



# COCHIN PORT TRUST

Civil Engineering Department

E-Tender No. T15/T-1946/2021-C

## NOTICE INVITING REQUEST FOR PROPOSAL FOR

Construction of International and Domestic Cruise Terminal and  
Other Allied Facilities at Mormugao Port Trust, Goa through  
Engineering Procurement Construction (EPC) contract



## VOLUME-V TECHNICAL SPECIFICATIONS JUNE 2021

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## VOLUME –V

### COCHIN PORT TRUST

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## VOLUME – V

### COCHIN PORT TRUST

#### 1. TECHNICAL SPECIFICATIONS – CIVIL WORKS

##### 1. DETAILED SPECIFICATIONS FOR MATERIALS

Except where otherwise specified or authorized by the Engineer-in-Charge, materials supplied by the contractor shall conform to the latest edition of code of practices published by the Bureau of Indian Standard. Samples of materials to be supplied by the contractor shall be shown to the Engineer-in-Charge sufficiently in advance for approval of its quality for use on the work.

All the materials to be used on the works shall have **ISI certification** mark if so available, unless otherwise specified elsewhere or shall be of approved brand with equivalent material as approved by the Engineer-in-Charge. Wherever any brands are specified for the materials /products to be used on the work, its equivalent quality material shall also be used, with the approval of the Engineer in Charge.

All materials supplied shall be stored appropriately to prevent deterioration/ damage from any cause what so ever and to the entire satisfaction of the Engineer-in Charge.

The materials required for the work shall be brought to the site and stacked at places shown by the Engineer-in-Charge and the same shall be got approved for use in work sufficiently in advance so that the progress of the work is not affected by the supply of materials.

##### 1.1. AGGREGATES FOR CONCRETE

**1.1.1.** Aggregates (fine and coarse) for concrete shall comply with the requirements of I.S. 383 – ‘Specifications for coarse and fine aggregate from natural sources for concrete’. Aggregate shall be obtained from sources approved by the Engineer-in-Charge. Aggregates, which are not perfectly clean, shall be washed in clean water to the entire satisfaction of the Engineer-in-Charge.

**1.1.2.** The fine aggregate shall be clean, hard, durable, uncoated, dry and free from injurious, soft or flaky pieces and organic or other deleterious substances.

**1.1.3.** Each type of aggregate shall be stored separately for the approval of Engineer-in-Charge. Wet aggregate delivered at the site shall be kept in storage for at least 24 hours to ensure adequate drainage before being used for concreting.

**1.1.4.** Contractor shall maintain at site at all times such quantities of each type of aggregate as are considered by the Engineer-in-Charge to be sufficient to ensure continuity of work.

## **1.2. CEMENT**

- 1.2.1.** Quality of cement used for the work shall be 43 grade ordinary Portland cement conforming to I.S. 8112 or 53 grade ordinary Portland cement conforming to I.S. 12269 or Pozzolona cement conforming to I.S. 1489 unless otherwise approved by the Engineer-in-Charge.
- 1.2.2.** The cement required for the work will have to be procured by the contractor and shall comply with the relevant IS code. As far as possible, the cement required for the work will have to be procured from the reputed make. The cement shall, if required by the Chief Engineer / Engineer-in-Charge, be tested and analyzed by an independent analyst at the Contractor's cost and result produced to the Engineer-in-Charge.
- 1.2.3.** Supply of cement shall be taken in 50 kg bags bearing manufacture's name and ISI marking or in bulk with adequate compatible installed storage facility. Samples of cement arranged by the contractor shall be taken by the Engineer-in-Charge and got tested in accordance with provisions of relevant B.I.S codes. In case, test results indicate that the cement arranged by the Contractor does not conform to the relevant B.I.S codes, the same shall stand rejected and shall be removed from the site by the contractor at his own cost within a week's time of written order from the Engineer-in-Charge to do so.
- 1.2.4.** A cement godown of adequate capacity as directed by the Engineer-in-Charge shall be constructed by the contractors at the site of the work for which no extra payment shall be made. The contractor shall be responsible for the watch and ward and safety of the cement go down. The contractor shall facilitate the inspection of the cement go down by the Engineer-in-Charge.
- 1.2.5.** The cement shall be stored in a weather proof building with facilities for inspection.
- 1.2.6.** The contractor shall maintain a cement register showing dates of receipt and issue, quantities used daily and balance which shall be accessible to the Engineer-in-Charge.

## **1.3. STEEL REINFORCEMENT**

- 1.3.1.** The reinforcement steel to be used for the work shall be procured by the contractor and shall be Thermo-Mechanically Treated bars of grade Fe-500D or / Fe415 grade conforming to I.S. 1786 as specified in the relevant documents/drawings unless otherwise approved by Engineer-in-Charge.
- 1.3.2.** The contractor shall have to obtain and furnish Manufacturer's test certificates to the Engineer-in-Charge in respect of all supplies of steel brought by him to the site of work. Samples shall also be taken and got tested by the Engineer-in-Charge as per provisions in this regard in relevant BIS codes. In case the test results indicate that the steel arranged by the Contractor does not conform to BIS codes, the same shall stand rejected and shall be removed from the site of work by the Contractor at his cost within a week's time of written orders from the Engineer-in-Charge to do so.



- 1.3.3.** The steel reinforcement shall be brought to the site in bulk supply as directed by the Engineer-in-Charge.
- 1.3.4.** The steel reinforcement shall be stored by the contractor at site of work in such a way as to prevent distortion and corrosion and nothing extra shall be paid on this account. Bars of different sizes and lengths shall be stored separately to facilitate easy counting and checking.
- 1.3.5.** For checking nominal mass, tensile strength, bend test etc., specimen of sufficient length as per I.S. 432/ I.S. 1608/ I.S. 1599 or as specified by the Engineer-in-Charge shall be cut from each size of the bar at random at frequency not less than the specified below.

Size of bar	For consignment below 100 tonnes	For consignment over 100 tonnes
Under 10 mm dia	One sample for each 25 tonnes or part thereof	One sample for each 40 tonnes or part thereof
10 mm to 16 mm dia	One sample for each 35 tonnes or part thereof	One sample for each 45 tonnes or part thereof
Over 16 mm dia	One sample for each 45 tonnes or part thereof	One sample for each 50 tonnes or part thereof

- 1.3.6.** The contractor shall supply free of charge the steel required for testing. The cost of tests shall be borne by the Contractor.
- 1.3.7.** Steel brought to site and steel remaining unused shall not be removed from site without the written permission of the Engineer-in-Charge.

**1.4. WATER**

- 1.4.1.** Clean fresh water free from oils, acids, alkalies, salt, sugar, organic materials or other harmful materials shall be used for washing aggregates, mixing and curing of concrete. The water used shall comply with clause 5.4 of I.S. 456-2000. Potable water is generally considered good for mixing concrete.
- 1.4.2.** Water has to be arranged by the contractor himself for the construction works including curing work at his own risk and cost.
- 1.4.3.** Samples of water arranged by the contractor shall be taken by the Engineer in Charge and got tested in accordance with the provisions of relevant BIS codes. In case test results indicate that the water arranged by the contractor does not conform to the relevant BIS codes, the same shall not be used for any works. The cost of tests shall be borne by the contractor.
- 1.4.4.** Wherever water is to be stored for construction purposes this shall be done in proper storage tanks to prevent any organic impurities getting mixed up with it.

## 1.5. ADMIXTURES IN CONCRETE

1.5.1. Admixture in concrete will be allowed only with prior approval of the Engineer-in-Charge. The contractor shall produce test certificates from recognized laboratories before use, if so desired by the Engineer-in-Charge.

## 1.6. WATER PROOFING COMPOUND

1.6.1. Water proofing compound shall be used for cement mortar for plastering or concrete work.

1.6.2. Integral cement water proofing compound conforming to IS 2645 and of approved brand and manufacture, enlisted by the Engineer-in-Charge from time to time shall be used.

1.6.3. The contractor shall bring the materials to the site in their original packing. The containers will be opened and the material mixed with dry cement in the proportion by weight, recommended by the manufacturers or as specifically described in the description of the item. Care shall be taken in mixing, to see that the water proofing material gets well and integrally mixed with the cement and does not run out separately when water is added.

1.6.4. The waterproofing material should at least satisfy following performance requirement as per the mentioned test standard/equivalent standard.

Properties	Test Method	Values
Hardness (Shore A)	ASTM D 2240 : 2002	80
Tensile Strength, N/mm <sup>2</sup>	ASTM D 412 : 2002	>1.2
Elongation at Break, %	ASTM D 412 : 2002	> 80
UV Resistant – Accelerated Weathering (2000 hours)	ASTM G 154 : 2000	No thermal degradation
Adhesion Strength, N/mm <sup>2</sup>	ASTM D 4541 : 2002	>1
Water Vapour Transmission, gm/m <sup>2</sup> /day	ASTM E 96 : 2000	15
Algae & Fungus Resistant	SS 345 : 1998	No algae & fungus growth
Crack Bridging	ASTM C 836 : 1995	Up to 2 mm width

## **1.7. SAND FOR MAKING MORTAR FOR MASONRY WORK / PLASTERING WORK**

**1.7.1.** Sand used for masonry mortar shall conform to IS: 2116. Sand used for plastering shall conform to IS: 1542.

## **1.8. 6MM SIZE AGGREGATE**

**1.8.1.** 6mm size graded aggregate conforming to IS 383 shall be used and which are not perfectly clean shall be washed in clean water to the entire satisfaction of the Engineer-in-Charge.

## **1.9. QUARRY DUST**

**1.9.1.** Quarry dust shall be crusher-run-screening with grading having 100 % passing through 2.36 mm sieve and 10 to 20 % by weight passing through 75 micron sieve. The same shall be cleaned, hard, durable, uncoated, dry, free from injurious soft or flaky piece and organic or other deleterious substances.

## **1.10. RUBBLE FOR MASONRY**

**1.10.1.** The stones used for masonry work shall be without round faces, sound and uniform in colour and of approved quality. The faces and sides of stone shall be hammer dressed.

## **1.11. BRICKS**

**1.11.1.** Brick for all brick work shall conform to common burnt building bricks (IS 1077) unless otherwise specified and to be wire cut. Bricks shall suit the required wall thickness and shall conform to IS : 1077 and shall have a minimum compressive strength of 35 kg/cm<sup>2</sup> and shall not absorb water more than 20% of its dry weight, when soaked in cold water for 24 hours. The tolerance limit shall be 6% for absorption.

**1.1.1.** In case where locally available bricks do not meet the standards, contractor shall carry out all the tests specified as above in IS : 1077 on the bricks and submit the test report to the Engineer-in-Charge, who will take a final decision on the use of the bricks which shall be binding.

## **1.12. CEMENT CONCRETE INTERLOCKING PAVER BLOCKS**

**1.12.1.** The paver blocks shall be 80mm thick of high density cement concrete interlocking blocks of not lower than M40 grade as per IS: 15658-2006. The paver blocks shall be factory made with strong vibratory compaction, of approved size, design, shape, colour and pattern.

## **1.13. CEMENT CONCRETE KERB STONE**

**1.13.1.** The cement concrete kerb stone shall be factory made, of not lower than M25 grade and of size 400 x 300 x 150mm or as specified elsewhere. However, the length and shape of stones to be provided at junctions, curves etc. shall be suitably modified to fit

into the general configuration. The finished stones shall be cured properly for a minimum period of 14 days.

#### **1.14. ALUMINIUM SECTIONS FOR WINDOWS AND PARTITIONS**

- 1.14.1.** Aluminium sections used for windows, Partitions, frame work etc. shall be suitable for use to meet architectural designs to relevant works and shall be subject to approval of the Engineer-in-Charge for technical, structural, functional and visual considerations. The aluminium extruded sections shall conform to IS 733 and IS 1285 for chemical composition and mechanical properties. The stainless steel screws shall be of grade AISI 304. The permissible dimensional tolerances of the extruded sections shall be as per IS 6477 and shall be such as not to impair the proper and smooth functioning/operation and appearance of doors and windows.
- 1.14.2.** Aluminium glazed windows shall be of sizes as shown in the drawings. The details shown in the drawings may be varied slightly to suit the standards adopted by the manufacturers of the aluminium work, with the approval of Engineer-in-Charge. Before proceeding with any fabrication work, the contractor shall prepare and submit, complete fabrication and installation drawings for each type of glazing windows and partition etc. for the approval of the Engineer-in-Charge. If the sections are varied, the contractor shall obtain prior approval of Engineer-in-Charge and nothing extra shall be paid on this account.
- 1.14.3.** The anodizing shall be of minimum 15 microns thickness.
- 1.14.4.** Powder coating of aluminium sections shall conform to IS 13871. The powder used for powder coating of aluminium sections shall be Epoxy/polyester powder of make approved by the Engineer-in-Charge. The contractor shall give detailed programme for powder coating in advance, to facilitate the inspection by Engineer-in-Charge or his authorized representative. Minimum thickness of powder coating for powder coated aluminium shall be 50 micron.

#### **1.15. ALUMINIUM WINDOW AND VENTILATOR SHUTTERS**

- 1.15.1.** Material, fabrication and dimensions of aluminum windows and ventilators manufactured from extruded aluminum alloy sections of standard sizes and designs complete with fittings, ready for being fixed into the building shall be as per IS 1948.
- 1.15.2.** The permissible dimensional tolerances of the sizes for window frame and frame works shall not vary by more than  $\pm 1.5$  mm.
- 1.15.3.** Aluminum alloy extruded sections used in the manufacture of extruded window sections shall conform to IS 733. Hollow aluminum alloy sections used shall conform to IS 1285
- 1.15.4.** Screws, threads of machine screws used in the fabrication of aluminum doors, windows and ventilators shall conform to IS 1362

## **1.16. EPDM- GASKETS**

**1.16.1.** The EPDM Gaskets are to render the glazing windows, ventilators etc. air and water tight. Samples of gaskets shall be submitted for approval and the EPDM gasket approved by Engineer-in-Charge shall only be used. The contractor shall submit documentary proof of using the above material in the work to the entire satisfaction of Engineer-in-Charge.

## **1.17. SEALANT**

**1.17.1.** The sealants of approved grade and colour shall only be used. The silicone for perimeter joints (between Aluminum section and masonry) shall be of make approved by the Engineer in Charge.

## **1.18. STRUCTURAL STEEL**

**1.18.1.** The mild steel flats / plates used for the work shall conform to I.S. 2062. The material shall be free from visible as well as hidden defects such as pitting cracks, laminations, twists etc. and excessive rusting.

## **1.19. STAINLESS STEEL TUBES, PLATES**

**1.19.1.** The stainless steel tubes, channels, plates etc. to be used for hand railing for stair and escalator and grab bars for toilets for differently abled shall be of grade 304 with wall thickness not less than 2mm. The stainless steel sections shall be of hairline finish.

## **1.20. VITRIFIED TILES FOR FLOORING / SKIRTING**

**1.20.1.** Vitrified Tiles shall be of approved premium quality, make and of approved colour and shade. The tiles shall be generally conforming to IS:15622 with water absorption less than 0.08% and having modulus of rupture greater than 500kg/sq.cm & modulus hardness 8.0. The tiles shall be flat, true to shape and free from cracks, crazing spots, clipped edged and corners. The tiles shall be of 800x800 mm or nearest available higher size with thickness not less than 12mm / 8mm for flooring / skirting tiles

**1.20.2.** The top surface of the tiles shall be glossy/ matt finish/ antiskid as approved by the Engineer-in-Charge. The underside of the tiles shall be completely free from glazing in order to adhere properly to the base.

**1.20.3.** Manufacturer's test Certificate for water absorption, breaking strength, abrasion resistance and crazing has to be produced by the contractor.

## **1.21. ANTI-SKID VITRIFIED TILES FOR FLOORING**

**1.21.1.** Vitrified tiles shall be of approved premium quality, make and of approved colour and shade. The tiles shall generally conform to IS 15622. They shall be flat, true to shape and free from cracks, crazing spots, clipped edged and corners. The tiles should have good anti-slip property and high scratch resistance. The flooring tiles shall be of 320mm x 320mm size or nearest available higher size with thickness not less than 10mm.

**1.21.2.** Manufacturer's test Certificate for water absorption, breaking strength, abrasion resistance and crazing has to be produced by the contractor.

## **1.22. CERAMIC GLAZED TILES FOR DADOING**

**1.22.1.** Ceramic tiles shall be of approved premium quality, make, luster printed and of approved colour and shade. The tiles shall generally conform to IS: 15622 and shall be conforming to Group B III or higher quality. They shall be flat, true to shape and free from cracks, crazing spots, clipped edged and corners. The glazing shall be of uniform shade. The wall tiles shall be of glazed type tiles and shall be of 300mm x 300mm size or nearest available higher size with thickness not less than 8mm.

**1.22.2.** The top surface of the tiles shall be glossy as approved by the Engineer-in-Charge. The underside of the tiles shall be completely free from glazing in order to adhere properly to the base.

**1.22.3.** Manufacturer's test Certificate for water absorption, breaking strength, abrasion resistance and crazing has to be produced by the contractor.

## **1.23. GRANITE SLAB FOR FLOORING**

**1.23.1.** Granite slabs shall be of approved best quality, approved colour, shade, make and pattern and mirror polished and generally confirm to relevant BIS specification. The surface shall be even without any veins, cracks or flaws. The slabs shall be of selected quality, hard, sound, dense, homogeneous in texture, free from cracks, decay, weathering and flakes. The sample of granite slab shall be got approved from the Engineer-in- Charge before use on the work. The slabs shall be machine cut to the requisite dimension. The size of slab shall be such that minimum joints shall be provided in longitudinal and transverse directions. The thickness of the slab shall not be less than 18mm.

## **1.24. MARBLE SLAB FOR FLOORING**

**1.24.1.** The Marble should be Italian Marble stone slab, Perlato, Rosso verona, Fire Red or Dark Emperadore etc. and free from all imperfections and injurious minerals that may interfere with appearance, strength, structural integrity and it's amenability to take good police. The colour /shade of the Marble shall be as specified in the relevant documents or as instructed by the Engineer-in-Charge. The thickness shall not be less than 18 mm.

## **1.25. GYPSUM BOARD**

**1.25.1.** Gypsum Board (Glass Fibre Reinforced Board) or equivalent conforming to IS - 2095 - 1996 and 2542-1981 shall be used. Technical detailing for fixing Gypsum Board along with jointing compound, paper tape, primer, screws, edge bead, angle bead etc. shall be as per manufacturers specification. Proper care is to be taken while handling, storing and cutting the Gypsum-board as per manufacturer's manual and the work shall be done in technical co-ordination /assistance with the trained staff of manufacturer, such services being offered free by them.

**1.26. ACRYLIC EMULSION PAINT EXTERIOR**

**1.26.1.** The weather proof exterior acrylic emulsion paint shall be of approved premium quality either “Weather coat” by Berger or Nerolac Excel or “Weather shield” by ICI Dulux or Snowcryn XT-premium by Snowcem India Ltd or equivalent. The coverage shall conform to the manufacture’s specification. The colour/shade shall be as per direction of the Engineer-in-Charge.

**1.27. CONCERTINA COIL FENCING**

**1.27.1.** Concertina coil shall be diameter 600 mm, 10m openable length (having 15 nos. round per 6 m length), spring core (2.5 mm thick) wire of high tensile strength of 165 kg./sq.mm with tape (0.52 mm thick) and weight 43.478 gm/metre.

**1.28. LATERITE GRAVEL FOR FILLING**

Laterite gravel shall be of best quality composed of large coarse siliceous grains, sharp and gritty to touch and shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of filling. The gravel shall be obtained from borrow areas approved by the Engineer-in-Charge.

**1.29. MATERIALS FOR GRANULAR SUB-BASE**

**1.29.1.** The material to be used for the work shall be natural sand, moorum, gravel, crushed stone/concrete, or combination thereof depending upon the grading required. The materials shall be free from organic or other deleterious constituents and conforming to grading 1 shown in table 400.1 MORT&H specification for Road and Bridge works. The materials shall have a 10 per cent fines value of 50 KN or (for sample in soaked condition) when tested in compliance with BS: 812 (Part 111). The water absorption value of the coarse aggregate shall be determined as per IS:2386 (Part 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 : 383.

**1.29.2.** Grading requirements : The aggregates shall conform to the grading given in the following Table:

**TABLE 1**

**(Table 400.1 of MORT&H ‘specification)**

Grading Requirements of aggregates for Close graded granular sub base

IS Sieve Designation	Percent by weight passing the IS sieve Grading 1
----------------------	--

75.00mm	100
53.00mm	80-100
26.50mm	55-90
9.50mm	35-65
4.75mm	25-55
2.36mm	20-40
0.425mm	10-15
0.075mm	3-10
CBR value	30

### 1.30. MATERIALS FOR WET MIX MACADAM

**1.30.1.** Aggregates: Coarse aggregate shall be crushed stone.

The aggregates shall conform to the physical requirements set forth in Table 400.12 of MORT&H's Specification for Road and Bridge works.

**1.30.2.** Grading requirements: The aggregates shall conform to the grading given in the following Table 2:

**TABLE 2**

**( Table 400.13 of MORT&H 'specification)**

Grading Requirements of aggregates for Wet Mix Macadam

IS Sieve Designation	Percent by weight passing the IS sieve
53.00mm	100
45.00mm	95-100
26.50mm	-
22.40mm	60-80
11.20mm	40-60
4.75mm	25-40
2.36mm	15-30
0.600mm	8-22
0.750mm	0-5

Materials finer than 425 micron shall have Plasticity Index (PI) not exceeding 6.

The final gradation approved within these limits shall be well graded from coarse to fine and shall not vary from the low limit on one sieve to the high limit on the adjacent sieve



or vice versa.

### **1.31. FIBRE GLASS REINFORCED PLASTIC (F.R.P.) DOOR**

- 1.31.1.** The FRP door frames shall be of cross-section 90 mm x 45 mm having single rebate of 32 mm x 15 mm to receive shutter of 30 mm thickness .The laminate shall be moulded with fire resistant grade unsaturated polyester resin and chopped mat . Door frame laminate shall be 2 mm thick and shall be filled with suitable wooden block in all the three legs. The frame shall be covered with fiber glass from all sides. M.S. stay shall be provided at the bottom to steady the frame.
- 1.31.2.** FRP door shall be manufactured as per specifications laid down in IS 14856, nomenclature of items & direction of Engineer-in-Charge.
- 1.31.3.** Tolerance of size of frame to be + 2 mm and on size of rebate shall be + 1 mm.
- 1.31.4.** The surface of the moulded frame shall be free from any visible defects such as small pores, crazing, blistering, wrinkling, impurities, defective impregnation, colour blots and aggregate defects, as mentioned in IS 14856. Scattered pin holes duly repaired and finished by applying resin and not noticeable shall be acceptable. Frame laminate shall be flat and shall have smooth and level surface. Laminate shall be finished in colour & shade as approved by Engineer-in-Charge.
- 1.31.5.** F.R.P. Shutters shall be manufactured conforming to the specifications as per IS 14856 and nomenclature of item & direction of Engineer-in-Charge.
- 1.31.6.** Blocks of any seasoned hardwood of bulk density not less than 450 kg./m<sup>3</sup> at 12 percent moisture content or any other material of sufficient thickness and length shall be provided inside the shutter at suitable place to hold fittings and fixtures such as aldrops, tower bolt, handle, sliding door bolt, mortice lock etc. Blocks for hinges shall be provided at three locations, unless otherwise specified by the purchaser. One at the centre and other two at 200 mm from the top and the bottom of the shutter. Blocks shall be provided at predetermined places in the shutter so as to fix hinges mortice locks, tower bolts, aldrops, door closures, etc. The finished surface shall be buffed and polished with wax.

### **1.32. MATERIALS NOT SPECIFIED**

- 1.32.1.** All materials not herein detailed and fully specified but which may be required for use on works, shall be subjected to the approval of the Engineer-in-Charge without which they shall not be used anywhere in the permanent works

### **1.33. SAMPLING AND TESTING OF MATERIALS**

- 1.33.1.** Sampling and testing of the material supplied by the contractor for use on the work shall be done as per the provisions of the relevant BIS codes/specifications. In the absence of BIS specification in a particular case, the sampling and testing shall be done as directed by the Engineer-in-Charge as sound engineering practice. Material conforming

to the specifications and approved by the Engineer-in-Charge shall only be used by the contractor.

**1.33.2.** All the sampling and testing shall be done at the contractor's cost.

## **2. DETAILED SPECIFICATIONS OF ITEMS OF WORKS**

Except where otherwise specified or authorised by the Engineer-in-Charge all items of works executed by the Contractor must conform to the latest edition of the Bureau of Indian Standard (BIS) Specifications, I.R.C., MORT&H's specifications and Code of practices published by BIS. Where no such specifications or code of practice exists the latest BSS codes of practice shall also be considered for adoption. The tenderer while indicating such specifications shall practice exists the latest BSS codes of practice shall also be considered for enclose the full set of the publication so referred and not in extracts. Photostat / Xerox copies in duplicate shall be forwarded which shall not be returned to the Contractor. In absence of any specification the department reserves the right to adopt trade specifications and /or sound engineering practices for the specialised work as may be decided by the Engineer-in-Charge which shall be final, conclusive and binding on the contractor.

Detailed specifications of items of works are described below.

### **2.1. DISMANTLING WORKS – GENERAL**

- 2.1.1.** The Bidders shall inspect the site and carry out the required investigation by himself about the present position and condition of the existing structures and assess the difficulties and the work involved in its dismantling and removal. It will be deemed that the Bidder has inspected the site and satisfied himself the condition of the structure and the nature of the work involved for the dismantling and removal and that the tenderer has estimated its cost accordingly and port will be in no way responsible for the lack of such knowledge and also consequences thereof to the tenderer. The dismantling shall be done carefully without causing any damage to the remaining / adjacent portions / structures.
- 2.1.2.** The details of dismantling works and special conditions thereof are attached as **Appendix-I.**
- 2.1.3.** The demolished material shall be crushed for re-use as road subgrade after retrieving the reinforcement and disposing off the unusable waste materials. The crushed material shall meet the codal requirements relating to usage of material for that specific purpose.
- 2.1.4.** All unused material shall be removed from site in a progressive manner either by use of a weekly emptied dump hopper or similar removal arrangement. The sellable wastes including the retrieved steel reinforcement bars/steel materials shall be sold only to authorized vendors. The Site and surrounds shall be kept tidy at all times.

- 2.1.5.** Trees, shrubs, any other plants, pole lines, fences, signs, monuments, buildings, pipelines, sewers and all other existing facilities within or adjacent to the project land which are not to be disturbed shall be protected from injury or damage. The Contractor shall provide and install at his own expense, suitable safeguards approved by the Employer for this purpose.
- 2.1.6.** During dismantling / demolishing and clearing, the Contractor shall take all adequate precautions against water pollution etc., and where required, undertake additional works to that effect in accordance with the general requirements of these specifications and to the satisfaction of the Employer. Before start of operations, the Contractor shall submit to the Employer for approval, his work plan including the procedure to be followed for disposal of waste materials etc., and the schedules for carrying out temporary and permanent erosion control works in accordance with the requirements of the Contract.
- 2.1.7.** The debris shall be cleared on completing each day's work, if so directed by the Engineer-in-Charge.

## **2.2. EARTH WORK EXCAVATION AND FILLING**

- 2.2.1.** Contractor shall be responsible for the true and proper setting out of the work in relation to original points, lines and levels of reference and for corrections of the level dimension and alignment of all parts of work.
- 2.2.2.** Earth work in excavation in all type of earths shall be done by mechanical means using Hydraulic excavator and or manual means in foundation, trenches, yard or drains including dressing of sides and ramming of bottoms, lifting the excavated earth, including getting out the excavated soil and disposal of surplus excavated soil as directed to the designated dumping ground or away from the Project Site as per local Municipality norms /regulation
- 2.2.3.** All excavations shall be carried out to give exact length, width and depth as per profiles indicated in the drawings or as directed by the Engineer-in-Charge. The phasing and method of excavation shall be to the approval of Engineer-in-Charge. The contractor shall provide suitable arrangements to prevent water from any source entering into excavated pits at his cost.
- 2.2.4.** Necessary shoring and timbering shall be provided as per IS:3764 for preventing slipping of the soil in trenches and for protecting the safety and stability of the existing structures. Dewatering, if required shall also be carried out to keep the excavated surface dry for construction..Excavation taken wider or deeper than required shall be filled back with earth or selected materials approved by the Engineer-in-Charge, thoroughly compacted in layers of thickness not more than 20 cm or as decided by the Engineer-in-Charge.
- 2.2.5.** In case of filling work, the Contractor has to bring good earth from source approved by Engineer-in-Charge including paying applicable royalty by mechanical transport/Dumper

filling as per drawing including ramming and watering of the earth in layers not exceeding 20 cm in trenches, plinth, sides of foundation etc. complete as per provision of IS: 3764.

### **2.3. FILLING WITH LATERITE GRAVEL**

Laterite gravel used for filling shall be of best quality composed of large coarse siliceous grains, sharp and gritty to the touch and shall be free of logs, stumps, roots, rubbish or any other ingredient likely to deteriorate or affect the stability of filling. The gravel shall be obtained from borrow areas approved by the Engineer-in-Charge.

The contractor shall, at his own cost, make arrangements to assess the work area. No claims shall be admissible on account of longer leads or due to any reason whatsoever.

Contractor shall carry out filling work in the area by dumping the laterite gravel/red earth directly from the lorries and it shall be done in 30cm layers in loose thickness. The top surface of the each layer shall be leveled and compacted using two passes of 8/10 Tonne road roller as per the directions of the Engineer-in-Charge. The final level to be achieved shall be as per the instructions of Engineer-in-Charge. The variation in the final level shall not be more than plus or minus 50mm.

Organic matter of any kind shall be removed and disposed off as directed by the Engineer-in- Charge.

Filling shall be finished in conformity with the alignment and levels as shown in the drawing and as directed by the Engineer- in-Charge.

### **2.4. POST CONSTRUCTIONAL ANTI-TERMITE TREATMENT**

Treatment of soil under existing or newly constructed floors, footing etc. or wherever required to form effective chemical barrier between foundation /slab and super structure /masonry wall that will prevent the insects to approach the building, shall be done using chemical emulsion @ one litre per hole; holes being 300 mm apart, including drilling 12 mm diameter holes and plugging with cement mortar 1 :2 (1 cement : 2 Coarse sand) to match the existing floor, with Chlorpyriphos EC (IS 8944 ) 20% or Lindane E.C.(IS 632) 20% with 1% concentration as per provisions of IS 6313 (Part 3) including taking all safety precautions during diluting and injecting/ application.

### **2.5. PLAIN AND REINFORCED CEMENT CONCRETE**

#### **2.5.1. General**

The concrete used for all works, concreting procedure etc. shall be in accordance with I.S. 456–2000.

#### **2.5.2. Concrete Mix**

Mix used for R.C.C. shall be of minimum M25 grade unless otherwise specified. Design mix shall be used for M25 and higher grade of concrete unless otherwise specified in the schedule.

### 2.5.3. Nominal Mix

For nominal mix concrete, proportion of fine aggregate to coarse aggregate shall be 1:2 by volume. The minimum cement content per cubic metre of nominal mix concrete shall be as PER Table 5 of IS: 456 -2000.

### 2.5.4. Design Mix

2.5.4.1. For design mix concrete of following grades of concrete the minimum cement content per cubic metre and maximum water cement ratio are as given below.

Sl. No	Grade of Concrete	Minimum cement content in Kg / m <sup>3</sup>	Maximum free Water cement ratio
1	M25	300	0.50
2.	M30	340	0.50
3	M40	400	0.50

2.5.4.2. For design mix concrete, the contractor shall make calculations jointly with Engineer-in-Charge and carryout all necessary tests at contractor's cost to determine the proportion by weight of cement, aggregates (coarse and fine), admixture if required and water necessary to produce concrete of required grade having the desired workability and, water cement ratio not exceeding the allowable limit, prior to commencement of work. The contractor shall submit the following for the approval of Engineer-in-Charge.

- i) The proportion of cement, coarse aggregate, fine aggregate and water so determined.
- ii) The sieve analysis of aggregates which he proposes to use in the works.
- iii) Full details of the tests conducted.
- iv) All calculations relevant to mix design.

2.5.4.3. When the proportions are submitted to the Engineer-in-Charge which he considers will produce concrete having the required properties, it shall become the declared proportions to be used for the work. The agreement by the Engineer-in-Charge to such declared proportions shall not relieve the contractor of any of his responsibilities to use in the work at all times concrete having the required properties. No deviation from the declared proportions shall be allowed unless and until the Engineer-in-Charge shall have given his written authorisation for the adoption of revised proportions for the concrete.

**2.5.4.4.** Sampling, testing and acceptance criteria for designed mix concrete shall be as per clause 15, 16 & 17 of I.S. 456 - 2000 unless otherwise specified. Sampling and testing shall be done at contractor's own cost. Testing shall be done in a laboratory approved by the Engineer-in-Charge.

#### **2.5.5. Size of Coarse Aggregate**

For all concrete, plain or reinforced of M20 and higher grades, 20 mm size graded aggregate conforming to I.S. 383 shall be used unless otherwise specified. If 20 mm graded aggregates as per I.S. 383 are not readily available, graded 20 mm aggregate shall be obtained by blending 20 mm and 12.5/ 10 mm aggregates in the proportion arrived based on the combined sieving of aggregates.

#### **2.5.6. Batching and Mixing**

**2.5.6.1.** For production of concrete, concrete batching and mixing plant, with type and capacity approved by the Engineer-in-Charge shall be installed at site by the contractor. The plant shall be approved by the Engineer-in-Charge and shall be installed at an approved location. All measuring equipments should be maintained in a clean serviceable condition, and their accuracy shall be periodically checked as directed by the Engineer-in-Charge.

**2.5.6.2.** In proportioning concrete, the quantity of both cement and aggregate should be determined by weight. Where the weight of cement is determined on the basis of weight of cement per bag, a reasonable number of bags should be weighed periodically to check the net weight. Where the cement is weighed on the site and not in bags it should be weighed separately from the aggregates. Water should be either measured by volume in calibrated tanks or weighed. Any solid admixture that may be added, may be measured by weight; liquid and paste admixture by volume or weight.

**2.5.6.3.** Except where it can be shown to the satisfaction of the Engineer that supply of properly graded aggregate of uniform quality can be maintained over the period of work, the grading of aggregate should be controlled by obtaining the coarse aggregate in different sizes and blending them in the right proportion when required, different sizes being stacked in separate stock piles. The grading of coarse and fine aggregate should be checked frequently for a given job being determined by the Engineer-in-Charge to ensure that the specified grading is maintained.

**2.5.6.4.** Under unavoidable circumstances, change from weigh batching to volume batching may be permitted by Engineer-in-Charge, on specific request from the contractor.

**2.5.6.5.** Ready mix concrete from out side source shall be allowed for use on the work subject to the conditions that: (i) written permission shall be obtained from the Engineer-in-Charge, (ii) all quality control measures as stipulated by the Engineer-in-Charge are strictly adhered to by the contractor at his cost, (iii) all design mix calculations as per Clause 2.4.4.4. of tender document shall be submitted by the contractor for approval of

the Engineer-in-Charge & approval obtained; and (iv) all expenses towards conveyance and incidentals of providing departmental supervision at the mixing plant shall be borne by the contractor.

#### **2.5.7. Assembly of reinforcement for Reinforced Cement Concrete.**

- 2.5.7.1.** The steel bars used for reinforcement works shall be HYSD bars, (Grade Fe 500 / Fe 415) or both, conforming to IS : 1786 - Specification for High strength deformed steel bars for concrete reinforcement.. All reinforcement shall be Thermo-Mechanically Treated bars of grade Fe-500D or more unless otherwise mentioned.
- 2.5.7.2.** The workmanship for bending & fixing of bars shall conform to IS:2502: The workmanship shall also satisfy the requirement of Code of practice IS:2751 for laying and finishing in-situ concrete work. The work includes straightening, cutting, bending, placing in position and binding as per relevant codes as specified or directed by Engineer-in-Charge..
- 2.5.7.3.** The contractor shall, when ordered, submit to the Engineer-in-Charge the detailed bar bending schedule for his scrutiny and approval sufficiently in advance (about four weeks) of the due date of commencement of the relevant items of works. While working out the bar bending schedule, the contractor shall ascertain the length of bars likely to be made available to him and the schedule shall be so made, keeping the wastage/ cut bits of bars to bare minimum without hampering technical requirements. If the size of the steel bars specified in the drawing or schedule is not available, the nearest size available shall be used. Revised drawing shall be issued to the contractor substituting the new size of reinforcement and bar bending schedule shall be prepared by the contractor accordingly. No extra payment shall be made to the contractor for making this substitution. The fabrication of reinforcement shall commence only after the bar bending schedule is approved by the Engineer-in-Charge.
- 2.5.7.4.** Reinforcement shall be cut to the exact length and made truly straight and then bent to the exact shape and dimensions as indicated in the drawings. The bending and fixing of bars shall be done in accordance with IS:2502 unless otherwise specified.
- 2.5.7.5.** All cut bits of steel are the property of the contractor. However, the contractor can dispose them off only with the permission in writing of the Engineer-in-Charge. If the department requires the cut lengths, they are to be handed over to the department and will be paid for at the rates at which they were purchased by the contractor.
- 2.5.7.6.** The reinforcement shall be cleaned by wire brush etc. to remove oil, grease, loose mill scale, loose rust or other deleterious matter that may reduce or destroy bond etc. before tying in position and also immediately before placing the concrete.
- 2.5.7.7.** All reinforcement shall be placed and maintained in accordance with the drawings. Tolerance on placing of reinforcement shall be in accordance with clause 12.3 of

IS:456-2000. Bolts, nuts, washers and rivets etc. required for complete erection of reinforcement and keeping in position shall be supplied by the contractor at his own cost.

### **2.5.8. Form work**

**2.5.8.1.** The steel/ marine plywood formwork shall be used for concrete work. However for precast units, steel form work shall only be used. The form work shall be designed and constructed to the shape, lines and dimensions shown in the drawings within the tolerance limit and specified in clause 11.1 of IS:456-2000. Joints of the form works shall be made water tight by providing suitable beadings /gasket as approved by the Engineer-in-Charge. All rubbish, particularly chippings, shall be removed from the interior of the forms before the concrete is placed and the form work in contact with the concrete shall be cleaned and thoroughly wetted or treated with an approved composition. Care shall be taken that such approved composition is kept out of contact with the reinforcement.

**2.5.8.2.** Before reuse, all forms shall be thoroughly scraped, cleaned, nails removed, holes that may leak suitably plugged and joints examined and when necessary, repaired and the inside retreated to prevent adhesion, to the satisfaction of Engineer. Warped timber shall be resized. Contractor shall equip himself with enough shuttering material to complete the job in the stipulated time.

### **2.5.9. Cover to Reinforcement**

**2.5.9.1.** Cover as specified in drawing shall be provided by using precast cement concrete block made from concrete of same grade as that of main work unless otherwise directed by the Engineer-in-Charge.

### **2.5.10. Transporting, placing, compacting and curing of concrete**

**2.5.10.1.** Transporting, placing, compacting and curing of concrete shall be as per clause 13 of IS:456-2000.

**2.5.10.2.** Concrete shall be transported from the mixer to the worksite as rapidly as possible which will prevent the segregation or loss of any ingredient, and for maintaining the workability.

**2.5.10.3.** The concrete shall be placed and compacted before setting commences and should not be subsequently disturbed. Care should be taken to avoid displacement of reinforcement or movement of formwork.

**2.5.10.4.** All concrete shall be vibrated unless otherwise specified or approved by the Engineer-in-Charge and such vibrating shall be as required by the Engineer- in-Charge. The mechanical vibrators complying with IS:2505, IS:2506 or IS:4656 shall be used for compacting concrete. All vibrations shall be carried out to a plan approved by the



Engineer-in-Charge. No workman shall be allowed to operate the vibrator without having received instructions and training in its use. Care must be taken to avoid segregation and excessive vibration.

**2.5.10.5.** Concreting shall be carried out continuously upto construction joints, the positions and arrangement of which shall be as directed by the Engineer-in-Charge. When the work has to be resumed the construction joints shall be prepared in accordance with clause 13.4 of IS:456-2000.

**2.5.10.6.** Unless otherwise specified, all concrete shall be kept continuously in a damp condition by ponding or by covering with a layer of sacking, canvas, hessian or similar materials with fresh water for not less than 7 days after laying the concrete. If curing is not done properly the department will be at liberty to engage labour for curing and the expenditure incurred will be recovered from the contractor's bill. The decision of the Engineer-in-Charge will be final on this.

**2.5.10.7.** Stripping time for the form work shall be as stipulated in clause 11.3 of IS:456-2000. Any impression, fins etc. that may occur from the form work shall be removed and treated with cement mortar 1:1.5 (1 cement: 1.5 sand).

**2.5.10.8.** Contractor shall arrange to fix any fixtures wherever necessary while doing concreting work without any extra cost. Cost of fixtures will be paid separately, if it is provided by the contractor.

## **2.6. BONDING COATING FOR OLD AND NEW CONCRETE**

Structural grade long open time, a two component, solvent less epoxy resin based bonding agent shall be provided and applied for bonding old concrete to new concrete. The bonding agent shall exhibit minimum open time of 6 hours and shall exceed the tensile strength of concrete in terms of its adhesive bond strength. This epoxy system on mixing shall yield an adhesive for internal or external bonding of renderings, granolithic toppings, and new concrete to old concrete. It shall be formulated to meet the requirement of ASTM C881 Type 2 (for bonding freshly placed concrete and old existing concrete), Grade 2 (Medium Viscosity), at an ambient temperature as per Class B & C of the Code. All the tools, plant, labour, materials including necessary scaffolding, etc. if required for successful completion of the work has to be arranged by the Contractor.

## **2.7. EPOXY ANCHORING**

Holes shall be drilled in concrete as specified in the relevant documents for proper anchoring. Thereafter, two component thixotropic, pure epoxy resin based chemical anchoring mortar is to be provided/supplied and applied in areas where heavy loads under critical conditions are to be fixed in concrete, as mentioned in the relevant documents and as directed by the Engineer-in-Charge. Both components of Masterflow 935 or equivalent, packed in a single cartridge with separate compartments, are correctly

mixed in the mixing nozzle during application. The product should be styrene free formulation and shall have very low shrinkage, even on big diameters.

## **2.8. EPOXY PROTECTIVE COATING OF REINFORCEMENT.**

Applying fusion bonded epoxy to reinforcing bars as per IS:13620-1993 specification for a thickness of 175 + microns including testing of coating at plant, extra cost for careful handling using PVC coated binding wires instead of G.I. wires, touching up the material supplied, repair work etc. complete as per detailed specifications of MORT&H -section 1600 and as directed by the Engineer-in-Charge.

## **2.9. BRICK MASONRY**

**2.9.1.** Brick for all brick work shall conform to common burnt building bricks (IS 1077) unless otherwise specified and to be wire cut.

**2.9.2.** The brick work shall have to be carried out in cement mortar as specified but not less 1:4 proportion and the bricks of Class Designation as specified less but not less than 35 (i.e 35 kg/sqcm)

**2.9.3.** Brick masonry shall conform to IS:2212. All bricks shall be thoroughly soaked in water for at least 6 hours before use. Brick work shall not be raised more than 14 courses per day. The grade of mortar shall be as specified in the Schedule of Quantities. Joints shall be restricted to a thickness of 10mm unless otherwise required and shall be squarely raked to a depth of 12mm while the mortar is still wet and brushed. Curing shall be done for 7 days.

## **2.10. CEMENT PLASTERING**

**2.10.1.** Cement plastering shall be with the grade of mortar and of thickness specified in the relevant document. The surface to be plastered shall be thoroughly cleaned and kept wet for 4 hours before plastering.

**2.10.2.** All the corners shall be rounded off to a radius of 25 mm unless otherwise specified.

**2.10.3.** Where smooth finishing is specified in the schedule the plastering shall be floated over with neat cement slurry using 2.2 kg of cement per square metre immediately after the final coat of plastering and rate quoted for plastering shall include cost of this finishing work.

**2.10.4.** The plastered surface on which glazed tiles or other similar type of finishing are to be provided subsequently shall not be finished smooth but shall be scarified for forming a base for providing the final surface finish as required.

**2.10.5.** The surface shall be cured for 7 days.

## **2.11. FIXING OF ALUMINIUM WINDOWS, AND PARTITIONS FRAMES**

### **2.11.1. Frame Work**

The shop drawings for each type of doors/windows/ventilators/partitions etc. shall be prepared to meet the requirement/ specifications and by taking into consideration varying profiles of aluminium sections being extruded by approved manufacturers. The shop drawings shall show full size sections of glazed doors, windows, ventilators etc. The shop drawings shall also show the details of fittings and joints. Before start of the work, all the shop drawings shall be got approved from the Engineer-in-Charge. Actual measurement of openings left at site for different type of door/window/ ventilators etc. shall be taken. The fabrication of the individual door/windows/ventilators/partitions etc. shall be done as per the actual sizes of the opening left at site. The frames shall be truly rectangular and flat with regular shape corners fabricated to true right angles. The frames shall be fabricated out of section which have been cut to length, mitered and jointed mechanically using appropriate machines. Mitered joints shall be corner crimped or fixed with self tapping stainless steel screws using extruded aluminium cleats of required length and profile. All aluminium work shall provide for replacing damaged/broken glass panes without having to remove or damage any member of exterior finishing material.

#### **2.11.2. Fixing of Frames**

The holes in concrete/masonry/any other members for fixing anchor bolts/ fasteners/ screws shall be drilled with an appropriate electric drill. Windows/ doors/ ventilators etc. shall be placed in correct final position in the opening and fixed to Sal wood backing using stainless steel screws of star headed, counter sunk and matching size groove of required size at spacing not more than 250 mm c/c or dash fastener. All joints shall be sealed with approved silicone sealants.

In the case of composite windows and doors, the different units are to be assembled first. The assembled composite units shall be checked for line, level and plumb before final fixing is done. Engineer-in-Charge in his sole discretion may allow the units to be assembled in their final location if the situation so warrants. Snap beadings and EPDM gasket shall be fixed as per the detail shown in the shop drawings.

Where aluminium comes into contact with stone masonry, brick work, concrete, plaster or dissimilar metal, it shall be coated with an approved insulation lacquer, paint or plastic tape to ensure that electrochemical corrosion is avoided. Insulation material shall be trimmed off to a clean flush line on completion.

The contractor shall be responsible for the doors, windows, ventilators, partitions etc. being set straight, plumb, level and for their satisfactory operation after fixing is complete.

#### **2.12. PROVIDING BASE COURSE OF FLOORING WITH CEMENT CONCRETE**

**2.12.1.** Thickness and grade of concrete for base course of flooring shall be as specified in the drawing / relevant document.

**2.12.2.** Before laying the base course of concrete the bed shall be well rammed and compacted and wetted thoroughly for two days. Drain holes, if necessary shall be provided as per the directions of the Engineer-in-Charge. The bed shall have slope similar to the finished floor surface.

**2.12.3.** Over the bed thus prepared cement concrete shall be laid to the specified thickness and to the slope as required. The concrete shall be compacted by ramming and shall be finished to an even surface and shall be kept wet for 48 hours.

### **2.13. FLOORING WITH VITRIFIED FLOOR TILES**

**2.13.1.** The vitrified floor tiles shall conform to IS:15622 ,with water absorption less than 0.08% and free from any manufacturing defect. The vitrified floor tiles shall be of approved make, colours and shades, size and thickness as mentioned in the relevant documents, but the thickness shall not be less than 12 mm.

**2.13.2.** The tiles shall be set in cement mortar 1:4 (1 cement : 4 sand) of average 20 mm thick laid to required level/ slope. Before laying cement mortar, the concrete surface shall be scrubbed with wire brush, all loose particles, foreign matters etc. shall be removed and the surface shall be made clean. Any undulations in the concrete shall be chipped off or made good with additional concrete of the same grade used for the under layer. For fixing tiles to mortar, neat cement slurry of honey like consistency using cement at the rate of 3.3 kg./m<sup>2</sup> shall be smeared on top of mortar bed. The joints between the tiles shall be uniform and of minimum thickness of 3 mm width. Grouting the joints of flooring tiles shall be done using epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg) including filling / grouting and finishing complete, as per direction of Engineer-in-Charge.

**2.13.3.** When the floor is ready to use the same shall be washed clean and dried with soft cloth or linen. If any tile is disturbed or damaged it shall be refitted or replaced and properly jointed and pointed.

### **2.13.4. FLOORING WITH ANTI-SKID VITRIFIED TILES**

**2.13.5.** The tiles should have good anti-slip property and high scratch resistance. The anti-skid vitrified floor tiles shall be of approved make, colours and shades, size and thickness as mentioned in the relevant documents, but the thickness shall not be less than 10 mm.

**2.13.6.** The Anti-skid tiles to be laid in floor, treads of steps, landing, unless other wised specified in the relevant documents, with cement based high polymer modified quick set tile adhesive (water based) conforming to IS: 15477, in average 6 mm thickness, including grouting of joints (Grouting the joints of flooring tiles having joints of 3 mm width, using epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg), including filling / grouting and finishing complete, as per direction of Engineer-in-Charge.

## **2.14. VITRIFIED TILE SKIRTING**

**2.14.1.** Tiles for skirting shall be of specified thickness and size of approved quality. They shall be uniform in size. They shall be laid with cement based high polymer modified quick set tile adhesive (water based) conforming to IS: 15477, in average 6 mm thickness, including grouting of joints. Grouting the joints of the tiles having joints of 3 mm width, shall be done using epoxy grout mix of 0.70 kg of organic coated filler of desired shade (0.10 kg of hardener and 0.20 kg of resin per kg). The skirting shall be provided for a height of 150mm or as specified else where / directed by Engineer in Charge.

## **2.15. CERAMIC TILE DADOING**

**2.15.1.** The Ceramic Glazed tiles shall first quality and conform to IS: 15622 .The tiles shall be of required size and thickness as specified in the relevant documents or as instructed by the Engineer-in-Charge, but the thickness shall be not less than 8mm.

**2.15.2.** The tiles shall be laid in Dado, skirting, riser of steps as mentioned in the relevant documents. The glazed tiles shall be set in cement mortar 1:3 (1 cement: 3 sand) of average 12mm thick laid to required level. Before laying cement mortar, the surface shall be scrubbed with wire brush, all loose particles, foreign matters etc. shall be removed and the surface shall be made clean. Any undulations shall be chipped off and made good. The plastered surface shall be scarified so as to fix the tiles. Ceramic tiles shall be joint free. Border tiles of approved design shall be provided.

**2.15.3.** The plastered and scarified surface shall be wetted and neat cement slurry of honey like consistency using cement at the rate of 3.30kg./m<sup>2</sup> shall be smeared on the surface just before fixing the tiles. The tiles shall be laid over the slurry to the correct level and alignment with minimum joint thickness. The joints shall be raked and pointed with tile jointing powder of same colour as tiles. Finally the surface shall be cleaned with oxalic acid.

## **2.16. GRANITE SLAB FLOORING**

**2.16.1.** The granite slab shall be set in cement mortar 1:4 (1 cement: 4 sand) of average 20 mm thick laid to required level. Before laying cement mortar, the concrete surface shall be scrubbed with wire brush, all loose particles, foreign matters etc. shall be removed and the surface shall be made clean. Any undulations in the concrete shall be chipped off or made good with additional concrete of the same grade used for the under layer. For fixing slab to mortar, neat cement slurry of honey like consistency using cement at the rate of 3.3kg./m<sup>2</sup> shall be smeared on top of mortar bed. The slab shall be washed and cleaned before laying. It shall be laid on top pressed, tapped with wooden mallet and brought to level. The slab shall be laid such that the joints in between adjacent slab shall not be more than 1mm and run in straight

**2.16.2.** After laying the slab, the surplus cement grout along the joints shall be cleaned off. The day after the slabs are laid, all joints shall be cleaned with wire brush to a depth of 5mm

and flush pointed with approved joint filler of same colour, including epoxy touch up, rubbing, curing and polishing etc. as specified and as directed by the Engineer-in-Charge.

**2.16.3.** The surface of the flooring as laid shall be true to levels, lines and shapes as directed by the Engineer –in-charge. When the floor is ready to use, the same shall be washed clean and dried with soft cloth or linen.

### **2.17. MARBLE FLOORING**

**2.17.1.** The Marble should be Italian Marble stone slab, Perlato, Rosso verona, Fire Red or Dark Emperadore etc. and free from all imperfections and injurious minerals that may interfere with appearance, strength, structural integrity and its amenability to take good police. The colour /shade of the Marble shall be as specified in the relevant documents or as instructed by the Engineer-in-Charge. The thickness of Marble shall be as mentioned in the relevant documents, but the thickness shall not be less than 18 mm.

**2.17.2.** The Marble shall be machine cut, mirror polished and in required design (Simple geometrical, abstract etc.) and in patterns in combination with Italian marble stones of different colours, shades and finished surface texture etc., in linear portions of the building, all complete as per the architectural drawings. The Marble has to be laid over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with white cement slurry @ 4.4 kg/sqm, pointing with white cement slurry admixed with pigment to match the marble shade, including epoxy touch up, rubbing, curing and polishing etc. as specified and as directed by the Engineer-in-Charge.

**2.17.3.** For making required pattern, design & shape as per architectural requirement very hi-skilled workmen and tools to be engaged for accuracy of the work

### **2.18. KOTA STONE FLOORING**

**2.18.1.** The Kota stone slab shall be of selected quality, hard, sound, dense and homogeneous in texture, free from crack, decay, weathering and flaws. It should be free from imperfections and injurious minerals that may interfere with appearance, strength and structural integrity. The thickness of the Kota stone slab shall be as specified in the relevant documents but not less than 25 mm.

**2.18.2.** The Kota stone slab has to be laid over 20 mm (average) thick base cement mortar 1 : 4 (1 cement : 4 coarse sand) and jointed with grey cement slurry mixed with pigment to match the shade of the slab, including rubbing and polishing complete.

### **2.19. EXTERNAL FLAMED FINISH GRANITE STONE FLOORING**

The work shall include providing and laying flamed finish Granite stone flooring in required design and patterns, in linear as well as curvilinear portions of the building all complete as per the architectural drawings with 18 mm thick stone slab over 20 mm (average) thick base of cement mortar 1:4 (1 cement : 4 coarse sand) laid and jointed with cement slurry and pointing with white cement slurry admixed with pigment of matching shade including rubbing, curing and polishing as specified and as directed by

the Engineer-in-Charge.

## **2.20. GRANITE COUNTER TOP etc**

**2.20.1.** The Granite should be free from all imperfections and injurious minerals that may interfere with appearance, strength, structural integrity and its amenability to take good polish. The colour /shed of the granite shall be as specified in the relevant documents or as instructed by the Engineer-in-Charge. The Granite thickness shall be 18 mm or more unless otherwise specified.

**2.20.2.** The Granite shall be gang saw cut, mirror polished, pre-moulded and pre-polished, machine cut for kitchen platforms, vanity counters, window sills, facias, Toilet hand wash counter top ,tread & rise of stair and similar locations of required size, approved shade, colour and texture .The Granite to be laid over 20 mm thick base cement mortar 1:4 (1 cement : 4 coarse sand), joints treated with white cement, mixed with matching pigment, epoxy touch ups, including rubbing, curing, moulding and polishing to edges to give high gloss finish etc.

**2.20.3.** For providing opening of required size & shape for wash basin/ kitchen sink in kitchen platform, vanity counter and similar location in Granite work, including making necessary holes for pillar taps etc. moulding, rubbing and polishing of cut edges etc. has to be done by engaging hi-skilled workmen and tools for accuracy of the work.

**2.20.4.** The Granite shall be Mirror polished where ever required to give high gloss finish as mentioned in the relevant documents or as instructed by the Engineer-in-Charge.

## **2.21. GRANITE STONE URINAL PARTITION**

The Granite stone slab shall be table rubbed, edges rounded and polished, of size 750x500 mm deep and 18 mm thick. The Granite stone slab to be fixed as urinal partitions by cutting a chase of appropriate width with chase cutter and embedding the stone in the chase with epoxy grout or with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 6 mm nominal size) as per directions of Engineer-in-charge and finished smooth.

## **2.22. STAINLESS STEEL RAILING**

The Stainless Steel railing for Staircase, Escalator Hand Railing and Grab bars at Toilets etc. shall conform Grade 304 and shall be made of Hollow tubes, channels, plates etc. with hairline finish, including welding, grinding, buffing, polishing and making curvature (wherever required) and fitting the same with necessary stainless steel nuts and bolts with the base. The base of the railing shall be fixed with necessary accessories & stainless steel dash fasteners, stainless steel bolts etc., of required size, on the top of the floor or the side of waist slab with suitable arrangement as per approval of Engineer-in-Charge.

## **2.23. INTERNAL CURTAIN GLAZING**

The internal Curtain Glazing shall be of Vision Glass Panels (IGUs) comprising of hermetically-sealed 6-12-6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthened clear float glass 6mm thick, spacer tube 12mm wide, dessicants, including primary seal and secondary seal (structural silicone sealant) etc. all complete for the required performances, as per the Architectural drawings, as per the approved shop drawings, as specified and as directed by the Engineer-in-Charge. The IGUs shall be assembled in the factory/ workshop of the glass processor and to be fixed in position. Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Airgap + 6mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m<sup>2</sup> degree K etc. The properties of performance glass shall be as per highest quality of reputed manufactures and to be decided by technical sanctioning authority as per the requirement.

## **2.24. EXTERNAL CURTAIN GLAZING**

**2.24.1.** The external Curtain Glazing shall be Double glass panels (IGUs) comprising of hermetically-sealed 6-12-6 mm insulated glass (double glazed) vision panel units of size and shape as required and specified, comprising of an outer heat strengthened float glass 6mm thick, of approved colour and shade with reflective soft coating on surface # 2 of approved colour and shade, an inner Heat strengthened clear float glass 6mm thick, spacer tube 12mm wide, dessicants, including primary seal and secondary seal (structural silicone sealant) for the required performances. The external Curtain Glazing shall be of Saint Goben/Modi/other approved make and shall be done as directed by the Engineer-in-Charge, as per the approved shop drawings. The IGUs shall be assembled in the factory/ workshop of the glass processor. Coloured tinted float glass 6mm thick substrate with reflective soft coating on face # 2, + 12mm Air gap + 6mm Heat Strengthened clear Glass of approved make having properties as visible Light transmittance (VLT) of 25 to 35 %, Light reflection internal 10 to 15%, light reflection external 10 to 20 %, shading coefficient (0.25- 0.28) and U value of 3.0 to 3.3 W/m<sup>2</sup> degree K etc. The properties of performance glass shall be decided by technical sanctioning authority as per the site requirement.

**2.24.2.** The work shall include designing, fabricating, testing, protection, installing and fixing in position semi (grid) unitized system of structural glazing for linear as well as curvilinear portions of the building for all heights and all levels, including: (a) Structural analysis & design and preparation of shop drawings for the specified design loads conforming to IS



875 part III (the system must passed the proof test at 1.5 times design wind pressure without any failure), including functional design of the aluminum sections for fixing glazing panels of various thicknesses, aluminium cleats, sleeves and splice plates etc. gaskets, screws, toggles, nuts, bolts, clamps etc., structural and weather silicone sealants, microwave cured EPDM gaskets for water tightness, Fabricating and supplying serrated M.S. hot dip galvanised brackets of required sizes, sections and profiles etc. to accommodate 3 Dimensional movement for achieving perfect verticality and fixing structural glazing system rigidly to the RCC/ masonry/structural steel framework of building structure using stainless steel anchor fasteners/ bolts, nylon separator to prevent bimetallic contacts with nuts and washers etc. of stainless steel grade 316, of the required capacity and in required numbers. Providing and filling, two part pump filled, structural silicone sealant and one part weather silicone sealant compatible with the structural silicone sealant of required bite size including double sided spacer tape, setting blocks and backer rod, all of approved grade, brand and manufacture, as per the approved sealant design, within and all around the perimeter for holding glass. The works shall include fabrication and installation of aluminium grid, installation of glazed units, T&P, scaffolding and other enabling temporary structures and services, cranes or cradles etc. as described above and as specified. The item of work includes all the structural and functional design, shop drawings checked by a structural designer, dully approved by Engineer-in-charge. The item shall also include all mock ups at site, samples of the individual components for testing in an approved laboratory, field tests on the assembled working structural glazing as specified, cleaning and protection till the handing over of the building for occupation. In the end, the Contractor shall provide a water tight structural glazing having all the performance characteristics etc. all complete as required, as per the Architectural drawings, as per item description/as specified/as per the approved shop drawings and as directed by the Engineer-in-Charge.

Note:-. The following performance tests are to be conducted on structural glazing system if area of structural glazing exceeds 2500 sqm. from the certified laboratories accredited by NABL (National Accreditation Board for Testing and Calibration Laboratories), Department of Science & Technologies, India. Cost of testing is payable separately.

The Engineer-in-Charge will decide the necessity of testing as per relevant codes and requirement and importance of the work. Performance Testing of Structural glazing system Tests to be conducted in the NABL accredited lab or by any other accreditation body which operates in accordance with ISO/ IEC 17011 and accredits labs as per ISO/ IEC 17025.1. Performance Laboratory Test for Air Leakage Test (-50pa to - 300pa) & (+50pa to +300pa) as per ASTM E-283-04 testing method for a range of testing limit 1 to 200 mVhr. 2. Static Water Penetration Test. (50pa to 1500pa) as per ASTM E- 331-09 testing method for a range up to 2000 ml. 3. Dynamic Water Penetration (50pa to 1500pa) as per AAMA 501.01- 05 testing method for a range upto 2000 ml 4. Structural Performance Deflection and deformation by static air pressure test (1.5 times design wind pressure without any failure) as per ASTM E-330-10 testing method for a range upto 50 mm 5.

Seismic Movement Test (upto 30 mm) as per AAMA 501.4-09 testing method for Qualitative test, Tests to be conducted on site. 6. Onsite Test for Water Leakage for a pressure range 50 kpa to 240 kpa (35psi) upto 2000 ml.

## **2.25. FRAMELESS TOUGHENED GLASS DOOR**

The shutter of the door shall be of approved brand and manufacture as per relevant document or as directed by the Engineer-in-Charge and of 12 mm thick frameless toughened glass. The work includes providing and fixing top & bottom pivot & double action hydraulic floor spring type fixing arrangement and making necessary holes etc. for fixing required door fittings, all complete as per direction of Engineer-in-Charge. Patch fitting glass door to internal curtain glazing (Glass doors D2 &D4).

## **2.26. TOUGHENED GLASS SENSOR SLIDING DOOR**

The shutter of the door shall be of approved brand and manufacture as per relevant document or as directed by the Engineer-in-Charge and of 12 mm thick toughened glass sensor Sliding door (Aluminium frame/frameless). The work includes including providing and sliding supports and fixing arrangement and making necessary work etc. for fixing required fittings, all complete as per direction of Engineer in Charge. Patch fitting doors to external sliding glass doors D1 & D2

## **2.27. FIBER REINFORCED PLASTIC (FRP) DOOR FOR TOILETS**

### **2.27.1. FIXING FRP FRAME**

The frames shall be fixed in prepared openings in the walls. All civil work and tiling should be completed before the fixing of the frames. The frames are to be fixed directly on the plastered wall. In case tiling is to be done in the place the frames are to be fitted, a 50 mm strip should be left untilted at the location where the frames are to be fitted. The frames are erected in the prepared opening such that the vertical members of the door frame are embedded 50 mm in the floor. The frame shall be fitted truly in plumb. A minimum of three anchor bolts or screws of size 65/100 shall be used to fix each vertical member. One bolt shall be fixed at 200 mm from the top member and one bolt shall be fixed at 200 mm from the floor. The third anchor bolt shall be fixed in the center. The top horizontal member shall be fixed using two 65/100 size anchor bolts or screws at a distance of 200 mm from both the corners.

### **2.27.2. FIXING OF FRP FLUSH DOOR SHUTTER**

For side hung shutters, each leaf shall be hung on three hinges one at the centre and the other two at 200 mm from the top and bottom of the shutters. Size and type of hinges and pivots shall be as specified. Flap of hinges shall be neatly counter sunk into the

recesses cut to the exact dimensions of flap. Screws for fixing the hinges shall be screwed in with screw driver and not hammered in. Unless otherwise specified, shutters shall be hung on butt hinges of size 100 mm. For shutter of more than 40 mm thickness butt hinges of size 125 × 90 × 4 mm shall be used.

## **2.28. MAIN DOOR (MD) AND OPENING**

The work shall include supply and fixing of door and opening framework as per the approved drawing including finishing as per Manufacturer's specifications/ Good Engg. Practice, as approved by Engineer-in-Charge.

## **2.29. DOOR OF TOILETS FOR DIFFERENTLY ABLED:**

The Toilet door shall be of size 1.5 m X 2.45 m to be of Sliding type as per the approved drawing and shall have Aluminium frame with zinc phosphate primer, Sliding shutter panel rolling on top hung rail, fixtures such as 2 Nos. handles 600mm long, locking system, MS-Z Hold fasts 300 mm long of 40x40x5mm, as approved by Engineer-in-Charge.

## **2.30. FIRE RATED DOOR**

The Powder Coated Fire Rated doors, frames & shutters made of Skin pass galvanized Iron sheet conforming to Base Steel as per IS 513 "D" Quality, Galvanized as per IS 277 with Hot Zinc Coating of 120 grams / Sqm with powder coating of thickness 60-65 Microns, frame with 1.2mm thick Skin pass Galvanized Iron sheet formed to double rebate profile of size 143 mm X 58 mm with maximum bending radius of 1.4 mm and filled with in-fill Polyurethane foam, the Door Shutters are with 0.80 mm thick Skin pass Galvanized Iron Sheet formed to provide a 46 mm thick fully flush, double skin door shell with Lock Seam joints at stile edges, fitted with in-fill of Honeycomb Kraft Paper and coated with polyester powders of Pure polyester/ epoxy polyester or polyurethane powder for powder coating of thickness 60 – 65 microns and are coated with Zinc Phosphate Primer to receive any paint on site or finished with Thermosetting Polyurethane paint of Aliphatic Grade providing high levels of scratch resistance and durability, the Shutter provided with 6 MM clear float vision glass in Rectangular shapes, Stainless Steel Ball Bearing Butt Hinges 3 mm thick fixed flush to the frame and shutter (Profile 102x76x3mm thick).Mortise Sash Lock with Lever Handles, Mortise Dead Bolt, etc for 120 minutes Fire Rated door conforming to IS:3614 (Part2) 1992.

## **2.31. SHAFT DOOR**

The Shaft doors shall be of Fire steel single leaf door of set U in IS/BS 120, GI 1.2 mm for frame, 0.8mm for shutter infill with honey comb material shutter with 47mm, frame with galvanized steel, fixtures (3 nos. of ball bearing butt hinge, SS 304, of size 100x75x3mm

with screws in SS 304, 1 no. of Mortise shaft lock H7, 57mm BS, with allen key and escutcheons, 1 no. of handle 120x40mm with superior finish, finished with Zinc phosphate primer paint as per approved drawing. The finished work shall be painted as specified.

## **2.32. PROVIDING AND FIXING UPVC JOINERIES**

**2.32.1.** The uPVC white colour fixed glazed windows/ ventilators shall be factory made comprising of multi-chambered frame and mullion (wherever required) extruded profiles duly reinforced with  $1.60 \pm 0.2$  mm thick galvanized mild steel section made from roll forming process of required length (shape & size according to uPVC profile), uPVC extruded glazing beads of appropriate dimension, EPDM gasket, G.I fasteners 100 x 8 mm size for fixing frame to finished wall, plastic packers, plastic caps and necessary stainless steel screws etc. Profile of frame shall be mitred cut and fusion welded at all corners, mullion (if required) shall be also fusion welded including drilling of holes for fixing hardwares and drainage of water etc. After fixing frame, the gap between frame and adjacent finished wall shall be filled with weather proof silicon sealant over backer rod of required size and of approved quality, all as per approved drawing & directions of Engineer-in-Charge.

Note: For uPVC frame, sash and mullion extruded profiles minus 5% tolerance in dimension i.e. in depth & width of profile shall be acceptable.

## **2.33. ALUMINIUM LOUVERS.**

The Aluminum Louvers frame shall be made of Aluminum tubes channels. The louvers should be fixed to the supporting frame with Aluminum cleats, GI screws, as per requirement. The whole assembly is to be powder coated with pure polyester paint, fixing as second skin layer as per design intent and as approved by Engineer-in-Charge.

## **2.34. ALUMINIUM FRAME AND TOUGHENED GLASS WINDOW**

The window work shall be made of Aluminium frame and Aluminium shutter frame with fixed 8mm toughened glass. The framing detailing shall be as per the approved drawing and fixtures such as Butt hinges, Tower Bolt, handles, stops shall be fixed with required no. of screws, bolts and nuts.

## **2.35. RECKLI FINISH CLADDING**

Reckli finish cladding mould to be used before casting concrete shall be as per drawing, requirement and as directed by the Engineer-in-Charge. Pattern of horizontally running brick mould for a natural rock look can be used up to 100 times as stamp layer before casting of concrete. The mould shall be placed on shuttering surface and to be used for

finishing work on Columns/External Entrance wall. The pattern shall be used multiple times where ever required. Pattern customization shall be as per design intent and as approved by Engineer-in-Charge. The work shall include installation with adhesive and also use of releasing agent.

### **2.36. STRUCTURAL STEEL WORK**

**2.36.1.** Structural steel work shall be with structural members like Structural steel tubes, rafters, continuous beams, rigid frame columns, rod bracing etc., for specially Designed framed Structures, riveted, bolted or welded in built up sections and framed work and the work is including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete.

**2.36.2.** Steel work shall be conforming to IS 2062, welded in built up sections/ framed work, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer using structural steel etc. as required or as directed by the Engineer-in-Charge.

**2.36.3.** Structural steel work riveted, bolted or welded in built up sections, trusses and framed work as per provision of IS 2062, including cutting, hoisting, fixing in position and applying a priming coat of approved steel primer all complete. with structural members like Structural steel tubes, rafters, continuous beams, wall purlin members, curved eaves, side wall grits if required, rigid frame columns, rod bracing etc., for specially Designed framed Structures.

**2.36.4.** The component parts shall be assembled and aligned in such a manner that they are neither twisted nor otherwise damaged and shall be so prepared that the specified camber, if any, is provided. Proper clamps, clips, jigs and other fasteners (bolts and welds) shall be placed in a balance pattern to avoid any distortion in the members and to ensure their correct positioning

**2.36.5.** Welding shall be done in accordance with the specifications laid down in IS 816 and as per detailed working drawing. Welding edges and the adjacent areas of the members (extending upto 20mm) shall be thoroughly cleaned of all oil, grease, scale and rust and made complete dry. Gaps between the members to be welded shall be kept free from all foreign matters. The welding procedure adopted and consumables used shall be got specifically approved by the Engineer in Charge. Excessive convexity, shrinkage cracks, under cutting, improperly fitted/misaligned parts, members distorted by the heat of welding etc. due to faulty welds shall be corrected – whole or portions – as directed by the Engineer-in-Charge.

**2.36.6.** The steel sections as specified shall be straightened and cut square to correct lengths. The steel work shall be hoisted and placed in position, carefully without any damage to itself and other building work and injury to workmen.

## **2.37. STRUCTURAL GI DECK SHEET WORK**

The GI sheet shall fulfil the requirement of the provision of IS 227. The thickness of the sheet and coating shall be as required as per design, as specified and /or as per directions of the Engineer-in-Charge but shall not be less than 8 mm. GI deck sheet shall be fixed on structural supports with studs.

## **2.38. PRE-ENGINEERED UNITS**

**2.38.1.** Pre-Engineered Building Units shall comprise of Columns made with Built-up material made with plate sections (Y/s 345 Mpa), Rafters/trusses made with plate sections / Hot rolled members (Y/s 250 Mpa), Wall bracings, Roof bracings made with Pipe (IS 1161 Y/s 250 Mpa) / Angle (Y/s 250 Mpa) sections for Strut tubes, for roof, wall, Canopy projection along the length of the building with 8.8 grade HSFG bolts for primary connections, 4.6 grade MS bolts for secondary connections, Minimum 2mm thick cold formed galvanized Purlins for roof and necessary clips, Flange braces etc.]. PEB/Space frame structure/Steel structure should be shot blasted and applied with four coats of PU paint (DFT: 120 microns). Structural steel of make SAIL / TATA / JSW / JSPL / VSP or equivalent make as approved by Engineer-in-Charge shall be used.

### **2.38.2. Aluminium Standing Seam Double Skin Roofing System**

The work shall include supply & installation of on-site manufactured single length PVDF 2 coated, Standing seam profile of approved make, double insulated Standing seam, Al roofing system; of nominal 400 mm effective cover width with three micro ribs and standing seam height of 65mm. The panel shall be concealed fixed, mechanically seamed for increased weather durability and greater resistance to wind uplift. The build-up of the roof shall consists of:1. Top layer –Sheet of approved make 65/400 as suitable, STRAIGHT profiled sheeting manufactured from Aluminum Alloy AlMn1Mg1- as specified, minimum material thickness of 0.9 mm and PVDF2 finish. The external PVDF2 coating shall be of 23-25 microns thickness and shall have protective guard film to prevent scratches during roll forming & handling. Back coat shall be 5 microns primer coat. The material properties shall be as follows:- Ultimate tensile strength: minimum 200 N/mm<sup>2</sup> 0.2% Proof Stress: minimum 185 N/mm<sup>2</sup>. E-clips of suitable height to be fixed to the purlins with SS 304 screws only. Other relevant accessories such as Ridge closures and foam filler at ridge and eaves, drip angle for water tightness, Gable end channels, Tolerance clips, gable end clips etc. should be used wherever required.

2. Insulation Layer: Insulation (approved Make) shall be 100mm thick 60Kg density having thermal conductivity of 0.38 W/mk. The 100mm thick insulation material provides thermal transmittance (U Value) of 0.36 W/m<sup>2</sup>K. 3. VCL Layer. A single layer film reinforced polyester yarn a six layer double sided Vapor control barrier, consisting of lamination of pure aluminum foil, aluminum film and high quality kraft paper reinforced with polyester yarn, thickness of 180-200 microns thickness, with tensile strength of N/25 mm in the machine direction of 150-170 and Water Vapor Transmission tested @

0.08 - 0.2. g/m<sup>2</sup>/day. 4. ST Clips of suitable height to be fixed with SS 304 screws only to support for straight panels. 5. Bottom Layer: Solid 30- 35 /200 Galvalume steel liner 550 MPa, 0.5mm TCT 1000 mm total cover width 35mm deep ribs spanning up multiple spans. Purlin Spacing shall be advised by the roofing manufacturer. The finish to the exposed surface of the liner will be polyester coating with film thickness of 15 to 20µm +/- 2 µm.

The minimum U value of the build-up shall be 0.36 W/m<sup>2</sup> K and acoustical performance STC shall be of 32dB with a negative tolerance of -2dB. The measurement shall be based on finished/covered surface area. The work shall include all other relevant accessories like, Ridge closures, gable end channels, tolerance clips, gable end clips, foam fillers etc. to be included as appropriate and wherever necessary. sealants etc. and work shall carried out by specialized agency. Vendor shall jointly work with the System Provider Company, Architect & Main Contractor to ensure a weather-tight solution at Expansion Joints, including if necessary, co-ordination with Drainage System Provider & Structural Design Engineer, Structural Fabrication Agency, and any other agency involved. The work shall also include all accessories for the expansion joint, nut bolts & panels. The erection / fixing /installation shall be done by specialized / authorized trained roofing installer, as per approved list (Kalzip/ Jindal/ Kingzip/equivalent). The installation team shall be fully trained and approved by the manufacturer.

### **2.39. DOUBLE HEIGHT TENSILE ROOFING SYSTEM**

The Double Height Tensile roofing system with structural supports consist of Tensile roof structures membrane 2mm roof sheeting Membrane shall be Preconstraint PVC/ PVDF coated with following characteristics:

Yarn: High Tenacity Polyester Yarn PES HT 1100 Dtex Coated fabric Weight: 750 g/m<sup>2</sup>  
Tensile Strength Warp/ Weft: 2800/ 2800 N/ 5cm Tear Strength Warp/ Weft: 300/ 280 N, at Double Height. The work shall include design, supply & installation with structural steel support/cable works as per architectural intent frame work and as directed by Engineer-in-Charge.

### **2.40. ENTRANCE TENSILE ROOFING**

The work shall include design, supply & installation of Tensile roof structures membrane/ Canopy with 2mm roof sheeting Membrane of Preconstraint PVC/ PVDF coated with following Characteristics:

Yarn: High Tenacity Polyester Yarn PES HT 1100 Dtex Coated fabric Weight: 750 g/m<sup>2</sup>  
Tensile Strength Warp/ Weft: 2800/ 2800 N/ 5cm Tear Strength Warp/ Weft: 300/ 280 N,complete item of work.

The work includes structural steel supports/cables works as per architectural intent frame work and as directed by Engineer-in-Charge.

#### **2.41. ALUMINIUM COMPOSITE CLADDING**

The work of Aluminum Composite Cladding shall be of Framing with Aluminium sections of 50mm x 25mm x 1.5mm thick rectangular tubes, 'L' angles, Screws, Wood Screws, GE Weather proof silicon sealant etc. with 4mm thick Aluminium Composite Panel non-FRs (Euro bond & Aludeccur & Alstrong /Alu Bond & Aluco Bond/ approved equivalent) of approved/specified colour comprising polyethylene core sandwiched between two skins of 0.50mm thick special alloyed sheet to have overall thickness of 4mm, as required and fixed over aluminium frames. The panel thus pre-fabricated shall be fixed to suit site conditions. The aluminium panel shall be pre-coated with highly weather resistant coating of fluoro carbon (PVDF) which can withstand solar radiation and industrial pollution and the exposed surface, with DUCO or approved equivalent. The main framework shall be fixed to Steel structure/masonry/slab to form suitable grid and aligned to perfect level and form. The aluminium composite panels shall then be fixed to the main frame leaving uniform gap of not more than 15mm between adjacent panels and to match adjacent glazing clips and filled with appropriate weather proof silicone to make it watertight and weather proof (DOW CORNING 789/ G.E/equivalent approved). This gap shall be made suitable as weather sealed junction without using exposed sealant surface and as directed by Engineer-in-Charge.

The cladding work shall be carried out as per Design intent and as directed by Engineer-in-Charge, on External Entrance walls/ Decorative Portico/ Decorative Column/ External roof bottom under decking.

#### **2.42. SOUNDSCAPES, SHAPES, ACOUSTICAL CIRCULAR CLOUDS**

Soundscapes, Shapes, Acoustical Circular Clouds of 1200mm dia. of reputed make, shall be provided and fixed for suspending the framework using Intermediate channels from soffit with ceiling angle & connecting clip to the ceiling channels fixed in a direction perpendicular to the intermediate channel, etc. complete for finished item of work as per approved specification and as directed by the Engineer-in-Charge.

#### **2.43. FALSE CEILING WORK**

Tiled false ceiling shall be of specified materials of size 595x595mm and it shall be fixed in true horizontal level, suspended on inter locking metal grid of hot dipped galvanized steel sections (galvanized @ 120 grams/ sqm., both sides inclusive) consisting of main "T" runner with suitably spaced joints to get required length and of size 24x38 mm made from 0.30 mm thick (minimum) sheet, spaced at 1200 mm center to center and cross "T" of size 24x25 mm made of 0.30 mm thick (minimum) sheet, 1200 mm long spaced between main "T" at 600 mm center to center to form a grid of 1200x600 mm and secondary cross "T" of length 600 mm and size 24x25 mm made of 0.30 mm thick (minimum) sheet to be interlocked at middle of the 1200x600 mm panel to form grids of 600x600 mm and wall angle of size 24x24x0.3 mm and laying false ceiling tiles of



approved texture in the grid and shall also include required cutting/making, opening for services like diffusers, grills, light fittings, fixtures, smoke detectors etc. Main "T" runners to be suspended from ceiling using GI slotted cleats of size 27 x 37 x 25 x 1.6 mm fixed to ceiling with 12.5 mm dia. and 50 mm long dash fasteners, 4 mm GI adjustable rods with galvanised butterfly level clips of size 85 x 30 x 0.8 mm spaced at 1200 mm center to center along main T. The bottom exposed width of 24 mm of all T sections shall be pre-painted with polyester paint, for all heights as per specifications, drawings and as directed by Engineer-in-Charge. GI Metal Ceiling shall be laid with plain Regular edge Global white color tiles of size 595x595 mm, and 0.5 mm thick with 8 mm drop; made of G I sheet having galvanizing of 100 gms/sqm. (both sides inclusive) and electro statically polyester powder coated of thickness 60 microns (minimum), including factory painted after bending etc. complete, supported to Structural steel frame work / Mezzanine floor

#### **2.44. FINE FISSURED RH99 GRID CEILING**

The ceiling shall be of FINE FISSURED RH99 GRID CEILING of 600mm X 600mm size, with 19mm thick, of reputed approved make. The framework shall be suspended using Intermediate channels from soffit with ceiling angle & connecting clip to the ceiling channels fixed in direction perpendicular to the intermediate channel, etc. complete, as per approved specification / as directed by Engineer-in-Charge.

#### **2.45. TOILET CUBICLES**

Toilet cubicles shall be with Intermediate Panel, Pilaster & Door: The intermediate panel shall be a continuous panel without any joints. All intermediate panels, panels, pilasters and doors shall be 12mm thick with edges chamfered. The solid compact laminate (Phenolic Core Board) is based on thermosetting resins, homogeneously reinforced with cellulose fibres. Top surface on both sides shall be melamine coated which is scratch and impact resistant. Hardware and fixing: All pilasters shall be supported by adjustable foot and non corrosive inserts. Top rail and wall fixing shall have exterior polyamide coating guaranteeing resistance to breakage, heat, humidity and chemicals. The base of the adjustable foot shall be anchored to the floor with a clearance height of 100mm. Aluminum U- Channel shall be used for the fixing of intermediate panels to the wall. Each Toilet compartment shall be equipped with the following accessories: Privacy Thumb turn, Aluminum U-Channel, Door Knob, Coat Hook, Auto Return Hinges, Adjustable legs, Coated Aluminum Top Profile, Aluminum Door stopper lining in Stainless Steel Smart Series etc. complete, as per approved specification and as directed by Engineer-in-Charge.

#### **2.46. DRIP COURSE/ GROVE IN PLASTER**

Drip Course and /or Groove in plaster shall be provided with rich cement mortar to facilitate the drainage of water from the coping and / or for ornamental purpose as per design and as directed by the Engineer-in-Charge. The work shall be carried out by hi-

skilled worker. For moulding to R.C.C. projections, the same specification shall be followed.

#### **2.47. WATER PROOF TREATMENT ON FLOOR AND WALLS**

The work includes application of integral crystalline slurry of hydrophilic in nature for waterproofing treatment to the RCC structures like retaining walls of the basement, water tanks, roof slabs, podiums, reservoir, sewage & water treatment plant, tunnels etc., prepared by mixing in the ratio of 5 : 2 (5 parts integral crystalline slurry : 2 parts water) for vertical surfaces and 3 : 1 (3 parts integral crystalline slurry : 1 part water) for horizontal surfaces and applying the same from negative (internal) side with the help of synthetic fiber brush. The material shall meet the requirements as specified in ACI- 212-3R-2010 i.e by reducing permeability of concrete by more than 90% compared with control concrete as per DIN 1048 and resistant to 16 bar hydrostatic pressure on negative side. The crystalline slurry shall be capable of self-healing of cracks up to a width of 0.50mm. The work shall be carried out with hi-skilled workman as per requirement and as per direction of the engineer-in-charge. **The product performance shall carry guarantee for 10 years against any leakage.**

#### **2.48. WATER PROOFING TREATMENT ON ROOFS**

The surface of roof slab shall be of sound concrete and honeycomb, if present, has to be rectified before application of water proofing treatment materials. Honeycombing of concrete shall be filled with polymer grouts and cracks on the concrete surface to be properly treated with polymer modified mortar (PMM). Roof shall have adequate slope so that water does not stagnate. Rain outlet should be of 100 mm to 150 mm or as directed by the Engineer-in-Charge .Adequate outlets shall be provided as per design or as directed by the Engineer-in-Charge. Rain water outlets shall be fixed in continuity of screed slope throughout the parapet wall, wherever applicable.

The water proofing treatment on roofs of slabs shall comprise of application of cement slurry mixed with water proofing cement compound consisting of applying:

- (a) after surface preparation, first layer of slurry of cement @ 0.488 kg/sqm mixed with water proofing cement compound @ 0.253 kg/Sqm.
- (b) laying second layer of fibre glass cloth when the first layer is still green. Overlaps of joints of fibre cloth should not be less than 10 cm.
- (c) third layer of 1.5 mm thickness consisting of slurry of cement @ 1.289 kg/sqm. mixed with water proofing cement compound @ 0.670 kg/sqm and coarse sand @ 1.289 kg/sqm. This will be allowed to air cure for 4 hours followed by water curing for 48 hours. The entire treatment shall be taken upto 30 cm on parapet wall and tucked

into groove in parapet all around.

(d) fourth and final layer of brick tiling with cement mortar.

## **2.49. PROVIDING AND APPLYING CEMENT PRIMER COAT**

### **2.49.1. Preparation of the Surface**

The surface shall be thoroughly cleaned of dust. 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 white cement putty mixed with water on the entire surface including filling up the undulations and then sand papering the same after it is dry.

### **2.49.2. Application**

The cement 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 as uniformly as possible leaving no brush marks. It shall be allowed to dry for at least 48 hours, before oil emulsion Paint is applied.

## **2.50. PROVIDING AND APPLYING ACRYLIC EMULSION PAINT**

**2.50.1.** Wall painting shall be done with acrylic emulsion paint of approved brand and manufacture to give an even shade (color shade and color scheme as per architectural selection and as approved by Engineer-in-Charge).

**2.50.2.** The surface shall be thoroughly cleaned of dust and then be sand papered to give a smooth and even surface. Over the prepared surface one base coat of primer for exterior emulsion paint of same brand shall be applied with hand brush in horizontal stroke followed immediately by a vertical one which together shall constitute one coat. After the primer coat has dried for at least 48 hours, the surface shall be lightly sand papered to make it smooth. All loose particles shall be dusted off after rubbing and the surface cleaned well. The first finishing coat of exterior/interior emulsion paint shall then be applied with hand brush in horizontal stroke followed immediately by a vertical one which together shall constitute one coat. The second coat shall be applied in the same way of first coat to obtain an even surface, after the first finishing coat dried as per the directions of the Engineer-in –Charge.

**2.50.3.** Two or more coats shall be applied @ 1.43 ltr/ 10 m<sup>2</sup> over and including priming coat of exterior primer applied @ 2.20 kg/ 10 m<sup>2</sup>

## **2.51. WHITE CEMENT WALL PUTTY WORK**

The work shall include providing and applying two coats of cement based readymade wall putty (JK White/ Birla Care/Asian Wall putty or approved equivalent) including preparation of the surface smooth by sand papering etc. as per direction of Engineer-in-

Charge .The consumption of Wall Putty shall not be less than 5 kg for 10 sqm. for both the coats. The Putty shall be prepared strictly as per detailed Manufacturer's specifications and applied after cleaning the surface thoroughly. Necessary curing shall be done before application of first coat and subsequent coat. The finish surface so prepared after application of both the coats shall be rubbed with Amery Paper (320 No.) to make the surface ready for application of painting.

## **2.52. CEMENT CONCRETE DRAINS**

**2.52.1.** The work shall include providing and laying design mix cement concrete of M-30 grade, in roads/ taxi tracks/ runways, using cement content as per design mix, using coarse sand and graded stone aggregate of 20 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction/ expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling joints with approved joint filler and sealants, complete all as per direction of Engineer-in-Charge (Item of joint fillers, sealants, dowel bars with sleeve/ tie bars will be be paid separately).

2.52.2.The work shall also include providing and placing in position 100 mm thick factory made machine batched & machine mixed Precast RCC Rectangular Covers on drains of footpath of various sizes, of M-25 grade cement concrete for RCC work, including cost of centering, shuttering, reinforcement of 8 mm dia TMT bars of Fe 500D grade @ maximum 100mm c/c on both ways , neat cement punning on finished surface, properly encased on all edges with 1.6 mm thick , 100 mm wide MS sheet duly painted over priming coat , reinforcement to be welded at edges with MS sheet and providing 2 Nos. 12 mm dia bar for hooks etc i/c cost of cartage, all leads & lift, handling at site etc. all complete as per direction of Engineer-in-Charge.

## **2.53. ROADS/ PAVEMENTS- PREPARATION OF SUBGRADE**

- a) The sub grade shall be levelled to the proper level and camber by filling depressions with excavated material and cutting of protuberances. The sub grade shall be cleaned of all dust, black cotton soil, dirt and other extraneous matters. Any ruts or soft yielding places that have appeared due to improper drainage, service under traffic or other reasons shall be corrected and rolled with 8 to 12 tonne roller till 95 per cent modified proctor density is achieved.
- b) The sub grade shall be made to have as nearly as practicable a uniform bearing power and all hard spots therefore be properly excavated to the level indicated by the

Engineer, refilled and compacted.

- c) All soft and sponge parts of the sub grade shall also be excavated and refilled with approved materials in 15 cm. layers for the same reason.
- d) The sub grade shall be watered as directed at least 12 hours before a roller is put on it.
- e) Proper access should be prepared for the roller to get to the sub grade and all manholes frames and covers should be removed and replaced by plates free of cost whenever they interfere with the free rolling of the sub grade.
- f) All places where trenches of more than 60 cm. in depth have been taken shall be marked for providing reinforcement where there is concrete base, after filling them in layer of 23 cm. thick and ramming to level few cms. above the formation level as directed.
- g) Trenches less than 60 cms. in depth may be filled with alternate layers of rubble and earth and properly consolidated without providing any reinforcement on them.
- h) Where concrete is to be placed on an existing base of concrete the following preparatory work should be carried out before placing of new concrete. All the joints and cracks in the base slab shall be cleaned and scaled with a suitable bituminous sealing compound, where the base slab shows signs of settlement at the edges or joints or in cracked areas such portions shall be removed and sub grade strengthened by placing on an additional granular material and compacting it either by rolling or by heavy rammer weighing not less than 15 Kg water being added to bring it to a stiff consistency.
- i) After treating the sub grade in the weak spots in the above manner the area shall be filled in with fresh cement concrete (1:3:6) conforming to the relevant concrete specifications to correspond to the levels of surrounding base concrete. Such freshly laid concrete shall be cured in the normal way for 10 days or till such time as the top concrete is laid. However, no top concrete shall be laid within 48 hours of laying the base concrete.
- i) After rolling, the camber, super-elevation and longitudinal slope, etc., of the sub grade shall conform in shape to those of the finished surface. This should be checked with the help of level stakes, strings and camber board, if necessary.

## **2.54. GRANULAR SUB-BASE 100MM THICK**

**2.54.1.** The work shall consist of laying and compacting well-graded material on the existing surface for laying interlocking paver blocks in accordance with the requirements of these specifications. The material shall be laid in single layer as sub-base (termed as sub-base hereinafter) as necessary according to lines and grades, as directed by the Engineer-in-Charge.

### **2.54.2. Construction operations**

#### **(i) Preparation of sub grade**

The sub grade shall be prepared to the required level and slope by removing all vegetation and other extraneous matter, lightly sprinkled with water, if necessary, and rolled with two passes of 80-100KN smooth wheeled roller, as directed by the Engineer-in-Charge.

**(ii) Spreading and compacting**

The sub-base material of grading specified in the Contract shall be spread on the prepared sub grade with help of a motor grader of adequate capacity, its blade having hydraulic controls suitable for initial adjustment and for maintaining the required slope and grade during the operation or other means as approved by the Engineer-in-Charge.

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 rotovator or similar approved equipment capable of mixing the material to the desired degree. If so desired by the Engineer-in-Charge, 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 width of surface or other means as approved by the Engineer-in-Charge so that, at the time of compaction, it is from 1% above to 2% 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 material shall be processed by mechanical or other approved means like disc harrows, rotavators until the layer is uniformly wet.

Immediately after spreading the mix, rolling shall be done by an approved roller. If the thickness of the compacted layer does not exceed 100mm, a smooth wheeled roller of 80 to 100 KN weight may be used. Rolling shall commence at the lower edge and proceed towards the upper edge longitudinally for portions having unidirectional slope and shall commence at the edge and progress towards the centre for portions having slope towards both the 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 level and slope shall be checked and any high spots or depressions, which become apparent, corrected by removing or adding fresh material. The speed of the roller shall not exceed 5 km per hour.

Rolling shall be continued till the density achieved is at least 98 percent of the maximum dry density for the material determined as per IS:2729 (Part 8). All loose,

segregated or otherwise defective areas shall be made good to full thickness of layer and re-compacted.

### **2.54.3. Surface finish and quality control of work**

The surface finish of construction shall conform to the requirements of Clause 902 of MORT&H specifications. Control on quality of materials and work shall be exercised by the Engineer-in-Charge in accordance with section 900 of MORT&H specifications.

**2.54.4.** The granular sub base shall be deemed complete only on carrying out the required operation including:

- (i) furnishing all materials to be incorporated in the work including all royalties, fees, rents where necessary and all leads and lifts;
- (ii) deploying all labour, tools, equipment and incidentals to complete the work to the specifications;
- (iii) carrying out the work in part width of the road/area where diverted; and
- (iv) carrying out required tests for quality control.

### **2.55. WET MIX MACADAM BASE (WMM)**

**2.55.1.** The work consists of providing, laying and compacting clean, crushed, graded aggregate and granular material, premixed with water, to a dense mass for 100mm thick in single layer over sub-base to lines and slope as per directions of the Engineer-in-Charge.

#### **2.55.2. Construction operations**

##### **(i) Preparation of Base**

The surface of the sub-base to receive the Wet Mix Macadam course shall be prepared to the specified lines and slope+ and made free of dust and other extraneous material. Any ruts or soft yielding places shall be corrected in an approved manner and rolled until firm surface is obtained, if necessary by sprinkling water. Any sub-base irregularities, where predominant, shall be made good by providing appropriate type of profile corrective course (leveling course) as per Clause 501 of MORT&H's Specification for Road and Bridge works or as directed by the Engineer-in-Charge.

##### **(ii) Provision of lateral confinement of aggregates**

While constructing Wet Mix Macadam, arrangement shall be made for the lateral confinement of wet mix. This shall be done by laying materials in adjoining shoulders along with that of Wet Mix Macadam layer and following the sequence of operations described in Clause 404.3.3 of MORT&H's Specification for Road and Bridge works or as directed by the Engineer-in-Charge.

### **(iii) Preparation of mix**

- (a) Wet Mix Macadam shall be prepared using appropriate methods which shall ensure production of mix of proper and uniform quality as directed by the Engineer in charge.
- (b) Optimum moisture for mixing shall be determined in accordance with IS: 2720 (Part-8) after replacing the aggregate fraction retained on 22.4mm sieve with material of 4.75mm to 22.4mm size. While adding water, due allowance should be made for evaporation losses. However, at the time of compaction, water in the wet mix should not vary from the optimum value by more than agreed limits. The mixed material should be uniformly wet and no segregation should be permitted.

### **(iv) Spreading of mix**

- (a) Immediately after mixing, the aggregates shall be spread uniformly and evenly upon the prepared sub grade in required quantities. In no case should these be dumped in heaps directly on the area where these are to be laid nor shall their hauling over a partly completed stretch be permitted.
- (b) The mix shall be spread either by a paver finisher or motor grader to get a uniform and level surface as directed by the Engineer-In-Charge. For portions where mechanical means cannot be used, manual means as approved by the Engineer –in-charge shall be used.
- (c) The surface of the aggregate shall be carefully checked with templates and all high or low spots remedied by removing or adding aggregate as may be required. The layer shall be tested by depth blocks during construction. No segregation of larger and fine particles should be allowed. The aggregate as spread should be of uniform gradation with no pockets of fine materials.

### **(v) Compaction**

- (a) After the mix has been laid to the required thickness, level and slope, the same shall be uniformly compacted, to the full depth with suitable roller. If the thickness of single compacted layer does not exceed 100mm, a smooth wheel roller of 80 to 100 kN weight may be used. The speed of the roller shall not exceed 5 km/hr.
- (b) In the portions having unidirectional slope, rolling shall commence from the lower edge and progress gradually towards the upper edge. Thereafter, roller should progress parallel to the centre line, uniformly over-lapping each



preceding track by at least one-third width until the entire surface has been rolled. Alternate trips of the roller shall be terminated in stops at least 1m away from any preceding stop.

- (c) In portions in slope, rolling should begin at the edge with the roller running forward and backward until the edges have been firmly compacted. The roller shall then progress gradually towards the center parallel to the centre line of the road uniformly overlapping each of the preceding track by at least one- third width until the entire surface has been rolled.
- (d) Any displacement occurring as a result of reversing of the direction of a roller or from any other cause shall be corrected at once as specified and/or removed and made good.
- (e) Along forms, kerbs, walls or other places not accessible to the roller the mixture shall be thoroughly compacted with mechanical tampers or a plate compactor. Skin patching of an area without scarifying the surface to permit proper bonding of the added materials shall not be permitted.
- (f) Rolling should not be done when the sub grade is soft or yielding or when it causes a wave-like motion in the sub grade. If irregularities develop during rolling which exceed 12mm when tested with a 3 metre straight edge, the surface be loosened and premixed material added or removed as required before rolling again so as to achieve a uniform surface conforming to the desired grade and camber. In no case should the use of unmixed material be permitted to make up the depressions.
- (g) Rolling shall be continued till the density achieved is at least 98 per cent of the maximum dry density for the material as determined by the method outlined in IS: 2720 (Part-8)
- (h) After completion, the surface of any finished layer shall be well closed, free from movement under compaction equipment or any compaction planes, ridges, cracks and loose material. All loose, segregated or otherwise defective areas be made good to the full thickness of the layer and re-compacted.

#### **(vi) Setting and drying**

After final compaction of wet mix macadam course, the surface shall be allowed to dry for 24 hours.

#### **2.55.3. Surface evenness**

The surface finish of construction shall conform to the requirements of Clause 902 of MORT&H's Specification for Road and Bridge works or as directed by the Engineer-in-Charge.

#### **2.55.4. Quality control**

For control on the quality of materials and works carried out, relevant provisions of Section 900 of MORT&H's Specification for Road and Bridge works shall apply or as directed by the Engineer-in-Charge.

**2.55.5.** The WMM shall be complete in full on carrying out the required operations including full compensation for making arrangements for traffic, furnishing all materials to be incorporated in the work including all royalties, fees, rents wherever necessary and all leads and lifts, all labour, tool, equipment and incidentals to complete the work to specifications, carrying out the required tests for quality control etc.

**2.56. PROVIDING AND LAYING CEMENT CONCRETE FOR ROADS**

The work includes providing and laying design mix cement concrete of M-30 grade, in roads, parking yard, using cement content as per design mix, using coarse sand and graded stone aggregate of 20 mm nominal size in appropriate proportions as per approved & specified design criteria, providing dowel bars with sleeve/ tie bars wherever required, laying at site, spreading and compacting mechanically by using needle and surface vibrators, levelling to required slope/ camber, finishing with required texture, including steel form work with sturdy M.S. channel sections, curing, making provision for contraction/ expansion, construction & longitudinal joints (10 mm wide x 50 mm deep) by groove cutting machine, providing and filling expansion joints with approved bitumen hot sealing compound of Grade A type and filler materials as required as per direction of Engineer-in-Charge.

**2.57. EXPANSION JOINT**

Bitumen hot sealing compound grade 'A' shall be provided/laid for expansion joints for proper sealing.

**2.58. RETRO REFLECTIVE REGULATORY SIGN BOARD**

The work shall include providing Retro-reflective regulatory sign board of size 900 mm dia meter made out of 2 mm thick aluminium sheet, face to be fully covered with high intensity encapsulated lens type retro -reflective sheeting as approved by Engineer-in-Charge. Letter, symbols, orders etc. shall be as per IRC - 67 with required colour scheme on the boards and with the high intensity grade A. The aluminium sheet to be riveted to M.S. frame of angle iron of size 40x40x4 mm. The boards shall be fixed to 1 No. 50x50 mm square post made of M.S. angle 50x50x4 mm, 4 m long welded to the frame with adequate anti-theft arrangement. Sheet work shall be painted with two or more coats of synthetic enamel paint over an under coat (primer) and back side of aluminium sheet to be painted with two or more coats of epoxy paint including appropriate priming coat per direction of Engineer-in-Charge.

## **2.59. RETROREFLECTIVE ROAD MARKING**

The work shall include painting concrete surface of Road / track marking with adequate numbers of coats to give uniform finish with road marking paint of superior quality of approved make as approved by the Engineer-in-Charge conforming to IRC-35 and /or IS 164 as the case may be, including cleaning the surface of all dirt, scales, oil, grease and other foreign material. The thickness of the paint shall be as per Manufacturer's specification.

The colour of the centre line shall be yellow. On undivided roads the centre line marking shall consist of a single solid continuous line of 150 mm wide lane markings of 1.5 m and 3 m gaps as the case may be and as per instruction of the Engineer-in-Charge

## **2.60. PROVIDING AND LAYING CEMENT CONCRETE PAVER BLOCKS**

**2.60.1.** The paver blocks shall be laid over the surface prepared as per Clause 2.55 above.

**2.60.2.** The work includes providing and laying factory made chamfered edge Cement Concrete paver blocks of M-40 grade. The work shall be executed in foot path, park & lawns driveway or light & traffic parking etc. of required strength, thickness & size/shape as mentioned in the drawing and as per instruction of Engineer-in-Charge. The Paver blocks shall be laid by table vibratory method using PU mould, laid in required colour, design & pattern as per the drawing.

**2.60.3.** The bed of coarse sand shall be spread over the above prepared surface to an average thickness not less than 50mm and it shall be rammed and compacted as directed by the Engineer-in-Charge. The blocks shall be set hand tight over the prepared compacted bed and the surface shall be rammed /compacted and vibrated for proper embedding/laying of the paver blocks into the sand bedding layer by using plate vibrator to bring out joints not more than 2 to 3 mm wide between blocks and the joints shall be filled with the coarse sand. The blocks shall be cut to the required size and pattern wherever required and finished as per manufacturer's specifications & direction of Engineer-in- Charge.

**2.60.4.** The top surface of the paved area shall be in uniform level and no protrusions shall be seen at the top.

## **2.61. PROVIDING AND FIXING PRECAST CEMENT CONCRETE KERB STONES**

**2.61.1.** The kerb stones shall be laid to line, level and curvature over the prepared trench making joints with or without grooves. Thickness of joints except at sharp curve shall not be more than 5mm.

**2.61.2.** The joints of kerb stones shall be joined with neat cement mortar 1:3.

**2.61.3.** The trenches shall be back filled properly as directed by the Engineer-in-Charge and compacted by ramming.

**2.61.4.** Drain holes of 150mm x 300mm with sufficient slope are to be provided at an interval of 2.5m for proper drainage of rain water, wherever required.

## **2.62. MAIN ENTRANCE CANOPY GATE**

Main Entrance Canopy Gate shall be of Aluminium Composite panels, framing with Aluminium sections of 50mm x 25mm x 1.5mm thick rectangular tube, 'L' angles, Screws, Wood Screws, GE Weather proof silicon sealant etc. with 4mm thick Aluminium Composite Panel non-FR (Euro bond & Aludeccur & Alstrong/Alu Bond & Aluco Bond/ approved equivalent) of specified colour comprising polyethylene core sandwiched between two skins of 0.50mm thick special alloyed sheet to have overall thickness of 4mm, as required and fixed over aluminium frames. The panel thus pre-fabricated shall be fixed to suit site conditions. The aluminium panel to be pre-coated with highly weather resistant coating of fluoro carbon (PVDF) which can withstand solar radiation and industrial pollution, exposed surface with DUCO or as approved. The main frame work to be fixed to Steel structure/masonry/slab to form suitable grid and aligned to perfect level and form. The aluminium composite panels then to be fixed to the main frame leaving uniform gap of not more than 15mm between adjacent panels and to match adjacent glazing clips and -filled with appropriate weather proof silicone to make watertight and weather proof (DOW CORNING 789/ G.E or approved make). The gap shall be made suitable as weather sealed junction without using exposed sealant surface and as directed by Engineer-in-Charge.

## **2.63. LANDSCAPING WORK**

Landscaping work shall be executed in the areas as shown in the drawings. The detailed of items to be executed are as given below.

- a) Clearing jungle including uprooting of rank vegetation, grass, brush wood, trees and saplings and removal of rubbish.
- b) Supplying and stacking of good earth at site.
- c) Supplying Manure, proper mixing of Manure with good earth in proportion recommended by a Horticulturist and as approved by Engineer-in-Charge. Qualified Horticulturist shall be deployed by the contractor at their own cost, from starting of the Landscaping work till handing over the Project for proper maintenance of the landscaping work.
- d) Spreading of mixture of dump manure and good earth in required thickness recommended by the Horticulturalist as per direction of officer-in-charge.
- e) Providing and laying Mexican grass turf with earth 50mm to 60mm thickness of existing ground prepared with proper level and ramming with tools wooden (Dhurmos) and then rolling the surface with very light roller to make the surface smoothen and light watering with sprinkler and maintenance for 30 days or more till

the grass establish properly, as per recommendation and supervision of Horticulturist and as per direction of Engineer-in-Charge.

- f) Preparation of beds for hedging and shrubbery by excavating 60 cm deep and trenching the excavated base to a further depth of 30 cm, refilling the excavated earth after breaking clods and mixing with sludge or manure in the ratio of 8:1 (8 parts of stacked volume of earth after reduction by 20% : one part of stacked volume of manure after reduction by 8%), flooding with water, filling with earth if necessary, watering and finally fine dressing, levelling etc. including stacking and disposal of materials declared unserviceable and surplus earth by spreading and levelling as directed. The work shall be executed under supervision of Horticulturist and as directed by the Engineer-in-Charge.
- g) Digging holes in soil and refilling the same with the excavated earth mixed with manure in the ratio of 2:1 by volume (2 parts of stacked volume of earth after reduction by 20% : 1 part of stacked volume of manure after reduction by 8%) flooding with water, dressing including removal of rubbish and surplus earth, if any. The work to be executed under supervision of Horticulturist and as directed by the Engineer-in-Charge.
- h) Anti termite treatment by digging holes 30 cm deep and 4 cm dia, 6 to 7 holes around the tree using chemical emulsion at the rate of 1.5 litres per hole in two time or more application to get the trees free from termite infection chemicals used Chlorpyrifos 20% EC in the ratio of 1% concentration and as per direction of Engineer-in-Charge.
- i) Plantation of Trees, Shrubs, and Hedge at site watering and maintenance / upkeep work of the plants including all preparatory and allied work. The details of plant shall be as furnished below.

Sl. No	Name of Plant	Nos
1	Trees Plant	316
2	Shrubs Plant	1100
3	Hedge Plant /Ground cover	35340
TREES & PALMS		
4	Bauhinia blakeana	5
5	Brassaia actinophylla	6
6	Terminalia mantaly	9
7	Cordia sebestena	4
8	Cassia fistula	3
9	Cupressus sempervirens aureum	14
10	Plumeria singapore dwarf	3
11	Caesalpinia pulcherima	32
12	Ficus benjamina	37
13	Jacaranda mimosifolia	17

14	Plumeria rubra	1
15	Spathodea campanulata	1
16	Tecoma gaudichaudi	10
17	Chrysalidocarpus lutescens	54
18	Ptychosperma microcarpum	60
19	Phoenix dactylifera	7
20	Wodyetia bifurcata	
21	Royastonia regia	27
22	Licuala grandis	3
	SHRUBS	
23	Alpinia purpurata	30
24	Alpinia zarumbet veriegata	325
25	Canna indica	60
26	Leucophyllum frutescens	30
27	Ficus panda	45
28	Alamanda scotii	70
29	Hymenocallis littoralis	320
30	Crinum chocolate	50
31	Rhapis excelsa	40
32	Ixora red drawf	60
33	Strelitzia juncea	70
	GROUND COVER	
34	Chlorophytum comosum	1920
35	Pennisetum setaceum	230
36	Tradescantia spathacea	4590
37	Wadelia trilobata	8300
38	Zephyranthes candida	20300

The whole work The work is to be executed under supervision of Horticulturist and as directed by the Engineer-in-Charge.

## **2.64. INSTRUMENTATION AND MONITORING**

### **2.64.1. Stability and Settlement of Adjacent Properties**

The Contractor shall be solely responsible for the stability of all-adjoining structures and facilities. The Contractor shall execute his work such that public roadways, private access road, underground utilities; principal building and permanent facilities in adjoining properties are adequately protected from the detrimental effects of instability and ground subsidence.

The Contractor shall be required to assess the settlements and ground movements that he anticipates will occur around the site boundaries due to his work. His calculations and

assumptions on which these assessments will be made shall form a part of his submission to the local authority for the purpose of obtaining statutory clearance and securing the permit to commence work. A copy of such calculations and assumptions shall be made available to the Engineer for his record.

### **Limits on Ground Movement.**

The Contractor shall be responsible for restricting the maximum settlement and lateral movement of the ground adjacent to the site to lesser of either the statutory limit imposed by the Local Authority or 50 mm, measured from the initial pre-construction reference level or line. The Contractors' compliance to these limits shall not relieve him of his sole responsibility to make good at his own cost and in the manner prescribed by the Engineer and / or the local authority, all consequential damages to adjoining structures, roads and other properties arising from ground movements caused by excavation work.

## **2.64.2. INSTRUMENTATION AND MONITORING**

The Contractor shall allow in his tender for the cost of implementing an adequate ground movement monitoring system complying with the minimum requirements set out in this section. He shall be responsible for installing, measuring, recording and maintaining all necessary surface settlement points, peizometers and inclinometers, including securing the required permits and written consents from the local Authority and / or the adjacent Owners to have instrumentation installed.

## **2.64.3. GROUP MOVEMENT INSTRUMENTATION AND MONITORING**

### **Settlement of Adjacent Ground Surface**

The Contractor shall undertake an initial level survey along the site boundaries and maintain level checks of surface settlement points at daily intervals, or at such intervals as the Engineer may decide, for the duration of this Contract. Surface settlement points as the Engineer may decide, for the duration of this Contract. Surface settlement points shall be laid out at not more than 3m apart, or at such distances as the Engineer may decide, in two orthogonal directions to form a horizontal survey grid next to the boundaries.

### **Ground Water Level and Lateral Movement**

Piezometers and inclinometers shall be installed around the Site to monitor the level of the water table and lateral ground movement in the vicinity of principal buildings, utilities and public roadways during construction. The contractor shall provide a minimum of one set of piezometer and inclinometer at every 30 m length of boundary with an adjoining building and roadway, or at such distances as the Engineer may decide.

### **Measurement of Tilt Existing Building**

In order to protect the adjacent buildings, at least 2 sets of tilt meters shall be installed on its walls or columns to measure any tilt during execution of piling works.

The Contractor shall make careful and regular checks on the rate and magnitude of any settlements or ground movements of adjoining buildings, permanent facilities and roadways for the currency of the Contract. Records of all checks on ground movements shall be maintained by the Contractor and submitted to the Engineer and / or the Local Authority not later than two (2) days after measurement, and immediately should settlement or ground movement be such as to endanger the stability of adjoining properties.

## **2.65. DILAPIDATION SURVEY**

Immediately after taking possession of the site and BEFORE commencing any work on Site. The Contractor shall conduct an adequate dilapidation survey of all principal buildings and permanent facilities around the site boundaries to establish their general pre-construction condition. The survey report shall be lodged with the Employer, the Engineer, the local Authority, the adjacent Owners, and with any other party that the employer may direct.

For each adjacent building or facility, the Contractor shall prepare a set of photographic records and a schedule listing the size of the superstructure, extent of underground structure, visible defects and any other relevant details pertaining to the general condition of that building or facility.

**SIGNATURE OF TENDERER**



**SPECIFICATIONS FOR**  
**DISMANTLING AND SALVAGE OF EXISTING STRUCTURES**

**1. DESCRIPTION**

The Work shall consist of:

- i) Dismantling and removing (in whole or in part) the existing structure together with salvaging, cleaning, handling and storing of all usable or valuable parts and materials, and disposing of non- salvable materials and debris.
- ii) Design, supply, fabrication, installation, maintenance and removal of demolition of existing terminal building steel roof structure & roofing material ;
- iii) Backfilling of cavities created; and
- iv) Site restoration.

Shoring (if required) shall be completed in accordance with the Specifications for Temporary Works.

**2. REFERENCES AND RELATED SPECIFICATIONS**

All reference standards and related specifications shall be current issue or the latest revision at the date of tender advertisement.

References

Related Specifications

- Specifications for Supplying and Placing Backfill
- Specifications for Temporary Works

**3. SUBMITTALS**

The Contractor shall submit the following to the Engineer, in accordance with the Special Provisions:

- i) A detailed plan and schedule clearly illustrating the method and sequence by which the Contractor proposes to dismantle and remove the existing timber or steel

structures (in whole or in part), including a description of the measures that will be implemented to meet the environmental requirements. The demolition procedure shall include detailed design notes and Shop Drawings that are sealed, signed and dated by a Professional Engineer licensed to practice in the Province of Manitoba necessary to describe the following:

- (a) Access roads, Site Work Roads, work bridges and working platforms in accordance with the Specifications for Temporary Works.
  - (b) Type and capacity of equipment.
  - (c) Sequence of operation, including position of equipment.
  - (d) Proposed method of traffic accommodation and protection of the travelling public, when required.
  - (e) Design of demolition catch platforms.
  - (f) Description of the measures that will be implemented to meet the requirements of Environmental Management Procedures, including all monitoring and reporting requirements.
  - (g) Details and schedule of site restoration.
  - (h) Measures to be taken to protect adjacent structures, adjacent grades and portions of existing structure to remain.
- ii) Upon completion of the Work, a letter bearing the seal of the Registered Professional Engineer certifying that he has carried out a personal inspection of the Work and the method of demolition and removal, including any temporary works and the measures to meet the environmental requirements, have been completed in accordance with his sealed plans and procedures.
- iii) A description of the quantity and location for the demolition waste that will be recycled and reused.

#### **4. CONSTRUCTION METHODS**

Closing To Traffic :

The Contractor shall not close any portion of the existing rail line or roadways to traffic or begin the dismantling and removal operations without prior written approval from the Engineer. The approval will not be given until all required traffic control devices have been erected and the requirements of the traffic control plan have been met to the satisfaction of the Engineer.

## **Dismantling and salvaging**

### **i) General**

The Contractor shall be fully responsible for ensuring safety in areas underlying and adjacent to the construction site. The Contractor will be responsible for any loss or damage caused as a result of his actions. The Contractor shall prevent movement, settlement or damage to adjacent structures, grades or portions of existing structures to remain. If the safety of the structure being removed, or adjacent structures or grades appear to be in danger, the Contractor shall cease operations and notify the Engineer immediately.

All bridge components, in whole or in part, that have been deemed non-salvable by the Engineer, shall not be reused in any other bridge or structure in the future, and shall be disposed of off-site

The Contractor shall obtain and pay for all licenses and permits, and shall comply with all Municipal, Provincial and Federal regulations related to demolition and disposal of these materials.

### **ii) Dismantling and Salvaging**

The existing structure shall be dismantled and removed in a careful and workmanlike manner and the use of equipment or facilities that might damage portions of the structure to be salvaged shall not be permitted. Bolts, screws, pins and nails shall be removed in such a manner as to avoid splitting and breaking of the timbers. Salvable material shall be cleaned, sorted and stored as to size and length for purposes of checking and preparing lists.

Salvable timber shall be trimmed to usable lengths as directed by the Engineer. Piles shall be cut off neatly at the proposed or existing ground line, as directed by the Engineer. When in water, the piles shall be cut off at the existing stream bed. All lumber such as decking shall be strapped in bundles of approximately 1 m<sup>3</sup>. The length of the salvaged stringers shall be clearly marked with yellow paint on both ends of stringer

### **iii) Salvable Materials**

Material having salvage value shall be carefully handled to avoid damage and shall be piled neatly at a location adjacent to the work. A detailed list of salvable material shall be prepared by the Contractor and provided to the Engineer.

Salvable material is the property of the Contractor will be held responsible for all material not accounted for. The salvable material shall not be used by the Contractor for any of his construction operations.

## **5. REMOVAL AND DISPOSAL OF NON-SALVABLE MATERIALS**

Any debris that falls off the structures onto the underlying ground, roadway or railway right-of-way shall be immediately cleaned up by the Contractor.

The Contractor shall remove all non-salvable materials and debris from the site as soon as possible. All material shall be deemed non-salvable unless noted otherwise on the Drawings or Special Provisions. Demolition debris shall become the property of the Contractor and shall be properly disposed of at an approved location, in accordance with the applicable Provincial and Municipal Regulations and Acts. Storage of non-salvable materials and debris will not be allowed on site without the written approval of the Engineer.

## **6. BACKFILLING OF CAVITIES**

The Contractor shall backfill all cavities created by the dismantling and removal operations with suitable material approved by the Engineer and in accordance with the Drawings and the Specifications for Supplying and Placing Backfill.

## **7. SITE RESTORATION**

The Contractor shall restore the site to the profile and grade as shown on the Drawings and to the approval of the Engineer.

## **8. QUALITY MANAGEMENT**

The Contractor shall allow the Engineer unhindered access to the demolition areas and shall assist the Engineer in carrying out inspections, including provision of access platforms. Upon completion of dismantling and removal (in whole or in part), a final inspection will be made by the Engineer.

Contractor is having all authorization to sell scrap /salvage materials to the third party post approval from client /PMC /engineer in incharge

## **9. ITEMS TO COVER IN DISMANTLING AND DISPOSSAL INCLUDING ALL LIFTS AND LEAD :**

- cement concrete manually/ by mechanical means including disposal of material
- Nominal concrete 1:3:6 or richer mix /equivalent design mix
- Nominal concrete 1:4:8 or leaner mix/ equivalent design mix

- R.C.C. work manually/ by mechanical means for Columns/ Beams/ Staircase and slab/UG tanks / etc complete
- brick work / laterite stone manually/ by mechanical means
- doors, windows and clerestory windows (steel or wood) shutter including chowkhats, architrave, holdfasts etc. complete
- aluminium/ Gypsum partitions, doors, windows, fixed glazing and false ceiling
- roofing including ridges, hips, valleys and gutters etc., and stacking the material within
- steel work in built up sections in angles, tees, flats and channels including all gusset plates, bolts, nuts, cutting rivets, welding etc. including dismembering and stacking.
- Disposal of moorum/building rubbish/ malba/ similar unserviceable, dismantled or waste material by mechanical transport including loading, transporting, unloading to approved dumping

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**SIGNATURE OF TENDERER**

**INTERNATIONAL & DOMESTIC CRUISE TERMINAL &  
ALLIED FACILITIES AT MORMUGAO PORT, GOA**

**SPECIFICATIONS FOR PHE WORKS**

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## **1. INTRODUCTION**

INTERNATIONAL & DOMESTIC CRUISE TERMINAL & ALLIED FACILITIES AT MORMUGAO PORT, GOA

## **2. SCOPE**

The scope of Public Health Engineering Services though not limited can be classified as follows

- Domestic & Flushing water supply system.
- Soil & Waste water drainage system.
- Water treatment plant
- Sewage Treatment Plant.
- Rain/storm water management system

## **3. STANDARDS AND CODES**

- NATIONAL BUILDING CODES
- INDIAN STANDARDS
- CPHEEO MANUAL (GOVT OF INDIA)
- UPC

## **4. CONCEPT OF THE SYSTEM**

**THE FOLLOWING SERVICES ARE ENVISAGED FOR THE COMPLEX:**

- Water treatment system for meeting domestic & drinking water quality requirement in acceptance limits as per IS 10500-2012
- Domestic Water shall be distributed to the top two floors by Booster pumps and by gravity to the remaining floors.
- Sewage treatment is as per SPCB/CPCB norms
- Reuse of Treated effluent from STP for flushing, cooling tower makeup & Irrigation Purpose
- Peripheral Storm water drainage system
- Provision of Roof rain water drainage system and collection. Reuse of stored rain water for domestic as per MOEF

## **SECTION – I: GENERAL REQUIREMENTS**

### **1.1 Scope**

The General character and the scope of work to be carried out under this section as illustrated in the drawings, specifications and scope of work attached herewith. The contractor shall carry out and complete the said work under this contract in every respect in conformity with the rules and regulations of the local authority. The Contractor shall furnish all labour, materials, appliances, tools and equipment necessary for the work for plumbing services installation including testing and commissioning as specified herein, and as per the relevant Bureau of Indian Standards (BIS), British Standards codes, and as shown on the drawings. This also includes any material, appliances and equipment not specifically mentioned here in or noted on the drawings as being furnished or installed which are necessary and customary to make a complete installation properly connected and in working order.

Carryout all incidental works connected with plumbing services installation such as excavation of trenches and back filling, cutting and chasing in concrete and brick and making good, cutting/drilling holes through walls, floors, and grouting for fixing of fixtures/equipment and so forth.

Furnish and install complete workable plumbing services installation as shown on the drawings and described in this specification and as per the latest Bureau of Indian Standards (BIS), British Standards (BS) specifications including all that which is reasonably inferred to all the buildings, internally and externally.

Complete installation of the sewerage and sewerage appurtenances internally as well as around the building.

Complete installation of all sanitary and plumbing fixtures in all buildings.

Co-operation with other trades in putting the installation in place. Any work done without regards or consultation with other trades, shall be removed by the contractor without additional cost to the Owner, to permit proper installation of all other work, as desired by the Architect/Consultant.

Repair all damage done to the premises as a result of this installation and remove all debris left by those engaged for this installation to the satisfaction of Architect/Consultant.

Cleaning of all plumbing and sanitary fixtures, testing and providing the satisfactory performance of all fixtures at the time of buildings are handed over to the Owner.

It is the responsibility of the contractor to take care of all the fixtures fitted until the time of handing over to the Architect/Consultant.

Painting of all exposed pipes shall be done by contractor as specified in the specification.

Assume full responsibility for getting the entire installation duly approved by the authorities concerned and for all expenses in connection with the same. Assume responsibility for obtaining and delivering to the Owner certificate of final inspection and approval by the concerned authorities.

## 1.2 Licensed Plumber

All work performed by the contractor shall be through licensed plumbing supervisor possessing a valid plumbing contractor's license employing Engineers, Technicians, Foremen, Plumbers, Masons, Helpers, etc., as required.

## 1.3 Regulations and Standards

The installation shall conform in all respects to the following standards in general:

<b><u>Pipes and Fittings</u></b>	
IS 13592	: Specification for unplasticized PVC pipes for soil and waste discharge system inside building including ventilation and rainwater.
IS 783	: Code of practice for laying of concrete pipes
IS 4985	: Specification for unplasticized PVC pipes for potable water supplies (second revision)
IS 3114	: Code of practice for Laying of CI pipes
IS 458	: Specification for precast concrete pipes (with or without reinforcement)
<b><u>Valves</u></b>	
IS 778	: Specification for copper alloy gage, globe and check valves for water works purposes.
IS 1703	: Specifications for copper alloy float valves (horizontal plunger type) for water supply fittings.
IS 4038	: Specification for foot valves for water works purposes.
IS 13095	: Butterfly valves for general purposes.
IS 12992 (Part 1)	: Safety relief valves, spring loaded
IS 5312 (Part 1)	: Specification for swing check type reflux (non-return) valves: part 1 Single door pattern.
IS 5312 (Part 2)	: Specification for swing check type reflux (non-return) valves: part 2 Multi door pattern.
<b><u>Sanitary Fittings</u></b>	
IS 2064	: Code of practice for selection, installation and maintenance of sanitary appliances
IS 2692	: Specification of ferrules for water services
IS 2548 ( Part 1&2 )	: Specification for plastic seats and covers for water closets.
IS 3004	: Specification for plug cocks for water supply purposes.
IS 1711	: Specification for self closing taps for water supply
<b><u>Pumps</u></b>	

IS 5600	:	Specification for sewage and drainage pumps
IS 8034	:	Specification for submersible pump sets for clear, cold, fresh water.
IS 8418	:	Specification for horizontal centrifugal self-priming pumps.
<b>General</b>		
IS 5329	:	Code of practice for sanitary pipe work above ground for buildings.
IS 12251	:	Code of practice for drainage of building basements
IS 1200 ( Part 1)	:	Method of measurement of building earthwork
IS 1200 ( Part 16)	:	Method of measurement of laying of water and sewer lines including appurtenance
IS 1200 ( Part 19)	:	Method of measurement of Water supply, plumbing and drains.
IS 2527	:	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS 6784	:	Method of performance testing of water meters (Domestic type).
IS 12235 ( Parts 1 to 11)	:	Methods of test for unplasticized PVC pipes for potable water supplies.
IS 782	:	Specification for Caulking Lead.( Third revision)
IS 1172	:	Code of basic requirements for water supply, drainage & sanitation (revised).
IS 1239 –(Part I)	:	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1239 –(Part II)	:	Specifications for mild steel tube, tubular and other steel pipe fittings.
IS 1726	:	Code of cast iron manhole frame and cover (third revision).
IS 1742	:	Code of practice for building drainage.( Second revision)
IS 2064	:	Code of practice for selection, installation and maintenance of sanitary appliances.
IS 2065	:	Code of practice for water supply to buildings.
IS 732 & IS 2274	:	Indian Standard code of practice for electrical wiring & installation.

The installation shall be in conformity with the bylaws and requirements of the local authority in so far as these become applicable to the installation. Wherever this specification calls for, a higher standard of materials and /or workmanship than those required by any of the above regulations and standards, then this specification shall take precedence over the said regulations and standards.

Wherever drawings and specifications require something that may conflict with the regulations, the regulations shall govern. This shall be referred to the Superintendent for arbitration.

## **1.4 Drawings and Specifications**

The drawings and specifications shall be considered as part of this contract and any work or materials shown on the drawings and not called in the specifications or vice versa shall be executed as if specifically called for in both.

The tender drawings indicate the extent and general arrangement of the fixtures, drainage system, etc.. The drawings indicate the points of supply and termination of work shall be installed as indicated in the drawings. However, any changes found essential to co-ordinate with this work and other trades shall be made without any additional cost. The drawings and specifications are meant for the assistance and guidance of the contractor, and exact location, distance and levels will be governed by the individual building and site conditions. Therefore, approval of the Superintendent shall be obtained before commencement of work.

## **1.5 Shop Drawings**

- The contractor shall submit to the Owner four copies of the shop drawings.
- Shop drawings shall be submitted under the following conditions:
- Indicate any changes in the layout in the contract drawings.
- Floor plans, Enlarged toilet details, schematic showing water supply and sanitary installation works
- Pumps /Equipment layout, control panel, wiring and piping diagram.
- Manufacturer's or Contractor's fabrication drawings for any materials or equipment.
- The contractor shall submit four copies of catalogues, manufacturer's drawings, equipment characteristic data or performance charts as required by the Owner.

## **1.6 As Built Drawings**

On completion of works, the Contractor shall submit one complete set of original tracings and two prints of "As built" drawings to the Owner. He should submit all drawings / information in AutoCAD latest version. These drawings shall have the following information:

- Contractor shall provide exact length and sizes of all piping on all floors and vertical stacks.
- Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.

- Run of all water supply lines with diameters, location of control valves and access panels.
- Contractor shall provide Location of all mechanical equipment with layout and piping connections.
- Contractor shall provide four sets of catalogues, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.
- All “Warranty Cards” given by the manufacturers shall be handed over to the Superintendent.

### **1.7Manufacturers’ Instructions**

Where manufacturers have furnished specific instructions relating to the materials used in this job and methods of construction that are not specifically mentioned in these documents, such instructions shall be followed in all cases. The contractor shall also furnish detailed instruction and operation manuals in triplicate including detailed completion drawings and Fire Safety Plans on a tracing cloth to approved scale. Further it is the responsibility of the contractor to train the Owner's personnel in the operation and maintenance of the system.

### **1.8Materials**

Materials shall be of approved make and quality specified. They shall conform to the respective Bureau of Indian Standards, British Standards Specifications and supported by Manufacturing Certificate / test certificate.

Samples of all materials shall be as per the list of approved brand manufacture, which shall be approved by the Superintendent before placing the order.

In any case of non availability of materials in metric sizes, the nearest size of FPS units shall be provided with prior approval of the Superintendent at no extra cost to the owner.

### **1.9Guarantee**

The contractor shall guarantee both the material and workmanship of first class quality corresponding to standard engineering practice. Any defective materials / workmanship shall be rejected, the contractor has to rectify / replace at his own cost. Guarantee certificate of the materials supplied shall be handed over to the owner.

## **SECTION – II: SOIL, WASTE AND VENT PIPES AND RAIN WATER PIPES**

### **1.1 General Requirements**

- Materials shall be of the approved make and quality specified. They shall conform to the respective Bureau of Indian Standards, British Standards Specifications, supported by Manufacturing Certificate and any other specification referred to herein.
- Pipes and fittings shall be fixed truly vertical, horizontal or on slopes as required in neat manner.
- Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, and in suspended ceilings.
- Pipes shall be fixed securely to walls and ceilings by suitable pipe supports at intervals specified.
- Access door for fittings and cleanouts shall be located that they are easily accessible for repair and maintenance.

## **1.2 Polyvinyl Chloride (PVC) Pipes and Fittings Material**

### **Soil, waste & vent pipes shall be PVC pipes & fittings.**

PVC (SWR) class pipes conforming to IS 13592 of dia 63mm up to 250mm dia of Type A are used in rain water & ventilation and Type B for soil and waste discharging system shall be used. The pipes shall be supplied in nominal lengths of 2, 3, and 4 or 6 meters, tolerance on specified lengths shall be +10mm and – 0mm. Any physical test requirements shall be as per IS 13592. And Pipe of higher Dia i.e. 160mm Dia. and above shall be agricultural series (6kg / sq. cm pressure rated) made as per IS 4985.

#### **1.2.1 HANDLING**

Because of their light weight, there may be a tendency for the PVC pipes to be thrown much more. Reasonable care should be taken in handling and storage to prevent damage to the pipes. Contractor should hold the fullest responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be given adequate supports at all times.

#### **1.2.2 LAYING**

The PVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be, as shown in the drawings. The minimum thickness of fittings shall be of 3.2 mm. the fittings shall be of injection mould type with solvent cement joint or rubber ring joint. The pipes and fittings shall be capable of withstanding



sun's rays. PVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets / supports as detailed in the drawings.

### **1.2.3 JOINTING**

The jointing of pipes to fittings shall be done as per the manufacturer's instructions / recommendations. The UPVC pipes and fittings shall be joined with Solvent Cement and jointing shall be carried out as follows:

1. Cut the spigot end of the pipe square.
2. All burrs from the internal and external surfaces should be removed.
3. The spigot should be marked with a pencil line and a distance equivalent to the socket depth. Clean the surface within the marked area.
4. Apply uniform coat of solvent cement on the external surface to the pipe and a lighter coat on the internal surface of the fitting.
5. Insert the pipe end into the socket of the fitting and push it in up to the mark.
6. Remove the excess solvent cement and hold the joint firmly in position for 30seconds to dry. Gluing should be avoided in a rainy or foggy weather.

The other method of jointing shall be rubber rings. The material of rubber ring should conform to IS 5382-1969. The ring is housed in groove formed in a plastic or metallic housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber rings are used, mineral oil or petrol or grease should be used. Joining of UPVC pipes shall be made means of solvent cement for horizontal lines and by rubber ring for vertical lines.

### **1.2.4 TESTING**

PVC pipes and fittings shall be tested for water tightness in accordance with IS 13592. The openings of the pipes shall be sealed for the section to be tested. The water pressure of 1mtr water column to be applied for a period of 15 minutes. The Engineer-in-Charge shall examine carefully all the joints for leakage.

## **1.3 PVC PRESSURE PIPES AND FITTINGS**

The PVC pressure pipes and fittings shall be used for conveying waste water from wash basins, Urinals, kitchen sinks, floor drain connecting to washing machines, etc. The pipes shall be class III, 6 Kg/cm<sup>2</sup>. PVC pipes and fittings shall be jointed with solvent cement. The pipes shall conform to IS 4985. Fittings shall be of injection moulded PVC conforming to IS 7634 (Part1) - 1975.

### **1.3.1 LAYING AND FIXING**

The pipe laying and jointing shall be done in accordance with IS 7634 (Part 3) – 1975. Pipes shall be cut to size and chamfered well. Pipes and fittings shall be jointed using solvent cement or rubber ring joints. The pipes and fittings shall be jointed accurately without any stress to achieve leak proof joints.

### 1.3.2 TESTING

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to the test pressure. The water pressure of 1mtr water column to be applied for a period of 15 minutes.

### 1.4 CAST IRON PIPES AND FITTINGS

Soil, waste and vent pipes in shaft and basement ceiling, podium drainage pipes- shall be cast iron pipes. All pipes shall be straight and smooth and inside free from irregular bore, blow hole, cracks and other manufacturing defects. Pipes shall centrifugally spun iron soil pipes conforming to I.S 3989-1984, 1729-1979.

Standard weight, dimension and DRIP SEAL required for joints shall be as follows:

For pipes conforming to IS 3989-1984 (centrifugally cast pipes)

Nominal dia		Thickness	Overall Weight6' length 1.83mm	Internal diameter of socket	Depth of lead
inches	mm	mm	kg.	mm	mm
2	50	3.5	8.5	73	25
3	75	3.5	12.7	99	25
4	100	4.0	19.2	126	25
6	150	5.0	35.5	178	38

### TOLERANCES

Tolerances on the external diameter of the barrel as mentioned below. The internal diameter of the socket and the depth of socket shall be as follows:

Dimension	Nominal diameter mm	Tolerance
mm		
External Diameter in barrel	50, 57	+ 3.0
	100	+ 3.5
	150	+ 4.0
Internal diameter of barrel	All diameters	+ 3.0
Depth of socket	All diameters	+ 10.0

**Dimension** Nominal - Size A

Pipe	{External diameter, B	50	75	100	150
	{Thickness, C	60	85	110	160
		5	5	5	5
	{Internal diameter, F	76	101	129	181
Socket	{Thickness, H	6	6	6	6
	{Internal depth, J	60	66	70	75
Overall length 1800mm					
Nominal Weight of Pipe		kg	kg	kg	kg
(Exclusive of ears)		11.41	16.52	21.67	31.92
Weight tolerances in all items +10%					

#### 1.4.1 Laying and Jointing

##### ***Cleaning of Pipes and Fittings***

All lumps, blisters and excess coating shall be removed from the socket and spigot end of each pipe. The outside of the spigot and the inside of the socket shall be wire brushed and wiped clean and dry and free from oil and grease before the pipe is laid.

##### **Closing the Ends of Pipe to Prevent Entry of Foreign Materials While Laying Pipe**

Every precaution shall be taken to prevent foreign material entering the pipe while it is being placed in the line. If the pipe laying team cannot put the pipe into the trench and in place without getting earth into it, the Engineer in charge may order a heavy tightly woven canvas bag of suitable size be placed over each end and left there until the connection is to be made to the adjacent pipe that before lowering the pipe into the trench. During laying operations, no debris, tools, clothing or any other material shall be placed in the pipe. After laying and jointing of a reach is completed the two free ends shall be kept closed to prevent entry of foreign materials, rodents and other animals.

##### **Cutting of Pipe**

The cutting of pipe for inserting fittings or closure pieces shall be done in a neat and good workmanship without any damage to the pipe so as to leave a smooth end at right angles to the axis of the pipe. For this purpose use of a pipe cutter is recommended. Pipe cutting machines are recommended for large dia of pipes. When pipe-cutting machines are not available for cutting pipes of large diameters, the electric arc cutting method may be permitted using carbon or steel rods.

Only qualified and experienced workmen shall be employed on this work. When the pipe-cutting machine is not available and the site conditions do not permit pipe cutting by machine, the pipe can be cut using a chisel. Flame cutting of pipes by means of ox-acetylene torches shall not be allowed.

### **Direction of Laying of Socket End**

On level ground, the socket ends should face the upstream. When the line runs uphill the socket ends should face the upgrade. The permitted tolerance for deflection for lead joint shall be 2.5 millimetres.

### **Jointing**

Jointing of socket and spigot pipes is done by DRIP SEAL (under dry conditions).

### **1.4.2 Testing**

The method which is commonly in use is filling the pipe with water, taking care to evacuate any entrapped air and slowly raising the system to the test pressure. The pressure of 1mtr water column to be applied for a period of 60 minutes.

### **1.4.3 Mode of Measurement**

Cast Iron Pipes shall be measured along the centre line of the pipeline including the specials in running meter (Rmt). Quoted rate shall include specials and the pipes shall be measured between:

- a. Chambers: Shall be recorded from the inside of one chamber to inside of another chamber.
- b. Gully trap and Chamber: Shall be recorded between socket pipe near gully trap and inside of chamber.

### **1.5 MS BRACKETS**

The brackets should be of 25x5mm MS angle and 50x 5 mm MS flat. The length and profile of bracket shall be as per site conditions. The brackets shall be provided hot dip galvanizing after fabrication. The brackets shall be fixed in true alignment and level. The bracket shall be fixed to the RCC members using 8mm dia anchor fasteners in adequate number based on length of bracket. The brackets can be fixed to masonry wall using holdfast arrangement. In such cases curing shall be done for at least 3 days.

The pipes shall be fixed to the brackets with the help of threaded U bolts or C clamp with 25x 6 mm GI Nut bolts. Spacing of bracket shall be governed by the pipe material.

### **1.6 PVC khurra**

The khurras shall be straight type or bend type as per the location of outlet. It consists of a rigid PVC body, leaf trap with grating, PVC sheet 400mmx400mm welded to collar.

The khurra should be fixed firmly on to the parapet wall or roof slab with concrete. Due consideration shall be given to the finished level of roof while fixing the same.

### **1.7 RCC Hume Pipes:**

The pipes shall be with or without reinforcement as required and of the class NP2 as specified. These shall conform to IS 458-2003. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process. All pipes shall be true to shape, straight, perfect sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate, mixing or moulding.

#### **1.7.1 Laying of pipes**

Loading, transporting and unloading of concrete pipes shall be done with care. Handling shall be such as to avoid impact. Gradual unloading by inclined plane or by chain block is recommended. All pipe sections and connections shall be inspected carefully before being laid. Broken or defective pipes or connections shall not be used. Pipes shall be lowered into the trenches carefully. Mechanical appliances may be used. Pipes shall be laid true to line and grade as specified. Laying of pipe shall proceed up grade of a slope.

If the pipes have spigot and socket joints, the socket end shall face upstream in the case of pipe with joints to be made with loose collars. The collar shall be slipped on before the next pipe is laid. Adequate and proper expansion joints shall be provided where directed.

In case where the foundation conditions are unusual such as in the proximity of trees or holes, under existing or proposed manholes etc., the pipe shall be encased all round in 15cm thick cement concrete 1:5:10 (1 cement, 5 fine sand, 10 graded stone aggregated 40mm nominal size) or compacted sand or gravel.

In cases where the natural foundation is inadequate the pipes shall be laid either in concrete suitably designed structure as specified. If a concrete cradle bedding is used the depth of concrete below the bottom of the pipe shall be at least 1/4th of the internal dia and shall extend up to the sides of the pipe at least to a distance of ¼ of the outside diameter of pipes 300 mm dia.. The pipes laid in trenches in earth shall be bedded evenly and firmly and as far up the haunches of the pipe as to safely transmit the load expected from back fill through the pipe to the bed. This shall be done either by excavating the bottom of the trench to fit the curve of the pipe or by compacting the earth under around the curve of the pipe to form an even bed. Necessary provision shall be made for joints wherever required.

When the pipe is laid in the trench in rock, hard clay, or other hard material, the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compact earth. In all place pipe shall be laid directly on such hard material.

When the pipes are laid completely above the ground the foundations shall be made even and sufficiently compacted to support the pipe line without any material settlement. Alternatively the pipe line shall be supported on PCC saddle blocks. Similar arrangement shall be made to retain the pipe line in the proper alignment, such as by shaping the top of the supports to fit the lower part of the pipe, the distance between the supports shall in no case exceed the length of the pipe. The pipe shall be supported as far as possible close to the joints. In no case shall the joint come in centre of the span. Care shall be taken to see that superimposed loads greater than the total load equivalent to the weight of the pipe when running full shall not be permitted.

### **1.7.2 Jointing of pipes:**

Joints are generally of rigid type. When specified flexible type joints may also be provided.

#### **SPIGOT AND SOCKET JOINT (RIGID):**

The spigot of each pipe shall be slipped home well in to the socket of the pipe previously laid and adjusted in the correct position. The opening of the joints shall be filled with stiff mixture of cement mortar in the proportion 1:2 (1cement, 2fine sand) which shall be rammed with caulking tool. After a day's work any extraneous material shall be removed from the inside of the pipe and the newly made joint shall be cured.

## **1.8 ECO Nu-Drain Pipe**

### **1.8.1 Material**

Plastic moulded inspection chambers are made as per BS and EN standards. Solid wall uPVC Nu-Drain pipes conform to IS:15328- 2003, Hi-tech structured wall pipes viz. Eco-drain, Foam Core and Ultra Plus DWC pipes conform to IS:16098 and meet all the test requirements of European and International standards. These pipes are made as per IS:16098 and meet all the test requirements of European and International standards for "Structured-wall pipes and fittings" for Underground Drainage and Sewerage. These pipes have equivalent stiffness and flexibility in combination with a weight reduction from 10 to 35%, depending on size. The pipes are plain ended and are available in 110 to 400mm sizes. The pipes are available in different stiffness classes as given in the table. These pipes are interchangeable with solid wall pipes and are compatible with regular PVC fittings.

### **1.8.2 Laying & Jointing**

Unique design of joints with fixed click ring and sealing ring, the system is completely leak-proof. Joints are stable, watertight and can accommodate angular deflection and axial displacement. Joints are designed to resist loads from horizontal and vertical forces. These joints can accommodate 3° angular deflection in any direction and hence offer good flexibility against lateral or vertical soil movements. The pipes laid in the soil shall be enclosed with selected sand filling as per the bill of quantities.

### Dimensions and Stiffness Class of Eco-Drain Pipes as per IS:16098

Pipe size OD (mm)	Pipe ring stiffness (KN/m <sup>2</sup> )					
	SN 2		SN 4		SN 8	
	Wall thickness (mm)					
	Min	Max	Min	Max	Min	Max
110	-	-	-	-	3.50	4.10
160	-	-	4.30	4.90	5.10	5.90
200	-	-	5.60	6.50	6.30	7.20
250	-	-	6.50	7.50	7.90	9.10
315	6.60	7.60	8.00	9.20	9.80	11.30
400	8.50	9.80	10.60	12.20	12.00	13.80

#### 1.8.3 Mode of Measurement

Stoneware pipes shall be measured along the centreline of the pipeline including the specials in running meter (Rm.) between:

- a. Chambers: Shall be recorded from the inside of one chamber to inside of another chamber.
- b. Gully trap and chamber: shall be recorded between socket pipe near gully trap and inside of chamber.

The quoted rate shall include the following:

- i. The cost of pipes, specials and other jointing materials.
- ii. Laying, jointing and curing.
- iii. Testing and making good the defects if any.

### SECTION – III: SANITARY FIXTURES INSTALLATION

#### 1.1 General

All fixtures shall be fixed in a neat workman like manner true to line and as recommended by the manufacturer or shown in the drawings. Care shall be taken to fix all fixtures, brackets and accessories by proper wooden cleats, rawl plugs, bolts and nuts.

Care shall be taken in fixing all approved chromium plated (CP) single lever fixtures and accessories so as not to leave any tool marks or damages on the finish. All such fixtures shall be tightened with fixed spanners. Use of 'Stiltson' type pipe wrenches with toothed

jaws shall not be allowed.

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

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

### **1.1.1 In brief the scope of work involves following**

Sanitary appliances and fixtures for toilets  
Chromium plated bath fittings  
Stainless steel sinks  
Accessories like towel rack, toilet paper holder, soap dish, tumbler holder, coat hook etc.

All appliances, fixtures and fittings shall be provided with all such accessories are required to complete the item in working condition whether specifically mentioned or not in the schedule of quantities, specifications and drawings. Accessories shall include proper fixing arrangements, brackets, nuts-bolts, washers, screws and required connection pieces etc.

### **1.2 European Type Water Closet**

The closet shall be white or colored as per BOQ and made of vitreous China and shall be of the best quality manufactured by an approved firm, and fixed by approved means. It shall have 100 mm dia `P` or `S` trap depending on the location of water closets and soil stacks with effective seal. The water volume shall be 3 and 6 litres per flush or 2 and 4 litres per flush. Each closet shall be provided with the following accessories:

- a. Double flapped heavy urea formaldehyde seat cover of approved make quality and color with rubber buffers and C.P. brass screws fixed to the pan.
- b. Exposed ceramic cistern of approved design.
- c. Cast-iron chair or rag bolt for wall hung type with C.P bolt & nut.

### **1.3 Wash Basins**

They shall be white or colored as per BOQ and of vitreous China with best quality manufactured by an approved firm and size as specified. Oval/circular wash basins shall be supported on a RC counter with necessary steel reinforcement and rectangular wash basins with or without pedestals shall be supported by a pair of rag bolts of approved design. The washbasin shall be circular or oval shape below or above counter or



rectangular with or without pedestal type as specified in Schedule of Quantities. The basin shall be provided with waste coupling, bottle trap, angle cocks, pillar cock/ basin mixer, connecting pipes and other accessories. The flow rate of pillar cock or basin mixer shall be less than 2 liters per minute at 60 psi pressure.

#### **1.4 Sink**

They shall be Stainless steel of AISI 304 -18/8 grade and shall be supported on counter. Each sink shall be provided with 40 mm CP waste coupling, CP bottle trap, Table/wall mounted sink cock/mixer, angle cock and other accessories.

#### **1.5 Health Faucet**

These shall be of brass CP .The make and model shall be as specified in the BOQ. These shall be fixed by means of stainless steel counter sunk screws to wooden/ plastic cleats firmly embedded in the wall.

- 15 mm CP health faucet with 1.0m long flexible tube with end nuts & Hook.
- 1 No 15mm CP brass angular stop cock with wall flange
- Hook with CP brass counter sunk screws.

#### **1.7 WATER HEATER**

These shall be of best approved make and type and capacity as per schedule of quantities. They shall be mounted on the wall with necessary bolts of approved make. They shall have braided hose inlet pipe, angle stop cocks, Built in safety valve, non-return valve. These shall be measured per number and the quoted rate shall include.

- Cost of water heater with all the built -in electrical accessories like pilot lamp, thermostat, standard length of cable and 3 pin 15A plug. Remote control assembly.(optional)
- Two angle stop cocks and connection pipes.
- Fixing accessories like bolts, nuts, etc.

#### **1.8 Angular Stop Cock**

These shall be of brass, CP. The make and model shall be as specified in the BOQ. These shall be fixed by means of Teflon tape, extension nipple of suitable length shall be provided, if required. The stopcock shall be provided with CP wall flange.

#### **2.0 Bib Cock & Stop Cock**

A bibcock is a draw off tap with a horizontal inlet and free outlet and stopcock (stop tap) valve with a suitable means of connections for insertion in a pipeline for

controlling or stopping the flow. They shall be of specified size and shall be screw down type. The closing device should work by means of a disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates. The handle shall be either crutch or butterfly type securely seated pattern. The cocks (taps) shall open in anticlockwise direction. The bib cock and stop cock shall be polished bright (Chrome plated).

## **2.1 Urinal**

Urinal shall be back inlet type, white colored and of vitreous China with best quality manufactured by an approved firm. The urinal shall be fixed with hangers and brackets. The urinal shall be provided with auto flush system with sensor, solenoid valve / pneumatic push cock / angle valve etc., complete. Make and model shall be as specified in the BOQ. The complete set shall comprise of the following.

- Urinal with auto flush system along with battery / electrically operated solenoid valve / with push cock.
- Fixing brackets,
- 32mm CP Bottle Trap, dome type grating, spreader etc., if the specified model is not having in-built units as indicated above the same shall be part of the scope of work.
- CP wall flanges (if required).

## **2.2 Urinal Division Plate**

Urinal division plate of size 700 x 340 x 120mm of approved make white glazed and is fixed to wall by using CP brass counter sunk screws etc., complete

## **3.1 Toilet Accessories**

### **3.1.1 Towel Rack**

Towel rack shall be of C.P. with reinforced bends and circular flanges. The size of the rail shall be as specified. The bracket shall be fixed by means of stainless steel screws to wooden/plastic cleats firmly embedded in the wall.

### **3.1.2 Toilet Paper Holder**

Toilet paper holder shall be of chromium plated as specified in the Material specification.

### **3.1.3 Towel Ring**

These shall be of CP as specified in the material specification. These shall be fixed by

means of stainless steel screws to wooden / plastic cleats firmly embedded in the wall.

#### **3.1.4 Grab Bar**

The grab bars shall be of stainless steel of approved quality. The size and location shall be as specified in the BOQ.

#### **3.1.5 Floor Traps Frame and Grating**

The floor trap frame and grating shall be of approved material as specified in the BOQ. The trap shall be fitted with stainless steel square grating. A minimum of 40mm depth of water seal shall be provided in the trap.

#### **3.1.6 Double Coat Hook**

These shall be of CP as specified in the material specification. These shall be fixed by means of stainless steel screws to wooden / plastic cleats firmly embedded in the wall.

#### **3.1.7 Hand Dryer**

The electric hand drier shall be twin blower type integrated with timer range 0 to 3 minutes. The drier shall be fully automatic. The make and model shall be as specified in the BOQ.

The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position. The hand drier shall be fully hygienic, rated for continuous repeat use (CRU). The rating of hand drier shall be such that time required to dry a pair of hands up to wrists is approximately 30 seconds. The hand drier shall be of wall mounting type suitable for 230 V, single phase, 15A, 50 Hz, AC power supply

### ***SECTION –I V: WATER SUPPLY SYSTEM***

#### **1.1 General**

##### **1.1.1 In brief scope of work involves following**

- Tapping of water from existing lines
- Puddles, piping for Sump and OHT
- Water lines within toilet, pantry, shaft, terrace etc
- Isolation valves, Pressure regulating valves, brackets and other accessories

##### **1.1.2 Manuals**

Three sets of all manuals for the systems shall be submitted to the client. This shall include instruction and maintenance manuals.

### 1.1.3 As-built Drawing

As built drawings as specified in the contract shall be submitted to the client on completion of work. Drawing shall clearly show pipe routes, component details including

### 1.1.4 Training

It is the responsibility of the Contractor to train the Owner's personnel in the operation and maintenance of the system.

## 1.2 WATER SUPPLY SYSTEM

### 1.2.1 PRESSURE REDUCING VALVE SET

Each pressure reducing valve set shall be complete with pressure reducing and isolating valves, pressure gauge on outlet. Each pressure reducing valve shall contain loading neoprene diaphragm and a full floating, self aligning, ignition resistant seat and shall be of the single stage, pressure reduction type with provision for manually adjusting the delivery pressure. The valve shall fail safe to the low pressure.

Valves shall be capable of operating and maintaining automatically the respective delivery pressure and flow rates as indicated and shall not be liable to creep. Valves shall also be capable of maintaining the pre-set downstream pressure under static condition.

### 1.2.2 BUTTERFLY VALVES

Butterfly valves shall be slim seal, short wafer type with standard finish. The valves shall be suitable for mounting between flanges drilled to ANSI 125. The valve body shall be cast iron. The disc shall consist of disc pivot and driving stem shall be in one piece centrally located. The disc shall move in bearings on both ends with 'O' ring to prevent leakage. The seat shall be molded with black nitrile rubber or nylon and shall line the whole body. The spindle shall be of AISI 41 steel. The valve shall be suitable for a working pressure of 16.5 kg/sq.cm and shall be complete with flow control lever and notches, factory machined companion flanges and bolts and nuts. These valves conform to BS 5155 with electro steel nickel coated SG Iron (N) and seat material EPDM3. The pressure rating & dia of valve shall be indicated on the valve body for proper identification.

### 1.2.3 BALL VALVES

The ball valve shall be of high-pressure type and shall be of sizes as specified and/or shown in the drawings the normal size of a ball valve shall be that, corresponding to the size of the pipe to which it is fixed. Ball valves shall have body of carbon steel. The ball and the shaft shall be of stainless steel. The seat shall be of PTFE. The valve shall be complete with socket weld ends and the float of copper sheet. The minimum thickness

of copper sheet used for making the float shall be 0.45mm for a float exceeding 115mm dia. The body of the high pressure ball valve when assembled in working condition with the float immersed to not more than half of its diameter shall remain closed against a test pressure of 3.5kg/sqcm. The ball valve shall generally conform to IS specification No.1703:1977. The weight of ball cock and the size of the ball cock shall be as per IS specification.

#### **BALL VALVES WITH HANDLE**

Body	:	Brass
Bore size	:	Full bore
Ball seal	:	PTFE
O Ring seal	:	Nitrile rubber / viton
Threads	:	BS 21 taper threads
Finish	:	Chrome plated
Pressure rating	:	PN 10 / 16 / 25
Application	:	water / Air / Oil.

#### **1.2 UPVC Sch 40 Pipes & Fittings**

The pipes shall be UPVC (Unplasticized Poly Vinyl Chloride) material for cold water supply piping system with Sch 40 and using solvent welded Sch 40 fittings i.e. Tees, Elbows, Couplers, Unions, Reducers, Brushing etc. including transition fittings (connection between PVC & Metal pipes / GI) i.e. Brass adapters both Male & Female threaded and all conforming to ASTM D-2466 with only PVC solvent cement conforming to ASTM F-493, with clamps / structural metal supports as required /directed at site, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer, client & consultant.

##### **i. Joining Pipes & Fittings**

- a. Cutting: Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.
- b. Deburring / Bevelling: Burrs should be removed from the outside and inside of pipe with a deburring tool/ pocket knife or file otherwise burrs may prevent proper contact between pipe and fittings during assembly. Also the outer end of pipe should be slightly chamfered.
- c. Fitting preparation: A clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. Dry assemble the pipe and fitting to ensure proper fit and alignment.

- d. Solvent Cement Application: An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket, otherwise too much of cement solvent can cause clogged water ways.
- e. Assembly: After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 20 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement within the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

An even bead of cement should be evident around the joint and if this bead is not continuous remake the joint to avoid potential leaks.

Set & Cure times:

Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table.

Minimum Cure time prior to pressure testing upto 180 PSI

Ambient Temperature	Size		
	1/2" to 1 1/4"	1 1/2" to 3"	4" to 8"
Above 15 deg C	1 hr	2 hr	6 hr
4 to 15 deg C	2 hr	4 hr	12 hr
Below 4 deg C	8 hr	16 hr	48 hr

- f. Testing: Once an installation is completed and cured as per above mentioned recommendations, the system should be hydrostatically pressure tested at 150 psi (10 Bar) for two hours. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out and replacing the same with new one by using couplers. No payment shall be made for reworking of already finished works.

- ii. Transition of PVC to Metals: When making a transition connection to metal threads, special Brass transition fitting (Male and female adapters) should be used. Plastic threaded connections/ transition fittings should not be used in the project.
- iii. Threaded Sealants: For fixing of bath fittings Teflon tape shall be used to make threaded connections leak proof. Hold tite shall be used for other threaded connections like valve etc.
- iv. Solvent Cement: Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves. Flow guard CPVC cement solvents have a minimum shelf life of 1 year. Aged cement solvent will often change colour or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company's seal and tightly close the seal after using in order to avoid its freezing. The freezed cement solvent should be discarded immediately and fresh one should be used. The solvent cement usage should be adhered to as given in table below

Diameter of pipe in inch	½"	¾"	1"	¼"	1½"	2"
Approx. nos. of joints which can be made per litre of solvent cement.	200 Nos	180 Nos	150 Nos	130 Nos	100 Nos	70 Nos

v. Hangers and supports

Spacing of supports should be as per the below mentioned table:

Pipe size	15.5°C	26.6°C	37.7°C	48.8°C	60°C
Inch	Ft	Ft	Ft	Ft	Ft
1/2	4 1/2	4 1/2	4	2 1/2	2 1/2
3/4	5	4 1/2	4	2 1/2	2 1/2
1	5 1/2	5	4 1/2	3	2 1/2
1 1/4	5 1/2	5 1/2	5	3	3
1 1/2	6	5 1/2	5	3 1/2	3

2	6	5 1/2	5	3 1/2	3
2 1/2	6 1/2	6	5 1/2	4	3 1/2
3	7	7	6	4	3 1/2
4	7 1/2	7	6 1/2	4 1/2	4
6	8 1/2	8	7 1/2	5	4 1/2

#### 1.4 Colour Code for Water Supply Pipes

Colour code for water-supply pipes shall be as per standard requirement. Details as mentioned below.

COLOUR CODE FOR GENERAL SERVICES				
SL NO	DESCPRITION	GROUND COLOUR	FIRST COLOUR BAND	SECOND COLOUR BAND
<b>A</b>	<b>WATER</b>			
1	Cooling	Sea green	French blue	-----
2	Boiler feed	Sea green	-----	-----
3	Condensate	Sea green	Light brown	-----
4	Drinking	Sea green	French blue	Signal red
5	Treated	Sea green	Light orange	-----
6	Cold water from storage tank.	Sea green	French blue	Canary yellow

#### 1.5 Disinfection of the Pipe Network

The entire water distribution network is to be disinfected by using residual chlorine of 0.2 ppm for a period of 2 (two) hours. The entire chlorinated pipe network is to be flushed out with fresh water before the water supply system is put into operation for domestic usage.

#### 1.6 Valves, Strainers and Pressure Gauges

##### 1.6.1 General



This section deals with different type of valves like butterfly valves, gate valves, ball valves, check valves, balancing valves and Strainers and pressure gauges. The contractor shall refer to the approved make of materials specified in the document & relevant drawings.

Valves shall be provided on branch pipe connections to mains and at connection to equipment where indicated. All valves are to be located for easy access. All valves shall be supported wherever necessary with MS brackets. Valves shall comply with IS 780 (Class I) for C.I sluice valves and IS 778 for G.M valves and tested.

Pressure gauges shall have outer diameter not less than 115mm with 10mm BSP full thread, brass body siphon and gauge cock of size 10mm. Dial gauges shall have adequate response for the pressures encountered within the specified (Range 0-15Kg/sq.cm).

#### **1.6.2 Valves**

All valves (gate, ball, check, safety) shall be of brass suitable for the particular service as specified. All valves shall be of the particular duty and design as specified. Valves shall either be of screwed type or flanged type, as specified, with suitable flanges and non-corrosive bolts and gaskets. Tail pieces as required shall be supplied along with valves. Gate, ball and check valves shall conform to Indian Standard IS: 776 and non-return valves and swing check type reflux to IS: 5312.

Sl. No	Type of Valve	Size	Construction	Ends
a.	Isolating Valve	15 mm to 50 mm	Gunmetal	Screwed
b.	Butterfly Valve	65 mm and above	Cast Iron	Flanged
c.	G.M. non return valve	15 mm to 32 mm	Gun Metal	Screwed
d.	Flap Type – Non return valve	40 mm and above	Cast Iron	Flanged

#### **1.6.3 Flanges and Unions**

Sufficient number of flanges and unions shall be provided as required to facilitate maintenance work after the piping is installed. Mild steel flanges shall be used for pipes. The flanges shall be connected to the pipeline by screwing or welding depending on the requirement. The flanges shall conform to the relevant ASTM standard for the particular material used for its manufacture. The flanges shall also conform to IS 5211.

#### **1.6.4 Relief Vents**

Drainage systems, especially those in tall buildings, are frequently found to develop extremely high and objectionable pneumatic effects in several specific portions of such piping. Special air pressure relief vents are recommended to control, within tolerable limits.

The air pressure relief vent, at least one-half the diameter of the building drain, should

be provided at the top of vertical offset so as to supply such additional air to the drain as may be required by the sudden increase in liquid velocity in the vertical offset. Where a building trap or other sharp change in flow direction is provided in the building drain downstream from the vertical offset, an air pressure relief vent should be provided at the base of, and within 3 ft (0.900m) of, the vertical offset. Lower relief vent should be branch –connected to the upper relief vent at a sufficient height.

The recommended provision for soil and waste stacks more than ten stories in height is to provide a yoke relief vent at each tenth story of the drainage stack, counting downward from the top story. The lower end of the yoke relief vent should connect to the drainage stack by means of a Y located below the horizontal branch drain serving fixtures in that story, and the upper end should connect to the vent stack by means of a T or inverted Y located at least 3 ft (0.900m) above the floor level as shown in the drawing.

### **1.6.5 Installation of Valves**

Valves should be installed in true tolerance of +/-5mm with respect to the center line of the pipe. Where threaded joints are encountered the threads should be initially sealed with PVC tape to avoid leakage due to improper tightening and leakage from threading.

Proper care has to be taken in welded installation so that the centreline of valve should not deviate from the pipe causing uneven load on the pipe and further stress during its operation. The welding should be done only after proper inspection of the joint by the Engineer-in-charge in the tacked position of the joint.

Before putting the line in operative mode the valves should be checked for free and easy operation of the hand wheel. Any burrs or foreign materials should be removed by flushing before final operation so that no choking in the valves should occur which might damage the valve seat.

## **1.7 PUMPS**

### **1.7.1 Submersible- Mono block Pump**

Supply, testing & commissioning of Horizontal Single/ Multi- stage submersible pump suitable for pumping clean, less viscous, non-aggressive liquids without solid particles or fibre. Pumps are fitted with standard & approved motor. Impeller & other parts of pump are made of SS304 with 3-phase motor, sand shield, liquid-lubricated bearings and pressure equalizing diaphragm. Pump Enclosure class (IEC 34-5):IP58. Pumps should contain integral suction strainer & fitted with priming mechanism. Motor parts are CED coated, fitted with carbon bushes. Double lip Seal back to back to arrangement

to ensure no water leakage inside the motor. Motor should be fitted with mechanical seal & withstand upto 6 kN having 4 SS segments and carbon thrust pads. Pumps are provided with stop ring. Motors should be locally rewindable. Motor should be capable of good starting torque and low starting current. Pumps shall be of NEMA with Standard AISI 416 Stainless steel shaft Rubber O-ring for all fasteners. All bearings should be water lubricated and square shape to enable sand particles from the pump. At the delivery of the pump each pump shall be fitted with a NRV & a valve of appropriate size & make of components shall be as per approved list. The pump shall be placed in a pump pit of adequate size such that the minimum submergence level is maintained at all times. Dry run protection, overload trip, shall be provided for each pump system. The pump shall be provided with a chain/ guide rope to lift the same. The pump shall be placed such that dust particles, etc do not enter the pump impeller & damage the same. A min clear ht of 100 mm shall be provided at the base of the pump to avoid dust particles entering the pump. The pump shall work with a min motor efficiency of 55-80%. Motor should be suitable for horizontal installation. Operating voltage 220 + 10% -15% for single phase and 415+ 10% -15% for three phases.

### **1.7.2 Storm Water Pump**

Supply, testing & commissioning of Vertical single-stage stainless steel submersible pump with vertical discharge port and integrated submersible 1/3-phase totally enclosed motor in insulation class F with thermal overload protection. Pump should be fitted with a suction strainer. The impeller is a SEMI OPEN impeller for 12 mm free passage suitable for pumping groundwater, surface water & rain water and similar. Pump is with a double shaft seal and an intermediate oil chamber pre-filled with non-toxic special oil.

The pump shall come with a riser pipe, a cooling jacket for continuous cooling of the motor by the pumped liquid and long-life deep-groove greased-for-life ball bearings. The pump shall be fitted with carrying handle and supplied with a 10 m mains cable. The mains cable should be of the plug type with glass sealing compound in the socket to prevent penetration of humidity into the stator windings. The pump shall work with a min motor efficiency of 55-80%. Operating voltage 220 + 10% -15% for single phase and 415+ 10% -15% for three phase

### **1.7.3 Horizontal Mono-block Pump**

Supply, testing & commissioning of Horizontal centrifugal multi-stage pump with axial suction port and radial discharge port close-coupled with a single/ three-phase TEFC motor with thermal overload protection. Pump and motor are mounted on a common base plate. The pump should be fitted with mechanical shaft seal. Impellers, intermediate chambers and shaft are made of stainless steel. Suction and discharge chambers are made of Cast iron. Motor should be IP 54 protection & Class F winding insulation. The pump shall work with a min motor efficiency of 65-80%. Operating voltage 220 + 10% -15% for single phase and 415+ 10% -15% for three phase

#### **1.7.4 Vertical Multi Stage Pump**

Supply testing & commissioning of vertical, non-self-priming, multistage, in-line, centrifugal pump for installation in pipe systems and mounting on a foundation. Pumps shall fitted with cartridge type mechanical seal. Impellers and intermediate chambers are made of Stainless steel, Pump head and base are made of Cast iron. The shaft seal shall have an assembly length according to EN 12756. Power transmission is via cast iron split coupling. Motor should be with IP55 protection & Class F winding insulation. The pump shall work with a min motor efficiency of 70-80%. Operating voltage 220 + 10% -15% for single phase and 415+ 10% -15% for three phase

#### **1.7.5 Pump**

The pumps shall be of the vertical multi-stage centrifugal design. The pump suction/discharge chamber (base) shall be in CI or SS as per requirement. Motors tool and pump shaft coupling shall be constructed of cast iron. The impellers, pump shaft, diffuser chambers, outer discharge sleeve, impeller seal rings, and seal ring retainers shall be constructed of stainless steel. Optional materials for the suction/discharge chamber and motor stool liner shall be stainless steel.

The pump impellers shall be secured directly to the pump shaft by means of a spine shaft arrangement for model of the lower sizes, and the pump impellers shall be secured to the shaft by a split cone and nut for higher sizes. The shaft journal and chamber bearings shall be Tungsten Carbide and Ceramic/ Bronze. All pumps shall be equipped with a high temperature cartridge mechanical seal assembly with Tungsten Carbide/ Carbon or Tungsten Carbide seal faces mounted in stainless steel components. The shaft seal shall be of the cartridge design; the larger pumps (with 7.5 Kw and above motors) shall be designed so that the cartridge seal may be replaced without removing the motors.

#### **1.7.6 Motor & Variable Frequency Drive**

The motors shall be TEFC type, class F insulation, 2 pole, efficiency class "Eff -1", should be a NEMA standard motor. Drive-end motor bearings shall be designed to absorb thrust and shall be adequately sized to ensure long motor life.

The variable frequency drive enclosure shall include dry-contact fault-output relay contacts along with analog and digital inputs. The motor shall detect/protect itself against under voltage, over voltage, excessive temperature, and set-point signal fault.

#### **1.7.7 Electronic Controller**

An electronic dedicated pump logic controller shall be a Hydro pneumatic system (Multi Pump Controller) or approved equal. The controller shall operate the pumps to maintain the required system pressure while using minimum energy and alternating between pumps to maintain relatively equal pump operating hours.

As flow demand begins, one of the pumps will start at low speed. As demand increases, the pump will speed up until it reaches full RPM. At this point the second pump will start in full speed. The speed of the first pumps will vary until it builds up required system pressure. This sequence will continue for additional working pumps, if demand is not met.

Pumps shall changeover automatically to maintain the system pressure depending on demand, time, and fault.

Electronic controller should perform flow estimation every 2 minutes so as to minimize or utilize the number of duty pumps and stop all pumps in an event of no demand, thereby the performance and energy consumption of the system is optimized.

If the system includes an optional standby pump, the controller shall exercise the standby pump as a part of the system and equally run the pump as other pumps in the system.

The controller shall accept a low-suction pressure or other suction fault input to shut down the system. The controller shall have a keypad and a graphical user interface display with Installation wizard for easy commissioning of the system.

### **1.7.8 Programmable Functions**

System functions shall be programmable through the keypad. These programmable functions and information shall include, but not be limited to:

- 1) Closed loop control.
- 2) Automatic pump alternations
- 3) Automatic cascade control of pumps
- 4) Set point adjustment and control
- 5) Clock Program
- 6) Flow estimation function
- 7) Programmable pump testing
- 8) Programming of No of starts/stops per hour
- 9) Remote controlling of the entire Hydro Pneumatic System through Ethernet.  
(User has to provide Static IP address to HPS system which can be accessed by BMS computer for remote control)
- 10) Standby pump designation
- 11) Friction Loss Compensation (set point)
- 12) Pump status
- 13) Elapsed running hours for each pump
- 14) System pressure set point
- 15) Actual system pressure

- 16) Pump speed (percentage)
- 17) Fault memory up to recent 24 faults with time stamping
- 18) To display calculated system flow
- 19) Pressure transducer design settings
- 20) Redundant primary sensor for pressure monitoring
- 21) High and low discharge pressure shut-down limit
- 22) Analog input for remote set-point control
- 23) Digital input for remote stop/start

### **1.7.9 Control Cabinet**

The controller shall be mounted in a control cabinet with an IP 52 enclosure of suitable rating (or specified optional cabinet) with the keypad and display screen mounted through the outer door. In addition to the electronic pump controller, the control cabinet shall include circuit breakers for each pump and the control circuit and control relays for alarm functions. Control cabinet shall include the following, but not be limited to:

1. Motor protection
2. Dry run protection – Float switch / Inlet pressure monitoring device for suction lift condition
3. Ethernet connectivity (Web based control)
4. 320 X 240 pixels VGA display with adjustable backlight
5. Pump Fault Lights – A Red light for fault indications
6. Visual Alarm
7. Pump Elapsed Time Meters
8. Manual Operation

The entire packaged pumping system shall be mounted on a Hot Dipped Galvanized MS or SS fabricated skid. The control cabinet shall be mounted in one of the following ways depending on the size of the cabinet.

1. On a Hot Dipped GI or MS fabricated with powder coated control cabinet stand attached to the system skid
2. On a Hot Dipped GI or MS fabricated with powder coated skid, separate from the main system skid
3. Floor mounted control cabinet with plinth.

### **1.7.10 Plumbing**

The suction and discharge manifolds shall be fabricated of Hot Dipped Galvanized MS or SS. Both manifolds shall be designed to attach to the system piping at either end of the manifold. Delivery manifold shall include a pressure gauge. The suction manifold shall have as standard a pressure switch or pressure sensor to detect low suction pressure or a float switch to prevent dry running. The discharge manifold shall include a pressure transducer with a 4-20mA output. The pressure transducer shall be factory installed and wired.

Isolation valves shall be installed on the suction and discharge of each pump. A check valve shall be installed on the discharge of each pump (optional on the suction side for suction lift applications).

The system shall include a diaphragm type pressure tank sized by the system manufacturer. All systems shall be factory tested for performance and hydrostatic tested to at least 1.5 times the system working pressure. The system manufacturer shall provide verified Factory Performance Tests and Witness Factory Performance Tests.

### **1.8 Water Level Controllers**

The water level controller shall be microprocessor based with LED indicators. Each transfer pump shall be provided with a level controller. The level controller shall be integrated with OHTs of all the four blocks. Tinned copper cable shall be run in conduits from pump room to individual OHT's. The level controller shall switch on the pump in case of low water level in any of the OHT. However the OHT having low water level shall only receive water as flow of water to other OHTs shall be stopped by float operated ball valve. The pump shall stop once all the OHTs are filled. Timer shall be provided to operate the working and stand by pumps alternately.

### **1.9 Connection to the RCC Water Tanks**

The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator to water storage tanks as called for. All pipes crossing through RCC work shall have puddle flanges fabricated from GI pipes of required size and length and welded to 6mm thick MS plate. All puddle flanges must be fixed in true alignment and level to ensure further connection in proper order.

Valves of an approved make shall be provided as near to the tank as practicable on every outlet pipe from the storage tank except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating.

The overflow pipe shall be so placed to allow the discharge of water being readily seen, except for flushing water tank, in case of which the overflow should be connected to waste pipe. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank.

### **1.10 Hot Water Piping Insulation**

#### **MATERIAL**

Insulation material for Pipe insulation shall be vidoflex/armaflex.

Thickness of the insulation shall be as specified for the individual application. Each lot

of insulation material delivered at site shall be accompanied with manufacturer test certificate for thermal conductivity values.

#### Insulation for pipes in exposed on wall or roof / plant room.

Insulating material in tube form shall be sleeved on the pipes. On existing piping, slit opened tube from insulating material shall be placed over the pipe and adhesive (as recommended by the manufacturer) shall be applied as suggested by the manufacturer. Adhesive must be allowed to tack dry and then press surface firmly together starting from butt end and working towards centre.

Wherever flat sheets shall be used it shall be cut out in correct dimension. All longitudinal and transverse joints shall be sealed as per manufacturer recommendations. The insulation shall be continuous over the entire run of piping, fittings and valves. All valves, fittings, joints, strainers etc. In hot water piping shall be insulated to the same thickness as specified for the main run of piping and application shall be same as above. Valves bonnet, yokes and spindles shall be insulated in such a manner as not to cause damage to insulation when the valve is used or serviced.

All insulation work shall be carried out by skilled workmen specially trained in this kind of work. All exposed insulated pipes shall be labelled (HWS / HWR) and provided with 300 mm wide band of paint along circumference at every 1200 mm for colour coding. Direction of fluid shall also be marked. All painting shall be as per relevant BIS codes.

#### Protective Coating over Insulation for exposed pipes (terrace)

To provide mechanical strength and protection from damage & UV rays all exposed pipe insulated with nitrile rubber as indicated in BOQ shall be provided with 28SWG aluminium Cladding. Due care shall be taken to ensure no damage is caused to the insulation while cladding.

#### MEASUREMENT OF INSULATION

Unless otherwise specified measurement for pipe insulation for the project shall be on the basis of centre line measurements described herewith

Pipe Insulation shall be measured in units of length along the centre line of the installed pipe, strictly on the same basis as the piping measurements. The linear measurements shall be taken before the application of the insulation. It may be noted that for piping measurement, all valves, orifice plates and strainers shall not be separately measurable by their number and size. It is to be clearly understood that for the insulation measurements, all these accessories including valves, orifice plates and strainers etc. shall be considered strictly by linear measurements along the centre line of pipes and no special rate shall be applicable for insulation of any accessories, fixtures or fittings whatsoever.



## 1.12 GI Pipes and Fittings

GI pipes and fittings shall be used for hot and cold water services other than internal concealed pipes. All internal and external piping shall be of heavy quality (Class C) galvanized iron, screwed socketed and shall conform to IS 1239 (Part-I). All fittings shall be malleable iron galvanized fittings of approved best Indian make. The details of pipes and sockets regarding nominal bore, thickness and weight in kg/m are as per IS-1879.

The following manufacturing tolerances shall be permitted on tubes and sockets.

i) Light tubes butt welded	:	+ Not limited - 8 percent
ii) Medium and Heavy tube welded	:	+ Not limited - 10 percent butt welded
iii) Medium tubes seamless	:	+ Not limited - 12.5 percent
iv) Single tube (light series)	:	+ 10 percent - 8 percent
v) Single tube (medium and heavy series)	:	+ /- 10 percent
vi) For quantities per load of 10 tonnes,		+ /- 5 percent Min (light series)
vii) For quantities per load of 10 tonnes,		+ /- 7.5 percent Min (medium and heavy series)

### 1.12.1 Laying and Jointing

Where pipes have to be cut or re-threaded, ends shall be carefully filed so that no obstruction to the bore is offered. Approved quality thread seal tapes and sealants shall be used for joints. For internal work all pipes and fittings shall be fixed truly vertical and horizontal, either by means of brackets or by hanger type supports or concealed as directed. For external work, G.I. pipes and fittings shall be laid in trenches. The width of the trench shall be the minimum width required for working. The pipes laid underground shall be not less than 60cm. from the finished ground level and a minimum horizontal distance of 60CM shall be maintained between other services lines. All buried pipes shall be provided with suitable anti corrosive treatment.

### 1.12.2 Testing

Before any pipes are painted or covered, they shall be tested to a hydrostatic pressure of 7kg/sqcm or 1.5 times the working pressure whichever is higher. Pressure shall be maintained for at least 6 hours without an appreciable drop in pressure. In addition to the sectional testing of water supply pipes, the contractor shall test the whole installation to the entire satisfaction of the engineer in charge. He shall rectify any leakages, failure of fittings or valves. However, the testing period could be held for also about 24 hours, upon requirement of the engineer in charge.

### 1.12.3 Mode of Measurement

G.I. pipes shall be measured along the centre line of the pipes and fittings. The quoted rate for respective item shall be per Rmt and shall include the following:

- a) Cost of respective pipes and specials.
- b) Laying, fixing and jointing with standard pipe clamps available for different sizes inside the wall chase and fixed on Hot dip galvanized MS angle iron brackets and GI U clamps for pipes in ducts as shown on the drawing.
- c) Cutting holes and chases in walls, floors, etc. and making good the same.
- d) All supporting arrangements, brackets, etc.
- e) Any other items mentioned in BOQ

### **1.13 Water Meter**

Water meters of approved make and design shall be supplied for installation at locations as shown. The water meters shall meet with the approval of local supply authorities, if they are used at municipal inlet lines. Suitable valves and chambers or wall meter box to house the meters shall also be provided along with the meters, but the same shall be measured separately.

The meters shall conform to Indian Standard IS: 779 and IS: 2373/2104

- Tanker Water Inlet
- Softener Outlet
- STP Outlet
- Treated Water tank outlet in flushing line
- Treated Water tank outlet in domestic line
- Treated Water tank outlet in landscaping line
- Cooling tower makeup water line

### **1.14 Electrical Works**

All electrical works shall be carried out as per the specifications and special conditions mentioned above under package – “Electrical works.”

### **1.15 Chlorinated PVC PIPES (CPVC)**

#### **SCOPE**

This specification covers requirements, test methods, and methods of marking for chlorinated poly (vinyl chloride) plastic hot-and cold-water distribution system components made in one standard dimension ratio and intended for water service up to and including 180<sup>0</sup>F (82<sup>0</sup>C). These components comprise pipe and tubing, socket-type fittings, street fittings, plastic-to-metal transition fittings, solvent cements, and adhesives. Requirements and methods of test are included for materials, workmanship, dimensions and tolerances, hydrostatic sustained pressure strength, and thermo-cycling resistance. The components covered by this specification are intended for use in residential hot and cold, potable water distribution systems.

The values stated in either inch-pound or SI units are to be regarded separately as standard. Within the text, SI units are shown in brackets. The values stated in each system are not exact equivalents therefore each system shall be used independently of

the other. Combining values from the two systems may result in non-conformance with the specification.

## **Materials**

**Basic Materials Description**—Chlorinated poly (vinyl chloride) plastics used to make pipe, tubing, and fittings meeting the requirements of this specification are categorized by two criteria; namely, basic short-term properties, and long-term hydrostatic strength.

**Basic Short-Term Properties**—This specification covers CPVC 41 pipe, tubing, and fittings made from plastic materials meeting the mechanical strength, heat resistance, flammability, and chemical resistance requirements for CPVC 23447-B in Specification D 1784.

CPVC 23447-B was formerly designated as CPVC Type IV Grade 1, and is herein designated as CPVC 41. This is also used in marking pipe, tubing, or fittings.

**Long-Term Hydrostatic Strength**—This specification covers CPVC 41 pipe, tubing, and fittings which are further defined by hydrostatic design stress as CPVC 4120. Pipe and tubing are so defined on the basis of long-term hydrostatic strength tests and are made from compounds having an established 180°F [82°C] hydrostatic design stress of 500 psi [3.45 MPa] or greater in accordance with Appendix XI and Test Method D 2837. Fittings are so defined by hydrostatic sustained pressure tests on fitting assemblies, required by this specification and based on the hydrostatic strength of the corresponding pipe or tubing.

No hydrostatic design stress, as such, exists for fittings until such time as long-term hydrostatic strength test methods for fittings are developed.

**Rework Material**—clean rework material generated from the manufacturer's own production may be used by the same manufacturer provided the pipe, tubing, or fittings meet all the requirements of this specification.

## **Classification**

**Pipe, Tubing, and Fittings**—This specification classifies CPVC 4120 pipe, tubing, and fittings by a single standard dimension ratio which shall be SDR II, by a maximum continuous use temperature which shall be 1800F [82°C] and by nominal pipe or tubing diameters from 3/8 in.[9.5 mm] through 2 in. [50 mm].

**Plastic-to-Metal Transition Fittings**—This specification classifies CPVC plastic-to-metal transition fittings intended for use up to and including 1800F [82°C] as CPVC-I800F on the basis of resistance to failure by thermo-cycling.

**Solvent Cements and Adhesives**— this specification classifies solvent cements and adhesives meeting the requirements contained herein as CPVC Solvent Cement or CPVC Adhesive.

## **General**

Wall Minimums—Table 1 and Table 2 show wall thickness minimums. Calculated SDR 11 tubing wall thicknesses that fall below 0.068 in. [1.73 mm] shall be arbitrarily increased to that value. Calculated SDR 11 fitting wall thicknesses that fall below 0.102 in. [2.59 mm] for the fitting socket bottom, or 0.128 in. [3.25 mm] for the fitting body, shall be arbitrarily increased to these values.

Interference Fit—the diameters and tolerances in Table 1 and Table 2 provide for socket-type joints having an interference fit based on the major diameter of pipe and tubing having a degree of out-of-roundness. This does not necessarily imply interference based on the minor diameter of the pipe or tubing.

Out-of Roundness—the maximum out-of-roundness requirements shown in Table 1 and Table 2 for pipe, tubing, and fittings apply to the average measured diameter.

Pipe and Tubing:

Outside Diameter and Wall Thickness—The outside diameters and wall thicknesses for pipe and tubing shall meet the requirements for dimension and tolerance given in Table 1 when measured in accordance with Test Method D2122.

Wall Thickness Range—the wall thickness range for pipe and tubing shall be within 12 % when measured in accordance with Test Method D 2122.

Flattening—there shall be no evidence of splitting, cracking, or breaking when the pipe is tested in accordance with 9.2

Length— Pipe and tubing supplied in straight lengths shall have a tolerance on any specified length of +1/2 -0 in. [+12.5, -0 mm].

Socket-Type Fillings:

Dimensions—Fitting sockets, inside diameters (waterways), wall thicknesses, laying lengths, and reducing bushing minimums shall meet the requirements for dimension and tolerance given in Table 2, Table 3, and Table 4 when measured in accordance with Test Method D2122. The spigot ends of street fittings shall meet the outside diameter and minimum wall requirements of Table 1.

Alignment—the maximum angular variation of any socket opening shall not exceed 1/20 off the true centreline axis.

### **Plastic –to-Metal Transition Fittings**

Back Dimensions—Plastic parts of plastic to metal transition fittings shall meet the dimensional requirements of Table 1 and Table 2 where applicable with the following exceptions. Such parts shall be exempted from the requirements for inside diameter (waterway) and wall thickness tolerance.

Thread Dimensions — Transition fittings that rely on interference fit and sealant shall be threaded with American National Standard Taper Pipe Threads meeting

the dimensional requirements of ANSI B2.1

**Thread Tolerance** — The manufacturing tolerance on CPVC threads, measured with a ring gauge, shall be a maximum variation of 1½ turns large or small when measured in accordance with Test Method D 2122.

**Starting Threads** — The entering ends of external CPVC threads shall have a Blunt Start (see Fig. 1) produced by making the width of the thread at the start approximately 50 to 75% of the full thread. The Blunt Start provides for easy entrance and protection of the thread, and shall be included in the measurement of thread length.

### **Hydrostatic Sustained Pressure**

**General** — Pipe, tubing, and fittings (tested as assemblies) shall meet the minimum hydrostatic sustained pressure requirements of both test conditions shown in Table 5 when tested in accordance with 9.2.

**Pipe and Tubing Quality**—Test condition B shall be termed the primary sustained pressure test for pipe and tubing and shall be used for quality control. Test condition A shall be termed the secondary sustained pressure test for pipe and tubing and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

**Fitting Quality**—Test condition A shall be termed the primary sustained pressure test for fittings and shall be used for quality control. Test condition B shall be termed the secondary sustained pressure test for fittings and shall be used for periodic performance qualification. Failure to pass either test is cause for rejection.

**Thermo cycling** — Plastic-to-metal transition fittings (other than metal socket-type transitions for use with adhesives assembled according to the manufacturer's instructions, shall not separate or leak when thermo cycled 1000 times between the temperatures of 600F and 1800F [160C and 820C] in accordance with 9.3.8

### **Requirements of Solvent Cement and Adhesive Joints**

CPVC Solvent Cements:

Note 6—CPVC solvent cements may exist which meet the requirements of the specification when used in accordance with the manufacturer's recommendations, without a primer or cleaner. It is recommended that those CPVC solvent cements which may be used without a primer or cleaner be clear or yellow in color. Otherwise, it is recommended that CPVC solvent cement requiring the use of primer or cleaner be orange in color. Color identification is recommended to facilitate cement recognition to prevent the misuse of the cement and to minimize the unintentional use of other cements that may fail at elevated service temperatures.

General—CPVC solvent cements, for use in CPVC 41, plastic-to-plastic, socket-type joints shall meet the requirements set forth in Specification F 493.

Hydrostatic Burst Strength—2-in. [50-mm] CPVC solvent cement joints shall exceed the minimum hydrostatic burst strength requirements given in Table 6 after a maximum drying interval of 2 h when tested in accordance with 10.1.3, Failure to pass the burst requirement at either temperature is cause for rejection.

Hydrostatic Sustained Pressure Strength—½-in. [15-mm] CPVC solvent cement joints shall meet the requirements of 6.2 when tested in accordance with 9.3.

Safe Handling of Solvent Cement—Refer to Practice F402.

#### CPVC ADHESIVES

General—CPVC adhesives (other than CPVC solvent cement), shall qualify for use in CPVC socket-type joints by a rigorous simulated use testing program as further defined in 7.2.2 and 7.2.3. CPVC adhesives shall be tested in the largest size joint and in the exact type of joint for which they are intended; that is, 2-in. [50-mm] plastic-to-metal or 2-in. [50-mm] plastic-to-plastic.

Hydrostatic Sustained Pressure Strength—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's recommended procedure, shall not separate or leak when tested in accordance with 10.2 at the hydrostatic sustained pressure condition given in Table 7.

Thermo-cycling—Socket-type CPVC adhesive joints, made and cured according to the adhesive manufacturer's recommended procedure, shall not separate or leak when thermo-cycled 10000 times between the temperatures of 60<sup>0</sup>F and 180<sup>0</sup>F [16<sup>0</sup>C and 82<sup>0</sup>C] in accordance with 10.2.

#### **WORKMANSHIP, FINISH AND APPEARANCE**

The pipe shall be homogeneous throughout and essentially uniform in color, capacity, density, and other properties. The inside and outside surfaces shall be semi-matte or glossy in appearance (depending on the type of plastic) and free of chalking, sticky or tacky material. The surfaces shall be free of excessive bloom, that is slight bloom is acceptable. The pipe walls shall be free of cracks, holes, blisters, voids, foreign inclusion, or other defects which are visible to the naked eye and which may affect the wall integrity. Holes deliberately placed in perforated pipe are acceptable. Bloom or chalking may develop in pipe exposed to direct rays of the sun (ultraviolet radiant energy) for extended periods and consequently these requirements do not apply to pipe after extended exposure to direct rays of the sun.

CPVC SCHEDULE 40 PRESSURE PIPES AND FITTINGS FOR WATER SUPPLY AS PER ASTM F- 441

Outside Diameters and Wall Thicknesses For CPVC 4120, SDR 11 Plastic Pipe As Per ASTM D-2846								
Nominal Size (in.) (mm)	Outside Diameter, in. (mm)		Wall Thickness, in. (mm)		Pressure Rating. PSI (Kg.Cm <sup>2</sup> )			
	Average	Tolerance	Minimum	Tolerance	73.4°F (23°C)		180°F (82°C)	
½* (15)	0.625 (15.9)	± 0.003 (0.08)	0.068 (1.73)	+0.020 (0.51)	400	(28.1)	100	(7.0)
¾ (20)	0.875 (22.2)	± 0.003 (0.08)	0.080 (2.03)	+0.020 (0.51)	400	(28.1)	100	(7.0)
1 (25)	1.125 (28.6)	± 0.003 (0.08)	0.102 (2.59)	+0.020 (0.51)	400	(28.1)	100	(7.0)
1¼ (32)	1.375 (34.9)	± 0.003 (0.08)	0.125 (3.18)	+0.020 (0.51)	400	(28.1)	100	(7.0)
1½ (40)	1.625 (41.3)	± 0.004 (0.10)	0.148 (3.76)	+0.020 (0.51)	400	(28.1)	100	(7.0)
2 (50)	2.125 (54.0)	± 0.004 (0.10)	0.193 (4.90)	+0.023 (0.58)	400	(28.1)	100	(7.0)

\* For ½" wall thickness minimum is not a function of SDR.

### 1.15.1 Support Spacing for PVC Pipe

#### Support and Spacing

To ensure the satisfactory operation of a PVC piping system the location and type of hangers should be carefully considered. Hangers should not compress, distort, cut or abrade the piping. All piping should be supported with an approved hanger at intervals sufficiently close to maintain correct pipe alignment and to prevent sagging or reversal. Pipe should also be supported at all branch ends and at all changes of direction. Support traps arms as close as possible to the trap. In keeping with good plumbing practices support and brace all closet bends and fasten closet flanges.

Recommended Horizontal or Vertical Support / pipe clamping	
Pipe Size in inches	Spacing in feet
½ " to 1" (Cold)	5.0 (1.52 m)
½ " to 1" (Hot)	2.5 (0.76 m)
1¼ " to 2" (Cold)	6.0 (1.82 m)
1¼ " to 2" (Hot)	(1.06 m)

### **1.15.2 Handling**

The pipe should be handled with reasonable care. Thermoplastic pipe is much lighter weight than the metal pipe. There is sometimes a tendency to throw it around. This should be avoided. The pipe should never be dragged or pushed from a truck bed. Pallets for pipe should be removed with a fork lift. Loose pipe can be rolled down timbers, as long as the pieces do not fall on each other or on any hard or uneven surface. In all cases, severe contact with any sharp objects (rocks, angle irons, forks on forklifts, etc.) should be avoided.

### **1.15.3 Storing**

If possible, pipe should be stored inside. When this is not possible, the pipe should be stored on level ground, which is dry and free from sharp objects. If different schedules of pipe are stacked together, the pipe with the thickest walls should be at the bottom. The pipe should be protected from the sun and be in an area with proper ventilation. This will lessen the effects of ultraviolet rays and help prevent heat build-up. If the pipe is stored in racks, it should be continuously supported along its length. If this is not possible, the spacing of the supports should not exceed three feet (3'). When storage temperatures are below 32°F, extra care should be taken when handling the pipe. This will help prevent any problems, which could be caused by the slightly lower impact strength of PVC and CPVC pipe at temperatures below freezing.

### **1.15.4 Laying, joining, curing**

**1.15.4.1** Systems should be installed in a good and workmanlike manner consistent with normal industry standards and in conformance with all local plumbing, fire and building code requirements. Failure to follow proper installation practices procedures or techniques can result in system failure, property damage or personal injury. Pipe and fitting systems should be used for their intended purpose as defined by local plumbing and building codes and the applicable ASTM standard.

**1.15.4.2** Follow manufacturers' instructions for all related products.

Cut pipe square as joints are sealed at the base of the fitting socket. An angled cut may result in joint failure.

Acceptable tools include miter saw, mechanical cut off saw or wheel cutter. Wheel type cutters must employ a blade designed for plastics.

Remove all burrs from inside and outside of pipe with a knife-edge, file, or de-burring tool. Chamfer (bevel) the end of the pipe 10° -15°

Remove surface dirt, grease, or moisture with a clean dry cloth.

With light pressure, pipe should go one half to one third of the way into the fitting socket. Pipe and fittings that are too tight or too loose should not be used.

Use an applicator that is one half the pipe diameters. Too large an applicator will force excessive cement into the inside of small diameter fittings. Too small applicator will not apply sufficient cement to large diameter systems.



**1.15.4.3 Recommended initial set times** Apply a full even layer of cement to the outside of a pipe and medium layer of cement to inside of a fitting. Assemble pipe and fitting socket until it contacts socket bottom. Give pipe a quarter turn. Hold pipe and fitting together until the pipe does not back out. See table for recommended cure times. Remove excessive cement from the exterior. A properly made joint will show a continuous bead of cement around the perimeter.

#### Testing Pressure System

Prior to testing, safety precautions should be instituted to protect personnel and property in case of test failure. Conduct pressure testing with water. DO NOT USE AIR OR OTHER GASES for pressure testing.

The piping system should be adequately anchored to limit movement. Water under pressure exerts thrust forces in piping systems. Thrust blocking should be provided at changes of direction change in size and at dead ends.

The piping systems should be slowly filled with water, taking care to prevent surge and air entrapment. The flow velocity should not exceed 1 foot per second.

All trapped air must be slowly released.

Primers are used in solvent cement joints of PVC plastic pipe and fittings as per ASTM F 656

Provided at all high points of the piping system. All valves and air relief mechanisms should be opened so that the air can be vented while the system is extremely dangerous and it must be slowly and completely vented prior to testing.

The piping system can be pressurized to 125% of its designed working pressure. However care must be taken to ensure the pressure does not exceed the working pressure of the lowest rated component in the system (valves, unions, flanges, threaded parts etc.) The pressure test should not exceed one hour. Any leaking joints or pipe must be cut out and replaced and the line recharged and retested using the same procedure

#### **1.16 Water Hammer Arrestors**

The effective fluid hammer, which results in breaking of pipeline caused due to series of hydraulic shock, should be arrested by means of a water hammer arrestor. The arrestor shall be capable of withstanding pressures upto 30 Kg/ Sq.cm and temperatures in the range of -400F to 2120F (-540C to +1000C). It shall be maintenance free with a companion flange to suit in the pipeline. The following materials are used for its manufacture

- Barrel – MS Class C (heavy class) pipe
- Cap - Malleable cast iron fittings attached to Barrel.

The sealed chamber type shall be installed upstream of flush valves or quick closing valves. The size to be as recommended by manufacturer's recommendation submitted for approval.

#### **1.17 AIR RELEASING VALVE**

A valve that releases air from pipeline automatically without loss of water or introduce air into line automatically if the internal pressure becomes less than that of the atmosphere.

Body	:	CI
Pressure rating	:	PN 10
Type	:	Screwed end
Strainer	:	Inbuilt
Gasket	:	Synthetic rubber as per IS 638 type B
Ball	:	Rubber coated wooden valve
Air release	:	Automatic
Bolt & nut	:	Caron steel BS 916.

**LIST OF APPROVED MAKES APPROVED MANUFACTURERS/SUPPLIERS**

S. No	Material			
1.	G.I / M. S Pipe	Tata	Jindal (Hisar)	Zenith
2.	G. I Fittings	Unik	KS	Zoloto
		R-Brand	Surya	
3.	SS Pipes	Jindal	Tata	VIGA
4.	HDPE Pipes	Reliance	Jain Irrigation	Oriplast
		Vertex	West Well	Supreme
5.	DI Pipes	Electrosteel	Jindal	Tata Ductura
6.	DI Fittings	Kartar	Electrosteel	Kalinga
7.	CI Fittings	Neel	Kartar	Electrosteel
8.	CI Double flanged sluice valve	Kirloskar	Sondhi	Kejriwal
9.	Float Valve	IVC	Leader	Zoloto
10.	UPVC Pipe and Fittings	Astral, Ashirwad, true flow	Supreme	Finolex
11.	Centrifugally Cast (Spun) Iron Pipes & Fittings	NECO	SKF	HEPCO
12.	Centrifugally Cast (Spun) Iron (Class LA) Pipes	NECO	Electro Steel	TATA
13.	Centrifugally Cast (Spun) Ductile Iron Pipes & Fittings	Electro Steel	Jindal (Hissar)	Kalinga
14.	C. I Manhole covers, Frames & GI Gratings	NECO	SKF	BIC
15.	SFRC Manhole covers & gratings	KK	OCR	PARGATI
16.	RCC Manhole covers & frames	KK Manhole	Grating Co. (P) Ltd	ACCURATE BUILDCON

17.	Gun Metal Valves, Globes	Kartar	Castle	Zoloto
18.	CP Brass Fittings	Jaquar	Kohler	Parryware
		Hindware	Grohe	ROCA
19.	Sanitary Fittings & Accessories	Hindware , Jaquar, Grohe, Cera	Kohler	ROCA
20.	Air purifier container	EURONICS	UTEC	JAQUAR
21.	Water Meter	Prima	Zoloto	Leader
22.	Brass Stop & Bib Cock	Zoloto	Sant	L&K
23.	PVC Pipe & Fittings	AKG, Astral, Ashirwad, true flow	Supreme	Finolex
24.	CPVC Pipes & Fittings	AKG, Astral, Ashirwad, true flow	Astral	Supreme
25.	Non Return Valve (Check valve) 1/2" to 1 1/4"	Zoloto	Sant	Leader
26.	Brass Ferrules	Dhawan Sanitary Udyog	Kalsi	Annapurna
27.	Polythylene water storage tank	SINTEX	POLYCON	SPL
28.	Insulation for hot water pipes	KAIFLEX	ARMAFLEX	CAREFLEX
29.	Insulation for external / exposed hot water pipes	KAIFLEX	ARMAFLEX	CAREFLEX
30.	Pipe protection for external water supply pipes	PYPKOTE	ARMAFLEX	MAKPOLYKOTE
31.	Stainless Steel Sink	Neelkanth	Nirali	Jayna
32.	Stone ware pipes	Perfect	Hind	Burn
33.	Plastic Encapsulated Foot Rest	KGM	KK	
34.	Gully Traps	Perfect	Hind	Burn
35.	RCC Pipes (NP-2)	Lakshmi	Sood & Sood	Jain & Co.
36.	Atactic Polypropylene	STP	HTL	Hydro Tech
37.	C. P Waste, Spreaders, Urinal Flush pipes	Jaquar	Parko	Hindware

38.	CI Double flanged sluice valve	KRILOSKAR	LEADER	SANT
39.	Pressure reducing valve	ZOLOTO	TIMME	SKS
40.	Ball Valves / wafer type valves	Zoloto	Leader	AIP
41.	Ball Cocks	GPA	Sant	L&K
42.	Fastners	Hilti	Intellotech	Fisher
43.	Water Heater	Racold	Venus	Jaquar
44.	Air Release Valves	AIP	Leader	Zoloto
45.	Pipecoat	IWL Ltd	Pypkote	STP

**SIGNATURE OF TENDERER**

# **TECHNICAL SPECIFICATION**

**FOR STP WORKS**

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The main source of effluent is resulting from Toilets and Pantry. The scope of work includes design, drawings, getting approvals from statutory bodies, coordinating during construction, erection, commissioning and obtaining best results of completely below ground

domestic sewage treatment plant with civil & structural , electrical, mechanical and piping. The treated effluent should be fit to reuse for gardening, flushing, Disposal purpose.

## **SECTION II    DESIGN CRITERIA**

The STP system is designed for:

- Treated water is suitable for toilet flushing, reuse to cooling tower/etc , irrigation and surface water bodies.
- Consistent water quality as per the specification
- Maximum recovery
- Low chemical usage
- High system flexibility for upgrading components
- High plant safety and
- Minimal supervision and maintenance
- Suitable redundancy for mechanical components
- System should be compatible to BMS critical alarms & signals shall be Transferred to centralised BMS system
- Necessary I/O points to be considered in PLC for data transfer to BMS. Vendor to share the list for approval

The following principles are incorporated:

- The components for treatment system are designed based on the N+1 redundancy concept.
- Regular service/backwash cycles

The System shall be designed for following capacities:

S NO	DESCRIPTION	Cum/day
1	STP	115

Sewage shall be treated on 24hours basis.

## 2.1 BASIC DATA ON RAW WASTE WATER (SEWAGE)

Quantity : 100 KLD

Sl. No.	Parameter	Quality Of Raw Sewage
1	pH	6.5 – 8.0
2	BOD <sub>5</sub> , mg/L	300-350
3	Turbidity, NTU	100
4	COD mg/l	500-600
5	E.coli	---
6	Residual Cl <sub>2</sub> , mg/l	---

## 2.2 TREATED WATER (SEWAGE) QUALITY

As stipulated by State Pollution Control Board (SPCB), the treated effluent quality shall be within the following values for various parameters. Quality shall be within the limits of PCB norms. Following are the few important guiding factors for treatment quality.

Sl.	Parameter	Quality Of	Treated
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**SECTION III**

No.		Treated Sewage as per PCB Circular.	Sewage (After UV treatment)
1	pH	6.5 – 9	6.5 – 9
2	BOD <sub>5</sub> , mg/L	≤10	<5
3	TDS, ppm	-----	<100
4	Turbidity, NTU	≤ 2	<1
5	E.coli	Nil	-----
6	Residual Cl <sub>2</sub> , mg/l	≥ 1	-----
7	COD, mg/l	<60	-----
8	Hardness mg/l	<50	-----
9	TSS in ppm	<10	<10
10	Chlorides in ppm	---	-----
11	Sulphates in ppm	---	-----
12	Silica in ppm	---	-----
13	Iron in ppm	---	-----
14	Manganese in ppm	---	-----

**GUIDELINES AND REQUIREMENTS**

Treated Effluent quality shall meet the quality as specified in the Section 2.2.

Components shall be easily accessible for maintenance.

Components and piping shall be clamped in such a way that vibrations and movements are avoided.

Standard	Title
IS 2379-1980	Pipe-line identification color code
CPHEEO	Central Public Health & Environmental Engineering Organization
ASTM	American Standard for Testing Materials
ASME	American society of mechanical engineers

**WORK BY OTHERS**

- All distribution pipe line from treated water tank to end use.
- Incoming Electrical main feeder to STP PLC panel.
- Earthing work to the main panels
- Supply, installation & testing of distribution pumps(Flushing & Cooling tower)
- Mechanical ventilation for STP

- **Flow meters for Flushing , cooling tower & landscape water**
- **Fresh water connection to the STP**
- **Exhaust fan**
- **Raw sewage inlet connection to bar screen**
- **Construction of civil tanks**

## **SECTION IV SYSTEM REQUIREMENTS (STP)**

Based on the raw sewage characteristics following treatment scheme is suggested:

The system shall comprise of Sewage treatment Plant equipment's. The installation shall be accordance with IS/ASME/ASTM standards. The main source of sewage is resulting from toilets. The system shall be capable of delivering treated effluent for reuse to toilet flushing, cooling tower make up and Irrigation applications. The Piping system shall be designed to limit pressure drop towards the end use. This shall be accomplished by adequate pipe sizing, and by limiting number of bends, elbows and other flow restrictions within the system. Possible leakage in joints and couplings shall be avoided.

### **1. Bar Screen:**

The pre-treatment shall comprise of bar screen to remove floating particles

### **2. Oil & Grease trap:**

Oil Skimmer to remove oil & grease and effluent will lead to Equalisation tank by gravity.

### **3. Collection cum Equalisation:**

The wastewater from office shall be collected in this collection sump for Equalisation. The effluent from Equalisation tank for mixing and avoid development of anaerobic growth. For mixing the sewage air will supply from the air blower through the coarse bubble diffusers and treated effluent is pumped to fine screen chamber to remove particles

### **4. Sequencing Batch Reactor**

A sequencing batch reactor (SBR) is a variation of the activated sludge process. As a fill and draw batch process, all biological treatment phases occur in a single

tank. This differs from the conventional flow through activated sludge process in that SBR's do not require separate tanks for aeration and sedimentation. SBR systems contain either two or more reactor tanks that are operated in parallel. The type of reactor tank chosen depends upon the waste water flow characteristics (e.g. high or low volume). In addition SBR systems typically have no primary or secondary clarifiers as settling takes place in the SBR.

The typical SBR process is as enclosed in the flow chart.

There are normally five phases in the SBR treatment cycle:

- i. FILL
- ii. REACT
- iii. SETTLE
- iv. DECANT
- v. IDLE

In the FILL phase, raw waste water is pumped into the reactor where it is mixed with the settled biomass from the previous cycle. Some aeration may occur during this phase. Then in the react phase, the reactor is aerated, allowing oxidation and nitrification to occur. During the settling phase, aeration and mixing are suspended to allow the solids to settle. The treated wastewater is then discharged from the reactor in the decant phase, for tertiary treatment through Pressure Sand filters, Activated Carbon Filter, softener, disinfection/UF/RO. In the final phase, the reactor is kept idle as it waits for the start of the next cycle. During this time, parts of the solids are removed from the reactor and disposed of as waste sludge.

Sludge wasting is an important step in the SBR process and largely affects system performance. The quantity and rate of wasting is determined by performance requirements.

Sequencing Batch Reactors are suitable for areas with little land, stringent treatment requirement, and small waste water flows. While constant cycles with time-fixed process phases are sufficient in most cases, phases should be individually adapted and optimized for each plant.

## **5. Filter press:**

The excess sludge from sludge conditioning tank shall be pumped to filter press, where it is subsequently dewatered mechanically. This dewatered sludge can be used as solid manure for agriculture and gardening.

## **6. Tertiary Treatment:**

The treated water stored in the decant Water Tank will be pumped through Pressure sand Filter, Activated Carbon Filter where the turbidity and residual BOD present will be completely minimized. Treated water shall be pumped to the softener to reduce hardness of water and treated water will disinfect through chlorination. The treated water will store in the final treated water tank and same shall be pumped for flushing & cooling tower Make up. **(Vendor has to design suitable treatment units (Softener, UF,RO, UV treatment, ) based on the treated water quality)**

Also, the same water shall be used for back washing of filters. The back wash drain, filter rinse drain and the decanted water shall be pumped/drained back to the Equalisation tank low as 10 mg/L with tertiary treatment.

- Mixed liquor suspended solids concentration (MLSS) is maintained 5000 to 10000 mg/l within the chamber.
- Suitable sampling valves shall be provided at the end of each treatment to monitor the quality of treated water.
- Local panels / operator panels with local indication and local control should be installed in order to monitor all parameters and locally control all the equipment.
- The operation of regeneration cycles/operation cycle shall be with integrated PLC. Necessary I/O points shall be considered in PLC to integrate with BMS for plant running status(Tank level indicators and flow meters)
- The sewage piping shall be through gravity to the sewage collection sump as indicated in Layout.
- All tanks shall have sufficient nozzles for inlet, outlet, fixing instruments, vent, drain & overflow.
- Treated Water Tank drains out and overflow water shall be connected to nearest external storm water drain.

## **SECTION V SCOPE OF CONTRACT & DESCRIPTION OF WORK**

### **SCOPE OF CONTRACT**

The tender is invited on turnkey basis for Design, Engineering, Supply, and Coordinating with civil & structural construction works, Erection and Commissioning of Sewage Treatment Plant (STP), to give treated effluent quality as per State Pollution Control Board (SPCB) as well as that specified in the Guarantee clause are within the scope of contract. The drawings attached herewith are preliminary. However, the successful contractor will be required to submit the Detailed design and Process & Structural drawings (shop drawings) incorporating the thickness of various structural members. These detailed drawings shall be submitted to Consultants for their comments & approval.

Vendor has to submit all the technical details for equipments used for operation of plant to the consultant and should get approval. All the works shall be carried out as per final "valid for construction drawings" only.

- a) This specification is intended to cover design, residual, engineering, manufacture, test and inspection at works, delivery to site properly packed for transportation, erection, testing, commissioning, performance demonstration at site and handing over to purchaser of treatment plant System as indicated in the schedule of Requirement and scope of work and as required for reliable and effective treatment plant system
- b) Supply, erection and commissioning of all the equipments required for the sewage treatment plant as per the individual equipment specification and details given herewith.
- c) Complete interconnecting piping between various units as per piping details given herewith including supply of all materials like GI pipes, fittings, all valves, gaskets, flanges, nuts and bolts including all materials required for necessary pipe supports and associated civil works, etc., complete.
- d) All electrical works including all electrical motors for the various equipments, cabling, LT panel, starters, etc., will be provided by the contractor. The scope of work includes coordinating all necessary civil works like construction of panel foundations, cable trenches, cable supports, lighting of entire plant as per drawing etc., complete. Commissioning of all the equipment after the electricity is supplied will be within the scope of contract.
- e) All temporary sheds, office, go downs, etc. required for storage of materials and for contractors supervisory personnel at site.

## **SECTION VI DETAILS OF CIVIL WORKS**

Civil works carried out inside treatment plant are as below which should be coordinated and vendor should furnish required levels and details.

<b>SI no</b>	<b>Description</b>	<b>MOC</b>
1	Bar screen Chamber	RCC
2	Oil & Grease chamber	RCC
3	Equalisation tank	RCC

4	SBR tank	RCC
5	Decant Tank	
6	Filter feed tank	RCC
7	Sludge Holding tank	RCC
8	Treated water tank	RCC
9	Drain pit	RCC
10	Internal Drains	RCC
11	Foundations for pumps, blowers and filters	RCC

## **SECTION VII DETAILS OF PIPING WORK**

Following piping works including excavation, back filling, masonry / structural pipe supports, puddle flanges, concrete bedding, pipe specials and Valves (Approved or Recommended valves or approved make only) are all included in the scope of contract.

- Piping design, material quality and components shall be according to supplier requirements.
- Welding shall be performed by certified person.
- Welded joints shall be treated after welding to ensure corrosion protection.
- Underground piping shall be installed in concrete culvert.
- Piping shall be equipped with a number of sampling points to be able to test effluent quality.
- Design velocity in the piping shall be: average 1.5 m/s and max 2.0 m/s.
- Design system with Dead Space Free (DSF) valves with access ports and therefore purging, testing and certification can be accomplished without exposing system to atmosphere.
- Components shall be easily accessible for maintenance and adjustments without use of special tools and mobile means of access.
- Hose connections are not allowed. Provide fixed piping for flushing and other service water applications
- Components, piping shall be claimed in such a way that vibrations and movements are avoided.
- Hydrostatic test at 1.5 times the working pressure is applicable for all pipes

## **SECTION VIII GENERAL**

Scope of contract for piping includes construction of necessary masonry valve chambers min 900 x 900 wherever necessary, removable type MS painted covers and extension spindles for valves.

The entire STP is proposed to construct below ground level.

All piping/Equipments/Motors/Cables and Pumps shall be clearly stated in the offer shall be got approved by Consultant before Supply & Installation.

All equipment GA drawings shall be submitted to Consultant for approval prior to fabrication/ ordering. The fabricated and brought-out equipments shall be inspected at Contractor Works by Consultant and shall be dispatched to site only after obtaining clear dispatch instructions in writing from Consultant.

It is obligatory on the part of the intending bidder to visit the site of work prior to submitting the offer and familiarise himself with local/site /soil conditions, availability of men, Materials and Machinery for successful and timely execution of the works. No extra shall be paid in case Contractor fails to ascertain correct site conditions before submitting the offer.

All MS hand railing/ladders shall be given two coats of synthetic enamel paint over a coat of red-oxide primer or approved make and shade, which shall be scope of civil contractor.

Any other item not specifically mentioned in this tender but is essential for proper and successful completion, commissioning and running of the STP for its commercial utilisation is also to be included in the scope of contract.

Fresh water line shall be provided to STP area but should be coordinated with all dependent services vendor.

## **SECTION IX    DETAILS OF ELECTRICAL WORKS**

### **GENERAL SPECIFICATION OF EQUIPMENT:**

- **Calibration certification, procedures and standards to all instruments has to be delivered.**
- **On all automatic valves notification of ON / OFF status.**
- **For automatic diversion valves, an interlock is require to ensure that the divert valve is fully open before the current operation valve closes.**
- **Where necessary automatic valves shall have notification ON / OFF status to the PLC.**
- **Local panels / operator panels with local indication and local control should be installed in order to monitor all parameters and locally control all the equipment.**
- **Main Electrical incoming feeder shall be terminated to Skid control panel, necessary Inter-connecting cables between Electrical control panel and equipment's on the skid to be provided by vendor**
- **The enclosure shall be dust and vermin proof and shall provide a degree of protection of not less than IP: 54 for indoor system and IP 65 for outdoor system.**

- The enclosure for control panel shall be fabricated with MS sheet & finally painted with RAL 7035 pebble gray.
- The equipment shall be provided with earthing studs with complete with lock nuts and washers.
- The system shall be designed to ensure maximum safety during operation, inspection, connection of cables and maintenance without taking any special precautions.
- All rotating/moving parts should be with 360 degree guarding
- All Variable Frequency Drives to have in – line chokes
- Motors above 7.5 KW to have star-delta/soft-starter/VFD
- Sufficient potential free contacts required for automation interface/handshake
- All hardware shall be corrosion resistant. All joints and connections of the panel members shall be made by cadmium plated high quality steel bolts, nuts and washers secured against loosening.
- All power and control cables shall be terminated through double compression nickel-plated brass cable glands.
- The incoming cable shall be XLPE insulated PVC sheathed Cu./Al. conductor armoured cables.
- The insulation grade for wires shall be 600 volts grade. All control wiring shall preferably be enclosed in plastic channels or neatly bunched together.
- All doors and movable parts shall be earthed using flexible copper connections to the fixed frame of the switchboard.
- All non-current carrying metallic parts of the mounted equipment shall be earthed.
- All motors in the generation system should have dry run protection and should be thermostat protected for high temperature trip
- Vendor to provide all other necessary protection required to motor with starter, PB, indication with measuring instruments.
- The Electrical main components shall be withstanding fault current of 50kA at 3 sec.
- The power and control terminal blocks, a minimum clearance of 200mm shall be maintained between terminal blocks and top and bottom plate.
- The main bus bar and connections shall be of high conductivity Aluminum, sized for specified current ratings with maximum temperature as per standards. The size of main bus shall also be suitable for the specified fault level of the panel.
- The earth bar shall be designed suitable for the short circuit current
- All the Electrical components shall be comply with our make list.
- 1 NO. LT Panel, cubicle type suitable for floor mounting and comprising incoming power control switch, Ammeters, Voltmeter, Phase Indicating Lamps, MCBs and Starters for the feeders all complete. Also to be provided are two nos. Automatic Level Controller for actuating the Raw Effluent /Treated effluent. Necessary Auto manual Selector Switches shall also be provided.
- Necessary power wiring by armoured PVC Cables or by PVC insulated wire in conduit from LT Panel to equipment motors shall be provided with necessary tray/support etc complete and internal lighting of entire Plant.
- Necessary earthing as per I.E. rules.
- Lighting shall be as per IS requirements and fixtures shall be PHILIPS make and the make and size of cables used should be approved from consultant.



- Energy meter (approved make) should be provided in the panel
- 2 no spare feeder with MCB suitable for 5 HP shall also be provided in the LT Panel.
- The switchboard shall be metal clad, totally enclosed, rigid, compartmentalized design, floor mounting, air insulated, extensible cubicle type for use on medium voltage power, 3 phases 4 wire 50 cycles system.
- The equipment shall be designed for operation in high ambient temperature and high humidity tropical atmospheric conditions. Means shall be provided to facilitate ease of inspection, cleaning and repairs for use in installations where continuity of operation is of prime importance.

### **CONTROL PANEL**

- The PLC shall be 21CFR Part-II for security settings.
- The PLC to give the trends, alarms, history and current status of generation skids for failure components and online instruments
- Metal cabinet conforming to IP 54 for indoor applications and IP 65 for outdoor applications. The cabinet shall be mounted on skid with proper provisions of incoming of electrical conduits & cables on the top / bottom. The cable shall be cleanly wired and terminated with clear and proper ferruling. The electronic portion of panel shall be removable type for break free installation. Cabinet shall be with a key lock arrangement.
- Each cores shall be with the standard color scheme of PVC insulation conforming to relevant IS standards. The cable shall be routed in a GI Cable trays / PVC conduits wherever required and the power cables shall be completely segregated from the system signal cables, No splices / joints are allowed in the cables.
- Cable glanding using suitable glands, End terminations with tin plated copper lugs, cable grounding, cable crimping and identification cable tags at both the ends of the cable.
- A 230V Single Phase UPS power supply shall be provided to power the PLC. Necessary voltage step-up/step-down precautions to be taken care by vendor.
- For all the instruments supplied along with PLC to be powered from PLC internal I/O cards only. External power supply will not be provided.
- The PLC shall be provided with Ethernet/ Control Net/ Device net and Modbus protocol to interface with BMS.
- Vendor should install AB make Ethernet Modem (9300 RADES) in control panel for remote technical support may be required in future from vendor.
- All programs and software to be in English language and software licences should be of lifetime validity.
- Vendor to provide back up of all application software and programs on a CD/DVD.

### **STANDARDS:**

Following equipments shall conform to the requirements of:

- a) Air Circuit Breaker (ACB) - IS 13947 - 1,2 / IEC 60947 - 1,2
- b) Moulded Case Circuit Breaker (MCCB) - IS 13947 - 1,2/ IEC 60 947 - 1&2
- c) Contactors - IS 13947 - 1,4
- d) Miniature Circuit Breaker (MCB) - IS 8828 - 1996/ IEC 898 - 1995

- e) Residual Current Circuit Breaker (RCCB) - IS 12640 - 1988 / IEC 1008
- f) HRC fuse link - IS 9224 and BS 8 :8
- g) Current Transformer - IS 2705 and IEC 185
- h) Potential Transformer - IS 3156
- i) Relay - IS 3231 & IS 8686 (For Static Relays)
- a) Indicating Instrument - IS 1248

**CONSTRUCTION:**

1. The switchboard shall be:

- a) Sheet steel enclosed, indoor floor mounted freestanding cubicle type.
- b) Made up of the requisite vertical sections modular type which when coupled together shall form continuous switchboards.
- c) Dust, vermin and damp proof and enclosure protection not less than IP 52.
- d) Each feeder/instrument compartment shall be provided with a hinged door interlocked with MCCB/SFU inside the compartment such that door can only be opened when MCCB/SFU in off position.
- e) Readily extendable as required by the addition of vertical sections after removal of the end covers.
- f) Switchboards shall have access to the feeders, bus bars, cable termination, cable alley, etc. as required.

2. Each vertical section shall comprise:

- a) A front-framed structure of rolled/folded CRCA sheet steel angle section of minimum 2 mm thickness rigidly bolted together. This structure shall house the components contributing to the major weight of the equipment such as circuit breaker cassettes, fuse switch units, main horizontal bus bars, vertical risers and other front mounted accessories.
- b) The structure shall be mounted on a rigid base frame of folded CRCA sheet steel of minimum 6 mm thickness and 75 mm height. The design shall ensure that the weight of the components is adequately supported without deformation or loss of alignment during transit or during operation.
- c) A cable chamber housing the cable end connections and power/control cable terminations. The design shall ensure generous availability of space for ease of installation and maintenance of cabling and adequate safety for working in one vertical / horizontal section without coming into accidental contact with live parts of the adjacent section.

- d) A cover plate at the top of the vertical section, provided with a ventilating hood where necessary. Any aperture for ventilation shall be covered with a perforated sheet having less than 1mm diameter perforations to prevent entry of vermin.
  - e) Front and rear doors fitted with dust excluding neoprene gaskets with fasteners designed to ensure proper compression of the gaskets. When covers are provided in place of doors generous overlap shall be ensured between sheet steel surfaces with closely spaced fasteners to preclude the entry of dust.
3. The total height of the panel shall not be more than 2300 mm unless otherwise specified and maximum height of switch operating handle shall not be more than 1800mm from FFL. The total depth of the panel shall be adequate to cater for proper cabling space.
  4. Doors shall be of minimum 14-gauge sheet steel and covers/partitions of 16G sheet steel. All sheet steel work forming the exterior of switchboards shall be smoothly finished, leveled and free from flaws. The corners should be rounded.
  5. The Components in the switchboards shall be so arranged as to facilitate ease of operation and maintenance and at the same time to ensure necessary degree of safety.
  6. Components forming part of the switchboards shall have the following minimum clearances:
 

Between phases	-	25mm
Between phases and neutral	-	25mm
Between phases and earth	-	25mm
Between neutral and earth	-	19mm

When, for any reason, the above clearances are not available, suitable insulation barrier / shielding shall be provided. Clearances shall be maintained during normal service conditions.

Creepage distances shall comply to those specified in relevant standards.

7. All insulating material used in the construction of the equipment shall be of non-hygroscopic material treated to withstand the effects of high humidity, high temperature and tropical ambient service conditions.
8. Functional units such as circuit breakers, fuse switches, MCCBs, etc. shall be arranged in multi-tier formation except that not more than two air circuit breakers shall be housed in a single vertical section.
9. Metallic/insulated shrouding shall be provided within vertical sections and between adjacent sections to ensure prevention of accidental contact with:

10. Main bus bars and vertical risers during operation, inspection or maintenance of functional units and front mounted accessories.
11. Cable terminations of one functional unit, when working on those of adjacent unit/units.
12. All covers providing access to live power equipment/circuits shall be provided with tool operated fasteners to prevent unauthorized access.
13. Provision shall be made for permanently earthing the frames and other metal parts of the switchgear by two independent distinct connections.
14. Only CRCA steel sheets shall be used for fabricating the cubicle.
15. Thickness tolerance for sheets shall be as applicable in relevant IS.

#### **METAL TREATMENT AND FINISH:**

1. After fabrication the panel shall undergo 7-tank treatment/sand blasting for removing Grease, Rust etc...
2. The panel shall be coated with zinc chromate primer (Applicable for outdoor panels).
3. After coating of primer, the panel shall be coated with Epoxy powder with shade RAL7032 prior to the approval of shade from Consultants.

#### **SECTION X TEST/TRIAL RUNNING AND COMMISSIONING**

The Contractor shall have to test the each equipment used for the plant for at least 72 hours continuous running with designed load and to the full satisfaction of Consultants. Any defects found, has to be rectified by the contractor at his own cost immediately and within reasonable time to be decided by client.

Necessary Instruments, Gauges, Labour/Supervisory Staff, Laboratory analysis etc., are to be furnished /provided by the Contractor free of cost to client. Vendor has to specify the value added services in his offer letter.

#### **SECTION XI COMMISSIONING/HANDING OVER**

During trial runs as described above, the Contractor shall satisfy Consultant in all respects regarding the satisfactory quality of effluent, quality of materials, equipments and workmanship used in the plant. Only after satisfying itself/himself regarding the above points, client will take over the plant and such date

of taking over shall be deemed as date of commissioning for all purposes, guarantees, and payment terms mentioned elsewhere in this tender. The guarantee period described elsewhere in the tender shall start from the date of commissioning.

## **GUARANTEE**

The under mentioned clauses shall govern in case of any contrary provisions given elsewhere in the document.

### ***Manufacturer's Guarantees***

The manufacturer's guarantee for design, workmanship and performance for all bought out items shall be made available to the owner and shall be valid at least for the entire defects liability period.

In the event of failure of any particular equipment, which fails more than three items during the guarantee period as mentioned in clause below, the contractor shall replace at his own cost that equipment. Manufacturer's/Contractor's guarantee, as mentioned in clause above, for such replaced equipment shall also be made available to the Owner and should be kept at least for one year from the date of last replacement.

### ***Performance Guarantee***

The Contractor shall give guarantee for a period of one year from the date of successful commissioning of the treatment plant against design, defective materials, workmanship, performance and guaranteed effluent quality. In the event the commissioning of the plant is not possible due to non-availability of effluent, contractor shall be issued mechanical completion certificate by client/consultant provided each equipment tested satisfactorily as directed by Consultant. However, the contractor shall have to maintain the plant at his own cost, in such a case for a period for three months beyond which period, if he is required to maintain further, he will be paid extra at mutually agreeable rate. However, the Contractor shall carry out testing and commissioning of the plant during the Defects Liability Period. Any defects found in the workmanship, materials or performance of the plant shall be made good by the Contractor at his own expense within the time specified by client/consultant.

### **For this purpose, the retention amount will be as follows:**

10% of the total value of Contract shall be retained and also treated as performance guarantee. The Successful Tenderer as per general conditions of contract shall be retained till the completion of satisfactory commissioning as stated above. The contractor at his own expense shall start and commission,

the plant and prove that it is giving satisfactory service and desired characteristic of the treated effluent, for two months before handing over the plant to the Owner. During this, the contractor shall train the Owner's operational staff without any extra cost to the Owner. The Contractor shall also have to guarantee the quality of the treated final effluent to meet the specification mentioned already. In case the quality of treated effluent varies from what is required, the contractor shall rectify the plant at no extra cost so as to achieve the requisite performance guarantee and satisfactory commissioning of the plant to the client/Consultant. In Case the contractor fails to achieve any of the aforesaid guarantees he will be penalised by an amount up to 10% (ten percent) of the total contract value. For this purpose any money due to the contractor shall be forfeited and adjusted against such penalty.

The contractor shall furnish the figures for average daily consumption of nutrients / Chemicals, if any. All the above guarantees will be based on collection and analysis of samples as mentioned in clause below.

#### **Oxygenation Capacity of Diffusers.**

The contractor, if directed by Consultant, shall at his own cost prove the Oxygenation capacity guaranteed by him for the diffusers provided by conducting oxygenation capacity tests on the unit by any standard and internationally recognised method to be approved by the Consultants.

#### **MECHANICAL GUARANTEES**

The Contractor shall guarantee for a period of one year for the failure of any particular part of the equipment. In the event of failure of any particular part of the equipment more than three times during the guarantee period, the Contractor shall replace it. In case it is found that the above mentioned failure is due to some other connected part of the equipment, that part shall also be rectified or replaced by the contractor to avoid such failures in the future. The guarantee for such replaced parts shall be extended by one year from the date of last replacement.

#### **COLLECTION AND ANALYSIS OF SAMPLES**

The guaranteed effluent shall be based on complete analysis of samples collected after stabilization of the plant.

Min. 2 nos. Raw Effluent and 2 nos. Treated Effluent samples per month shall be collected and got analysed at the Pollution control Board approved Laboratory.

### **SECTION XII ANNUAL MAINTENANCE**

The contractor shall include in the offer for maintaining the treatment plant including all the consumables etc., qualified personnel shall be posted on the site on shift basis, to take the sampling and carry out the tests. A complete

record has to be maintained for all the tests carried out at regular intervals.

One operator per shift and one supervisor during general shift based on 3 shifts/day shall be posted. The senior chemist of the contracting firm shall visit at least once a week for monitoring plant operation.

Also one Senior Mechanical Technician shall visit the plant for inspection and supervision of maintenance of all equipments.

**NOTE:**

- Data sheet to be duly filled before submission
- Provide detailed specification with guarantee details of the equipments, for which data sheet is not filled.
- Provide efficiency curves and catalogues for the equipments used.

**SECTION -XIII DOCUMENTS SUBMISSION**

**Documents to be submitted along with BID**

- **Mass balance diagram with indication of flow at each stage**
- **Process & Instrument diagram with indication of Effluent quality stage wise**
- **Equipment layout with dimensions & clearances**
- **Technical specifications for Piping, mechanical, electrical & instrumentation areas**
- **Mechanical/Piping/Electrical/Instrumentation equipment data sheets**
- **Civil pedestal/Foundation requirements**
- **Building layout/sections**
- **Electrical load list & feeder requirement in Kw, Feeder size, Panel GA , SLD**
- **Instrument list and specifications**
- **List of alarms, I/O points.**
- **List of makes for piping, mechanical equipment's, electrical , instrumentation works**
- **List of Subcontractors**
- **List of Deviations from tender**

Documents to be provided

- **Equipment catalogues along with technical specifications & data sheets in standard formats in DQ.**
- **Complete Water balance & Detailed P&ID**
- **General Arrangement drawing of all the equipment's**
- **Civil/Structural foundation requirements**
- **Any other utilities**
- **Electrical and Instrumentation drawings**
- **Quality assurance plan**

- **Feeder list along with feeder Rating for all equipment's**
- **Material test certificates**
- **Instruments test and calibration certificates**
- **Testing procedures with standard codes/Regulations**
- **FAT Document**
- **Operation and Maintenance manuals**
- **IQ/OQ/PQ documentation**
- **Recommended Spares list for 2 years.**
- **GFC drawings**

SECTION -XVI LIST OF MAKE :

ION EXCHANGE , THERMAX / EQUIVALENT CPWD Dept. Approved makes & materials

Note : vendor should submit all shop dwgs for consultants approval before execution

**SIGNATURE OF TENDERER**