

## Technical Specification of Sanitary Works

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## **1.0 GENERAL**

### **1.1 Scope**

The Contractor shall furnish all materials, labour and related items necessary to complete the work indicated on the Drawings and Specified herein.

### **1.2 General**

Unless specifically mentioned otherwise, all the applicable codes and standards published by the Indian Standard Institution and its subsequent revision and all other Standards which may be published by them before construction work starts, shall govern in respect of design, workmanship, quality and properties or materials and method of testing.

Some of these available Standards are listed below.

|                 |   |
|-----------------|---|
| IS: 458 - 1971  | Specification for Cement Concrete Pipes with and without Reinforcement                      |
| IS: 778 - 1964  | Specification for Gun Metal Gate, Globe and Check Valves for Water, Steam and Oil only      |
| IS: 780E -1966  | Specification for Sluice Valve for Various Purpose  |
| IS: 781 - 1984  | Specification for Cast Copper Alloy Screw Down Bib Taps and Stop Valves for Water Services. |
| IS: 781E -1959  | Specification for Sand Cast Brass Screw down Bib Taps and Stop Taps for Water Services      |
| IS: 783 - 1959  | Code of Practice for Laying of Concrete Pipes.  |
| IS: 1171 - 1963 | Basic Requirement of Water Supply, Drainage and Sanitation.                                 |
| IS: 1703 - 1989 | Water Fittings -Copper Alloy Float Valves (Horizontal Plunger Type) - Specification         |
| IS: 1726 - 1991 | Cast Iron Manhole Covers & Frames -Specification  |
| IS: 1742 -1983  | Code of Practice for Building Drainage  |
| IS: 2064 -1962  | Code of Practice for Selection, Installation and Maintenance of Sanitary Appliance          |
| IS: 2065 – 1983 | Code of Practice for Water Supply in Building   |
| IS: 2373 – 1963 | Specification for Water Meters (Bulk type)  |
| IS: 2470 - 1985 | Code of Practice for Installation of Septic Tanks.  |
| IS: 2556 - 1967 | Specification for Vitreous Sanitary Appliances (Vitreous China).                            |
| IS: 3597- 1966  | Method of Test for Concrete Pipe  |
| IS: 5329- 1969  | Code of Practice for Sanitary Pipe Work Above Ground for Building.                          |

The Contractor will submit all samples to the Engineer for approval, together with Manufacturer's literature and installation instructions and obtain his full approval before placing any material orders or commencing the works.

In cases where materials are not available in Metric Measurements (as referred to) the nearest size Imperial units shall be provided, with prior approval of the Engineer, at no extra cost to the contract.

### **1.3 Basic Materials and Method**

All materials provided for the Contract will be in strict accordance with the latest version of the applicable Indian Standards. All manufacturer's data, specifications and relative information together with samples will be submitted to the Engineer for approval prior to being purchased, otherwise at the Contractor's own risk.

### **1.4 Materials Trade Names Variations**

Tenders shall be based upon complete installations. Products required which are not shown or mentioned, or not specified herein as to manufacturer, quality, etc. shall be furnished of the highest quality (commercial standard).

Materials shall be new and free from all defects.

All materials, apparatus or equipment called for on the Plans or in the Specifications by trade names, or the name of a particular manufacturer, or by catalogue reference are the materials, apparatus, or equipment which should be allowed for in the Tender, or qualification submitted at the time of Tender submission.

### **1.5 Regulations**

The work shall be carried out in accordance with all rules, regulations, by-laws and requirements of all authorities having jurisdiction. All changes and alterations required by an authorized inspector of any authority having jurisdiction shall be carried out at no cost to the employer.

### **1.6 Drawings and Specifications**

These Specifications shall be considered as an integral part of the Drawings which accompany them. Neither the Plans nor the Specifications shall be used alone. Any item or subject omitted from one, but which is mentioned or reasonably implied in the other shall be considered as properly and sufficiently specified and therefore must be supplied by the Contractor.

Misinterpretation of any requirements of either the Drawings or Specifications shall not relieve the Contractor of his responsibility for properly completing his work.

The Contractor shall apply to the Engineer for any explanation which he may require in regard to the meaning and intent of any clause in the Specification and Contract. He shall be held responsible for any errors or losses consequent upon failure to obtain such explanation.

The Contractor shall consult with the Engineer to obtain detail drawings or instructions for exact location of equipment as work progresses, before installing fitting or equipment and will be responsible for coordination with all other work trades including finishes.

Drawings show general location and routes to be followed by pipes, ducts, etc. where not shown, or shown diagrammatically, the Contractor shall install them in accordance with best trade practices.

### **1.7 As Built Record**

The Contractor shall request a complete set of drawings, (white) from the Engineer and use these for "As Built" records.

"As Built" records shall be retained in the site office and kept up to date daily in regard to changes in actual installation from the Plans and Specifications. Alterations to duct work, piping services, etc. shall be noted and the revised arrangement drawn in accurately, complete with dimensions from column lines. Every precaution shall be taken to protect the Drawings from damage and loss.

The "As Built" records shall be made available to the Engineer upon request and made available at each site meeting. After no further alteration can be expected and the Contract is nearing completion, the records shall be submitted for final approval.

The Contractor shall include on "As Built" records the dimensions location of all buried piping and valves, and during construction plainly mark location of exterior services and valves to prevent damage to these until the Project is completed.

### **1.8 Cutting and Patching:**

Openings not indicated on the Architectural or Structural drawings which are required for bringing equipment into the building or for other temporary or permanent service, shall be approved by the Engineer. The Contractor will provide, maintain and restore these openings and shall pay for their provision and restoration. Ample notice shall be given of size and location of such openings.

The Contractor shall ensure that he does not undertake any cutting that may impair the strength of the building. No holes, except expansion bolts and small screws may be drilled into the structure without obtaining prior approval.

All cutting and patching work shall be done in a neat and workman like manner by mechanics skilled in the trades.

### **1.9 Painting**

All equipment supplied under this Specification shall be delivered to the site with a factory applied prime coat of paint unless noted otherwise. All supports and hangers shall receive a prime coat of paint.

Painting where required for pipe, duct services, equipment identification including stenciling shall be carried out by a paint tradesman under this division in accordance with the workmanship and material specification.

All factory prime-coated or finish coated equipment shall be touched up or repainted if equipment is marred during shipment or installation.

### **1.10 Expansion and Contraction**

Unless shown otherwise, the Contractor shall be responsible for measures to control the thermal movement of piping and apparatus. Piping shall be erected in such a manner that strain and weight does not come upon cast connections or apparatus.

Where possible, the effect shall be obtained by providing changes in direction and loops in pipe runs, supplemented by the necessary guides, anchors and limit stops.

### **1.11 Clean Up**

The Contractor shall clean all exposed metal surfaces from grease, dirt or other foreign materials. Chrome plated and polished work shall be left bright and clean. All openings in pipes and fixtures shall be properly capped and plugged during construction.

Fixtures and equipment shall be properly protected from damage during the construction period and shall be cleaned in accordance with the manufacturer's instructions.

### **1.12 Pressure Testing**

#### **General**

- i. These clauses shall apply to all piping systems including the plumbing and drainage systems, which shall also be governed by the applicable requirements of the IS specifications.
- ii. The Contractor shall notify the Engineer 24 hours in advance of all test.
- iii. Tests of piping system or protection thereof shall include all apparatus forming part of the complete systems, except where such apparatus is factory tested prior to installation in the systems.
- iv. All tests shall be performed before the application of pipe covering or before being concealed.

- v. Except where otherwise noted, test pressure shall be twice the maximum working pressure of the systems, or 0.5 N/mm<sup>2</sup>, whichever is greater. Test fluid shall be water, unless otherwise indicated. All defects found shall be rectified by removing and remarking the particular section. Caulking of thread, hammering and welding of leak joint shall not be allowed.
- vi. Piping systems may be tested in whole or in part. Each system to be tested shall be suitably isolated from existing or new systems using temporary blanks between flanges, thickness of blanks shall be approved by the Engineer or caps. Where necessary for testing purposes, a pair of flanges shall be installed in the piping system for the installation of blanks. Tests shall not be performed against a closed valve.
- vii. All drains, vents, safety or relief valves and other pressure sensitive devices shall be removed prior to testing, and the openings capped or plugged. It is not permissible to plug or seal safety or relief valves. Air shall be removed from all high points to the satisfaction of the Engineer before flushing vent openings.
- viii. Temporary blanks or caps shall be removed when testing has been satisfactorily completed and drains, vents, safety or relief valves etc. replaced.
- ix. At least four hours shall elapse after erection before any welded or brazed line is subjected to test pressure.
- x. When test pressure is attained, the test pump or compressor shall be disconnected and the connection capped. The test pressure gauge shall be left in the system.
- xi. At least four hours shall elapse after test pressure is applied before the system is inspected for leaks. All joints, glands, connections etc. shall be carefully inspected for leaks and tightened as necessary.
- xii. Test pressure shall be maintained without loss for a period of 24 hours.
- xiii. Joints or connections which continue to leak after tightening shall be completely dismantled, checked, cleaned (replace if necessary), re-assemble and retested. Opening, caulking or hemp shall not be used for leaking joints.
- xiv. All water shall be drained from system following testing to prevent damage.
- xv. During testing, precautions shall be taken to prevent injury to persons or property as a result of sudden rupture of a piping system.

## **2.0 SOIL ,WASTE ,VENT AND RAIN WATER PIPES**

### **2.1 Scope**

Work under this section shall consist of furnishing all labour, materials, equipment and applications, necessary and required to completely install all soil, waste, vent and rain water pipes as required by the drawings, specified hereinafter and given in the Bill of Quantities. Without being restricted to the generality of the foregoing, the soil waste and vent pipes system shall include:

- Vertical and horizontal soil wastes and vents pipes, rain water pipes and fittings, joints, clamps and connections to fixtures.
- Connection of all pipes to sewer and storm water lines as shown on the drawings at ground floor levels.
- Floor and urinal traps, clean-out plugs and inlet fittings.
- Waste pipe connection from all fixtures e.g. Washbasins, sinks, urinals, kitchen, equipment and plant room equipment.

### **2.2 General Requirements**

All materials shall be of the best quality conforming to the specifications and subject to the approval of the Engineer. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc.

Fitting positions shall in all cases line up with & conform to access panels for ease of maintenance. Pipes shall be securely fixed to walls by suitable clamps at intervals specified. Access doors for fittings and clean-outs shall be so located that they are easily accessible for repair and maintenance. All work shall be executed as directed by the Engineer.

### **2.3 PVC Pipes and Fittings: Soil, Waste and Vent Pipes**

Where specified, soil, waste and rain water pipes shall be 4 or 6 kg. f/cm<sup>2</sup> working pressure rigid PVC single socketed push-on rubber joint pipes. PVC pipe should have a length of 3m or 6m with moulded PVC fittings of thickness not less than 3.2mm. Pipes shall be of colour specified by the Engineer. Fitting for PVC pipes shall be moulded and include tees, bends, reducers, offsets, plugs etc. Outlets of suitable diameter for connection to the appliance shall be provided. PVC pipes shall be jointed as recommended by the manufacturer. Fixing of PVC pipes shall be done in the best workmanship.

Before use at site, all pipes shall be tested by filling up with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blowholes and cracks. All defective pipes shall be rejected and removed from the site.

Pipes shall be further tested after installation, by filling up the stack with water. All opening and connections shall be suitably plugged. The total head for PVC pipes shall not exceed 10 meters. All pipes shall be fixed in gradient towards the outfall drain. Pipes inside toilets shall be chased and concealed or otherwise as shown on the Drawings.

PVC pipes to be laid in trench or floor or wall. Complete installation of PVC pipes include supply of pipes and necessary fittings such as Tees, Bends, Reducers, Crosses, Couplers, epoxy materials etc., trench excavation in any type of soil and backfilling with proper compaction, chasing in wall or floor and repair to original finish, laying and jointing of PVC pipes and fittings and pressure testing. The trench width shall be 2 times 300 mm + outer diameter of pipe, and the pipes laid underground shall not be less than 600mm from the ground level.

All soil and waste pipes shall be tested to detect any leakage etc. in accordance to IS: 5329-1969.

Measurements:

PVC Pipes shall be measured along the centre line of pipes and fittings in running meter between socket to socket or bend,tee of pipes and pvc fittings as tee,bend,door tee etc.count by number.

### **2.4 ASTRAL uPVC Foam core Pipes & ASTRAL uPVC DWV**

:-Providing, fixing, testing and commissioning ASTRAL uPVC Foam core Pipes & ASTRAL uPVC DWV Click Ring type fittings for drain, waste and vent including injection moulded fittings e.g. tees, bends, clamps, Y junctions, reduces couplings, adapters, door bend and terminal cowl etc. jointing with lubricant/rubber ring/ solvent cement including cuttings the walls and floor as required and making good the walls and floors as required at site for internal drainage system. Installation to be made with proper anchoring, fasteners, clamps, etc and shall be to the satisfaction of the Engineer-In-Charge.

PVC Pipes shall be measured along the centre line of pipes and fittings in running meter between socket to socket or bend,tee of pipes and pvc fittings as tee,bend,door tee etc.count by number.



#### 2.4.1. UPVC Pipes

All Soil, waste, vent and rain water pipes shall be unplasticized rigid Poly Vinyl Chloride (UPVC) pipes conforming to IS: 4989-1958. Pipes shall be of following specifications:

| Normal diameter | Working pressure<br>kgf/cm <sup>2</sup> |
|-----------------|---|
| 50mm            | 6                                       |
| 75mm            | 4                                       |
| 110 mm          | 4                                       |
| 160 mm          | 4                                       |

Pipes shall be of colour specified by the Engineer. Fitting for UPVC pipes shall include couplings tees, bends, elbows, unions, reducers, nipples and plugs. Outlets of suitable diameter for connection to the appliance shall be provided. Contractor shall use pipes and fittings of matching specifications. Fittings shall be of the required degree of curvature with or without access door. Access door shall be screw type with neoprene gaskets as shall be approved by the Engineer.

#### 2.4.2 Clamps:

Holder bat clamps shall be of standard design and fabricated from M.S. flat 40 mm x 3 mm thick and 12 mm dia. rod and 6 mm nuts bolts. They shall be painted with two coats of black bitumen paint before fixing. Holder bat clamps shall be fixed in cement concrete of 1:2:4 mix.

Where holder bat clamps are to be fixed on RCC column, wall or beam they shall be fixed with 40mm x 3mm flat iron "U" type clamps with anchor fasteners of approved design. Rates for both types of clamps shall be the same and no addition or deduction shall be made.

Structural clamps shall be fabricated from MS structural members e.g., rods, angles, channels, flats as per detailed Drawing. Contractor shall provide all nuts, bolts, welding and paint the clamps with one coat of red oxide.

#### 2.4.3 Pipe Supports and Hangers:-Spacing for supports & hangers of fixing for internal piping shall be as given in the following table.

| Kind of Pipe | Size of Pipe<br>(mm) | Interval          |                 |
|--------------|----------------------|-------------------|-----------------|
|              |                      | Horizontal Run(m) | Vertical Run(m) |
| UPVC         | 50                   | 2                 | 2               |
|              | 75                   | 2.5               | 2.5             |
|              | 100                  | 2.5               | 2.5             |

#### 2.4.4 Waste Pipe from Appliances

Waste pipe from appliances e.g. wash basins, sinks, urinals, bath tubs, water coolers shall be of UPVC pipes with proprietary fixtures & fittings of the approved make conforming to all relevant ISS & also to IS 4984-1978. All pipes shall be fixed in gradient towards the out-falls of drain. Spacing for clamps for such pipes shall be as follows:

|            | Vertical | Horizontal |
|------------|----------|------------|
| Pvc Pipes  | 300cm    | 240cm      |
| HDPE Pipes | 180cm    | 120cm      |

Pipes shall be galvanized steel tubes conforming to IS 1239-1979 (medium class) and quality certificates shall be furnished. Pipes shall be provided with all required fittings, e.g. tees, couplings, bends, elbows, unions, reducers, nipples, and plugs. All GI waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

## **2.5 Traps**

### **2.5.1 Floor Traps**

Floor traps shall be pvc, deep seal with an effective seal of 50mm. All waste pipes shall be over the trap. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate) and extended 35 mm below finished floor level. Contractor shall provide all necessary shuttering and centering for the blocks. Size of the block shall be 300 mm x 300 mm and of the required depth.

### **2.5.2 Floor Trap Inlets**

Where specified, the Contractor shall provide a special type 4 way pvc multi port inlet hopper without or with one, two or three inlet sockets to receive the waste pipes.

### **2.5.3 Grating for Floor Traps**

Floor traps shall be provided with 125 mm dia. Chrome Plated (CP) Brass or Stainless Steel grating with rim of approved design and shape. Minimum thickness shall be of 3 mm.

### **2.5.4 Urinal Traps**

Urinal traps shall be PVC 'P' or 'S' trap with or without vent and set in cement concrete blocks as specified without extra charge.

## **2.6 Fixing**

All vertical pipes shall be fixed by MS clamps truly vertical. Branch pipes shall be connected to the stack at the same angle as that of the fittings. A heel rest bend supported on concrete block shall be provided at the feet of the stack. No collars shall be used on vertical stacks. Each stack shall be terminated at top with a cowl (terminal guard).

Horizontal pipes laid to the correct slopes running along ceilings shall be fixed on structurally adjustable clamps of special design shown on the drawings or as per details shown on the drawings or as directed. Horizontal pipes shall be laid to uniform slope and the clamps adjusted to the proper levels so that the pipes fully rest on them. The Contractor shall provide all sleeves, openings, hangers, inserts during the construction. He shall provide all necessary information to the building contractor for making such provision in the structure as necessary and as required.

### **2.6.1 Joining**

All joints to be O ring type wahser and Solvent as per specification and instruction of Engineer. Fixing of UPVC pipes shall be done in the best workmanship.

### **2.6.2 Clean Outs**

Clean-outs shall be full pipe size up to 100 mm and a minimum of 100 mm on larger pipes with cast brass plug and caulked lead seat. A clean-out shall be installed at, or as close as possible to, the base of every vertical waste, soil and drain stack. A clean-out shall be installed at the up-slope of each pipe at which a building drain or branch changes direction by 45° or more.

Clean-outs in horizontal drainage piping shall be at intervals not greater than:

- 15 m where the piping is of dia. 100 mm and smaller.
- 30 m where the piping is of large than dia. 100 mm.
- 6 m where waste pipes are horizontally connected to sinks.

Nickel Bronze or Stainless Steel Floor Plates with Frames shall be installed on finished floors for access to clean-outs. Clean-outs on horizontal lines in finished areas shall be as per IS Specifications.

### **2.6.3 Cement Concrete**

Soil and waste pipes under floor in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate), 75 mm bed and all round. When pipes are running well above the structural slab, the encased pipe shall be supported with suitable cement concrete pillars of 150 mm x 150 mm of required height at interval of 1800 mm. Rate for concrete around pipes shall be inclusive of pillars support, shuttering and centering.

### **2.6.4 Painting**

Pipe fittings and clamps in exposed positions shall be painted with three or more coats of ready mix oil paint of approved make, quality and shade.

### **2.6.5 Cutting and Making Good**

Pipes shall be fixed and tested as building work proceeds. Contractor shall provide all necessary holes, chases in structural members as building work proceeds. Wherever holes are cut or left originally they shall be made good with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate) and the surface restored as in original condition. No additional payment shall be made for cutting and making good holes.

## **2.7 Tolerances:**

Acceptable tolerance for pipes to IS: 3989 and IS: 1729 shall be as follows:

- |    |                |       |
|----|----------------|-------|
| a. | Wall thickness | 15%   |
| b. | Length         | 20 mm |
| c. | Height         | 10%   |

## **2.8 Testing**

Before use at site, all pipes shall be tested by filling up with water for at least 10 minutes. After filling, pipes shall be struck with a hammer and inspected for blow holes and cracks. All defective pipes shall be rejected and removed from the site within 48 hours. Pipes with minor sweating shall be

accepted at the discretion of the Engineer. Pipes shall be tested after installation, by filling up the stack with water. All opening and connection shall be suitably plugged. However the total head in the stack shall not exceed 3m.

Alternatively, the Contractor may test all soil and waste stacks by a smoke testing machine. Smoke shall be pumped into the stack after plugging all inlets and connections. The stack shall then be observed for leakages and all defective pipes and fittings removed or repaired as directed by Engineer.

## **2.9 Measurement**

### **General**

Rates for all items quoted shall be inclusive of all work and items given in the above mentioned specifications and Bill of Quantities and applicable for the work under floor, in shafts or at ceiling level at all heights and depths. All rates are inclusive of preparing timber block-outs in RCC and chasing masonry work and making good the same. All rates are inclusive of pre-testing and on site testing of all the installations and materials prior to commissioning to the satisfaction of the Engineer.

**Pipes** (Unit of measurement: Linear meter to the nearest centimetre)

PVC Pipes shall be measured per running meter correct to a centimetre for the finished work, which shall not include proprietary fittings, e.g. crosses, sockets, nipples and nuts but exclude bends, tees, elbows, reducers. The length shall be taken along centreline of the pipes and fittings. All pipes and fittings shall be classified according to their diameters, method of jointing and fixing substance, quality and finish. The diameters shall be nominal diameter of internal bore. The pipes shall be described as including all cutting and waste. In case of fittings of an equal bore, the largest bore shall be measured. Cement concrete around pipes shall be measured along the center of the pipe line measured per linear meter and include any masonry supports, shuttering and centering cutting complete as described in the relevant specifications. Slotted angles/channels shall be measured per linear meter of finished length and shall include support bolts and nuts embedded in masonry walls with cement concrete block and nothing extra will be paid for making good the same.

### **Pipes Specials**

PVC pipe specials e.g. bend, tee, Y- joint etc shall be measured by numbers. Rate shall be for plain or reducers used wherever required as per the site condition.

### **Measurement**

Unit of measurement shall be the number of pieces. Floor and urinal traps, traps gratings, hoppers, clean-outs, plugs shall be measured by numbers and shall include all items described in the relevant specifications. Bolt welding shall be by number of complete pipe joints.

## **3.0 SANITARY-WARES**

### **3.1 Scope**

Work under this section shall consist of furnishing all labour materials necessary and required to completely install all sanitary fixtures, chromium plated fittings and accessories required by the drawings and specified hereinafter or given in the schedule of quantities. Without restricting to the generality of the foregoing the sanitary fixtures shall include all sanitary fixtures, CP fittings and accessories, etc, necessary and required for the buildings. Whether specifically mentioned or not, all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required. All exposed pipes within toilets and near fixtures shall be chromium-plated brass or copper unless otherwise specified. All hot water pipes shall be lagged & properly insulated from the hot water storage tanks to the hot water taps & outlets.

### **3.2 General Requirements**

Sanitary fixtures shall be of the best quality approved by the Engineer. Wherever particular makes are mentioned, the choice of selection shall remain with him. All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned in the schedule of quantities, specifications or drawings or not. All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Engineer/interior designer's requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern desired. Fixing screws shall be half round head chromium plated brass screws with CP washers wherever required as per directions of Engineer. All fittings and fixtures shall be fixed in a neat workmanlike manner true to level at heights shown on drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor.

### **3.3 Orissa Type Pan or IPWC commode & Cistern**

Pan or Comode shall be of white vitreous china first class quality, single or double symphonic close 'P' or 'S' trap coupled with cistern with fittings, brackets as specified in the Bill of Quantities. The W.C. pan/Commode and cistern shall be new free from cracks, crazes, and blisters and shall have smooth surfaces.

#### **3.4 European pattern W.C. commode with flush valve or cistern.**

These shall be of white glazed vitreous china first class quality, double or single trap symphonic water closet suite as specified in the Bill of Quantities, P or S Trap flushing cistern or flush valve as specified conforming to Indian standard Specification. The commode and flushing cistern shall be free from cracks, blisters and shall have smooth surface.

Fixing :- W.C. commode shall be fixed to floor with CP brass screws or by means of 75mm long 6.5mm dia counter sunk bolts and nuts imbedded in floor concrete or as per the instruction of the Project Engineer. The base of pedestal of the commode shall be filled with white cement mixed with pigment to match the shade of floor or as directed by the Project Engineer. Following measure shall be adopted for fixing the W.C. commode

The central axis of the commode shall be perpendicular to the finished face of wall.

The outlet of the commode shall be centrally placed in the rubber gasket of the Pvc. pipe as per drawing or as directed by the Project Engineer and shall have not leakage.

The distance between centre line of outlet of W.C. commode and finished wall face shall be so adjusted as to rest squarely against the finished wall face.

Seat and lid: This shall be of ISI marked solid of heavy duty quality and fitted exactly on the rim of the W.C. Commode with C.P. brass hinges, rubber buffers and C.P. brass nuts.

#### **3.4.1 Flushing Cistern**

Flushing Cistern shall be of white vitreous china first class quality with push/pull handle of 10 lit capacities. Cistern shall have mosquito proof cover ball valve with copper float, lever and siphon complete with necessary unions etc. for inlet outlet and overflow connections. Cistern shall be fixed on rolled cantilever bracket, which shall be firmly embedded in the wall by making holes of required sizes. Brackets shall be grouted in holes with cement mortar 1:2 (1cement: 2 fine sand). The wall used for making holes shall be made good to original condition.

#### **3.4.2 Flush Pipe:**

Cistern shall have 32 mm. dia. outlets for flush pipe connected to W.C. pan. /commode Flush pipe shall be of chromium plated. Vertical drop of flush pipe shall be embedded in the wall with

a long bend from outlet of cistern. Horizontal piece shall be laid under floor. The chase of embedding shall be made good with cement concrete 1:2:4 mix. Jointing between C.P. flush pipe and W.C. pan shall be made with white lead, yerr, and water proofing compound or any other suitable method. The joint shall be absolutely leak proof.

### **3.4.3 Ceramic/plastic cistern**

Cistern shall be connected of 450mm Length with brass unions at the ends. One end shall be connected to cistern inlet and the other to distribution line with a angle cock in between for control of flow.

### **3.4.4 Stop Cock:**

Stop Cock shall be of C.P. brass.

### **3.4.5 Fixing:**

The W.C. pan or comode shall be laid in floor slope towards the pan in a workman like manner care being taken not to damage the pan in the process of fixing. If damaged in any way, it shall be replaced at no cost to the Employer. The pan shall be fixed on a proper base of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone ballast 20mm. nominal size) taking care that cushion is uniform and even without having any hollows between the concrete base and pan. Joining between the pan and finished floor shall be neatly done and no hair cracks shall be visible. Joining between the outlet of pan white trap shall cement concrete and water proofing compound and made leak proof.

## **3.5 Mixing Fittings :**

Mixing fittings shall be C.P. brass of approved quality with modern head for hot and cold for spray and rim with diverter.

### **3.5.1 Angle Valve :**

Angle valve shall be of 12.7mm dia. C.P. brass with C.P. cap and c.p. nipple .The connection between angle valve and supply line laid in chase shall be made in a manner so that the union is flush with finished face of the wall and no threaded portion of the angle valve or supply line is visible.

## **3.6 Urinals**

Urinals shall be lipped type half stall white glazed vitreous china of size 610 x 400 x 380 mm size. Flat back urinals shall be provided with 15 mm dia. spreader, 32 mm dia. PVC bottle trap with pipe and wall flange, and shall be fixed to wall by one CI bracket and two CI wall clips complete as recommended by manufacturer's directives with approval by Engineer. Urinals shall be fixed with CP brass screws. Flush pipes shall be GI pipes concealed in wall chase but with chromium-plated bends at inlets and outlets wherever they are visible.

Urinals may be flushed with flush valves, if given in the schedule of quantities and as described in the item

Waste pipes shall be concealed by chasing into the walls as directed by the Engineer. Specifications for waste pipes shall be same as given in the relevant section of this specification.

**Urinal partition** shall be white glazed porcelain of size 680 x 300 mm (division plate).

### **3.7 Wash Basin**

Wash basins shall be white glazed vitreous china size, shape and type specified in the schedule of quantities, as shall be approved by the Engineer. Each basin shall CI brackets and clip-sand the basin securely fixed to wall. Placing of basin over the brackets without secure fixing shall not be accepted. They shall be provided & fixed in place early so that the built up vanity may be installed in sufficient time to comply with completion dates. Each basin shall be provided 32mm dia. C.P. Waste Coupling with C.P. Chain and Rubber plug, 32mm dia. C.P. or pvc P or S trap ,15mm dia. C.P. Bib-cock/mixer, pipe connector etc. fittings as given in the schedule of quantities. Each basin shall be provided with mixing fitting or pillar tap as specified in the Bill of Quantities and/or as approved by the Engineer. Basins shall be fixed at proper heights as shown on drawings. If heights are not specified, the rim level shall be 79cms or as directed by the Engineer.

#### **3.7.1 Stainless steel wash basin**

Stainless Steel Wash basin shall be JENA or NERALI or approved brand heavy quality of size and shape specified. These shall be fixed to wall by means of CI or MS brackets or if under counter type, fixed under counter. Wash basins shall have one 15 mm CP push-on type pillar tap, 32 mm dia. CP waste with chain and plug, 32 mm PVC bottle trap with pipe to wall and flange. The wash basin shall be securely fixed to the brackets by means of studs or lugs fixed on the brackets. The basins shall have 15 mm dia. 500 mm long PVC connector pipes with angular stop cock at inlet.

### **3.8 Sinks**

Sinks shall be stainless steel as specified in the schedule of quantities. Each sink shall be provided with CI brackets and clips and securely fixed. Counter top sinks shall be fixed with suitable angle iron clips or brackets as recommended by the manufacturer. Each sink shall be provided with 32 mm dia. C.P. waste coupling with C.P. chain rubber plug, 32 mm dia. bottle trap with clean out hole and plug ,15 mm dia. C.P. Sink cock. Fixing shall be done as directed by the Engineer and shall be coordinated with the Interior Fit-out Program. Supply fittings for the sinks shall be fittings or CP cock/mixer as specified in the Bill of Quantities.

#### **3.8.1 Fixing:**

The sink shall be laid in wall in a workman like manner care being taken not to damage the sink in the process of fixing. If damaged in any way, it shall be replaced at no cost to the Employer. The sink shall be fixed on a proper base of cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone ballast 20mm. nominal size) taking care that cushion is uniform and even without having any hollows between the concrete base and sink. Joining between the sink and wall shall be neatly done and no hair cracks shall be visible. Joining between the outlets of sink shall be made leak proof.

### **3.9 Stainless Steel Scrub Sink/slucice/sterilization sink**

Stainless Steel Scrub Sink, sluice, sterilization sink shall be of shape and type as specified in the Bill of Quantities. The scrub sink shall be fabricated from 16 SWG stainless steel as per bill of quantity. The sink shall be fitted with a 38mm waste coupling and joined to the wall drain pipe. The sink is fabricated by fabricator with the equivalent quality.

#### **3.9.1 Fixing**

The sink is fixed to the wall with nickel-painted pan head screws and mild steel brackets as indicated in the drawings.

The fittings shall be 15mm elbow-operated mixer or sensor of approved make.

### **3.10 Towel Rail**

Towel Rail shall be of C.P. brass heavy quality of size 15mm x 600mm, 15mm x 450mm.

#### **3.10.1 Fixing**

Brackets shall be fixed to wall by means of C.P. brass screws to wooden plugs or crawl plugs or dash fasteners firmly embedded in the wall or as directed by the Engineer.

### **3.11 Toilet Paper Holders**

Toilet Paper Holders shall be white vitreous china, Stainless steel or CP and of size as specified in Bill of Quantity .

#### **3.11.1 Fixing**

These shall be fitted in recess in masonry on 80mm thick cushion of cement concrete 1:2:4 and jointing to the masonry with white cement or with approved materials to match with dado work.

### **3.12 Soap Dish:**

Soap Dish shall be of white vitreous china, Stainless steel or CP of size as specified in Bill of Quantity.

#### **3.12.1 Fixing**

These shall be fitted in recess in masonry on 80mm thick cushion of cement concrete 1:2:4 and jointing to the masonry with white cement or with approved materials to match with dado work.

### **3.13 Mirrors**

Mirrors shall be electro-coated copper 5.5mm thick of guaranteed quality and reputed make. The size shall be as specified in the Bill of quantities & the drawings. The image shall be clear and without waviness at all angles of vision. Mirrors shall be provided with plastic frame fixed with CP brass semi-round headed concealed screws and cup washers or CP brass clamps as specified or instructed by the Engineer.

### **3.14 Shower Set**

Shower set shall comprise of one or two CP brass stopcocks, concealed as specified in the Bill of Quantities. Each shower set shall be provided with bathtub spout hot and cold with CP Telephonic shower of approved quality to be approved by the Engineer or as specified in the Bill of Quantities or detailed as per the drawings. Concealed stop cockswall mixer or divertor shall be so fixed to allow for tiled or other finishes as keeping the wall flange clear off the finished wall. Wall embedded in the finishing shall not be accepted flanges.

### **3.15 Accessories**

The Contractor shall install all chromium plated and porcelain accessories as shown on the drawings in compliance to the manufacturer's specifications directed by the Engineer, and given in the Bill of Quantities. All CP accessories shall be fixed with CP brass half round head screws and cut washer in wall with raw plugs and shall include cutting and making good as directed by him. Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 mix (1 part cement and 2 part fine sand) and fixed in relation to the tiling work.



### **3.16 Measurement**

Unit of measurement shall be based on the number of fixture. Rate for providing and fixing of sanitary fixtures, accessories, urinal partitions shall include all items, and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable. Rates for all items under specifications above shall be inclusive of cutting holes and chases and making good the same, CP screws, nuts, bolts and any fixing arrangement required and recommended by manufacturers, testing and commissioning.

## **4.0 WATER SUPPLY WORKS**

### **4.1 Scope**

Work under this section consists of furnishing all labour, materials, equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the schedule of quantities. Without restricting to the generality of the foregoing, the water supply system shall include the following:

- Connecting the mains supply to the designed tanks as per the drawings.
- Control valve, masonry chambers and other appurtenances.
- Connections to all plumbing fixtures, pantries and overhead tanks.
- Excavation and refilling of pipe trenches.
- Pipe protection and painting

### **4.2 General Requirements**

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Engineer. Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workman like manner. Short or long bends shall be used on all main pipelines as far as possible. If HDPE ,Ppr, Pvc,Cpvc,multilayer pipes are used then methods approved by the manufacturer shall be used. Pipes shall be fixed in a manner as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages, etc. Pipes shall be securely levelled to the required slopes & fixed to walls and ceilings by suitable clamps at intervals specified. Valves and other appurtenances shall be located to provide easy accessibility for operation, maintenance and repairs.

### **4.3 GI Pipes, Fittings & Valves**

All pipes inside the building and where specified, outside the building shall be galvanized steel tubes conforming to IS 1239-1979 of class specified. When class is not specified they shall be of medium class. Fittings shall be malleable iron galvanized fittings of approved make. All fittings shall have manufacturer's trademark stamped on it. Fittings of GI pipes shall include couplings, bends, tees, nipples, reducers, unions, and bushes. Fittings shall be IS 1979 (part I to X) 1975. Pipes and fittings shall be joined with screwed fittings. Care shall be taken to remove butt from end of pipe after cutting by a round file. Genuine red lead with grumet and a few strands of fine hemp shall be applied and seal tape shall be used for C.P fittings and gate valves. All pipes shall be fixed in accordance with layout and alignment shown on drawings. Care shall be taken to avoid air pockets. GI pipes inside toilets shall be fixed in wall chases well above the floor. No pipes shall be run inside a sunken floor unless specifically instructed. Pipes shall be run under ceilings or floors and other areas as shown on drawings.

#### 4.4 PPR pipes and fittings

All water supply pipes inside the building and where specified shall be 3 layer PPR (Polypropylene Random Copolymer) brand tubes conforming to DIN 8077 : 1999-07 of class PN 16. The inner layer should be of anti-microbial PPR layer, the inner of black plain PPR layer and the outer layer of UV stabilized PPR layer. The details of class PN 16 pipes regarding outer bore, thickness and weight are given below:

| Outer bore (mm) | Thickness (mm) | Weight per meter (kg) |
|-----------------|----------------|-----------------------|
| 16              | 2.2            | 0.095                 |
| 20              | 2.8            | 0.148                 |
| 25              | 3.5            | 0.230                 |
| 32              | 4.4            | 0.370                 |
| 40              | 5.5            | 0.575                 |
| 50              | 6.9            | 0.896                 |
| 63              | 8.6            | 1.410                 |

Fittings shall be PPR brand malleable iron galvanized fittings. All fittings shall have manufacturer's trademarks stamped on it. Fittings for pipes shall include tees, unions, elbows, bends, reducers, nipples, crosses etc

Pipes and fittings shall be jointed with PPR fittings. Care shall be taken to remove burr from the end of the pipe after cutting by a round file. All pipes shall be fixed in accordance with layout and alignment shown on the Drawings. Care shall be taken to avoid air pockets. As far as possible, pipes inside toilets shall be fixed in wall chases well above the floor.

PPR pipes in shafts and other locations shall be supported by G.I. holder bat clamps of approved design. Pipes in wall chases shall be anchored by iron hooks. For external works, PPR pipes and fittings shall be laid in trenches. The trench width shall be 2 times 300 mm + outer diameter of pipe, and the pipes laid underground shall not be less than 900mm from the ground level. Complete installation of PPR pipes include supply of pipes and necessary fittings such as Tees, Bends, Reducers, Crosses, Unions etc., trench excavation in any type of soil and backfilling with proper compaction, chasing in wall or floor and repair to original finish, laying and jointing of PPR pipes and fittings and pressure testing.

Contractor shall provide adequate number of unions on all pipes to enable dismantling later on. Unions shall be provided near each gunmetal valve, stopcock or check valve and at an interval of 20m on straight runs or as specified.

#### Testing

All water supply PPR pipes, fittings and valves shall be tested by hydrostatic pressure of 7 kg/cm<sup>2</sup>. Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site.

In addition to the testing carried out during the construction, the Contractor shall test the entire installation after connections to the pumping systems or mains. The Contractor shall rectify all leakage, and shall replace all defective materials in the system.

After commissioning of the water supply system, the Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. The valves, which do not operate effectively, shall be replaced by new ones at his cost and tested as above.

Upon completion of all the tests and necessary replacements, all domestic water piping shall be disinfected as below:

After thoroughly flushing the system with clean water to remove sediment, the system shall be filled with a measured quantity of sodium hypochlorite solution shall be added to the water to give free residual chlorine of 50 mg/l. After 1 hour of retention, the system shall be drained, refilled and returned to service.

#### Measurement

Measurement for the Contract Item "PPR pipes" will be made per running meter of complete installation. Measurement will be made in running meter for installed pipeline including all PPR fittings. No extra measurement will be made for PPR fittings separately. Valve shall be measured by number.

### **4.5 CPVC pipe for hot and cold water**

Providing, fixing, testing and commissioning ASTRAL CPVC (Chlorinated Poly Vinyl Chloride) CTS SDR 11 water supply pipes & fittings NSF marked as specified in the Bill of Quantities for hot and cold water distribution conforming to ASTM 2846 using fittings i.e. Tees, Elbows, Couplers, Unions, Reducers, Bushings etc. including transition fittings connection between CPVC & metal pipe/G.I i.e. Brass Adaptors (Both male & Female threaded), with IPS WELD ON CPVC solvent cement as per ASTM F-493, with fabricated and subsequently hot dip galvanised clamps / structural steel supports as required / directed at site including cutting chase and fitting the same with cement concrete cement mortar as required. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of the Engineer-In-Charge.

### **4.6 Clamps**

GI pipes in shafts and other locations shall be supported by MS clamps of design approved by Engineer. Pipes at ceiling level shall be supported on structural clamps fabricated on MS structural brackets as described in relevant sections of this specification. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

### **4.7 Unions**

The Contractor shall provide adequate numbers of unions/flanges on all pipes to enable dismantling later. Unions shall be provided near each gunmetal valve, stop cocks or check valves and on straight runs as necessary at appropriate locations and required and/or directed by the Engineer.

### **4.8 Flanges**

Flanged connections shall also be provided on all equipment connections as necessary and required or as directed by the Engineer. Connections shall be made by the correct number and size of bolt-and made with 3mm thick insertion rubber washers. Where hot water or steam connections are made insertion gasket shall be of 1.5mm thick compressed fiber gaskets approved by the Architect. Bolt hole diameter for flange shall conform to match the specification for CI sluice valve to IS 780.

#### **4.8 Trenches**

All GI pipes below ground level shall be laid in trenches and shall have a minimum cover of 60cms. Excavation for trenches shall be done as specified in subsequent pages of this documents but the width and depth of the trenches shall be as follows:

| Dia. of pipes | Width of trenches | Depth of trenches |
|---------------|-------------------|-------------------|
| 15mm to 50mm  | 30cms             | 75cms             |
| 65mm to 100mm | 45cms             | 100cms            |

Where specified all GI pipes in trenches shall be protected with fine sand 15cms all-round before filling in the trenches.

#### **4.9 Pipe Protection**

Where specified in the schedule of quantities all pipes in chase or below ground shall be protected against corrosion by applying two coats of bitumen paint, wrapping with polythene tape and finishing with one more coat of bitumen paint.

#### **4.10 Valves**

Valves 65mm dia. and below shall be heavy gunmetal full-way valves or globe valves conforming to IS 778-1971 class I. Valves shall be tested at the manufacturers with test results and their name stamped on it. The Engineer shall approve all valves before they are allowed to be used in the works.

#### **4.11 Air Valves**

Air valves shall be provided in all high points in the system to prevent air locks, as shown on the drawings or directed by the Engineer. Air valves shall be gunmetal or CI of size as specified in the Bill of Quantities. Each air valve shall be provided with an isolation gunmetal full-way valve for size 65mm dia and below and CI double flanged valve 80mm dia. and above.

#### **4.12 Scour Valves**

Scour valves shall be provided at all low points in the system as shown on drawings or directed by Engineer. Valves shall be gunmetal full-way valves for sizes 65mm dia and below and CI double flanged valves 80mm dia. and above.

#### **4.13 Valves**

Valves shall be heavy gunmetal full way gate valves or non return valves conforming to I.S. 778-1964 (Class – I) valves shall be tested at manufacturer's works to 21 kg/sq.cm and shall have manufacturer's name stamped on it. All valves shall be approved by the Engineer before they are allowed to be used on work.

#### **4.14 Brass Fittings**

All brass stop cocks and bib cocks shall be heavy type bright finished with renewable leather washers conforming to I.S. 781-1967. The weight shall be as follows:

| Diameter<br>mm | Stop Cocks<br>kg | Bib Cocks<br>kg |
|----------------|------------------|-----------------|
| 15             | 0.40             | 0.40            |
| 20             | 0.75             | 0.75            |
| 25             | 1.30             | 1.25            |

#### 4.15 Ball Cocks

Ball cocks used for storage tanks shall be high or low pressure ball cocks with brass lever rods and polythene ball floats. The ball floats shall conform to Indian Standard which shall be hammer tested.

#### 4.16 Manhole Frames & Cover for Water Tanks

Each tank shall be provided with adequate number of C.I. lockable type manhole frames and standard cast iron tank covers as specified in Bill of Quantities. Manhole covers shall be of sizes shown on drawings and shall be approved by the Engineer.

Concrete tanks:

- The Contractor shall provide puddle flanges fabricated from MS/GI pipes of required sizes and lengths and welded to 5mm MS plates. All puddle flanges must be fixed in true alignment and level and shall be back welded to the reinforcement to prevent movement during concreting.
- The Contractor shall make connection of pipelines laid and fixed by him to concrete, masonry or steel tanks as required at site. No additional payment shall be allowed for making connections.

#### 4.17 Water Meters

Water meters shall be of the domestic type, inferential and semi-positive water meter conforming to IS 779-1961. Insulation of the meter shall conform to IS: 2401-1963.

#### 4.18 Testing

- a. All pipes fittings and valves shall be tested by hydrostatic pressure as follows:

For medium class pipes 7.0 kg/sq.m

For heavy class pipes 10.5 kg/sq.m

Pressure shall be maintained for a period of at least two hours without appreciable drop in the pressure after fixing at site.

- b. In addition to the testing carried out during the construction the Contractor shall test the entire installation after connections to the overhead tanks or pumping systems or mains. He shall rectify all leakages, and shall replace all defective materials in the system at his own expense without any extra money.

- c. After commissioning of the water supply system, the Contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. The valves which do not operate effectively shall be replaced by new ones at his cost and tested as above.

#### **4.19 Measurement**

G.I. pipes above ground shall be measured per running meter (to the nearest cm) and the rate shall be inclusive of all fittings including unions, elbows. Clamps, cutting chases and hooks in wall and floors and making good the same and testing of pipes and fittings.

G.I. pipes below ground shall be measured per running meter and the rate shall be inclusive of all fittings including unions, excavation for trenches refilling and disposal of surplus earth and testing.

Gunmetal valves, non return valves, ball cocks, foot valves, stop cocks, bib cocks, shall be measured by number.

For Painting for pipes with enamel or black bituminous paint, no separate payment shall be admissible.

Protection to pipes with polythene tape shall not be measured separately.

### **5.0 PIPE INSULATION**

Pipe Insulation: THERMAL INSULATION TUBES:-Providing and fixing in position 6 mm wallthick Aero flex thermal insulation tubes for Insulation to hot water line pipes as per need joining and covering with Aero seal adhesive and ever seal tapes as and where required and also Aero coat paints to exposed pipe lines etc. all complete as per instruction of the Engineer, all complete

### **6.0 STORAGE TANKS**

#### **6.1 General**

The Contractor shall provide and install Storage tanks in accordance with the Detailed Drawings and as specified in Bill of Quantities and in the location shown on the Plans.

The Contractor shall provide inlets, outlets, and overflow pipes, socket for float level switch and inter connection. The overflow and vent pipes shall be provided with a mosquito proof brass net. The vent pipes of size mentioned shall be provided with bends and pieces of pipes facing downward. The holes in the tanks for the inlets, outlets, overflows, etc. shall be made as per the manufacturer's specifications.

#### **6.2 GI Storage Tank**

GI storage tank shall be of riveted construction. The sheet shall be of specified gauge thickness riveted to angle iron frames as required. The sheets shall be fixed by means of 6 mm diameter rivets at 32 mm pitch on all sides except on top angle iron frame which shall be at 62 mm pitch. Holes for riveting shall be drilled and not punched. White Lead shall be applied before the surface to be jointed. The tank shall confirm to the Drawings.

#### **6.3 RCC Storage Tanks**

RCC storage tanks shall be constructed as per the Drawings. The Contractor shall provide puddle flanges fabricated from GI pipes of required sizes and welded to 300 x 300 x 6 mm MS plate. All

puddle flanges must be fixed in true alignment and level and shall be tack welded to the reinforcement bar to prevent movement during construction.

The Contractor shall make connections of pipe lines laid and fixed by him to existing concrete, masonry or steel tanks as required at site. No additional payment shall be allowed for making connection.

#### **6.4 Plastic tanks**

The tanks shall be vertical or horizontal type as required and of One Piece Moulded (without any seam, joints or weld) High Density Polyethylene. The tank shall be provided with a manhole of size 400 mm in diameter. The tanks shall be of Hill take, Roof top.

Contractor shall provide inlets, outlets, and overflow pipes, socket for float level switch and inter connection. The overflow and vent pipes shall be provided with a mosquito proof brass net. The vent pipes of size mentioned shall be provided with bends and pieces of pipes facing downward. The holes in the tanks for the inlets, outlets, overflows, etc. shall be made as per the manufacturer's specifications.

All outlets connections shall be at least one size higher than the pipe connections and shall be connected to the pipes by reducers (no reducing bushes will be accepted).

#### **6.5 Support for Overhead Water Storage Tanks**

The tanks where required shall be on the roof top over an elevated RCC platform other structural members as shown on the Drawing. The tanks shall be put in such a manner that the bottoms of all the tanks have a sufficient bearing. The Contractor shall provide all supporting and fixing devices (such as mild steel ring around the tanks with anchoring members) necessary to fix the tanks and fitting securely in position as per the manufacturer's Specifications. The fixing devices shall be rigidly anchored into the building structure. All the devices shall be rust proof and shall be so fixed that they do not present any unsightly look.

### **7.0 PLUMBING FIXTURES**

#### **7.1 Electric Water Heater**

Water heater shall be complete packaged unit with insulated heavy gauge factory painted metal casing as shown on the Drawings. Electric heaters shall have glass lining with magnesium anode rod, ceramic heating element, anti-mixing baffle (to avoid quick mixing of cold and hot water) and nylon bushes in order to avoid electrolysis problems.

Electrical heaters shall be provided with double safety thermostat and safety valve. Electric heaters shall be furnished with cord and plug for connection to grounded sockets. Size as indicated on Drawings.

#### **7.2 Plumbing Fixtures**

Plumbing fixtures shall be new free from flaws and blemishes and shall have a clear smooth surface. Fixtures shall be white in colour unless stated otherwise. Visible parts such as trim, supplies, traps, etc. shall be heavy chrome plated brass.

Each fixture shall be provided with a trap and with loose key compression stops in addition to a valve or faucet on the fixture.

Each fixture shall be piped up with domestic hot water as applicable and cold water, waste and vent in accordance with the schedule.

### 7.3 Chrome Plated (CP) Brass Fittings

All mixers, fittings, bib cocks, etc. shall be of the best quality heavy pattern of approved make.

All CP fittings shall be fixed in a neat workmanlike-manner and shall not carry tool mark and scratches. All valves shall carry identical CP handles (Knobs) approved by the Engineer.

## 8.0 MAMHOLE AND CHAMBERS

All manholes, chambers, septic tanks and other such works designated to be constructed shall be as specified in the Schedule of Quantities.

All manholes, chambers, septic tanks, etc. shall be supported on a base of cement concrete of such thickness and mix as given in the Schedule of Quantities or shown on the Drawings.

Where not specified, manholes shall be constructed as follows:

| Internal Dimensions<br>of Manhole Chamber | Maximum Depth<br>mm       |
|---|---------------------------|
| 450 mm x 450 mm                           | up to 750                 |
| 600 mm x 600 mm                           | up to 750 mm              |
| 800 mm x 800 mm                           | up to 1000 mm             |
| 1200 mm x 900 mm                          | over 1000 & up to 1500 mm |
| 1400 dia. or 1200 x 900 mm                | over 1500 & up to 3000 mm |

All manholes shall be provided with cement concrete benching in 1:2:4 mix. The benching shall have a slope of 100 mm towards the channel. The depth of the channel shall be the full diameter of the pipe. Benching shall be finished with a floating coat of neat cement.

The manhole chamber covers and frames shall comply with the following ratings:

Road gratings Med. Duty

- 406 mm x 356 mm o/a frame - 102 kg

Road gratings Med. Duty

- 508 mm x 356 mm o/a frame - 140 kg

Manhole covers L. Duty

- 600 mm x 600 mm o/a frame with 500 mm square lid - 78.5 kg

Manhole covers Med. Duty

- 750 mm x 750 mm o/a frame with 600 mm dia. round lid - 216 kg

Manhole covers L. Duty

- 450 mm round (single seal) o/a frame - 20 kg

All manholes shall be plastered with 12 mm thick cement mortar 1:3 (1 cement: 3 coarse sand) and finished inside with a floating coat of neat cement. Manholes shall be plastered outside as above cut with rough plaster.

All manholes with depths greater than 1.2 m shall be provided with 20 mm square or 25 mm round rod catch rings set in cement concrete or brickwork in 1:2:4 mix, 300 mm vertically and staggered. Catch rings shall be coated with tar before embedding.

All manholes shall be provided with cast iron covers and frames and embedded in reinforced cement concrete slab. Weight of cover and frame thickness of slab shall be as specified in the Bill of Quantities or given above.



### **8.1 Drop Connection:**

Drop connections of the required sizes shall be provided between branch sewer and main sewer or in the main sewer itself in steep ground when the difference in invert level of the two exceeds 450 mm.

Drop connections from gully traps to main sewer on rectangular manhole shall be made inside and shall have HCI special type door bend on top and heel rest bend at bottom connected by an HCI pipe. This pipe shall be supported by holder bat clamps at 1800 mm intervals with at least one clamp for each drop connection. All joints shall be lead caulked joints 25 mm deep.

Drop connection from branch sewer to main sewer shall be made outside the manhole with glazed stoneware tee connection, vertical pipe and bend at the bottom. The top of the tee shall be finished up to the surface level and provided with a CI hinged type frame and cover 300 mm x 300 mm. The connection shall be embedded in cement concrete 1:2:4 mix, 150 mm all round the pipe and tee up to the surface chamber of the tee. Drop connection made from vertical stacks directly into manholes shall not be considered as drop connections. They shall be paid for under the relevant soil and waste pipes work items.

### **8.2 Making Connections:**

The Contractor shall connect the new sewer line to the existing manhole by cutting the walls, benching and restoring them to the original condition. A new channel shall be cut in the benching of the existing manhole for the new connections. The Contractor shall remove all sewage and water if encountered in making the connection without additional cost.

### **8.3 Septic Tank**

The septic tank shall be constructed as per the detailed drawing and item provided thereof in particular.

Excavation for the septic tank is to be excavated in open trenches etc., to true lines and depth as per invert level of the inlet manhole as shown or required including planking and shuttering as necessary. The inlet level, bottom level and outgoing level must be properly followed as per the Drawing and direction and the septic tank should be air tight, water tight, and light is also excluded to help decomposition of the sewage.

Septic tank should be initially filled with water, disinfections should not be used beyond very small quantities which may be absolutely necessary. Since they kill bacterial life and the septic tank will not function. Soap and grease from bathrooms are also harmful.

Two sets of CI manhole covers and frames 450mm (round) are to be provided and fixed on the top RCC slab as per the Drawing. 90 degree tee to be provided for and outlet of septic tank. All level pegs for inlet and outlet pipes and invert level shall be approved by the Project Engineer prior to proceeding to work.

### **8.4 Soak Pit**

The soak pit work shall be done as per the Drawing. The earthwork in excavation shall be carried out to the exact dimensions given in the Drawing. The soak pit shall be constructed and honeycomb dry brick shaft as per the Drawing. Round the shaft and within the radius of given measurement shall be placed well-burnt brickbats. Brickbats of sizes 50 to 80 mm shall be packed round the radius of given measurement. The top of the slab shall be as per the Drawing or direction of the Project Engineer.

**8.5 Pumps**

Pumps shall be Crompton, Kirloskar or equivalent brand of said capacity and installed in pump house or shed including its structure and base plate as per drawings or supplied drawings. The pumps shall be installed with all wiring and electrical fixtures such as switches, wires, light, low and high level guard and pump control panel.

**8.6 Measurement**

Measurement of works shall be made in unit piece of works as specified.

**8.9 Colour code**

Pipe for various uses shall be painted with colour code for pipes as approved by the Project Engineer.

## **9.0 SANITARY AND SEWER PIPES**

### **9.1 HDPE / PVC Pipe system**

#### Material

HDPE pipes shall conform to NS 206/2046 or other equivalent standards. The High Density Polyethylene shall be of high quality and of wall thickness conforming to a working pressure of 4.0 Kg/sq.cm. The pipe shall be manufactured using virgin GM 5010 T2 raw materials as manufactured by Panchakanya Plastics or equivalent.

Fitting shall be of high density polythene pipe of series II, made at site there from shall be true to shape, smooth and cylindrical, their inner and outer surface being as far as practicable concentric. These shall be sound and cast so as to be free from cracks, pinholes or other imperfections.

#### Fixing

Jointing, laying and testing shall be as per the manufacturer's specifications. Pipes shall be of color specified by the Project Engineer. Fitting for HDPE pipes shall include couplings, tees, bends, elbows, unions, reducers, nipples and plugs. Outlets of suitable diameter for connection to the appliance shall be provided.

No joints shall be covered until these are checked and tested by the Project Engineer. Inlet and outlets of levels of the soil pipe and waste pipe line shall be strictly followed (Peg marking to be approved).

#### Measurement

HDPE pipe shall be measured per running meter and fitting per number as stated in the BOQ.

### **9.2 RCC Hume Pipes**

RCC Hume Pipes shall be socket and spigot joint and class shall be NP2 or NP3 as specified in BOQ. Unless specified otherwise, pipe shall be lowered into the trench and installed singly. Pipes shall not be joined until after they have been lowered into the trench.

The line and levels of the pipeline are shown approximately on the drawings. The pipes shall be accurately installed to the lines, levels, grades and positions set out by the contractor from data given on the drawings or supplied to him by the Engineer. The excavated bed shall be properly compacted and 75 mm thick PCC 1:3:6 base to be done. Pipe shall rest on the PCC base for the full length of the pipe barrel. Earthwork in excavation and back filling, concreting works shall be according to the Civil Works specification.

The contractor shall keep the interior of pipes clean and free from water, dirt, stones or other foreign matter as installation proceeds and at the end of day's work or at other times when installation work is not proceeding, the open ends of pipes shall be sealed off by a wooden plug or approved stopper.

The pipe trench shall be kept free from water all the times. The contractor shall take all necessary precautions to prevent the pipe from floating due to water entering the trench from any source, and shall assume full responsibility for any damage due to this cause. It shall be at the contractor's expense to restore and replace the pipes to its specified condition and grade if it is displaced due to floating.

The contractor has to take necessary precautions including shoring of trenches and dewatering from trench, if necessary, without any extra cost.

The collar of each pipe shall be placed home in the socket of the one previously laid, and the pipe then adjusted and fixed in the correct position with the spigot of the pipe accurately centred in the socket. A ring of gasket in or tarred rope yarn shall be inserted in the socket of each pipe previously laid and driven home with a wood caulking tool and wooden mallet, such yarn when in position shall not occupy more than one quarter of the total depth of the socket. The socket shall then be completely filled with cement sand mortar of 1:2 and a fillet shall be protected by means of a cover of damp jute which shall be kept moist for at least 24 hours after forming.

#### Measurement

Measurement for sewer installation will be taken from inside of manholes and all specials shall be included in the linear measurement (in running meters). No extra measurement will be done for trench excavation, dewatering, shoring of trenches, PCC bedding, supply and installation of RCC Hume pipes and specials, trench back filling with proper compaction, resealing of original floor or ground finish etc.

## **10.0 SOLAR WATER HEATER**

### **10.1 General Requirement**

Each solar water heater shall be 1.6 sq.m absorber collector with integral insulated hot water tank of 200 /300/400 litres capacity .The collector plate will be of 15 dia GI pipes running vertically collector plate will be of 15mm dia G.I pipes manifold at the bottom, at 90 mm c/c, welded to 25mm dia G.I pipe manifold at bottom, the 15 mm dia G.I pipes supply fittings and wired on to corrugation of 1830 X 830 corrugated G.I sheet. The collector surface shall be painted with 1 coat of red lead primer and two coats of blackboard matt black paint. The under side of collector plate (where it rest on 50mm fibre glass wool )shall be painted with 1 coat of red lead primer and two coats of white enamel.

Single glazing cover shall be 5.6 mm clear glass with the fully weatherproofed 25mm, air gap between the glass and collector surface .There shall be 50mm deep fibreglass wool insulated beneath and around the side edges of the collector plate. A 25mm drain pipe shall be provided with plug or end cap at the lowest part of the solar panel.

The top end of the G.I pipes running vertically shall enter and be welded to a 90 litre hot water tank lying across the top and of the solar panel, this tank, if of oxy-acetylene gas welded joint, is to be of gauge thickness 10 SWG .If of arc welded, the tank shall not be of gauge thinner than the 10 SWG. The tank shall be painted with the 1 coat of red lead primer and 2 coats of white enamel .There shall be a vent pipe of 15mm dia. rising from the central topmost portion of the insulated hot water tank, from which the hot water supply is also drawn off the vent pipe rises from the tank.

The hot water shall be insulated with 75mm thick fibreglass wood all around and the whole solar panel plug insulated hot water tank encased in a weather proof box of 24 BWG G.I sheet (unpainted).

Minimum vertical distance between the bottom of cold water storage tank and top of the solar panel /hot water storage shall be 600mm .The whole solar collector tank system shall be mounted on stout framework of GI pipes or MS Angles at 40°- 45° to the horizontal and facing south ,clear of any shadowed areas throughout the year. The frame shall be fitted with foot rest plates 150mm X 150mm & sat on Tow elf pads in order to avoid damage to the both roof deck finish and to the absorbed set.

A material used in the construction of the solar heater shall be clean, free from dust, rust, oil, or other blemishes. Welded joint should be thoroughly tapped and brushed free of welding scale, residue etc. The solar water unit is to be able to withstand a pressure maximum of 2 kg/cm<sup>2</sup> (20m vertical head ) the system shall be pressure tested and flushed before installation ,and shall be pressure tested again after installation to the satisfaction of Engineer.

**10.2 Measurement:**

Unit of measurement shall be based on the number. Rate for providing and fixing of solar heater with (booster) electric rod with thermostat of 3 k.w. shall include all items, and operations stated in the respective specifications and Bill of Quantities, and nothing extra is payable.

**11.0 TESTING AND COMMISSIONING**

**11.1 Testing and Commissioning:**

Piping shall not be buried, concealed or insulated before being properly tested.

The tests shall be carried out in accordance with the requirements of all authorities having jurisdiction.

Storm waste and sanitary drainage systems within the building shall conform the following:

The tightness of joints and the soundness of piping shall be tested in the presence of the Engineer. After drains and roof leaders have been placed in position and branches installed, but before the fixtures have been set and connected or the main drain has been connected permanently to the sewer.

The test shall be carried out in the following manner. Openings and pipe ends throughout the work shall be securely closed by means of approved plugs and the entire system, including rising stacks, rain- water leaders, branches to the fixtures and all horizontal mains and drains shall be filled with water up to the top of the highest opening. This water shall stand at the same level for not less than two hours. Another test shall be made of the entire plumbing system after the fixtures have been set and the main sewers connected to the drains. This test shall consist of turning the water into all pipes, fixtures and traps in order that any imperfect material or workmanship may be detected.

Where it is impossible to test the whole system at any time, it may be divided into parts. A smoke test shall also be made and any other test required by the Engineer.

Any leaks discovered shall be made tight while the system is under pressure. If this is impossible, the pipe, etc. shall be removed and refitted and the test reapplied until satisfactory results have been obtained.

**11.2 Water Piping:**

Water piping shall be tested at 10.5 kg per sq. cm pressure for a period of not less than 24 hours. The pressure must remain constant for the period and the leaks, if any, shall be made tight while the system is under pressure. If this is impossible, the joint shall be re-made and the test reapplied until satisfactory results have been obtained.

**11.3 Disinfection**

Before being placed in service, all sanitary water piping shall be thoroughly flushed and chlorinated by the application of a chlorinating agent which shall calcium or sodium hypo chloride obtained from an approved manufacturer.

The chlorinating solution shall have a chlorine dosage of 50 ppm and shall be injected into the system at one end through a cock or tapped connection. All valves and accessories on the system shall be operated to ensure treatment of entire system. The solution shall be retained in the system for a period of at least 24 hours. At the end of this period the water shall be flushed from the line at its extremities until the water at these points is of the same quality as the source of supply.

#### 11.4 Commissioning and Testing

Before commissioning and testing of fixtures, the Contractor shall ensure that all soil and waste stacks and drainage system are connected to the respective manholes and the out fall. He shall also ensure that the water supply system has been commissioned and tested.

Fixtures shall be cleaned and all debris and dirt removed. All stickers, labels, etc. shall be removed with hot water.

Cold water shall be let in each fixture individually. The fixtures shall then be observed for any leakage or drip at inlet and outlet connection. The rate of flow for each fixture shall be adjusted by control valves. All defective part shall be replaced and retested.

After commissioning of the cold water system, water heaters shall be charged with hot water. After expelling all air in the system by allowing the water to flow through the tap for sometime, the heaters shall be switched on. Each heater shall be observed for any leakages and its thermostatically controlled operations. If necessary, thermostats shall be reset and any leakage or defects in the heater repaired or replaced.

On satisfactory testing and commissioning of the fixtures, the Contractor shall clean all fixtures and accessories by a suitable detergent and hand over the bath room in absolutely clean and usable conditions.

The Contractor shall remove all debris, dirt and surplus materials caused by the work. The system shall be left complete and ready for use.

#### 12.0 FIRE HYDRANT SYSTEM

- The scope of work covered in this specification shall also include the information contained in the NBC Code and following IS specification.
  - IS: 1648 – 1961
  - IS: 3614 – 1966
  - IS: 3844 – 1966
- **General:** Provide complete wet riser pipe system, all of approved manufacture. Notwithstanding any other provision elsewhere in the contract, the sole responsibility of supplying and installing the complete installation totally and finally acceptable to the local Fire Brigade and the Regional council of Fire section, rest entirely with the contractor and the contractor shall obtain certificate to the effect from the authorities concerned
- All pipes, fittings and accessories of the entire installation should be painted with one coat of approved quality primer and two coats of anti corrosive paint of approved quality and shade. The rate quoted for supplying and fixing shall include for painting as well.
- **Pipe installation & fittings:** All supply pipes shall be of heavy duty 'C' class GI quality as per IS:1239 (Indian Tube Co. Make) or approved equivalent to that required by the local Fire Brigade and THE REGIONAL COUNCIL OF FIRE SECTION as follows:
  - Wrought iron pipes shall be GI treated and fixed in accordance with the Fire Brigade Department's requirements. As far as possible, it is preferred to have all pipes joints welded with flanges.
  - The joints shall be distributed in normal conformity with local fire brigade requirements, if any, and in consultation with Engineer for case of future maintenance, repair and inspection. They shall be secured clear off the wall surface by means of C.I. or M.S. holder bat clamps or brackets.
  - **Flanges:** All flanges shall be as per IS table.

- **Fittings:** All fittings such as bends, tees, elbows and reducers etc. shall be fabricated out of pipes of quality as approved.
- **Control Valves:** All main control valves other than in the cabinets shall be of cast iron, sluice type, manufactured by approved make.
- **Check Valves:** All check valves shall be REC II type, specially designed to close without shock under conditions of rapid arrestation or reversal flow in water columns working on a pressure of 10 kg/cm<sup>2</sup> manufactured by approved make.
  - **Fire Hose Cabinet:** Provide fire hose cabinets of approved manufacture and size with 30" X24" to two hose length of 15m each and one branch pipe with locking arrangement. Fire Hose Cabinet.
    - Cabinet shall consist of 65mm dia hose reel with 30m length or (15mX 2) gun metal branch with nozzle coupling reel.
    - All fire hose cabinets shall be sized to receive landing valve, hose reel and fire extinguishers. The word **FIRE HYDRANT** shall be painted on cabinets.
  - **Hose Reel:** Swinging hose reel with 20mm hydraulic rubber braided hose 30m long, swinging up to 170° nozzle shape reel carrier, with drum set all complete.
  - **Shock Control:** Provide MS fabricated air cushion tanks on top of each riser of 225mm dia. and 1200mm long with shut off drain and air release valve as shown.

**12.1 FIRE SPRINKLERS SYSTEM:-**Providing, fixing, testing and commissioning ASTRAL's BlazeMaster® CPVC fire sprinkler pipe as per ASTM F442 in SDR13.5 and fittings as per ASTM F437 (schedule 80 threaded), ASTM F438 (schedule 40 socket) and ASTM F439 (schedule 80 socket). Both pipe and fittings shall be Listed by Underwriters Laboratories for use in wet automatic fire sprinkler systems and shall bear the logo of the Listing Agency. Installation to be made with proper special type anchoring, fasteners, clamps, etc and shall be to the satisfaction of the Engineer-In-Charge.

## **13.0 DEEP TUBEWELLS SPECIFICATION**

### **13.1 Procedure**

The following procedure shall be followed:

- 1.1 The method of drilling should be Cable Tool or Hydraulic Rotary (Direct or Reverse).
- 1.2 During the course of drilling, the contractor shall take geological samples of the different strata and record these on bore hole log sheets. The soil samples packed with minimum of 0.50 Kg and sealed in polythene bags, together with the log sheets shall be submitted to the Employer as soon as possible.
- 1.3 After completion of drilling, the contractor shall carry out an electro resistivity survey both down and up the bore hole.
- 1.4 Based on the geological log and electro resistivity survey results, the contractor shall submit his detailed proposal for the tubewell assembly he considers most suitable to be installed. Approval of the proposed assembly must be received in writing from the Employer before installation.
- 1.5 The tubewell assembly shall be installed in the bore hole using centralisers at a maximum of 24 meter centers.

- 1.6 The contractor shall carry out a verticality test immediately after installation of the assembly and shall furnish readings at 3 meter intervals. Bore holes or tubewells assemblies outside the limits specified will be repaired or rejected.
- 1.7 The well shall be gravel packed using well rounded non-calcareous pea-gravel placed by back wash method in a continuous operation. The gravel packing shall conform to clause 3 of this specification.

### **13.2 TUBEWELL ASSEMBLY**

- 2.1. The contractor shall provide all necessary materials required for the complete assembly for the bore hole, housing pipe, casing pipe, necessary seamless MS sockets, well screen, plug and centralisers. Each assembly shall be approved by the Employer before installation.
- 2.2. The dia. of housing pipe shall be of mild steel heavy duty pipe of min. thickness 7.0 mm with pipe lengths of 6 m. having plain/ beveled ends suitable for welding. The housing pipe shall project a distance of 300- 500 mm above the ground level. The top of the housing pipe shall have a flange welded on to which a blank flange shall be bolted on at all time when the well is not attended by the contractor.
- 2.3 The dia. of casing pipe shall be as specified in the bill of quantities and of mild steel heavy duty pipe of minimum thickness 5.4 mm with pipe length of 3 or 6 m. having plain/beveled ends suitable for welding.
- 2.4 The housing pipe and casing pipe shall be joined by means of electric welding.
- 2.5 Well screen / slotted pipe shall be in accordance with IS: 8110 - 1976 or equivalent having following requirements:

The well screen pipe shall be seamless or electrical resistance welded, corrosion-resistant material of mild steel heavy duty pipe having thickness of 5.4 mm. to guard against the effect of corrosion and to ensure reasonable life of tubewell. The percentage slot opening in the slotted pipe shall be 12 ~ 15 percent and the slot size shall be 1.2 ~ 1.6 mm 65 ~ 75 mm. and shall be distributed in rows as closely and evenly as possible, staggering the slots between each row. The rows shall be vertically arranged. Slots shall be rectangular in shape and tapered with smaller opening on the outside of the pipes so that the solid particles passing through the outer lip do not clog. The outer lip shall be sharp edged. The slotted pipes and screens shall be coated with anti-corrosive protective treatment.

- 2.6 There must be a minimum length of 3 meters of casing pipe below the lowest screen pipe as a sand trap and this must be fitted with welded conical steel plug with a solid point.
- 2.7 All pipes and screens shall be of the best quality and contractor shall submit full details concerning the specifications and sources of supply before bringing the materials on site.
- 2.8 All housing and casing pipes shall be thoroughly cleaned and descaled before assembly and shall be painted with one priming coat and one thick top coat of an approved non toxic corrosion inhibiting paint.



- 2.9 All welds shall be allowed to cool before applying the necessary paint to the joints as specified above which must be allowed to dry before lowering down the well.
- 2.10 After installation a verticality test shall be carried out and the limit shall be 1 cm. in 48 meters.

### **13.3 GRAVEL PACKING**

- 3.1 The contractor shall fill the annular space between the well assembly and the wall of the bore hole with filter pack gravel in the manner and to the extent specified below.
- 3.2 The gravel pack shall be thoroughly washed, rounded non calcareous pea-gravel with a minimum size of 2 mm. and maximum size of 5 mm.  

The particle size distribution and pack aquifer ratio shall confirm to IS: 4097 - 1967 specification for gravel for use as pack in tubewells. The overall grading shall be approved by the Employer before placing.
- 3.3 The gravel pack shall be placed around the tubewell assembly in a continuous operation using the back wash method to prevent bridging and reduce the possibility of damage to the tubewell assembly by the sudden collapse of bridged gravel. Circulation of water should continue until the entire gravel is packed, and then clean water should be pumped through the casing to remove drilling mud.  

The gravel shall extend from the bottom of the bore hole to a level of approximately 1.5-3 meters below ground level. A steekpile of 1 m<sup>3</sup> of gravel pack shall be left after completion of packing as spare for subsequent topping up.

### **1. SEALING OF BORE HOLE**

- 3.4. After completion of gravel packing, the contractor shall supply and place in position two 50 mm dia GI pipes approximately 6 meters long. They shall extend from just inside the gravel packing to the top of the housing pipe. The pipes are required for topping up the gravel packing and shall be fitted with socket and plug.
- 3.5 After the placing of 'Top up' pipes, the space between the borehole and the housing pipe shall be sealed with an approved concrete mix made with fine aggregate of maximum size 10 mm. or with cement slurry.  

The contractor shall submit his proposals for sealing the well for approval before commencing slurry.

### **13.4 DEVELOPING THE WELL**

The well shall be developed by the contractor using bailer and plunger for mechanical surging and then by airlift pumping. Developing work shall be done with a higher capacity than the rated capacity of the tubewell. The airlift pumping shall be carried out using a 50 mm. dia pipe set to an agreed depth and coupled to a compressor of at least 450 cfm capacity. Drawdown and discharge shall be measured. The completion of the development shall be certified by the Employer when the well water becomes sparklingly clear and contains less than 20 parts per 100,000 of silt or sand. Duration of the development shall be counted only for the actual

mechanical surging and air compressing. Sodium Hexametaphosphate treatment shall be done prior to air pumping.

### 13.5 PUMPING TEST - STEP DRAWDOWN AND CONTINUOUS

5.1 The contractor shall carry out the step draw-down test with a suitable pump having sufficient capacity and discharge measuring device as specified below. The pump should have a total lifting capacity of over 75 meters.

- (a) The pumping rate shall be kept constant at the following rates for the following period of time:

| Pumping Rate              | Time       |
|---------------------------|------------|
| <u>m<sup>3</sup> / hr</u> | <u>hrs</u> |
| 25                        | 2          |
| 50                        | 2          |
| 76                        | 2          |
| 100                       | 2          |
| 150                       | 2          |
| 200                       | 2          |

- (b) The drawdown corresponding to each of the above pumping rates shall be measured and recorded by the contractor.
- (c) The pumped discharge shall be measured and recorded by the contractor using flow meter or a right angled V-notch weir made of steel preceded by a stilling chamber.
- (d) The contractor shall measure the solids content in the pumped water in each of the different steps.
- (e) All test results shall be handed to the Employer as soon as the tests are completed.

Note: The pumping rate and time of pumping shall be changed as per yield of tube well

5.2 The Employer will advise the discharge for the continuous pumping test which shall be recorded by the contractor.

The procedure shall be:

| <u>Time after starting</u> | <u>Measurement interval</u> |
|----------------------------|-----------------------------|
| 0 to 20 mins               | every minute                |
| 20 mins. to 1 hr.          | every 5 mins.               |
| 1 hr. to 2 hrs.            | every 10 mins.              |
| 2 hrs. to 6 hrs.           | every 30 mins.              |
| 6 hrs. to 24 hrs.          | every hrs.                  |

The pumped discharge shall be measured and recorded for the step drawdown test.

### **13.6 Report Submission**

The contractor shall provide three copies of Report of the works which will include tubewell drilling, Electrical Resistivity test, well design, pumping test, water sample test etc.

### **13.7 WELL DISINFECTION**

After completion of all tests the well shall be thoroughly disinfected by means of a chlorine compound - bleaching powder or high test hypochlorite. The contractor must submit full details of his proposals for approval before carrying out well disinfection which should include for the circulation of heavily chlorinated water within the bore hole.

## **14.0 Water Treatment Plant**

### **1.1 SCOPE**

This Specification covers the Supply, delivery, installation, testing and commissioning of Water Treatment Plant (WTP) including all required civil works associated with Water Treatment Plant.

### **1.2 REFERENCE DOCUMENT**

The work specified in this section shall be in accordance with the following standards, or approved equal, except as they are modified and supplemented herein:

| S.No. | References | Subject                   |
|-------|------------|---------------------------|
| 1.    | IS         | Indian Standards          |
| 2.    | WHO        | World Health Organization |
| 2.    | NS         | Nepal Standards           |

### **1.3 RELATED WORK**

The Contractor shall become familiar with other Divisions of the specifications affecting work of this trade.

Electrical Supplies: To the Water Treatment Plant.

Sanitary: Water supply and distribution pipings.

Civil Works: Aeration System, Water Tanks & Foundation works for WTP

### **1.4 GENERAL REQUIREMENT**

The scope of work covered by this Chapter shall be deemed to comprise the supply, delivery, installation, testing and commissioning of WTP as in BOQ and shown on drawings and as specified. It shall also include the supply of the appertaining materials and structural parts, internal pipings and valves, support structures for pipings, scaffolding, off loading on site and all operations in connection with these works, unless otherwise specified in the Bills of Quantities.

Materials, which the Contractor shall supply and install and which thereafter will be incorporated in the works, shall be new and unused. They shall comply with the regulations regarding quality and dimensions. Materials that are not standardised shall be used only with the approval of the Engineer.

The materials shall be protected from rain and inclement weather all to the satisfaction of the Engineer. The cost of covering materials shall be deemed to be included in the respective unit prices.

## **1.5 SAMPLES/SUBMITTALS**

Representative samples of followings may be required before awarding the contract / starting the work at site to check upon the material quality:

- Piping Materials

The samples shall be kept with the Engineer for future reference and comparison. All materials supplied shall conform to these approved samples in all respects.

All above materials shall have to be approved by the Engineer. Any of these materials not up to the specification must be removed from the site immediately at Contractor's own cost.

## **1.6 RAW WATER ANALYSIS**

Raw Water which has to be treated has been tested and has been analyzed as follows:

| S.No.  | Parameters                   | Unit                 | Result            | Normal Level* | WHO |
|--|------------------------------|----------------------|-------------------|---------------|-----|
| <b>PHYSICAL</b>  |                              |                      |                   |               |     |
| 1  | Turbidity                    | NTU                  | 5                 | (5-10)        | 5   |
| 2  | Colour                       | *Hazen               | 15                | (5-15)        | 15  |
| 3  | Temperature                  | oC                   | 25                | -             |     |
| <b>CHEMICAL</b>  |                              |                      |                   |               |     |
| 4  | pH                           | -                    | 7.3               | (6.5-8.5)     |     |
| 5  | Electrical Conductivity      | µS/mS/cm             | 640               | (400-1500)    |     |
| 6  | Total Alkalinity             | as CaCO <sub>3</sub> | 442               | (500)         |     |
| 7  | PPH Alkalinity               | as CaCO <sub>3</sub> | Nil               | -             |     |
| 8  | Total Hardness               | as CaCO <sub>3</sub> | 170               | (100-500)     | 500 |
| 9  | Calcium Hardness             | as CaCO <sub>3</sub> | 100               | -             |     |
| 10   | Magnesium Hardness           | as CaCO <sub>3</sub> | 70                | -             |     |
| 11   | Calcium                      | as Ca                | 40                | (75-200)      |     |
| 12   | Magnesium                    | as Mg                | 17                | (<30-150)     |     |
| 13   | Total Iron                   | as Fe                | 1.5               | (0.3)         |     |
| 14   | Total Ammonia                | as N                 | 52                | (1.5)         |     |
| 15   | Chloride                     | as Cl <sup>-</sup>   | 5.76              | (250)         |     |
|  | Amonia                       | Mg/l                 |                   |               | 1.5 |
|  | Iron                         | Mg/l                 |                   |               | 0.3 |
| The above raw water analysis can be taken as reference for designing the vessel sizing and quantity of media e |                              |                      |                   |               |     |
| 1.7  | <b>Capacity of the Plant</b> |                      | <b>BIOLOGICAL</b> |               |     |
|  | Coliforms                    | MPN/100ml            |                   |               | Nil |
|  | E.coli                       | MPN/100ml            |                   |               | Nil |

\* National Drinking water guidelines Nepal 2065, Groundwater.

Treatment Plant of 10 m<sup>3</sup>/hr. to be designed to work for 16 hours.

## 1.8 Quality of the Treated Water

Potable water should match standards set by National Drinking water guidelines Nepal 2065, Groundwater and WHO.

## 1.9 MATERIALS

### 1.9.1 Water Treatment Plant

#### 1.9.1.1 Aeration System

An Open Cascade Type Aeration System should be made with concrete outside the plant room as per the drawing attached herewith.

#### 1.9.1.2 Oxidation Chamber

The Water

Oxidation Chamber to remove iron available in raw water shall be put after the aeration system. It shall as per the following specifications:

|  |   |                                     |
|--|---|-------------------------------------|
| Diameter (mm)                          | : | As per design                       |
| Height on straight (mm)                | : | As per design                       |
| Media                                  | : | Graded Sand & MnO <sub>2</sub>      |
| Material of construction               | : | MS with Inside & outside Epoxy Coat |
| Working pressure (kg/cm <sup>2</sup> ) | : | 3.5                                 |
| Service flow rate (m <sup>3</sup> /hr) | : | 10                                  |
| Valves type                            | : | Diaphragm                           |

#### **1.9.1.3 Dual Media Filter**

A Dual Media Filter to remove turbidity available in raw water shall be put after the oxidation chamber. It shall as per the following specifications:

|  |   |                                     |
|--|---|-------------------------------------|
| Diameter (mm)                          | : | As per design                       |
| Height on straight (mm)                | : | As per design                       |
| Media                                  | : | Graded Sand & Anthracite            |
| Material of construction               | : | MS with Inside & outside Epoxy Coat |
| Working pressure (kg/cm <sup>2</sup> ) | : | 3.5                                 |
| Service flow rate (m <sup>3</sup> /hr) | : | 10                                  |
| Valves type                            | : | Diaphragm                           |

#### **1.9.1.4 Activated Carbon Filter**

A Dual Media Filter to remove turbidity available in raw water shall be put after the oxidation chamber. It shall as per the following specifications:

|  |   |                                     |
|--|---|-------------------------------------|
| Diameter (mm)                          | : | As per design                       |
| Height on straight (mm)                | : | As per design                       |
| Media                                  | : | Graded Sand & Activated Carbon      |
| Activated Carbon Iodine value          | : | 850 (min.)                          |
| Material of construction               | : | MS with Inside & outside Epoxy Coat |
| Working pressure (kg/cm <sup>2</sup> ) | : | 3.5                                 |
| Service flow rate (m <sup>3</sup> /hr) | : | 40                                  |
| Valves type                            | : | Diaphragm                           |

#### **1.9.1.5 Coagulant Dosing Pump**

An electronic fully automatic dosing pump shall be installed before aeration system for doing alum or chemical used for acoagulation. It shall as per the following specifications:

|                       |   |                                  |
|-----------------------|---|----------------------------------|
| Dosing Capacity (lph) | : | 0-5                              |
| Type                  | : | Diaphragm, positive displacement |
| Dosing Rate           | : | Electronically controlled        |

#### 1.9.1.6 Sodium Hypochlorite Dosing Pump

An electronic fully automatic dosing pump shall be installed before aeration system for dosing sodium hypochloride or chemical used for aogulation. It shall as per the following specifications:

|                       |   |                                  |
|-----------------------|---|----------------------------------|
| Dosing Capacity (lph) | : | 0-15                             |
| Type                  | : | Diaphragm, positive displacement |
| Dosing Rate           | : | Electronically controlled        |

#### 1.9.1.7 pH Correction Dosing Pump

An electronic fully automatic dosing pump with online pH sensor shall be installed at the end of potable water treatment plant for dosing chemical to adjust the achieve the required pH. It shall as per the following specifications:

|                       |   |                                  |
|-----------------------|---|----------------------------------|
| Dosing Capacity (lph) | : | 0-10                             |
| Type                  | : | Diaphragm, positive displacement |
| Dosing Rate           | : | Electronically controlled        |

#### 1.9.1.8 Tank for Dosing Chemical

A tank for preparation of the chemical with level sensor shall be used. It shall as per the following specifications:

|                       |   |                             |
|-----------------------|---|-----------------------------|
| Dosing Capacity (lph) | : | 200 (min.)                  |
| MOC                   | : | Chemical Resistant PVC/HDPE |
| Features              | : | With level sensor           |

#### 1.9.1.9 Cation Exchange Unit

A Cation Exchange Unit for removal of cation impurities shall be installed after the activated carbon filter. It shall as per the following specifications:

|  |   |  |
|--|---|--|
| Diameter (mm)                          | : | As per design                            |
| Height on straight (mm)                | : | As per design                            |
| Resin                                  | : | Cation Resin (Hydrogen Base)             |
| Resin quantity (ltrs)                  | : | 2000 (Recommended)                       |
| Regenerant quantity (HCl 100% kgs)     | : | to be specified                          |
| Regeneration mode                      | : | to be specified                          |
| Material of construction               | : | MSRL / Suitable Chemical Resistant<br>SS |
| Valves type                            | : | Diaphragm                                |
| Working pressure (kg/cm <sup>2</sup> ) | : | 3.5                                      |
| Service flow rate (m <sup>3</sup> /hr) | : | 40                                       |
| Regeneration tank MOC                  | : | HDPE/PVC with level sensor               |
| Regeneration tank capacity (ltrs)      | : | 200 (min.)                               |

#### 1.9.1.10 Degassification System

A Degassification Unit for removal of gaseous impurities shall be installed after the cation exchange unit. It shall as per the following specifications:

|  |   |  |
|--|---|--|
| DG tower Diameter (mm)                 | : | As per design                            |
| Height on straight (mm)                | : | As per design                            |
| Tower internals                        | : | Rashig Rings                             |
| MOC Tower                              | : | MSRL / Suitable Chemical Resistant<br>SS |
| Working pressure (kg/cm <sup>2</sup> ) | : | Atmospheric                              |
| Service flow rate (m <sup>3</sup> /hr) | : | 40                                       |
| No of blowers required                 | : | Two (One standby)                        |
| MOC Blower                             | : | MSRL / Suitable Chemical Resistant<br>SS |
| No of DG pumps required                | : | Two (One standby)                        |
| DG pump capacity (m <sup>3</sup> /hr)  | : | 10                                       |
| DG pump head (kg/cm <sup>2</sup> )     | : | 3.5                                      |
| Material of construction               | : | SS 316 (Body, Impeller, Shaft)           |
| Pump type                              | : | Multistage, Centrifugal inline vertical  |

#### 1.9.1.11 Degassification Sump

A Degassification underground sump of suitable capacity for retention of water for minimum 1 hour shall be made in concrete after the degasification tower.

#### 1.9.1.12 Organic Scavenger

A Organic Scavenger Unit for removal of anion and organic (ammonia) impurities shall be installed after the degasification sump. It shall as per the following specifications:

|  |   |  |
|--|---|--|
| Diameter (mm)                          | : | As per design  |
| Height on straight (mm)                | : | As per design  |
| Resin Type                             | : | Organic Removal<br>(Macroporous Strong Base Type I Anion Exchange Resin with Controlled Pore Size) |
| Resin quantity (ltrs)                  | : | 600 (Recommended)  |
| Regenerant quantity (NaOH 100% kgs)    | : | to be specified  |
| Regeneration mode                      | : | to be specified  |
| Material of construction               | : | MSRL / Suitable Chemical Resistant<br>SS   |
| Valves type                            | : | Diaphragm  |
| Working pressure (kg/cm <sup>2</sup> ) | : | 3.5  |
| Service flow rate (m <sup>3</sup> /hr) | : | 10   |
| Regeneration tank MOC                  | : | HDPE / PVC with level sensor   |
| Regeneration tank capacity (ltrs)      | : | 200 (min)  |

#### 1.9.1.13 Filter Feed Pumps



Filter Feed Pumps shall be installed before Oxidation Chamber and before Cation Exchange Unit. It shall as per the following specifications:

|                                    |   |  |
|------------------------------------|---|--|
| Pump capacity (m <sup>3</sup> /hr) | : | 10   |
| Pump head (kg/cm <sup>2</sup> )    | : | 3.5  |
| Material of construction           | : | Body (Cast Iron), Impeller (Bronze)<br>Shaft (Stainless Steel) |
| Pump type                          | : | Single stage, Centrifugal                                      |

#### 1.9.1.14 Electrical Control Panel

A fully automatic electrical control for operating the Potable Water Treatment Plant. It should have incoming MCCB, Copper Bus Bars, Isolation Switch, Indicating Lamps, Voltmeter and ammeter for mains incoming, sequential starting of Water Pumps and Dosing pumps, alarms for level sensors with complete protections. It shall as per the following specifications:

|                 |   |                        |
|-----------------|---|------------------------|
| Number Required | : | One                    |
| MOC             | : | MS with Powder Coating |

### 1.10 GUIDE FOR APPROVED MAKES

Following makes of the equipments, instruments and accessories are approved and recommended to use. Please give proper justification for makes out of the below list. However, the Contractor can propose alternative brand and should be approved by the Engineer prior to ordering and shipment.

#### 1.10.1 Mechanical

|                              |   |                                 |
|------------------------------|---|---------------------------------|
| Filter Vessels               | : | IS or equivalent                |
| Chemical Dosing Pumps        | : | Grundfos / Hanna                |
| Chemical Tanks               | : | Sintex or equivalent            |
| Water Pumps                  | : | Grundfos                        |
| Resin                        | : | Thermax / Ion Exchange / Dow    |
| MS Pipes                     | : | TATA/JINDAL/HULAS/RAJESH METALS |
| Valves                       | : | AUDCO / Danfoss / Leader        |
| Strainers                    | : | AUDCO / Danfoss / Leader        |
| NRV                          | : | AUDCO / Danfoss / Leader        |
| Foot Valves                  | : | AUDCO / Danfoss / Leader        |
| Level Sensor                 | : | ADVANCE/MINICONTROLLER/EQUIV.   |
| Level Switches               | : | LEVCON/MINILAC/EQUIV.           |
| Level Guage                  | : | LEVCON/SIGMA INSTRUMENTS        |
| Pressure Guage/Indicators    | : | FIEBIG / H GURU                 |
| Temperature Guage/Indicators | : | FIEBIG / H GURU                 |
| Testing Meters               | : | ABB/Siemens                     |
| Flowmeters                   | : | DANFOSS / EQUIVALENT            |
| Conductivity Meter           | : | Hanna or Equivalent             |
| ORP Meter                    | : | Hanna or Equivalent             |
| RO Pressure Tube             | : | GE / Dow / Equivalent           |
| RO Membrane                  | : | GE / Dow                        |
| Micron Filter Housing        | : | GE / Dow / Equivalent           |
| Micron Filter Cartridges     | : | GE / Dow                        |

#### 1.10.2 Electrical

|                     |   |                                     |
|---------------------|---|-------------------------------------|
| Switchgears         | : | Merlin Gerin/ABB/Siemens/ Schneider |
| Contactors          | : | Merlin Gerin/ABB/Siemens/ Schneider |
| Push Button element | : | L&T                                 |
| Indicating Lamps    | : | L&T                                 |
| Protective Relay    | : | GECA/ABB/Siemens                    |
| MCB                 | : | Schneider/Merlin Gerin/Siemens      |
| Electrical Cables   | : | Water Proof                         |

## **1.11 TECHNICAL DATA REQUIRED**

The Below data needs to be mentioned for each equipments/instruments/parts as mentioned below:

### **1.11.1 Water Pumps**

- Discharge (m<sup>3</sup>/hr.) as per BOQ
- Head (m)
- Make
- Model
- Pump Discharge (m<sup>3</sup>/hr.) (Max./Min.)
- Pump Head (m<sup>3</sup>/hr.) (Max./Min.)
- MOC
- Body
- Impeller
- Shaft
- Power of Motor
  - P1
  - P2
- Shaft Seal Type & Material
- Type of Coupling
- Efficiency of Pumps

### **1.11.2 Filter**

- Make
- Model
- Dia (mm)
- Height (mm)
- Type of Flow
- Material of Construction
- Shell / Dished end thickness
- Max. Working Pressure
- Hydro Test Pressure
- Max. Flow Rate
- Min. Flow Rate
- Filtration Rate
- Inlet/outlet pipe size
- Type of Media's

- Media's quantity
- Type of Valves
- Back Wash Frequency
- Pressure Drop across bed

### **1.11.3 Cation / Organic Scavanger**

- Make
- Model
- Dia (mm)
- Height (mm)
- Type of Flow
- Material of Construction
- Shell / Dished end thickness
- Max. Working Pressure
- Hydro Test Pressure
- Max. Flow Rate
- Min. Flow Rate
- Min. Flow Rate
- Inlet/outlet pipe size
- Type of Media's
- Resin quantity
- Make / Type of Resin
- Make / Type of Valves
- Regeneration Frequency
- Output between regeneration
- Regeneration chemical quantity

## **1.12 WARRANTY**

A 12 month warranty shall be given for all equipments and accessories applicable from the date of handover. The defective parts and accessories shall be replaced completely free of cost (no extra cost against customs or any other taxes shall be paid separately).

## **1.13 AFTER SALES SERVICE**

### **1.12.1 Preventive Maintenance**

Preventive maintenance details as specified by the manufacturers and chart shall be submitted. It should be carried out by the contractor at no extra cost within warranty period.

### **1.12.2 Breakdown Maintenance**

Breakdown maintenance calls shall be attended within 2 hours by the contractor within warranty period.

## **1.14 EXECUTION**

### **1.13.1 Laying of Pipes & Installations**

Pipings should be laid as specified in the standard guidelines.

Layout drawings, detailed foundation drawings, P&I drawings, piping routing drawings and other detailed drawings should get approved by the engineer before starting the works.

#### **1.14.2 Erection of Vessels**

Erection of Vessels should be carried out using the cranes, fork lift or other appropriate means of erection tools.

#### **1.14.3 Charging of Media**

All media used should be washed and cleaned before before being poured into the vessel.

#### **1.14.4 Cleaning**

All left over and waste materials left shall be cleaned off on the same day that the work in that specific area is over. The welded joints and drills should be grinded and cleaned to perfection.

### **1.15 MEASUREMENT**

Measurement for payment of completed works shall be measured in complete lot including required civil works.

### **1.16 RATES AND BASIS OF PAYMENT**

The rate shall include the cost of materials and labour required for all the operations described above. The rate shall also include the following:

- (a) Scaffolding works.
- (b) Supports, hangers and trays for Pipings, accessories and cables.
- (c) Rough cutting and waste of pipe and fittings.
- (d) PVC Sleeves used in walls, underground and ceiling for pipes.
- (e) All required Civil Works related to the completion of water treatment plant.

The payment for entire work shall be made at their respective contract unit rate which shall be the full and the final compensation to the Contractor to complete the work as per these Specifications.

### **1.17 AREA OF THE PLANT**

Please refer the layout drawing provided with this tender document for the area available for the installation of the plant.

### **1.18 DOCUMENTATION AND CERTIFICATES**

#### **1.18.1 Test Certiftcate**

Test Certificates specified and required standards shall be submitted for all the equipments, vessels, valves, strainers, fittings, medias, resins and membranes and all other accessories and instruments being used in the plant.

#### **1.18.2 Certificate of Testing**

As and when water treatment plants, parts, equipment or shall have passed the tests referred in the specifications, the engineer or engineer's representative shall furnish to the contractor a certificate.

#### **1.18.3 Manuals**

A proper and detailed operation and service manual shall be submitted for all the equipments, accessories and parts used in the works as specified in the BOQ at the time of handover.

#### **1.18.5 Drawings**

Drawings like as built detailed layout, pipeline drawings, schematic diagrams, circuit diagrams shall be submitted at the time of handover.

### **14.1 STANDARDS**

In case of any disagreements between the contractor and the employer over the quality or execution of the works, the following standards shall be followed:

IS : 4270 Specification for steel tubes used for water wells.

IS : 2800 Code of practice for tubewell construction.

IS : 4097 Specification for gravel for use as pack in tubewells.

## 15.0 Make of Equipment and Approved Manufacturers

| S. NO.   | Description   | Manufactures / Brand Name  |
|--|---|--|
| <b>Part – I Sanitary Plumbing Installation</b> |   |  |
| <b>A. Sanitary Fixture and Faucets</b>         |   |  |
| 1.   | Vitreous China Sanitary ware  | a. Parryware Sanitaryware<br>b. Hindware Sanitary ware<br>c. Cera or Approved Equivalent           |
| 2.   | C.P. brass Faucets, Wastes, Traps etc.  | a. Parryware,jaquar or approved equivalent<br>b. ARK<br>c. Ess-Ess o rEssco or Approved Equivalent |
| 3.   | C.P. Flush Valves for W. C.   | a. Parrywr,Jaquar or approved equivalent<br>b. Ark,Ess-Ess,Essco or Approved Equivalent            |
| 4.   | C. P. Angle Valves (Ball Valve Type)  | a. Parryware,Jaquar or approved equivalent<br>b. Ark,Ess-Ess,Essco or Approved Equivalent          |
| 5.   | C. P. Bathroom Accessories(toilet paper Holder,Glass shelf,Towel Rod,Soap Tray etc) | a. Parryware or approved equivalent<br>b. Jaquar<br>c. ESS ESS or Approved Equivalent              |
| 6.   | C. P. Wastes, Spreaders, Urinal Flush Pipe  | a. Parrywae or approved equivalent<br>b. Jaquar<br>c. ESS ESS or Approved Equivalent               |
| <b>B. Pipes and Fittings</b>                   |   |  |
| 1.   | UPVC Soil, Waste & Vent Pipes and Fittings  | a. Panchakanya or Approved Equivalent<br>b. Prince<br>c. Finolex<br>d. Supreme                     |
| 1.   | G.I. Pipes  | a. Hipco<br>b. Jindal, Hissar or Approved Equivalent   |
| 3.   | G. I. Fittings  | a. R' Brand<br>b. Unik Brand<br>c. Sun or Approved Equivalent                                      |
| 4.   | CPVC Pipes and Fittings   | a. Astral ,NSF mark  |
| 5.   | RCC Pipes   | a. Local of approved quality   |
| 6.   | Grattings strainers Cleanouts etc.  | a. Neer' Brand (Sage Metals)<br>or Approved Equivalent   |
| <b>C. Insulation</b>                           |   |  |
| 1.   | Synthetic polymeric Rubber Compound insulation                                      | a. Superlon  |

b. Aeroflex or Approved Equivalent

**D. Valves**

1. Gunmetal Gate Valves, Non-return Valves, Float Valves
2. Ball Valves
  - a. Sant or Approved Equivalent
  - b. Laxmi
3. C. P. Angle Valves
  - a. Parryware or approved equivalent
  - b. Jaquar
4. Butterfly Valves
  - a. Ark
  - c. ESS-Ess or Approved Equivalent
  - a. Audco
  - b. Keystone
  - c. C & R
  - d. Advance or Approved Equivalent

**E. Manhole Covers Grattings etc.**

1. C. I. Manhole Covers
  - a. Nepal Dhalaut Pvt. Ltd
  - b. swastika

**F. Pumps & Motors**

1. Clear Water Pumps
  - a. Crompton
  - b. Kirloskar
  - c. Pedrollo
  - d. Salmson, France
  - e. Grundfos, U K or Approved Equivalent
2. Package Hydropneumatic Systems
  - a. Grundfos, U K
  - b. Salmson, France or Approved Equivalent
3. Drainage Pumps
  - a. Grundfos, U K
  - b. Salmson, France
  - c. KSB
  - d. Nocchi, Italy
  - e. Pedrollo or Approved Equivalent
4. Level Controllers
  - a. Femack or Approved Equivalent

**Part - II Fire Fighting Installation**

**A. Pipes & Fittings**

1. Mild Steel Pipes / G. I. Pipes conforming to IS:1239
  - a. Tata
  - b. Jindal (Hissar) or Approved Equivalent
2. Mild Steel Pipes conforming to IS:3589
  - a. Swastrik
  - b. Prakash Surya or Approved Equivalent
3. G. I. Fittings
  - a. R' Brand
  - b. Sun
  - c. Unik Brand or Approved Equivalent

**B. Valves**

1. C. I. Sluice Valves & Non-return Valves
  - a. Kirloskar / C & R
  - b. I.V.C. or Approved Equivalent

2. Butterfly Valves
    - a. Keystone
    - b. Audco
    - c. C&R
    - d. Advance or Approved Equivalent
  3. Brass Fullway Valves
    - a. Zoloto
    - b. RB-Italy
    - c. Leader
    - d. Sant or Approved Equivalent
  4. Gunmetal Gate Valves and Non-return Valves
    - a. Leader
    - b. Zoloto
    - c. Sant or Approved Equivalent
  - C. Gun Metal Fire Fighting Fittings & Accessories**
    1. Gunmetal Landing Valve, Branch Pipe Nozzle, Fire Brigade Connection Male-female Couplings etc.
      - a. Minimax
      - b. Vijay
      - c. Newage
      - d. Firex or Approved Equivalent
  - D. Hose Pipes & First Aid Hose Reels**
    1. Fire Hose Pipe
      - a. Jaishree
      - b. Firex
      - c. Newage or Approved Equivalent
    2. First Aid Hose Reel
      - a. Tiger(ISI Marked)
      - b. Newage or Approved Equivalent
  - F. Pumps, Electric Motors**
    1. Pumps, Electric Motors
      - a. Kiloskar
      - b. Mather & Platt
      - c. Crompton
      - d. KSB or Equivalent Approved
    2. Motors for Pumps
      - a. Siemens
      - b. ABB
      - c. Kirloskar Electric or Approved Equivalent
  - G. Fire Extinguishers**
    1. Portable Fire Extinguishers
      - a. Minimax
      - b. Vijay
      - c. Firex
      - d. Safex
      - e. Cease Fire or Approved Equivalent
  - H. Electric Switch Gear and Starters**
    1. Electric Switch Gear
      - a. Siemens
      - b. L & T
      - c. GE
      - d. ABB
      - e. Merlin Gerin or Approved Equivalent
- PART- III MACHINERY & PLANT**
1. Water Filtration Plant
    - a. ION Exchange,
    - b. Acqua Tec,
    - c. Thermax Co., or Approved Equivalent