shall be securely mounted. The contacts of all switches shall be opened positively and mechanically by the movement of elevator car.

1.25 TERMINAL BUFFERS

1.25.1 Heavy-duty spring Buffers/ polyurethane rubber pads as per OEM to adhere the latest safety parameters shall be installed as a means of stopping the car and counter weight at the extreme limits of travel. Buffers in the pit shall be mounted on steel channels, which shall extend between both the car and counter weight guide rails. Oil buffer as per OEM standard is acceptable.

1.26 ELECTRICAL INSTALLATION REQUIREMENTS

1.26.1 IS: 4666 – 1980 amended up to date state the requirement for main switches and wiring with reference to relevant regulations and read in conjunction with clause-3.1 (i).

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1.27 ELECTRICAL WIRING AND WIRING FOR SIGNALS

1.27.1 Complete electric wiring shall be done in copper cable/ wires by the elevator supplier as per clause 7.1.2 of IS: 1860-1980 amended up to date and read in conjunction with clause-3.1 (i).

The wiring for signals, landing call buttons & indicators shall use serial communication technique to reduce the number of wires and read in conjunction with clause-3.1 (i)

1.28 TRAVELLING CABLE

1.28.1 Flat traveling cable shall be 16/20 core to give better running performance.

1.29 OVER LOAD WARNING

1.29.1 Over load warning feature with audiovisual indication shall be provided (Visual indication shall show "Over Loaded" and a buzzer shall also operate). Car shall not move until the overload condition is removed.

1.29.2 A load plate giving the rated load and permissible maximum number of passengers should be fitted in each lift car in a conspicuous position.

1.30 INTERCOM SYSTEM

1.30.1 Intercom suitable to hook to EPABX shall be provided inside the car for making emergency calls.

1.31 EMERGENCY RESCUE DEVICE:

1.31.1 AUTOMATIC EMERGENCY RESCUE DEVICE:

Elevator system shall have automatic battery operated emergency rescue device to automatically rescue passengers trapped in the elevator car in between floors in the event of power failure having following features:

Automatic operation and immediate actions in the event of mains failure capable to move the elevator to the nearest landing, opens the doors automatically. Shall have sealed maintenance free battery back up of suitable size with automatic charging unit and auto change over unit on mains failure. Message indicator in the elevator car.

1.32 MANUAL EMERGENCY RESCUE DEVICE

1.32.1 Manual emergency rescue device shall be provided to rescue the passengers trapped in the elevator car in the event of failure of battery operated automatic emergency rescue device. The elevator car stopped in between floors due to power failure shall be brought to the nearest landing by releasing the break by means of pulling the mechanical lever provided in the last landing. The standard constructional feature of OEM for this manual emergency rescue device is acceptable.

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1.33 OPERATION

1.33.1 The elevator shall be operated in simplex mode (with/ without attendant) and generally the elevator shall be in automatic mode. However a two position key- operated switch marked to indicate "ATT" (Attended Operation) and "AUTO" (Automatic Mode) shall be provided. When the switch is in the position of "ATT" mode, the elevator shall be in attendant mode. It will connect the hall button pushes to the annunciate, provided in the car, to register the calls. In automatic mode, momentary pressure of the car button/ landing button will send/ bring the car to this landing and car will automatically stop.

CHAPTER H -LIST OF APPROVED MAKES- CIVIL & PLUMBING SERVICES

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	Good quality locally available material 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 1st Quality
8	Bank internal ,bedroom and toilet doorframe Teak wood	Ghana teak wood 1st Quality
9	Bank internal ,bedroom and toilet doorframe water proof flush door with lamination two site	Century / Anchor / Archid / Green
10	Main Door heavy duty SS Ball Bearing Butt Hinges ,Brass Mortise Locks & Latches, SS Tower bolt, Handle & Stopper.	Hardware – Godrej / Ebco / Hettich

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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
12	UPVC frame for windows, Ventilator, glazing	Fenesta / Kommerling, with Saint Gobin glass
13	Water proofing material / compound.	Pidilite / Sika / DR. Fixit
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.

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ATER 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 FINOLEX	ASTRAL / ASHIRWAD / SUPREME /
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 FINOLEX	USING ASTRAL / ASHIRWAD / SUPREME /
PVC FITTINGS (MOULDED) FINOLEX	USING ASTRAL / ASHIRWAD / SUPREME /

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LIST OF APPROVD MAKES - FIRE SUPRESSION SYSTEM

A. 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

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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

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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 / Logitech
38	Cat-6 cable	D-Link/ Amp / Avaya / Belden / Krone Communication / Molex / Dax / Cisco
39	Data logging System	Delta / ABB / Schneider / Kaco Monitoring / SMA / Energy Recommerce / Refusol / Energy Tracking lic
40	Paints	ICI / Asian / Berger / Kansai Nerolac

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m	**APPROVED MAKES – ELEVATOR**
1	OTIS / SCHINDLER/ MITSUBISHI /KONE / JOHNSON

Note:-

1. The contractor will use one of the approved makes as approved by the Client / Engineer - in-charge.
2. In case of different quality / pattern of same make, the pattern/ quality shall be approved by the Client / Engineer – in – charge.
3. All the items included in the list or otherwise to be used in the work should conform to CPWD and relevant BIS specifications / relevant codes, as applicable.
4. If any item is missing in the above list, its make will be decided by the Client / Engineer – in-charge.
5. If any major equipment is using a small component of make other than that given as a standard component with the equipment, the same shall be accepted.

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