**SECTION D 8 – External Plumbing Works**

# TECHNICAL SPECIFICATIONS

#  C.1 Technical Specification - Plumbing Systems

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| --- | --- |
| **C.1.1** | **General**  |
|  | This specification covers design, testing, jointing and water supply line.**Standard**The equipment and pipes covered in this specification shall comply with following latest Indian StandardsIS: 1239-2004 GI PIPEIS:4736 – 1986 Galvanising for GI pipesIS: 554 - 1999 Pipes TheadsIS: 780 – 1984 Full Way ValvesIS: 15778 CPVC Pipes & FittingsIS: 15801 PPR PipesIS: 10500 Drinking WaterSP 35 – Plumbing StandardWHO standard for water qualityStatic & mobile Pressure vessel act / Indian explosives act |
| **C.1.2** |
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**C.1.3 Specification**

**C.1.4 Design Basis**

The basis of design of Water supply requirements is as per NBC – 2016 part IX for calculating the total water requirements.

1. **Joining Pipes & Fittings**
2. **Cutting**

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut. All burrs should be removed for proper contact between pipe and fittings during jointing.

1. **Solvent Cement Application**

Only CPVC solvent cement conforming to ASTM-F-493 should be used for joining pipe with fittings. An even coat of solvent cement should be applied on the pipe end and a thin coat inside the fitting socket.

1. **Assembly**

After applying the solvent cement on both pipe and fitting socket, pipe should be inserted into the fitting socket within 30 seconds, and rotating the pipe ¼ to ½ turn while inserting so as to ensure even distribution of solvent cement with the joint. The assembled system should be held for 10 seconds (approximately) in order to allow the joint to set up.

1. **Testing**

The system should be hydrostatically pressure tested at 150 psi (10 Bar) for one hour. During pressure testing, the system should be fitted with water and if a leak is found, the joint should be cut out the replaced with new one.

1. **Transition of Flow guard CPVC in metals**

When making a transition connection to metal threads, special brass/plastic transition fitting (Male and female adapters) should be used. Plastic threaded connections should not be over torque.

4.01 Threaded sealants Teflon tape shall be used to make threaded connections leak proof.

4.02 Solvent Cement Only CPVC solvent cement conforming to ASTMF 493 should be used for joining pipe with fittings and valves.

1. **Hangers and supports**

For Horizontal runs, support should be given at 3 feet (90 cms) intervals for diameters of one inch and below and at 4 feet (1.2 m) intervals for larger sizes.

Supports should be as per the below mentioned table:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Size of pipe | 20ºC | 49ºC | 71ºC | 82ºC |
| Inch | Ft. | Ft. | Ft. | Ft. |
| ½” | 5.5 | 4.5 | 3.0 | 2.5 |
| ¾” | 5.5 | 5.0 | 3.0 | 2.5 |
| 1” | 6.0 | 5.5 | 3.5 | 3.0 |
| 1¼” | 6.5 | 6.0 | 3.5 | 3.5 |
| 1¼” | 7.0 | 6.0 | 3.5 | 3.5 |
| 2” | 7.0 | 6.5 | 4.0 | 3.5 |

1. **Galvanized Iron Pipes & Fittings**

The pipes shall be galvanised mild steel welded (ERW) or (HFW) screwed and socketed conforming to the requirements of IS:1239. The Galvanising shall conform to IS:4736, the zinc coating shall be uniform, adherent reasonably smooth and free from such imperfections as flux, ash and drop inclusions, bare patches, black spots, pimples, lumpiness, runs, rust strains, bulky white deposits and blisters. The pipes and sockets shall be cleanly finished, well galvanised in and out and free from cracks, surface flaws laminations and other defects. All screw threads shall be clean and well cut. The ends shall be cut cleanly and square with the axis of the pipe.The fittings shall be malleable iron and comply with all the requirements of the pipes. The sizes of pipes and fitting are specified in the schedule of quantities.

1. **DI PIPES AND FITTINGS**

**a) DI Pipes:**

All DI pipes / fittings used for different units as shall be Class K-9 as per IS 8329 and IS 9523 with up to date amendments. The pipes shall be cement mortar lined on inner face suitable for sewage and painted with bituminous paint on outer surface.

**b) DI Double Flanged Pipes:**

The DI welded D/F pipes shall be conforming to IS 8329 with up to date Amendments Class K-9 barrel. The pipes shall be cement mortar lined on inner face suitable for sewage and painted with bituminous paint on outer surface. The flange rating shall be PN 1.6 with working pressure of 10 kg/m2.

1. **Laying and Jointing of GI Pipes**

The galvanised pipes and fittings shall run in wall chase or ceiling or as specified. The fixing shall be done by means of standard pattern holder bat clamps keeping the pipes about 1.5 cm clear of the wall where to be laid on surface. Where it is specified to conceal the pipes, chasing may be adopted for pipes fixed in the shafts, ducts etc. there should be sufficient space to work on the pipes with the usual tools. As far as possible, pipes may be buried for short distances provided adequate protection is given against damage and where so required special care to be taken at joints. Where directed by the Owner/PMC, pipe sleeves shall be fixed at a place the pipe is passing through a wall or floor for reception of the pipe and allow freedom for expansion and contraction and other movements. In case of pipe is embedded in walls or floors it shall be painted with anticorrosive bitumastic paints of approved quality. Under the floors the pipes shall be laid in layer of sand filling.

 Galvanised iron pipes shall be jointed with threaded and socket joints, using threaded fittings. Care shall be taken to remove any burr from the end of the pipes after threading. Teflon tape, White lead or an equivalent jointing compound of proprietary make shall be used, according to the manufacturer’s instructions, with a grommet of a few strands of fine yarn while tightening. Compounds containing red lead shall not be used because of the danger of contamination of water. Any threads exposed after jointing shall be painted with bituminous paint to prevent corrosion.

1. **PIPING INSTALLATION SUPPORT**

The Contractor, on the award of the work, shall prepare detailed working drawings, showing the cross-sections, longitudinal sections, details of fittings, locations of isolating and control valves, drain and air valves, and all pipe supports. He must keep in view the specific openings in buildings and other structure through which pipes are designed to pass. Piping shall be properly supported on , or suspended from , on stands, clamps, hangers as specified and as required. The Contractor shall adequately design all the brackets, saddles, anchor, clamps and hangers, and be responsible for their structural stability.Pipe work and fittings shall be supported by hangers or brackets so as to permit free expansion and contraction. All accessories and ancillaries of support system such as brackets, saddles, clamps, hangers etc. shall be hot dip galvanized after fabrication. Further to permit free movement of common piping, support shall be from a common hanger bar, fabricated from galvanised steel sections. Pipe hangers shall be provided at the following maximum spacings:

|  |  |  |
| --- | --- | --- |
| **Pipe Dia****(mm)** | **Hanger Rod Dia****(mm)** | **Spacing between Supports** **(m)** |
| Up to 25 | 6 | 2 |
| 32 to 50 | 10 | 2.7 |
| 80 to 100 | 12 | 2.7 |
| 125 to 150 | 16 | 3.6 |

1. **Anchor Fasteners**

All pipe supports, hangers and clamps to be fixed on RCC walls, beams, columns, slabs and masonry walls 230mm thick and above by means of galvanised expandable anchor fasteners in drilled holes of correct size and model to carry the weight of pipes. Drilling shall be made only by approved type of power drill as recommend and approved by manufacturer of the anchor fasteners. Failure of any fastening devices shall be the entire responsibility and contractor shall redo or provide additional supports at his own cost. He shall also compensate the DPL for any damage that may be caused by such failures.

1. **Unions**

Contractor shall provide adequate number of unions on all pipes to enable easy dismantling later when required. Unions shall be provided near each gunmetal valve, stop cock, or check valve and on straight runs as necessary at appropriate locations as required and/or directed by Owner/PMC.

1. **Flanges**

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by the Owner/PMC. Connections shall be made by correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water connections are made insertion gasket shall be of suitable high temperature grade and quality approved by the Owner/PMC. Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S. 780. and C.I. butterfly valve to IS: 13095.

1. **Trenches**

All water supply pipes below ground shall be laid in trenches with a minimum cover of 60 cms. The width and depth of the trenches shall be as follows:-

 Dia of pipe Width of trench Depth of trench

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 15 mm to 50 mm 30 cms 75 cms

 65 mm to 150 mm 45 cms 100 cms

1. **Sand filling**

G.I. pipes in trenches shall be protected with fine sand 15 cms all round before filling in the trenches.

1. **Painting (Painting for CPVC pipes not required)**

All pipes above ground shall be painted with one coat of red lead and two coats of synthetic enamel paint of approved shade and quality. Pipes shall be painted to standard colour code given in this document or specified by Owner/PMC.

1. **Pipe protection (Protection for CPVC pipes not required)**

 All G.I. pipes in wall chase /below floors or laid under ground shall be protected against corrosion by the application of two coats of bitumen paint covered with polythene tape and a final coat of bitumen paint.

G.I. waste pipes buried in ground or sunken slab shall be protected with multilayer bitumen membrane tape 3mm thick with a final coat of hot or cold applied bitumen. Pypkote or equivalent.

1. **Butterfly Valves**

 Valves 65 mm dia and above shall be cast iron butterfly valve to be used for isolation. The valves shall be bubble tight, resilient seated suitable for flow in either direction and seal in both direction with accompanying flanges and steel handle.

 Butterfly valve shall be of best quality conforming to IS: 13095.

1. **Non Return Valve (Slim Type)**

Where specified non return valve (swing check type) shall be provided through which flow can occur in one direction only. It shall be single door swing check type of best quality.

Each Butterfly and Slim Type Swing Check (NRV) Valve shall be provided with a pair of flanges screwed or welded to the main line and having the required number of galvanised nuts, bolts and washers of correct length.

1. **GUNMETAL FRRRULE CONNECTION**

 (a). Design features

 1. shall be able to be installed with drilling and tapping machines .

2. shall be able to be used for dry & under pressure drilling.

3. shall be able to be installed directly in Cast Iron, Ductile Iron, Steel Pipe mains.

4. shall be able to be installed on UPVC or AC mains through PVC clamp saddles, flat brass straps.

5. shall have an inlet male taper thread for mounting on the pipe saddle.

6. shall have an outlet female parallel thread for jointing of the service line

7. isolation/control of water shall be handled by the inner plug

 Evaluation

 Sample Testing Samples will be tested for,

 Compliance with the requirements described in clause Nos. (c.), (d.), (e.) and (f

 Compliance with the test pressure

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| --- |
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| --- | --- | --- |
| **Test**  |  | **Acceptance Criteria**  |
| Material Data as specified in clause (c)  |  | Only one random selected sample will be tested. If the sample shall comply, only then offers will qualify for further evaluation.  |
| Dimension check as specified in clauses (d) & (e)  |  | One randomly selected sample from the balance two will be checked and it shall comply with specifications.  |
| Stem construction as specified in clause (f)  |  |  |
| Pressure Tests  |  |  |

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1. **Water Meter**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- |
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| Feature |
| Detail |
| Principle of operation Ultrasonic transmit time using inline flow cell  |
| Approvals OIML R49-1  |
| Battery life 15 years  |
| Temperature tolerance 85°C ambient and 60°C water  |
| Pressure rating 20 Bar (Max. Operating Pressure)  |
|  32 Bar (Max. Tested Pressure)  |

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1. **MOTORISED BUTTERFLY VALVE**

Description : Wedge gate valve with rising stem, flanged

 ends and electric motor operated

Pressure class : Class 1500 (200 bar) working pressure 3000 psig

 Size : 8” diameter

Type : Gate valve (To be used as on off valve)

 Quantity : 3 numbers

Pressure class : Class 150 (10-15 bar) working pressure 150 psig

 Size : 24” diameter

Type Gate valve (To be used as on off valve)

Quantity : 1 number

Actuated by : Electric motor

Operating medium : Air

Operating temperature : 60 C

Leakage class : IV

Actuating time : ~ 30 sec for 24” valve

(Fully open to fully closed) : ~ 20 sec for 8” valves

Matching flanges : 2 nos for each valve

1. **Sluice Valve**

 All valves 80 mm dia and above shall be C.I. double flanged butterfly valves. Each sluice valve shall be provided with wheel for valves in exposed positions and cap top for underground valves. Contractor shall provide suitable operating keys for Sluice Valves with cap tops.

1. **Air Realeas valves**

 25 mm dia screwed inlet cast iron single acting air valve shall be provided on all high points in the system or as shown on drawings.

# C.2 Drinking Water Supply System - RO (Reverse Osmosis System)

1. **GENERAL**

The System is designed considering Bore-well Water as the Feed Source.

The Basis of Design considered is, as per the quality of water of 2000 ppm TDS as a tentative base.

|  |  |  |
| --- | --- | --- |
| **Parameter** |  | **Value** |
| Raw Water Flow Rate | **:** | 3.5 M3/Hr |
| Product Water Flow Rate | **:** | 60 LPH |
| Design Recovery | **:** | 50 % |
| Reject Flow | **:** | 1.00 M3/Hr |
| Operating Pressure | **:** | 12.5 bar |

Plant to be designed at water temperature of 25 degrees.

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Please note that the recovery of Reverse Osmosis plant shall directly depend on critical parameters like silica, SDI, hardness, Iron, Chlorine and fluorides. Assuming them to be within range , the recovery works out to be 50%.

Treated water quality at the outlet of RO Plant:

Total Dissolved Solids : < 200 ppm

1. **STANDARD**

Except where modified by this specification, the RO shall be designed, manufactured and tested in accordance with the latest editions of the following standards. The Bidder may propose alternative standards, provided it is demonstrated that they give a degree of quality and performance equivalent to or better than the referenced standards. Acceptability of any alternative standard is at the discretion of the Purchaser. The Bidder shall furnish a copy of the alternative standard proposed along with the bid. If the alternative standard is in a language other than English, an English translation shall be submitted with the standard and parameter as mention below:

|  |
| --- |
| LIMITING CONDITIONS IN FEED WATER FOR R.O. PLANT OPERATION: |
| Ph | : | 7-8  |  | Temperature | : | 25- 35° C |
| Turbidity | : | < 1 NTU |  | SDI | : | < 3 |
| Free Chorine | : | NIL |  | Iron as Fe | : | <0.1 ppm |
| Manganese as Mn | : | < 0.1 ppm |  | Oil & Grease  | : | < 1 ppm |

1. **Process Description: -**

The treatment scheme comprises of pre-treatment and reverse osmosis block. The process description is as follows:

* 1. **Pre-Treatment: - Dual Media Filter**

The system is provided with a Dual Media Filter. The main purpose of the filter is to remove the Suspended Solids & reduce Turbidity. The Filter is provided with Inlet Distributor, Bottom Collector & various Filtration Media like pebbles, gravels, sand and anthracite to achieve effective filtration. Externally, the filter has either a Multiport Valve or mesh of valves to assist in various service requirements like Filtration, Backwash & Rinse.

* 1. **Activated Carbon Filter-**

The system is provided with an activated carbon Filter. The main purpose of the filter is to remove the free chlorine, organics, colour or odour etc. The Filter is provided with Inlet Distributor, Bottom Collector & Filtration Media like Activated carbon of high i-value and supporting media to achieve effective filtration. Externally, the filter has either a Multiport Valve or mesh of valves to assist in various service requirements like Filtration, Backwash & Rinse.

* 1. **Micron Cartridge Filter:**

A micron filter of 5 micron is included in the system to prevent passage of particulates to the high pressure pump and membrane. The micron filter is of PP housing. The micron cartridge will be polypropylene.

1. **Reverse Osmosis System:**

**C.2.4.1 High Pressure Pump:**

The system is provided with a high pressure pump of suitable flow rate, head & material of construction. The pump is provided with low pressure switch to ensure smooth operation.

**C.2. 4.2 Reverse Osmosis Block:**

The RO Block comprises of membranes encased inside the pressure tubes. The membranes considered are thin film composite in spiral wound construction. The feed water at high pressure enters the RO block and gets separated in to permeate (product) and reject (waste) streams. The product water is usually taken to a tank & pumped for further use. The reject water is drained in nearby drain. The RO Block is provided with adequate instrumentation & interlocks to ensure smooth operation. The RO block is also provided with automatic flush valve on reject line. This valve ensures the flushing of accumulated salts & maintains the clean membrane surface.

1. **Post Treatment: -**

**C.2.5.1 UV system:**

The system is provided with an ultraviolet based system for final disinfection of treated water before entering into treated water tank. The UV system comprises of a quartz based UV lamp, SS housing and display panel.

**C.2.5.2 PH Correction Dosing Set (optional):**

The system is provided with a tank (HDPE) & dosing pump to dose the appropriate solution to increase the PH. Usually Sodium Hydroxide (non drinking applications) or Soda Ash (for drinking application) solution is used. The pump has provision to change the dosage rate by manually controlling the knob.

1. **Termination into Treated water tank**

The Treated water will be sent to the treated water tank capacity 1000 litres holding capacity. The RO plant will be synchronized with the treated water tank to facilitate auto operation of the plant.

# C.3 Soft Water Supply System for HVAC cooling tower’s

**C.3.1 GENERAL**

The soft water supply is considering for cooling tower and chillers as feed through the softening treatment plant.

**C.3.2 REQUIREMENT**

The domestic water shall be treated through softener and brine tank. The softener function by treating cooling tower makeup ro remove calcium and magnesium hardness. Calcium and magnesium hardness in the makeup is removed as the water passes though the softening system. The low solubility calcium and magnesium ions are exchange for sodium, which is very soluble. Softener plant shall include brine tank of M.S. welded construction lined internally with rubber similar as main vessel and capable of regenerating the softening plant. The brine tank shall have overflow & drain, outlet fitting complete regeneration assembly comprising of power valve, ejector, brine suction valve and all associated pipe work. A density meter for brine shall be included.

# C.4 Underground Water Tank and Pump Room

Storage tanks for water supply shall be in reinforced cement concrete built by the building Contractor.

Each tank shall be provided with lockable type manhole cover fabricated from M.S. sheets. Manhole covers shall be 560-600 mm dia and fully galvanised after fabrication or as approved by the Owner/PMC.

 **C.4.1 Specifications for Pumps**

**C.4.1.1Water Transfer Pumps (Imported Stainless Steel Pumps)**

 Water supply pumps shall be suitable for clean filtered water. Pumps shall be single stage, monobloc vertical/horizontal, centrifugal pumps with stainless steel body and stainless steel (DIN W-Nr .1.4301) impeller, stainless steel shaft and mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.

 All parts in contact with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.

 Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 410 volts, 3 phases, 50 cycles A.C. power supply and operating at 2900 RPM nominal speed.

 Each pumping set shall be provided with 100-mm dia gunmetal “Borden” type pressure gauge with gunmetal valve and connecting piping.

 Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Owner/PMCs.

**C.4.1.2 Submersible pumps**

. Submersible pumps for sewage/drainage shall be single stage, single entry pump. Pump shall be with C.I. casing and C.I. two vane open type dynamically balanced impeller connected to a common shaft to the motor. The vane for sewage pump will be open type, while for drainage pump etc. It will be of semi open type.

 Stuffing box shall be provided with mechanical seals

 Each pump shall be provided with water cooled squirrel cage induction motor suitable for 415 volts, 3 phase, 50 cycles AC power supply.

 Each pump shall be provided with liquid level controller for automatic operation of the pump between predetermined levels. Operation of level controller shall be similar to as discussed in subsequent paras below.

 The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.

 Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

**C.4.1.3 Level Controllers**

 Level controllers shall be electronic low voltage type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe. The level controller will be used for following applications: -

**C.4.1.4 Sump Pump level controller & high water alarm**

 To cut off the drainage sump pump when the sump is empty and to start when: -

 a) Duty pump No. 1 at pre-determined level No.1

 b) Duty pump No.2 at a higher pre-determined level.No.2 and also to sound alarm

 **Pipe & Fittings (for Headers and Connection**s)

 Pump suction and delivery headers shall be Galvanized iron pipes/MS heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer’s instructions.

 **Vibration Eliminators**

 All suction and delivery lines as shown on the drawings shall be provided with double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

**C.4.1.5 Valves**

 **Butterfly Valves**

 Butterfly Valves shall be cast iron body with following details: -

a) Disc shall be CI heavy duty electrolyses nickel plated abrasion resistant.

b) The shaft be EN-8 Carbon Steel with low friction nylon bearings.

c) The seat shall be drop tight constructed by bonding resilient elastomer inside a rigid backing.

d) Built in flanged rubber seals.

e) Actuator to level operated for valves above ground and T Key operated for valves below ground.

f) Built in flanges for screwed on flanged connections.

 Manufacturer’s details on fixing and installation will be followed.

**C.4.1.6. Non Return Valves (NRV)**

a) Non return valves will be used at location to allow flow only in one direction and prevent flow in the opposite direction.

b) NRV shall be cast iron slim type with cast iron body and gunmetal internal parts and accompanying flanges.

 **Painting and cleanup**

a) On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer.

b) Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.

c) Provide painted identification legend and direction arrows on all equipment and piping as directed by engineer-in-charge.

1. On final completion of the work, contractor should cleanup the site, filter room of all surplus materials rubbish and leave the place in a broom-clean condition.

**C.4.1.**7. **Cables**

 Contractor shall provide all power and control cables from the motor control centre to various motors, level controllers and other control devices.

. All power and wiring cables shall be aluminum conductor PVC insulated armoured and PVC sheathed of 1100 volts grade.

 All control cables shall be copper conductor PVC insulated armoured and PVC sheathed 1100 volts grade.

 All cables shall have stranded conductors. The cables shall be in drums as far as possible and bear manufacturer's name.

 All cable joints shall be made in an approved manner as per standard practice.

 **C.4.1.8. Cables trays**

 Contractor shall provide M.S. Slotted cable trays at locations as shown on the drawings and of sizes as given in the schedule of quantities.

 Cables trays shall be supported from the bottom of the slab at intervals of 30 cms at both ends by welding support rods with insert plates or to reinforcement bars. Cutting of holes in the slab for exposing of reinforcement bars and making good the same after welding of support rods shall be included in the rate of the tray and no separate payment shall be made on this account.

 Cost of clips, bolts, nuts, supports rods and any other materials required to fix the trays in proper manner shall be included in the ate for trays.

**C.4.1.9.** **Earthing**

 All equipment installed by the contractor shall be suitably earthed by making proper connection by means of G.I. Wires to the main earthing system laid by the electrical contractors.

**C.4.1.10. Motor control centres**

 Switchboard cubicles of approved type shall be fabricated from 16 gauge M.S. Sheet with dust and vermin proof construction. It shall be painted with stove enamelled paint of approved make and shape. It shall be fitted with suitable etched plastic identification plates for each motor. The cubicle shall comprise of the following:- (switchgear as given in the schedule of quantities).

 a) Incoming main switch fuse unit of required capacity.

 b) Isolation switch fuse unit, one for each motor.

 c) Fully automatic DOL/star delta starters suitable for motor H.P. with push buttons one for each motor and on/off indicating neon lamps.

 d) Single phasing preventer of appropriate rating for each motor.

 e) Rotary duty selector switch.

 f) Panel type ampere meters one for each motor.

 g) Panel type voltmeter on incoming main with rotary selector switch to read voltage between phase to neutral and phase to phase.

 h) Neon phase indicating lamps and indicating lamp for each motor.

 i) Rotary switch for manual or auto operation for each pump.

 j) Fully taped separate aluminium bus bars of required capacity for normal and emergency supply where specified.

 k) The panel shall be prewired with colour coded wiring. All interconnecting wiring from incoming main to switch gear, meters and accessories within the switch board panel.

All switch gears and accessories shall be approved make.

Switchboard cubicles shall be floor or wall mounted type as recommended by manufacturers.

**C.4.2. WATER TREATMENT PLANT:**

**C.4.2.1 Multi-grade Pressure Sand Filter:**

 Multi-grade Pressure sand filter shall be vertical types of required diameters. The shell and dish end shall be fabricated from M.S. plates conforming to relevant IS standard suitable for withstanding the working pressure given in schedule of quantities. The minimum thickness of shell shall be 5 mm and dished ends shall be 6mm. The filter shall have at least one pressure tight manhole cover and at least one side hole with cover for maintenance purposes. Filter shall be painted with two or more coats of non-toxic corrosion resistant epoxy paint inside and two coats of zinc chromate primer and subsequently with two coats of synthetic enamel paint of approved quality and colour outside.

 Filters shall be provided with an efficient under drain system and raw water distributor.

 Filter shall be provided with frontal piping comprising of inlet, outlet, backwash and rinse complete with valves, piping shall be of GI, 100mm dia dial bourden type gunmetal pressure gauges with gunmetal isolation cock and connection piping on inlet and outlet, sampling cock on raw water inlet and filtered water outlet, drain connection with valve.

**C.4.2.2 Activated Carbon Filter:**

 Activated Carbon Filter shall be vertical types of required diameters. The shell and dish end shall be fabricated from M.S. plates conforming to relevant Indian Standard suitable for withstanding a working pressure given in schedule of quantities. The minimum thickness of shell shall be 5mm and dished ends shall be 6mm. The Activated Carbon filter shall have at least one pressure tight manhole cover and at least one side hole with cover. Filter shall be painted with two or more coats of non-toxic corrosion resistant epoxy paint inside and two coats of zinc chromate primer and subsequently with two coats of synthetic enamel paint of approved quality and colour outside.

 Activated Carbon Filter shall be provided with a strainer plate at the lower end and a raw water distributor at the top.

 Activated Carbon Filter shall be provided with frontal piping comprising of inlet, outlet, backwash and rinse complete with valves, piping shall be of M.S epoxy coated (Heavy Class), 100mm dia dial bourden type gunmetal pressure gauges with gunmetal isolation cock and connection piping on inlet and outlet, sampling cock on raw water inlet and filtered water outlet, individual drain connection with valve.

**C.4.2.3 Softener:**

 Water softener shall be vertical types of required dimensions. The shell and dish end shall be fabricated from M.S. plates conforming to relevant IS standard suitable for withstanding the working pressure given in schedule of quantities. The minimum thickness of shell shall be 5mm and dished ends shall be 5 mm. The softener shall have at least two pressure tight manhole covers. Softener shall be painted with two or more coats of non-toxic corrosion resistant epoxy paint inside and two coats of zinc chromate primer and subsequently with two coats of synthetic enamel paint of approved quality and colour outside.

 Softener shall be provided with an efficient under drain system comprising of sufficient no, of PP strainers with removable nuts and check nuts installed on a strainer plate of proper thickness raw water distributor at the top and 1 No. all plastic regenerate distributor at required level. The strainer plate shall be accessible from lower end.

 Softener shall be provided with frontal piping comprising of inlet, outlet and backwash regeneration and rise complete with valves, piping shall be of GI, 100mm dia dial bourden type gunmetal pressure gauges with gunmetal isolation cock and connection piping on inlet and outlet, sampling cock on raw water inlet and softened water outlet, drain connection with valve.

 Regeneration assembly comprising of power valve, ejector, brine suction valve and all necessary piping.

**C.4.2.4 Brine Tank:**

 Brine tank shall be M.S. vertical, cylindrical self-supporting open tank in M.S. plate welded construction. Brine tank shall have nozzle for inlet, outlet, drain and overflow etc. with proper support structure. Brine tank shall be lined internally with 3mm fibre lining applied with Bis-resins. Externally, it shall be coated with 2 coats of zinc chromate primer followed by 2 coats of synthetic enameled paints.

**C.4.2.5 Chlorine Dosing System:**

 Chlorine dosing system shall be electronic diaphragn type dosing pump both stroke length and frequency controls, foot valves, dosing valve and interconnecting tubing. The pump shall be mounted on a virgin chemical grade HDPE tank.

**C.4.3. Automatic Water Tank Level Controls:**

**C.4.3.1 Raw Water Storage Tank (U.G.T.):**

 When the water reaches predetermined low level, an audio-visual automatic alarm will sound and the filter feed water pump will be stopped automatically. The alarm will have a switch which will enable the operator to switch it off. When the water rises above low level to a predetermined height, the filter feed water pump will start automatically if the high water levels in the treated water tank so demand.

**C.4.3.2 Treated Water Storage Tanks (U.G.T.):**

 When the water reaches high level in the treated water storage tank an audio-visual automatic alarm will sound and the filtered feed water pump to water treatment system will stopped automatically. The alarm will have a switch which will enable the operator to switched it off. When the water reaches predetermined low level in treated water tank an audio visual automatic alarm will sound and the filtered water feed pump will start automatically.

**C.4.3.3 Soft Water Tank: (As Required)**

 When the water reaches high level in soft water storage tank and audio-visual automatic alarm will sound and soft water booster pump will stop automatically. The alarm will have a switch which will enable the operator to switched it off. When the water reaches predetermined low level in soft water storage tank, an audio visual automatic alarm will sound and the soft water booster pump will start automatically. Provision shall be made in the system to protect the soft water booster pump from dry run protection.

# C.5 Sewerage System & Drainage System

**1 Excavation**

 **Alignment and grade**

 The sewer pipes shall be laid to alignment and gradient shown on the drawings but subject to such modifications as shall be ordered by the Owner/PMC. No deviations from the lines, depths of cutting or gradients of sewers shown on the plans and sections shall be permitted except by the express direction in writing of the Owner/PMC.

 **Excavation in tunnels**

 The excavation for sewer works shall be open cutting unless the permission of the Owner/PMC is obtained for laying pipes in tunnel where sewers have to be constructed along narrow passages or difficult ground.

 **Opening out trenches**

 In excavating the trenches, etc. the solid road metalling, pavement, kerbing, etc. and turf is to be placed on one side and preserved for reinstatement when the trenches or other excavation shall be filled up. Before any road metal is replaced, it shall be carefully sifted. The surface of all trenches and holes shall be restored and maintained to the satisfaction of the Owner/PMC.

 The Contractor shall grub up and clear the surface over the trenches and other excavations of all trees, stumps roots and all other encumbrances affecting execution of the work and shall remove them from the site to the approval of the Owner/PMC.

 **Obstruction of roads**

 The Contractor shall not occupy or obstruct by his operation more than one half of the width of any road or street and sufficient space shall then be left for public and private transit, he shall remove the materials excavated and bring them back again when the trench is required to be refilled. The Contractor shall obtain the consent of the Owner/PMC.

 **Removal of filth**

 All night soil, filth or any other offensive matter met with during the execution of the works, immediately after it is taken out of any trench, sewer or cess pool, shall not be deposited on to the surface of any street or where it is likely to be a nuisance or passed into any sewer or drain but shall be at once put into the carts and removed to a suitable place to be provided by the Contractor.

 Depths of **Excavation**

 The trenches shall be excavated to such a depth that the sewer shall rest on concrete as described in the several clauses relating there to and so that the inverts may be at the levels given in the sections.

 **Refilling**

 After the sewer or other work has been laid and proved to be water tight, the trench or other excavations shall be refilled. Utmost care shall be taken in doing this, so that no damage shall be caused to the sewer and other permanent work. The filling in the haunches and upto 75 cms above the crown of the sewer shall consist of the finest selected materials placed carefully in 15 cms layers and flooded and consolidated. After this has been laid, the trench and other excavation shall be refilled carefully in 15 cms layers with materials taken from the excavation, each layer being watered to assist in the consolidation..

 **Contractor to restore settlement and damages**

 The Contractor shall, at his own costs and charges, make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also, at his own expense and charges, repair and make good any damage done to buildings and other property if in the opinion of the Owner/PMC the damage is due to his negligence.

 **Disposal of surplus soil**

 The Contractor shall at his own costs and charges provide places for disposal of all surplus materials not required to be used on the works. As each trench is refilled the surplus soil shall be immediately removed, the surface properly restored and roadways and sides left clear.

 **Timbering of sewer and trenches**

1. The Contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed timbered in loose or sandy strata and below the surface of the sub soil water level.
2. All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall take place.

c) The Contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

 **Shoring of buildings**

 The Contractor shall shore up all buildings, walls and other structures, the stability of which is liable to be endangered by the execution of the work and shall be fully responsible for all damages to persons or property resulting from any accident.

 **Removal of water from sewer, trench etc**.

a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.

b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses and charges to the requirements of the Owner/PMC.

 **Width of trench**

 Recommended width of trenches at the bottom shall be as follows:-

 100 mm dia pipe 55 cms

 150 mm dia pipe 55 cms

 225-250 cms dia pipe 60 cms

 300..400 mm dia pipe 75 cms

 Maximum width of the bed concrete shall also be as above. No additional payment is admissible for widths greater than specified.

**2 Salt glazed stoneware pipes (Where applicable)**

 Stoneware pipes shall be of first class quality salt glazed and free from rough texture inside and outside and straight. All pipes shall have the manufacturers name marked on it and shall comply with approved makes.

**3** **Laying and jointing of stoneware salt glazed pipes**

a) Pipes are liable to be damaged in transit and notwithstanding tests that may have been made before despatch each pipe shall be examined carefully on arrival at site. Each pipe shall be rung with a wooden hammer or mallet and those that do not ring true and clear shall be rejected. Sound pipes shall be carefully stacked to prevent damage. All defective pipes should be segregated, marked in a conspicuous manner and their use in the works prevented.

b) The pipes shall be laid with sockets leading uphill and rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation sufficiently deep to allow the pipe jointer room to work right round the pipe and as short as practicable to admit the socket and allow the joint to be made.

c) Where pipes are not bedded on concrete the trench bottom shall be left slightly high and carefully bottomed up as pipe laying proceeds so that the pipe barrels rest on firm ground. If excavation has been carried too low it shall be made up with cement concrete at the Contractor's cost and Charges.

d) If the bottom of the trench consists of rock or very hard ground that cannot be easily excavated to a smooth surface, the pipes shall be laid on cement concrete bed to ensure even bearing.

 **Jointing of pipes**

a) Tarred gaskin shall first be wrapped round the spigot of each pipe and the spigot shall then be placed into the socket of the pipe previously laid, the pipe shall then be adjusted and fixed in its correct position and the gaskin caulked tightly home so as to fill not more than one quarter of the total length of the socket.

b) The remainder of the socket shall be filled with stiff mix of cement mortar (1 cement : 1 clean sharp washed sand). When the socket is filled, a fillet should be formed round the joint with a trowel forming an angle of 450 with the barrel of the pipe. The mortar shall be mixed as needed for immediate use and no mortar shall be beaten up and used after it has begun to set.

c) After the joint has been made any extraneous materials shall be removed from inside of the joint with a suitable scraper of "badger". The newly made joints shall be protected until set from the sun, drying winds, rain or dust. Sacking or other materials which can be kept damp shall be used. The joints shall be exposed and space left all round the pipes for inspection by the Owner/PMC. The inside of the sewer must be left absolutely clear in bore and free from cement mortar or other obstructions throughout its entire length, and shall efficiently drain and discharge.

 **Testing**

 a) All lengths of the sewer and drain shall be fully tested for water tightness by means of water pressure maintained for not less than 30 minutes. Testing shall be carried out from manhole to manhole. All pipes shall be subjected to a test pressure of at least 1.5 metre head of water. The test pressure shall, however, not exceed 6 meter head at any point. The pipes shall be plugged preferably with standard design plugs with rubber plugs on both ends. The upper end shall, however, be connected to a pipe for filling with water and getting the required head.

b) Sewer lines shall be tested for straightness by: (i) inserting a smooth ball 12 mm less than the internal diameter of the pipe. In the absence of obstructions such as yarn or mortar projecting at the joints the ball should roll down the invert of the pipe and emerge at the lower end, (ii) means of a mirror at one and a lamp at the other end. If the pipe line is straight the full circle of light will be seen otherwise obstruction of deviation will be apparent.

c) The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Owner/PMC.

d) A test register shall be maintained which shall be signed and dated by Contractor,

**4**   **Gully traps**

 Gully traps shall be of the same quality as described for stoneware pipes in clause 4.1 above and used where shown on drawings.

 Gully traps shall be fixed in cement concrete 1:5:10 mix and a brick masonry chamber 30x30 cms inside in cement mortar 1:5 with 15x15 cms grating inside and 30x30 cms C.I. sealed cover and frame weighing not less than 7.3 kg to be constructed as per standard drawing. Where necessary, sealed cover shall be replaced with C.I. grating of the same size (1 cement : 5 coarse sand : 10 stone aggregate 40 mm nominal size)

**5. Cement concrete and masonry works (for manholes and chambers etc.)**

 **Materials**

 a) **Water**

 Water used for all the constructional purposes shall be clear and free from oil, acid, alkali, organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for constructional purpose.

b) **Aggregate for concrete**

 The aggregate for concrete shall be in accordance with NFPA. In general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Owner/PMC. The size of the coarse aggregate shall be done as per NFPA.

 c) **Sand**

 Sand for various constructional purposes and its grading shall comply in all respects with NFPA. It shall be clean, coarse hard and stone, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Owner/PMC.

d) **Cement**

 The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement.

e) **Mild steel reinforcement**

 The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements.

f) **Bricks**

 Brick shall have uniform colour, thoroughly burnt but not over burnt, shall have plain rectangular faces with parallel sides and sharp right angled edges. They should give ringing sound when struck. Brick shall not absorb more than 20% to 22% of water, when immersed in water for 24 hours. Bricks to be used shall be approved by the Owner/PMC.

g) **Other materials**

 Other materials not fully specified in these specifications and which may be required in the work shall conform to the NFPA. All such materials shall be approved by the Owner/PMC.

 **Cement concrete (plain or reinforced**)

a) Cement concrete for pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the Owner/PMC. Rate for cement concrete shall be inclusive of all shuttering and centring at all depth and heights.

b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.

c) All concrete work shall be cured for a period of at least 7 days. Such work shall be kept moist by means of gunny bags at all times.

 **Masonry work**

 Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed with bricks as specified in the Schedule of quantities in cement mortar of mix as specified in schedule of quantities. All joints shall be properly raked to receive plaster.

 **Cement concrete for pipe support**

 a) Wherever specified or shown on the drawings, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities. Width of the bedding shall be the width of the trench as specified.

1. Unless otherwise directed by the Project Engineer, cement concrete for bed, alround or in haunches shall be laid as follows :-

 upto 1.5 m upto 3 m beyond 3 m

 depth depth depth

 ------------------------------------------------------------------------------------------

 Mix of concrete (1:4.8 ) (1:4:8 ) (1:4:8 )

 (no sub soil water)

 Stone ware pipes Al round upto Haunches Alround

 RCC Pipes Alround upto Haunches upto Haunches)

 Under sub-soil water

 Mix of concrete (1:3:6) (1:3:6) (1:3:6)

 R.C.C. Pipes or SW.pipes All round All round All round

 Under the building (1:3:6) (1:3:6) (1:3:6)

 RCC Pipes or SW pipes Alround Alround Alround

 (Concrete mix refer to cement : coarse sand: stone aggregate 40 mm nominal size)

c) R.C.C. pipes or C.I. pipes may be supported on brick masonry or precast R.C.C. or in situ cradles. Cradles shall be as shown on the drawings.

d Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

**Manholes and chambers**

 All manholes, chambers and other such works as specified shall be constructed in brick masonry in cement mortar 1:5 (1 cement : 5 coarse sand) or as specified in the Schedule of Quantities.

 All manholes and chambers etc. shall be supported on 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:-

 (all dimensions internal clear in cms)

 Size of manhole 90x80 120x90 90 dia at bottom 122 dia at bottom

 type Rect. Rect. Conical Conical

 ----------------------------------------------------------------------------------------------------------------

 Maximum depth 150 240 167 239

 Average thickness

 of R.C.C slab 15 15 - -

 Size of cover and 60x45 50 dia 50 dia 50 dia

 frame mm 116 or 116 or 116 or 116 or

 Weight of cover 38 kg 225 kg 225 kg 225 kg

 and frame

 ---------------------------------------------------------------------------------------------------

 All manholes shall be provided with cement concrete benching in 1:2:4 mix (1 cement : 2 coarse sand : 4 stone aggregate 20 mm nom. Size) The benching shall have a slope of 10 cms towards the channel. The depth of the channel shall be full diameter of the pipe. Benching shall be finished with a floating coat of neat cement. as per standard details.

 All manholes shall be plastered with 12/15 mm thick cement mortar 1:3 (1 cement : 3 coarse sand) and finished with a floating coat of neat cement inside. Manhole shall be plastered outside as above but with rough plaster mixed with water proofing compound.

 All manholes with depths greater than 0.8m shall be provided with 20 mm square or 25 mm round rods aoristic coated catch rings set in cement concrete blocks 25x10x10 cms in 1:2:4 mix 30 cms vertically and staggered. **Foot rests** shall be coated with coal tar before embedding.

 All manholes shall be provided with cast iron/steel fibre reinforced plastic (SFRC) covers and frames and embedded in reinforced cement concrete slab. Weight of cover, frame and thickness of slab shall be as specified in the Schedule of Quantities or given above.

 Road gullies, ramp drains, gratings in basement shall be cast iron with M.S. frame or Steel Fibre Reinforced Concrete (SFRC) with frame as specified in the Schedule of Quantities.

**6 Making connections**

 Contractor shall connect the sewer line of the building to the main manhole by providing making holes and channels etc.

**7 Reinforced cement concrete pipes**

 All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be centrifugally spun S & S RCC pipes of specified class. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

**8 Laying**

 R.C.C. spun pipes shall be laid on cement concrete bed or cradles as specified and shown on the detailed drawings. The cradles may be precast and sufficiently cured to prevent cracks and breakage in handling. The invert of the cradles shall be left 12 mm below the invert level of the pipe properly placed on the soil to prevent any disturbance. The pipe shall then be placed on the bed concrete or cradles and set for the line and gradient by means of sight rails and bonding rods etc. Cradles or concrete bed may be omitted, if directed by the Owner/PMC.

 **Jointing**

 After setting out the pipes the socket shall be centred over the spigot and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 cement: 2 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 450 to the longitudinal axis of the pipe on both sides of the collars neatly.

 **Testing**

 All pipes shall be tested to a hydraulic test of 1.5 m head for at least 30 minutes at the highest point in the section under test. Test shall also be carried out similar to those for stoneware pipes given above the smoke test shall be carried out by the Contractor, if directed by the A test register shall be maintained which shall be signed and dated by Contractor,/ Owner/PMC.

# C.6 Rain Water Harvesting Pit

* 1. Boring/Drilling bore well of required dia for casing strainer pipe by suitable method prescribed in IS 2800 (Part I), including collecting samples from different strata, preparing and submitting strata chart/bore log, all complete as per direction of Engineer-In-Charge.
	2. Vertical position in bore well, unplasticized PVC medium well casing (CM) pipe of required dia, conforming to IS 12818 etc. all complete for all depths as per direction of engineer-in-charge.
	3. Earth work in excavation by mechanical means (Hydraulic Excavator/ Manual means over areas (exceeding 30 cm in depth. 1.5 m in width as well as 10 sqm on path) Including disposal of excavated earth, lead upto 50m and lift upto 1.5 m neatly dressed.
	4. Spreading & levelling stone aggregate 20mm nominal size in recharge pit, in reduced thickness, for all lead & lifts, all complete.
	5. Jamuna sand under floors, including watering ramming consolidating and dressing complete.
	6. Geotextile having thickness of 400 GSM, Having minimum tear Strength of 250 ASTM D4533, width wise atleast215 ASTM D4533 having puncture strength of 1550 pulse as per ASTM D6241 having elongation at break % of 57 plus as per ASTM D 4595 in Two layers, made out of long fibers to hold the modules and protect liner including cutting, sizing, head welding, and needle punched for high porosity and proper percolation. Complete as per entire satisfaction of Engineer-In-Charge.
	7. CGWB approved pure rain filters desilting suspended solid catcher made out of FRP and strainers including bucket of SS 304 grade with long fiber foam size around 600mm dia, green colour, filtration capacity 40 kiloleters per hour with porosity of 600 micron including providing and fixing of first flush diverter at the inlet junction of the filter complete in accordance to the design, drawing and specification complete as per entire satisfaction of Engineer-in-Charge.
	8. FRP (Fiber Reinforced Polymer) based mirofilter drum/extension of 780 mm dia wall thickness 25 to 30 mm thick on or in CGWB approved pure rain filters of dia according to the design, drawing and specification complete as per entire satisfaction of Engineer-In-Charge.
	9. Co-polymer based rainwater harvesting structure including supply of cross wave of size 494 mm x 494 mm x 220mm with minimum void ratio of 94.7% having a weight of 1.8 and spacers having size of 988 mm x 240 mm x 25 mm having a weight of 0.8 kg and arranging the same in as directed by the Engineer-in-Charge and in complete accordance to the design, drawings.
	10. Gravel packing in tube well construction in accordance with IS 4097, including providing gravel fine/medium coarse, in required grading & sizes as per actual requirement , all complete as per direction of Engineer-in-Charge.
	11. Filling available excavated earth (Excluding rock) in trenches, plinth, sides of foundation etc. in layers not exceeding 20 cm in depth, consolidating each deposited layer by ramming and water.
	12. Pre-cast RCC manhole covers and frame of required shape and approved quality H D - 20 Circular shape 560 mm internal diameter
	13. Bail plug/Bottom plug of required dia to the bottom of pipe assembly of tube well as per IS:2800 (Part-I).
	14. Providing orange colour safety foot rest of minimum 6mm thick plastic encapsulated as per IS:10910, on 12mm dia steel bar conforming to IS: 1786, having minimum cross section as 23mm X 25mm and over all minimum length 263mm and width as 165mm with minimum 112 mm space between protruded legs having 2mm tread on top surface by ribbing or chequering besides necessary and adequate anchoring projection on tail length on 138mm as per standard drawing and suitable to with stand the bend test and chemical resistance identification mark to be visible even after fixing, including fixing manhole with 30X20X15cm cement concrete block 1:3:6(1 cement: 3 Coarse sand: 6 graded stone aggregate 20mm nominal size) complete as per design
	15. Threaded mild steel cap or spot welded plate to the top of bore well housing/ casing pipe ,removable as per requirement.
	16. Constructing brick masonry manhole (silt chamber type) inside size 1.20X0.90c 1.20m deep with FPS brick class designation 75 in cement mortar 1:4 (1 Cement: 4 coarse sand ) 15mm thick RCC top slab with 500mm dia opening in cement concrete 1:2:4 (1 cement: 2 C/sand: 4 graded stone aggregate, n/size reinforced with 18.92 kg cold twisted steel bars 20cm foundation concrete 1:4:8 (1 cement: 4 C/sand: 8 graded stone aggregate 40mm size) inside plastering 12 mm thick with cement mortar 1:3 (1 cement: 3 C/sand) finished with a floating coat of neat cement and providing 75 mm thick bed concrete in 1:2:4 mix (1 cement: 2 C/sand: 4 graded stone aggregate. 20mm n/size) including neat cement punning inside the manhole etc. all complete as per direction of Engineer-in-Charge.
	17. Cement concrete of specified grade excluding centering and shuttering - All work upto plinth level1:2:4 (1 Cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size)
	18. Polyethylene pipe of working pressure 6kg per square cm confirming to IS:4985 including jointing with sealing ring confirming IS:5382 leaving 10mm gap for thermal expansion.
	19. Excavating trenches of required width for pipes, cables, etc. including excavation for sockets, and dressing of sides, ramming of bottoms, depth upto 1.5m, including getting out the excavated soil, and then returning the soil as required in layers not exceeding 20cm in depth, including consolidating each deposited layer by ramming, watering, etc. and disposing of surplus excavated soil as directed, within a lead of 50m : Pipes, cables etc.
	20. Constructing brick masonry manhole in cement mortar 1:4 (1 Cement : 4 Coarse sand) with RCC top slab with cement concrete 1:2:4 mix (1 cement : 2 C/Sand : 4 Graded Stone aggregate 20mm nominal size),foundation concreate 1:4:8 (1 cement : 4 C/sand : 8 graded stone aggregate 40 mm size) inside plastering 12 mm thick with cement mortar 1:3 (1 cement : 3 C/sand) finished with a floating coat of neat cement and making channels in cement concrete 1:2:4 mix (1 Cement : 2 C/sand : 4 graded stone aggregate. 20mm n/size finished with a floating coat of neat cement complete as per standard design. All complete as per direction of Engineer-In-Charge. Inside size 120x90 cm and 90 cm deep including C.I cover with frame (medium duty) 500mm internal diameter, total weight of cover and frame to be not less than 116 kg (weight of cover and 58 kg and weight of frame 58 kg). with common burnt clay F.P.S (non- modular) bricks of class designation 7.5
	21. Non-pressure NP2 class (light duty) R.C.C. pipes with collars jointed with stiff mixture of cement mortar in the proportion of 1:2 (1 cement:2 fine sand) including testing of joints etc. complete.
	22. Making connection of drain or sewer line existing manhole including breaking into and making good the walls, floors with cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 graded stone aggregate 20mm nominal size) cement plastered on both sides with cement mortar 1:3 (1 cement: 3 coarse sand), finished with a floating coat of neat cement and making necessary channels for the drain etc. complete.

# C.7 Garden Irrigation System

 **1 The System**

 The garden hydrant system should be executed for a total working system.

 System components shall be pipes, valves, controllers, various types of sprinklers and drip irrigation lines with emitters as approved by the Owner/PMC.

**2 uPVC Pipes & Fittings**

 Garden hydrant mains shall be rigid uPVC pipes. If class is not mentioned in the schedule of quantities the same shall be class IV (10 kg/cm2).

 Fittings for uPVC pipes shall be injection moulded fitting with spigot & sockets suitable for solvent weld joints. Fittings must have suitable provision for expansion.

 Solvent shall be of make and type approved by pipe and fittings manufacturer. Joint shall be made in an approved manner as recommended by the manufacturer.

 uPVC flanges at intervals of 20-25 m for all pipes 65 mm dia and above shall be provided for easy maintenance.

 Suitable uPVC thread adapter for connection between pipes & valves shall be provided.

 Cement concrete supports and anchor blocks shall be provided at all bends, tees and other locations as directed by the Owner/PMC. Connections at garden hydrant outlet, near valves must also be anchored.

 **G.I. Pipes & Fittings**

 Vertical connection for garden hydrant points shall be galvanised steel tubes (medium class) with matching malleable iron fittings of approved make.

 **Garden Hydrants**

 Garden hydrants shall be 25 mm dia gunmetal valves installed on G.I. pipes as per details.

 **Valves**

Valves shall be as specified in section for Water Supply.

**Sprinkler**

**Supply of Drip & Accessories**

Heavy duty Gear Driven Rotor Sprinkler is provided with discharge Range of 0.10 Lps - 0.25 lps, Radius 6.5 m - 12.5 m, Adjustable Arc 23˚ - 360˚ with check valve having inlet of 3/4" with all fittings as required and Pop up spray Sprinklers Radius 5.7 m, Discharge 0.17 lps at 2.5 Kg/cm2 pressures.

The tubing shall be made of ASTM Standard PVC Materials and capable to work up to pressure of 5.5 kg/cm2 at 43°C and a surge pressure of 12.5 kg/cm2. The fittings shall be made of UV resistant thermo plastic.

**Control and Safety Valve**

Control and safety valve shall be provided like double action air release valve 1”, control valve 63mm Teflon seal plain, Control valve 40mm Teflon Seal plain, Butter fly valve, valve box, plastic quick coupling valve male or female and sub main flush valve.etc.

**Filter and Accessories**

Sand media filter shall be provided with the 100m3/hr with the tentative capacity and Disc Clean Filter 50 m3/hr T shape 3” made of special plastic Alloy which give very hight stiffness, toughness, heat and inpact resisance with 2” inlet and outlet. The Metallic polit pressure Relief Valve size 2” along with all necessary fittings body shall of Metallic construction with maximum upstream pressure 12.0 kg/cm2 and maximum relief setting 0.7 kg/cm2 and minmum relief setting shall be 0.5 kg/cm2 .

**Pump, Starter and Accessories**

Mono block pump with head 70m (tentative) discharge 11.5lps with base freme, Suction& delivery pipes, pumps base foundation as necessary required and Automatic starter panel suitable to above pump comprising of Two Star Delta Starters, MCCB, phase indication lights, single phase preventer , connection cables .

**Automation Accessories**

Programmable Controller including Extension Cards, Communication adaptor, HMI application for software and controller etc. shall be provided for automation accessories and other item shall be provided like solenoid valve plastic 2”, Pressure Relief valve plastic 2”,. Online UPS 1KVA WITH BATTERY BACKUP, SERVO0 STABALIZER 150.230 VAC., Electrical control panel for automation and wire.

**3 Trenches**

 All pipes below ground shall be laid in trenches with a minimum cover of 100 cms. The width and depth of the trenches shall be as follows: -

 Dia of pipe width of trench depth of trench

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 15 mm to 50 mm 30 cms 100 cms

 65 mm to 100 mm 45 cms 100 cms

 This will not apply to drip irrigation pipes which may be laid just below the surface or on surface.

**4 Testing**

 All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 7 kg/cm2 or 1.5 times the working pressure, whichever is higher. Pressure shall be maintained for a period of at least thirty minutes without any drop. A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and the Owner/PMC.

 In addition to the sectional testing carried out during the construction, Contractor shall test the entire installation after connections to the pumping system. He shall rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the contractor during the defects liability period without any cost.

 After commissioning of the water supply system, Contractor shall conduct performance test to ensure that the system operates as specified. The test shall be conducted over a period of 15 days.

# C.8 SEWERAGE TREATMENT PLANT (MBBR)

**C.8.1 GENERAL:**

 The scope of this section covers the design, manufacture, supply, erection, testing and commissioning of Sewerage Treatment Plant complete with necessary equipment, interconnecting piping network etc.

 a) Designing:

i) Complete process design

ii) Complete process schematic diagram

iii) General arrangement drawing with dimensions for designing the structure for structural consultant

iv) Complete schedule of equipment mechanical and electrical i.e. pumps, motors, pipes, valves and other appurtenances, switchgear cable etc.

v) Detail layout plan of the Sewerage Treatment Plant including Tertiary Treatment and Treated waste holding tanks (Layout should match the plan space provided).

vi) A schedule of quantities has been drafted for general guidelines to the vendor. The vendor will submit the offer as per BOQ given. No change in Technical specifications pertaining to materials of construction, duty head requirement, treatment, piping materials will be acceptable.

vii) Contractor shall perform the testing and commissioning of the complete plant after installation of the plant. The output parameter test reports shall be given from recognized test lab like IIT Delhi or Shriram Test house.

viii) Contractor shall operate the plant for three months from the date of commissioning of the Complex including the cost of consumables.

ix) Contractor shall give the training to personnel of the employer for operation and maintenance of the plant.

**C.8.2** **PROCESS SCHEME & EQUIPMENTS DATA SHEET**

The envisaged STP scheme is indicated in Flow Diagram Drawing. Kindly refer the same for basic scheme envisaged.

 **PROCESS FLOW DIAGRAM.**

Equalization Tank

Oil & Grease Trap

Screen Chamber

**Raw Sewage**

Raw Sewage Pumps

Air Blowers

MBBR Tank 1

MBBR Tank 2

Chlorine Doser

Tube Settler

Chlorine Contact Tank

Filter Press Feed Screw Pump

Multi Grade Filter

Filter Press

Activated Carbon Filter

Sump

Flushing Water Tank

Flushing Water Transfer pumps

Sump Pumps

**Sludge Cake for Disposal**

**For Flushing**

**C.8.3 EQUIPMENTS DATA SHEET.**

1. **SS Bar Screens**

|  |  |  |
| --- | --- | --- |
| MOC  | : | SS 304 |
| Qty | : | 02 Nos. |
| Size | : | 500 X 750 mm |

1. **Raw Sewage Pumps / Equalization Transfer Pumps**

|  |  |  |
| --- | --- | --- |
| No. Of units  | : | 02 Nos (1working / 1 Standby) |
| Motor  | : | 0.75 KW |
| Capacity | : | 8.0 cum / hr. at the head of 10-12 mtrs. |
| Solids  | : | Up to 55 mm |
| Casing  | : | CI |
| Impeller  | : | CI |

1. **Sludge Re-circulation Pumps**

|  |  |  |
| --- | --- | --- |
| No. Of units  | : | 02 Nos (1working / 1 Standby) |
| Motor  | : | .75 KW |
| Capacity | : | 10 cum/hr at a head of 10-12 mtrs. |
| Casing  | : | CI |
| Impeller  | : | CI |

1. **Air Blowers**

|  |  |  |
| --- | --- | --- |
| Type  | : | Twin Lobe |
| No. of units | : | 02 Nos (1working / 1 Standby) |
| Head | : | 0.5 kg/cm2 |
| Capacity | : | 150 m3/hr  |
| Rating  | : | 5 KW |

1. **Filter Feed Pumps**

|  |  |  |
| --- | --- | --- |
| No. Of units  | : | 02 Nos (1working / 1 Standby) |
| Type  | : | Horizontal, Centrifugal |
| Capacity | : | 11 cum/hr at a head of 30-35 mtrs. |
| Casing  | : | CI |
| Impeller  | : | CI |
| Rating  | : | 1. KW
 |

1. **Dual Media Filter**

|  |  |  |
| --- | --- | --- |
| Qty  | :  | 01 No.  |
| Service Flow rate | : | 11 cum/hr  |
| Size  | : | 36” dia x 62” height |
| MOC  | : | FRP |
| Media  | : | Pebble / Gravel / Coarse Sand / Fine Sand / Anthracite |
| Working Pressure  | : | Max. 2.0 – 2.25 kg/cm2 |
| Backwash time | : | 20 min. |
| Rinse time | : | 1. in.
 |

1. **Activated Carbon Filter:**

|  |  |  |
| --- | --- | --- |
| Qty  | : | 01 No.  |
| Service Flow rate | : | 11 cum/hr |
| Size  | : | 36” dia x 62” height |
| MOC  | : | FRP |
| Media | : | Pebble / Gravel / Activated Carbon. |
| Working Pressure  | : | Max. 2.0 – 2.25 kg/cm2 |
| Backwash time | : | 20 min. |
| Rinse time | : | 10 Min.  |

1. **UV Sterilizer**

|  |  |  |
| --- | --- | --- |
| No. Of units  | : | 1 operating  |
| Capacity | : | 15 cum/hr |

**9. Bio Tech Media**

|  |  |  |
| --- | --- | --- |
| Qty | : | 2.5 cu.mtr |
| Type  | : | MBBR  |

**10. Tube Dek Media**

|  |  |  |
| --- | --- | --- |
| Qty | : | 13.0 cu.mtr |
| Type  | : | Tube Dek Media  |
| Length of Module | : | 3000 mm |
| Width of Mudule  | : | 2500 mm |
| Height of Module  | : | 750 mm |

**11. Filter Press feed pump**

|  |  |  |
| --- | --- | --- |
| No. Of units  | : | 02 No.  |
| Type  | : | Screw Type |
| Capacity | : | 1000 lph at a head of 30-40 mtrs. |
| Rating  | : | 1.0 KW  |

**12. Filter Press**

|  |  |  |
| --- | --- | --- |
| Plate Size  | : | 450 mm X 450 mm |
| No. of Plates  | : | 22 Nos. |
| Holding Capacity | : | 100 Ltr.  |

**C.8.4 STRUCTURAL CIVIL WORKS**

**1.0 Bar Screen Chamber:**

a) Material of construction - RCC

b) Material of construction of Bar Screen - Perforated SS 304

c) Thickness of Bar Screen Sheet - Min. 2mm

d) Water Proofing requirements (internal/ext.) - As per approval

**2.0 Oil & Grease Chamber:**

a) Material of construction - RCC

b) Thickness of Oil & Grease Chamber Sheet - Min. 2mm

c) Water Proofing requirements (internal/ext.) - As per approval

**3.0 Equalization Tanks:**

a) Material of construction - RCC

b) Size - As per approval

c) Height - As per site condition.

d) Clean out provision - As per approval

e) Water proofing requirements - As per approval

**4.0 FAB / MBBR Reactors:**

a) Material of construction - RCC

b) Size - As per approval

c) Height - As per approval

d) Clean out provision - To be specified by vendor

e) Water Proofing requirements (internal/ext.) - To be specified by vendor

**5.0 Tube Setting Tank:**

a) Material of construction - RCC

b) Size - As per approval

c) Height - As per site condition.

d) Clean out provision - As per approval

e) Sludge transfer to sludge holding tank - Through air ejector system using solenoid

 Valve

f) Water Proofing requirements (internal/ext.) - As per approval

**6.0 Chlorine Contact Tank:**

a) Material of construction - RCC

b) Size - As per approval

c) Height - As per site condition.

d) Clean out provision - As per approval

e) Water Proofing requirements (internal/ext.) - As per approval

**7.0 Sludge Holding Tank:**

a) Material of construction - RCC

b) Size - As per approval

c) Height - As per site condition.

d) Clean out provision - As per approval

e) Water Proofing requirements (internal/ext.) - As per approval

**8.0 Irrigation Water Tank:**

a) Material of construction - RCC

b) Volumetric capacity required - 1,00,000 litres

c) Height - As per site condition.

d) Clean out provision - As per approval

e) Water Proofing requirements (internal/ext.) - As per approval

**9.0 Equipment Foundation:**

a) Material of construction - RCC M 20

b) Sizes & thickness - As per approval.

**10.0 Plant Room:**

a) Material of construction - As per approval.

b) Drain channels & sump - As per approval

# C.9 PUMPS & ACCESSORIES

**1.0 WATER SUPPLY, DRAINAGE & SEWAGE PUMPS:**

- Variable Drive Hydro Pneumatic System

- Water Supply and Drainage Pumps/Sewage Pumps

1.1 All incidental jobs connected with Treatment Plant services installation such as cutting chases in concrete and brick and making good, cutting/ drilling holes through walls, floors and grouting for fixing of fixtures, equipment foundation, Structural supports & other supports as required at site shall be part of STP works.

1.2 Contractor shall submit the samples/catalogues of each material/equipment giving technical data. Only after written approval of samples/catalogues, the Contractor shall place the order.

1.3 Preparation of shop drawings - Contractor shall submit the detailed shop drawings after coordinating with structural, architectural and other services drawings. All structural openings & pipe sleeves shall be identified. Shop drawings shall be fur­nished within four weeks after the award of the contract.

1.4 Contractor shall furnish and install a complete working Sewage Treatment Plant installation as per ap­proved shop drawings and as described in this specifications and as per the latest BIS codes.

Before starting the work at site the contractor shall examine all services drawings and report to Architect/ Consultant for discrepancies and obtain clarifications. Any work done without regard or consultation with other trades, shall be removed by the contractor without additional cost to the owner.

1.5 Cleaning of all equipment and piping in­cluding flushing of all pipe work to remove any foreign matter shall be carried out in sections as the work progresses.

1.6 Contractor shall temporarily cover & protect all equipments & open pipe ends etc. It is the responsibility of the Contractor to protect all the installed fittings and all equipments until the time of testing, commissioning & handing over to the owners.

1.7 Painting of all concealed and exposed pipes, equip­ment as specified including weather proof treatment on exposed/ buried pipe work shall be part of this contract

1.8 Testing & commissioning of all systems including submission of test reports.

1.9 Contractor shall submit as installed drawings, operation and maintenance manual for all equipment’s/operations etc. Framed operating & main­tenance instructions shall be provided in plant room.

1.11 Contractor shall submit the list of various manufac­turers/ suppliers/dealers including their detailed addresses & telephone numbers from whom the various materials/ equipment shall be purchased.

**2.0 GENERAL REQUIREMENTS:**

2.1 All materials shall be new of the best quality conforming to specifications and subject to the approval of Owner/PMC.

* 1. All equipment shall be of the best available make manufactured by reputed firms.
	2. All equipment shall be installed on suitable foundations, true to level and in a neat workmanlike manner.
	3. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
	4. Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
	5. Each pumping set shall be provided with a Ball Valve / butterfly valve on the suction and delivery side and a dual plate type return valve on the delivery side.
	6. All delivery headers/hanging pipes within the pump house shall be floor supported.

**SPECIFICATION FOR PUMPS :**

**3.0 VARIABLE SPEED HYDOPENUMATIC BOOSTER SYSTEM:**

3.1 General:

1. This section of the specification covers the supply, installation, testing, commissioning of the Variable Speed Hydropneumatic Booster system.
* Booster should consist of the components as per the below specifications as Minimum.
* Complete system shall be tested at the manufacturer’s local factory, in accordance to the provisions of the appropriate standard before delivery.
* Manufacturer should have facility of witness test with proper test bed.

**3.2 System Descriptions:**

* The variable speed booster system shall be supplied and installed as designed.
* **The system shall comprise of number of pumps in parallel and it shall be a package system manufactured by the manufacturer of the pumps at their factory.**
* **System assembled by the dealers locally will not be accepted.** The system shall consist of:
* Vertical In Line Multistage Centrifugal pumps..
1. Variable Frequency Drives (VFD).
* Pre-pressurized bladder or diaphragm type pressure vessel complete with pre-charged nitrogen gas to the design pressure settings.
* Control panel complete with MCCB, MCB, fuses, microprocessor based dedicated Pump Logic with built in graphical display of VGA 240 x 320 pixels.
1. Pipe work and valves, pressure transmitter, pressure gauge, check valve, ball valve/gate valve and all necessary fittings etc to the satisfactory operation of the system and to make system as complete. Only supply & delivery line will be connected to start the system

All these components should be as per the specifications written in 3.3.

**3.3 Components of Variable Speed Booster:**

3.3.1 Pumps and Motors:

3.3.1.1Type of Pump :

1. The pump shall be of approved make of vertical-in-line multistage centrifugal type suitable for speed up to 2900 rpm.
2. The suction and discharge port shall be in line with each other. The maximum operating liquid temperature for the pump shall be up to 120 deg C.
3. The motors shall be vertically stool mounted on top of the pump casing and the pump casing shall be designed to take the dynamic load of the motor. The motor shall be provided with thrust bearing to cater for the downward thrust of the pump.The manufacturer of the pump should have a local factory with at least 5 years of experience and able to provide after sales service. The factory must have a pump testing facilities with approved test bed to carry out pump as well as complete booster performance witness testing.

3.3.1.2 Pump Selection:

* Each pump shall have the stable characteristics and the operating point shall fall within the acceptable range on the pump curve. Duty point should not be selected at extreme right or left side of the curve.
* The pump performance curve shall be complying with the tolerance according to ISO 9906, Annex A.

3.3.1.3 Pump Head and Base :

* Pump head and base should be made of CED (Cataphorasis Electro deposit) coated Cast Iron.
* The motor terminal housing shall be of a completely watertight design with tight cable glands to prevent ingress of water. For bigger motor, the housing shall have provision for the lubrication of the motor bearing to enable the pump to run effectively with only periodic withdrawal for maintenance and lubrications, if required.
* For motor sizes more than 7.5 kw, extended coupling should be provided to enable the changing of the mechanical shaft seal without the need to lift up or dismantling of the motor. For pumps up to 7.5 Kw mechanical seal should be changeable without dismantling/opening pump.

3.3.1.4 Shaft, Impeller and Guide Vanes :

* All the inter stage components (impeller, intermediate chambers, diffusers) as well as sleeves and guide vanes shall be made of stainless steel 304 material.
* The impeller shall be fitted to a rounded shaft with split cone and split cone nut to prevent the stages of the pump been collapsed. For smaller pumps splined shaft is acceptable.

3.3.1.5 Mechanical Seal :

* The mechanical shaft seal shall be of cartridges type with seal faces of silicon carbide material.
* It should be possible to change mechanical seal without opening the pump to reduce downtime.

3.3.1.6 Motor :

1. The electric motor shall be of total enclosed fan cooled (TEFC) squirrel cage induction type suitable for operation on a 415V / 3 ph/ 50 Hz voltage supply. The motor shall be designed based on 40 deg C ambient temperature and up to a maximum of 2900 rpm. The motor shall be of class F insulation and a minimum of IP 55 enclosure with a maximum surface temperature of 120 deg C.
2. The motor shall comply with the requirement of BS 4999 or other compatible IEC standard.
3. All motors shall be sized for pump operation based on non-overloading conditions for the full QH curve. The motor shall also be suitable for at least 40 start/stop per hour.
4. Direct on line starting method is required for motor up to 5.5 kw and star delta starting is required from 7.5 kw onwards.

**All motor should be of minimum Class – II efficiency.**

**4. Variable Frequency Drives (VFD) :**

* VFD shall be Pulse Width Modulation (PWM) type, microprocessor controlled design labelled as CE. Drive shall have customer modifiable adjustments of 2 to 600 seconds accel & decel time, Minimum & Maximum frequency, V/I ratio and Carrier frequency. Speed reference signal shall be customer selectable for 4-20 mA, 0-5 VDC and 0-10 VDC. The VFD shall be suitable for elevations up to 1005 meters above sea level without de-rating. Maximum operating ambient temperature shall be to 45 Deg C. shall be suitable for environment condition up to 95% non-condensing.
* Built-in DC link filters to avoid power factor correcting devices like Capacitors, line reactors etc.,
* Energy saving mode with boost function (Sleep/ Wake Mode), Quick set up menu.

VFD should be mounted inside the panel cabinet.

**5 Dedicated Pump Logic Controller (PLC) :**

PLC should of the same make, as of pump i.e. Pump manufacturer should provide dedicated pump logic controller for this application. **General purpose PLC programmed for boosting application will not be accepted.**

The microprocessor controller based Pump Logic controller (PLC) shall be of standard software configure type

**a) The PLC should have the following features as minimum:**

1. Built-in PI-controller.
2. External input signal both digital and analog.
3. Alarm output.
4. Operation output.
5. Graphical Display VGA 240 x 320 pixels.
6. Ethernet connection port (RJ 45).
7. External BUS communication port.
8. Service port.
9. Built-in HELP TEXT.
10. Built-in start up wizard.
11. Upgradeable soft ware program.
12. Back light for specific button to be light up only when applicable.
13. Backlight to be dimmed when not used for more the 15 min.
14. Adjustable contrast for display.
15. Selectable service language.
16. Selectable units between SI and US.
17. Manual entry of pumps data.
18. Primary and Standby sensors.
19. Data logging.

**The PLC should be able to perform the following functions as minimum:**

1. Selectable auto/manual mode for both system and individual pump from Controller
2. Selectable pump speed (user define speed in %)
3. Max speed
4. Min speed
5. Set point influence
6. Additional set point up to 6 set point
7. Adjustable number of start/stop
8. Adjustable system time and error correction value
9. Adjustable ON/OFF band (stop function)
10. Selectable number of standby pump(s)
11. Pump test function
12. Security setting with pass word for operation and setting
13. External fault input
14. Selectable dry running protection for either digital or analog signal
15. Selectable auto/manual reset for dry running protection
16. Selectable open/close loop operation

**The PLC should be able to display the following alarms, whenever it occurs:**

* Alarm log up to 24 event
* Time and date of log alarm
* Current alarm with alarm code and description
* Water shortage
* Max pressure
* Min pressure
* Alarm all pump
* External Fault
* Dissimilar sensor
* Primary sensor
* Fault sensor
* Communication fault
* Over temperature, pump
* Other fault, pump
* VFD not ready
* Fault, Ethernet

**d) The PLC should be able to display the following values :**

* System status
* Individual pump status
* Pump hour run
* Individual pump speed
* Set pressure
* Actual pressure
* Date and Time
* Menu code and sub code for individual display

**6 Control Panel :**

 The panel shall be equipped with all the necessary electrical components, VFD and the PLC, as mentioned above. The control panel and the PLC shall cover the following functions as minimum:

a) Flexibility and simplicity in allowing the necessary re-adjustment of the booster system delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges including built in set up wizard and help text.

b) Built-in frictional loss compensation or influence factor, which will automatically increase the delivery pressure setting according to the increase in flow demand. This shall be able to minimize the system pressure differences and provide a more constant pressure in the supply line. This is also to save the energy consumption of the motor when running and low speed.

c) Automatic changeover of the pumps to be controlled by the PLC to ensure equal running of all the pumps.

d) When the system is not operating for more than 24 hours, it shall automatically start the pumps for a few seconds per day. This will ensure the readiness of all the pumps at all times. The standby pumps shall be activated upon failure of duty pump. In the event of PLC failure, the pumps shall be able to start/stop manually.

e) The PLC shall be able to cut off the booster system when excess pressure in the discharge common manifold is registered (maximum limit provision). In a reverse situation, the PLC panel shall be able to cut off the booster system when low pressure in the common suction manifold is registered (minimum limit).

f) Capability of receiving either analogue or digital input signal concerning shortage of water supply, preventing the pumps from dry running.

1. It should automatically start the pumps when the level is back to normal.
2. In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the VGA Display unit and alarm lights are activated.
3. The control panel door shall be displayed with at least the following components:
4. Graphical display VGA 240 x 320 pixels with back light
5. Pumps selections up to 6 pumps
6. Pump status button (including individual pump speed, system Pressure and estimated flow rate)
7. System status, alarm, operation & setting button
8. Additional Buttons for changing values, accepting changes, help For scrolling data etc
9. Connection for necessary devices for programming, supervising and monitoring operation data/system, status shall be incorporated into the panel/PLC.

k) Pump Selector Mode

Selection should be provided to enable any pump to be the lead pump, first duty pump, second duty pump and standby pump as desired. There shall be alternating mode selection too, where all pumps are operated cyclically upon each call for pumping.

l) Liquid Level Control

To prevent dry running, electrode liquid level or float level control shall be provided in the suction tank to shut down the system in the event of low water level.

m) Pump Isolation

It shall be possible to isolate any pump for maintenance without affecting the performance of the system in the automatic mode.

o) Alarm

Alarm should be displayed in case of any problem. Alarms should be as per details given in PLC section.

All panels/controllers shall be tested at the factory according to the procedures stipulated, before dispatch. The manufacturer shall carry all spare-parts for the controllers. All spares of the controllers shall be readily available for a minimum period of 10 years after the production of the particular model of controller has been discontinued.

**7 Hydro Pneumatic Pressure Tank :**

The hydro-pneumatic tank shall be of bladder or diaphragm type with pre-pressurized air/nitrogen. It shall be capable of handling the designed effective system protection (ESP) Volume to protect pump and operating controls by ensuring that the actual pump operation conform to the manufacturer's specified minimum running time and maintaining the designed pressure range.

The shell shall be constructed with deep-drawn carbon steel.

The diaphragm/membrane shall be of heavy-duty type. This diaphragm/membrane should be the only component in contact with the liquid.

The tank shall have a maximum operating pressure of 10 bars and shall be able to handle a maximum liquid temperature of 90oC.

**8 Pressure Transmitter :**

Pressure transmitters shall be field mounted and shall transmit an isolated 4-20mA DC signal indicative of process variable to the pump logic controller via standard two wire 24 DC system. Unit shall have stainless steel wetted parts and it should be installed at the discharge header. It should have watertight, electrical enclosure capable of withstanding minimum 10 bar static pressure.

**9 Headers & Accessories:**

 The suction and discharge manifolds shall be stainless steel SAFFricated of Hot Dipped Galvanized MS. Both manifolds shall be designed to attach to the system piping at either end of the manifold. Delivery manifold shall include a pressure gauge. The discharge manifold shall include a socket to install a pressure transducer with a 4-20mA output. The pressure transducer shall be factory installed and wired. Isolation valves shall be installed on the suction and discharge of each pump. A check valve shall be installed on the discharge of each pump (optional on the suction side for suction lift applications). Base frame should also be made of galvanized sheet.

**10 Booster System Working:**

The system shall be under the control of a microprocessor based pump logic controller (PLC). 2 nos. of pressure transmitter (primary and standby) shall be incorporated into the system to detect the pressure at the discharge manifold and feedback to the PLC.

The system shall maintain a constant pressure at all times regardless of the system demand. The activation of the next duty pump in a high demand situation shall not base on a different set point. However the PLC should have a flow test function to determine the numbers of pumps in operation and a stop function into the controller to stop all pumps from operation, whenever there is no demand, which prevent and reduce wear and tear of the system as well as reduce energy consumption. The controller shall also ensure alternation of all pumps for even running hours.

The lead pump shall operate when the system pressure reduces to the preset point. If demand escalates, the lag pumps shall commence operation as required. During next operation lead pump to become lag and lag pump to become lead pump automatically. The system shall vary the frequency of each pump (in case of multi VFD system) and it will be equalized to ensure smooth operation to meet the specific demand. Under decreasing hydraulic demand, the reverse to the above description shall apply.

**OPERATIONS**

The control circuit shall enable automatic and manual operations of the system.

a) Automatic Operation

Everything will be controlled by PLC in this case.

* 1. Manual Operation

Either one or all pumps shall be capable of being started and stopped by their respective push buttons or MCB’s.

The control panel should have starters for this purpose

1.0 PUMPING SETS FOR FILTER FEED PUMPS, SOFTENER FEED PUMPS, TREATED WATER TRANSFER PUMPS:

1.1 Water supply pumps shall be suitable for Raw / clean filtered water. Pumps shall be single/multi stage, monobloc vertical/horizontal, centrifugal pumps with C.I body and bronze impeller, stainless steel shaft, mechanical seal and coupled to a TEFC electric motor. Each pump should be operating to a curve required by the operating conditions.

* 1. All parts in contact with water shall be corrosion resistant stainless steel DIN-Nr.1.4401.
	2. Each pump shall be provided with a totally enclosed fan cooled induction motor of suitable H.P. The motors shall be suitable for 415 volts, 3 phase, 50 cycles A.C. power supply and shall conform to IS 325 operating at 2900 RPM nominal speed.
	3. Each pumping set shall be provided with 100-mm dia 150 mm dia gunmetal “Borden” type pressure gauge with gunmetal ball valve and connected piping.
	4. Pump or the whole set shall be stable on rubber vibration eliminating pads appropriate for each pump as recommended by the manufacturer and accepted by the Owner/PMCs.

**2.0 SUBMERSIBLE PUMPS:**

2.1 Submersible pumps for sewage/drainage shall be single stage, single entry pump. Pump shall be with dynamically balanced impeller connected to a common shaft to the motor. The vane for sewage pump will be open type, while for drainage pump, etc. It will be of semi open type.

* 1. Stuffing box shall be provided with mechanical seals.
	2. Each pump shall be provided with water cooled squirrel cage induction motor suitable for 415 volts, 3 phase, 50 cycles A.C. power supply.
	3. Each pump shall be provided with liquid level controller for operating the pump between predetermined levels.
	4. The pumping set shall be for stationary application and shall be provided with pump connector in it. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation, without disturbing delivery pipe the pump unit shall have a back pull out design. A rust proof chain shall be provided for each pump.
	5. Pump shall be provided with all accessories and devices necessary and required for the pump to make a complete working system.

**3.0 LEVEL CONTROLLERS:**

3.1 Level controllers shall be electronic low voltage type using required number of stainless steel type probes, shrouded in PVC sheath or encapsulated in a stainless steel pipe.

**4.0 PIPE & FITTINGS (FOR HEADERS AND CONNECTIONS) :**

4.1 Pump suction and delivery headers shall be galvanized iron pipes heavy class with matching fittings. The pipe joints shall be threaded as per manufacturer’s instructions.

4.2 Vibration Eliminators : Provide on all suction and delivery lines as shown on the drawings double flanged reinforced neoprene flexible pipe connectors. Connectors should be suitable for a working pressure of each pump and tested to the test pressure given in the relevant head. Length of the connectors shall be as per site requirements in accordance with manufacturer details.

**5.0 VALVES :**

**5.1 Butterfly Valves :**

All valves 65 mm dia and above shall be C.I. slim seal butterfly valves or sluice valve. Butterfly valves shall be of best quality conforming to I.S. 13095 of class specified.

**5.2. Non-Return Valves (Check Valves) :**

 Non-return valves shall be cast iron dual plate type with cast iron body and gunmetal internal parts conforming to IS : 5312.

**6.0 PAINTING AND CLEANUP :**

6.1 On completion of the installation contractor shall scrub clean all pumps, piping, filters and equipment and apply one coat of primer as required.

6.2 Apply two or more coats of synthetic enamel paint of approved make and shade on steel pipes.

6.3 Provide painted identification legend and direction arrows on all equipment and piping as directed by Owner/PMC.

6.4 On final completion of the work, contractor shall cleanup the site Pump room of all surplus materials rubbish and leave the place in a broom-cleaned condition.

**8.0 TECHNICAL DATA**

Contractor shall fill in the following Technical data for each pump:

**1.0 SUBMERSIBLE SUMP PUMPS:**

 Make :

 Model :

 No. of Stages :

 Head/Stage :

 Power Requirement :

 Efficiency :

 Discharge in L.P.S. :

 Total Head :

 Suction end I.D. :

 Delivery end I.D. :

 Solid Handling Capacity :

**MATERIAL:**

 a) Body :

 b) Impeller :

 c) Shaft :

 Type of impeller :

 Is it suitable for direct coupling? :

 MOTOR:

 Make :

 Model :

 R.P.M. :

 Rating :

 Over Load Capacity :

 Class of Insulation :

 Details of Additional protection in

 winding :

 Motor Efficiency :

 Is it suitable for direct coupling to

 pump ? :

 Type of rotary movement :

 Size and type of cable for connections:

**2.0 FILTER FEED PUMPS:**

 Make :

 Model :

 No. of Stages :

 Head/Stage :

 Power Requirement :

 Efficiency :

 Discharge in L.P.S. :

 Total Head :

 Suction end I.D. :

 Delivery end I.D. :

**MATERIAL:**

 a) Body :

 b) Impeller :

 c) Shaft :

 Type of impeller :

 Is it suitable for direct coupling? :

**MOTOR:**

 Make :

 Model :

 R.P.M :

 Rating :

 Over Load Capacity :

 Class of Insulation :

 Details of Additional protection in

 winding :

 Motor Efficiency :

 Is it suitable for direct coupling to

 pump ? :

 Type of rotary movement :

 Size and type of cable for connections:

**3.0 SOFT WATER TRANSFER PUMPS:**

 Make :

 Model :

 No. of Stages :

 Head/Stage :

 Power Requirement :

 Efficiency :

 Discharge in L.P.S. :

 Total Head :

 Suction end I.D. :

 Delivery end I.D. :

**MATERIAL:**

 a) Body :

 b) Impeller :

 c) Shaft :

 Type of impeller :

 Is it suitable for direct coupling? :

**MOTOR:**

 Make :

 Model :

 R.P.M :

 Rating :

 Over Load Capacity :

 Class of Insulation :

 Details of Additional protection in

 winding :

 Motor Efficiency :

 Is it suitable for direct coupling to

 pump ? :

 Type of rotary movement :

 Size and type of cable for connections:

**4.0 HYDRO PUMPS**

**(FOR IRRIGATION):**

 Make :

 Model :

 No. of Stages :

 Head/Stage :

 Power Requirement :

 Efficiency :

 Discharge in L.P.S. :

 Total Head :

 Suction end I.D. :

 Delivery end I.D. :

**MATERIAL:**

 a) Body :

 b) Impeller :

 c) Shaft :

 Type of impeller :

 Is it suitable for direct coupling? :

MOTOR:

 Make :

 Model :

 R.P.M :

 Rating :

 Over Load Capacity :

 Class of Insulation :

 Details of Additional protection in

 winding :

 Motor Efficiency :

 Is it suitable for direct coupling to

 pump ? :

 Type of rotary movement :

 Size and type of cable for connections:

**5.0 SLUDGE TRANSFER PUMPS**

 Make :

 Model :

 No. of Stages :

 Head/Stage :

 Power Requirement :

 Efficiency :

 Discharge in L.P.S. :

 Total Head :

 Suction end I.D. :

 Delivery end I.D. :

 Material of body :

 Max. solids handling capacity :

**MOTOR:**

 Make :

 Model :

 R.P.M :

 Rating :

 Over Load Capacity :

 Class of Insulation :

 Details of Additional protection in

 Winding :

 Motor Efficiency :

 Type of rotary movement :

 Size and type of cable for

 Connections :

**6.0 MULTI GRADE PRESSURE SAND FILTER:**

 Type of pressure filter :

 Quantity :

 Filtration Rate (m3/hr./m2)

 Dimensions. Dia x H.O.S. (mm) :

 Maximum flow rate through filter :

 Minimum flow rate through filter :

 Average flow rate through filter :

 Backwash flow rate :

 Duration of Backwash :

 Minimum pressure for backwashing :

 Maximum pressure for backwashing :

 Material of construction :

 Working weight of filter :

 Total turbidity in treated water :

 Maximum pressure drop across the filter :

 at the end of filter run (kg/cm2)

 Filtering Media :

 Depth of Media :

**7.0 ACTIVATED CARBON FILTER**

Type of filter :

No. of Filter(s) :

Filtration Rate (m3/hr./m2/mtr. bed depth) :

Dimensions. Dia x H.O.S. (mm) each filter :

Maximum flow rate through filter (m3/hr) :

Minimum flow rate through filter (m3/hr) :

Average flow rate through filter (m3/hr) :

Backwash flow rate (m3/hr) :

Duration of Backwash (Minutes) :

Minimum pressure for backwashing :

Maximum pressure for backwashing :

Material of construction :

Working weight of filter :

Filter Media :

Quality

Absorbent Media

 **Activated Carbon**

 Mesh Size

 Iodine No.

 Quantity

 Manufacturer

 Dust/Ash Content (Max.)

**8.0 SOFTENER**

a) Make :

b) Model :

c) Dimensions (Dia mm) :

d) H.O.S. (mm) :

e) Regeneration Tank Capacity (Ltrs) :

f) Type of Resin :

g) Quantity of Resin (Ltrs) :

h) Make of Resin :

i) Max. Operating Pressure Kgs./cm2 :

j) Min. Operating Pressure Kgs./cm2 :

k) Max. Treatment Flow m3/hr :

l) Min. Treatment Flow m3/hr :

m) Design Treatment Flow m3/hr :

n) Back Wash Flow Rate m3/hr :

o) Back Wash Time (Min) :

p) Regenerant Required :

q) Qty. Required Per regeneration (Kgs.) :

r) Regenerant Injection Time (Min.) :

s) Slow Rinse Flow Rate m3/hr :

t) Slow Rinse Period (Min.) :

u) Final Rinse Flow Rate m3/hr :

v) Final Rinse Time Minutes :

w) Net Output per Regeneration m3 :

**9.0 BRINE TANK:**

a) Capacity Ltrs. :

b) Dia. (mm) :

c) H.O.S. (mm) :

d) M.O.C. :

e) Thickness of sheet :

f) Type of anticrossive lining (FRP) :

g) Thickness of lining (Min. 3 mm) :

h) Sizes of Nozzles :

i) Inlet :

ii) Outlet :

iii) Drain :

iv) Overflow :

**10.0 CHOLORINE DOSING SYSTEM:**

1. No. of Tank :
2. Capacity of Tank :
3. M.O.C. of Tank :
4. No. of Dosing Pump :
5. Max. dosing flow rate (LPH) :
6. Min. dosing flow rate (LPH) :
7. Operating pressure (kg/cm2) Max. :
8. Material of construction (Liquid End) :
9. Type of the pump :
10. Make of the pump :

**11.0 ALUM/ HYPO DOSING SYSTEM :**

a) Polyelectrolyte Dosing Pump:

 Quantity :

 Model :

 Pump Type :

 Make :

 Material of construction :

 Flow rate :

b) Dosing Tank :

 Quantity :

 Capacity :

Material of Construction

 :

**12.0 ROTA METER:**

1. Type :
2. Capacity m3/hr :
3. Connecting Size (mm) :
4. Materials of Tube :

e) Material of Wetted Parts :

f) Make :