

TECHNICAL SPECIFICATIONS FOR PLUMBING SYSTEM

NAME OF WORK :

CONSTRUCTION WORK BHUJ ARCHEOLOGY

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A. DESIGN CRITERIA

A.1 SCOPE

This report describes the designed intent and approach for providing internal and external water supply and its storage system, internal sanitary installations, sewage and rain water drainage system for the buildings. The objective of the design proposal is to provide dependable and reliable services in coordination with other services, integrating requirement and needs of the Project.

Water used for various purposes like drinking, irrigation etc. shall conform to the BIS standards. Contractor to follow the Operation and Maintenance protocol as per the GRIHA V-2015 requirements.

A.2 REFERENCE STANDARDS

Following standard & guidelines shall be adopted while designing, Planning the Plumbing system.

- American Society of Plumbing Engineers(ASPE)
- International Plumbing Code
- National Building Code 2016
- Handbook on water supply and drainage (SP-35)
- ECBC Requirements, Energy Conservation Building Code
- GRIHA V – 2015

A.3 WATER SUPPLY

The water demand shall be based on the following requirements:-

- Domestic water requirement.
- Flushing water requirement.
- Water requirement for firefighting .
- Drinking water requirement.
- landscape water requirement.
- HVAC makeup water requirement.

B. TECHNICAL SPECIFICATIONS

This report describes the designed intent and approach for providing internal and external water supply and its storage system, internal sanitary installations, sewage and rain water drainage system for the buildings. The objective of the design proposal is to provide dependable and reliable services in coordination with other services, integrating requirement and needs of the Project.

B.1.1 OPERATING PRINCIPLE FOR WATER SUPPLY SCHEME

Water supply for the building requirements will be provided through direct connection to main existing supply lines of local authority. Tank capacity is as listed in above water demand table. From underground tank it will be further supplied to Overhead tank. Based on the fixture units and the flow requirement, piping distribution will be made to supply cold waters to the toilets and kitchens. Solar water heaters shall be provided to cater the requirement of hot water in pay wards. Provision of RO+ UV purification Plant shall be provided for domestic purpose.

B.1.2 WATER SUPPLY PIPE DESIGN CRITERIA

Pipe sizing shall be based on fixture unit calculation as per IPC standard. Pipe size of riser shall be restricted to 100 mm to optimize on capital cost, and for ease of installation and maintenance. Water supply pipes will be placed in the service shaft. The maximum design velocity for sizing pipe shall not exceed 2.0 m/s. All pipes and fittings shall be manufactured of Chlorinated polyvinyl chloride (CPVC).

B.1.3 RAIN WATER DISPOSAL

Rain water from terraces and other open areas shall be collected through rain water down take pipes.

Rainfall in other open areas such as hard court, green areas etc. shall be collected through catch basins and RCC box drain channels .Drain channels shall be connected to water recharging system for reuse of rain water.

All road crossings for services shall be provided with RCC Hume pipe and manholes for the ease of maintenance and to avoid any digging of roads.

Ground shall have slope towards storm water collection system in order to collect surface water

B.2 SANITARY FIXTURES & FITTINGS

The scope of this section consists of Installation, testing and commissioning of following items:

- Sanitary appliances and fixtures for toilets.
- Chromium plated brass fittings
- Stainless steel sinks
- Accessories e.g. towel rods, toilet paper holders, soap dish, liquid soap dispensers, towel rails, coat hooks etc.
- Hand driers, drinking water fountains etc.

Whether specifically mentioned or not the Contractor shall provide for all appliances and fixtures all fixing devices Such as nuts, bolts, screws, hangers as required.

B.2.1 GENERAL REQUIREMENT

The sanitary fixtures and fittings shall be installed at the correct assigned position as shown on the drawings and as directed by the Architect/PMC / Owner's Site Representative and shall fully meet with the aesthetic and symmetrical requirements as demanded by the Architect/PMC / Interior Designer. Accessories shall include proper fixing arrangements, brackets, nuts, bolts, washers, screws and required connection pieces

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per Architect/PMC requirements. Wherever necessary, the fittings shall be centered to dimensions and pattern as called for.

Fixing screws shall be half round head chromium plated (CP) brass screws, with CP brass washers unless otherwise specified.

Fixtures shall be installed by skilled workman with appropriate tools according to the best trade practice.

All appliances, fittings and fixtures shall be fixed in a neat workmanlike manner true to level and to heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions.

All materials shall be rust proofed; materials in direct or indirect contact shall be compatible to prevent electrolytic or chemical (bimetallic) corrosion.

Wall flanges shall be provided on all walls, floors, columns etc. wherever supply and disposal pipes pierce through them. These wall caps shall be or chromium plated brass fittings and the receiving pipes and shall be large enough to cover the punctures properly.

Sanitary appliances, subject to the type of appliance and specific requirements, shall be fixed in accordance with the relevant standards and the following:

- Contractor shall, during the entire period of installation and afterwards protect the appliances by providing suitable cover or any other protection so as to absolutely prevent any damage to the appliances until handing over (The original protective wrapping shall be left in position for as long as possible)
- The appliances shall be placed in correct position or marked out in order that pipe work can be fixed or partially fixed first.
- The appliance shall be fixed in a manner such that it will facilitate subsequent removal if necessary.
- The appliance shall be securely fixed. Manufacturer's brackets and fixing methods shall be used wherever possible. Compatible rust-proofed fixings shall be used. Fixing shall be done in a manner that minimizes noise transmission.
- Appliances shall not be bedded (e.g. WC pans, pedestal units) in thick strong mortar that could crack the unit (e.g. ceramic unit)
- Pipe connections shall be made with demountable unions. Pipe work shall not be fixed in a manner that it supports or partially supports and appliance.
- Appliances shall be fixed true to level firmly fixed to anchor or supports provided by the manufacturer and additional anchors or supports where necessary.

The contractor shall fix all plumbing fittings such as water faucets, shower fittings, mixing valves etc. in accordance with manufacturer's instructions and connect to piping system. The contractor shall supply all fixing materials such as screws, crawl plugs, unions, collars, compression fittings etc., as required.

Joints / gaps between all sanitary appliances / fixtures and the floor / walls shall be caulked with an approved mildew resistant sealant, having antifungal properties, of colour and shade to match that of the appliances / fixture and the floor / wall to the extent possible.

B.3 WATER SUPPLY (ITEM 104,105)

The scope of this section comprises the supply, installation, testing and commissioning of piping network for water supply for internal & external services as follows:

- Bore well / Municipal Supply
- Drinking Water Supply.
- Domestic Hot & Cold Water Supply
- External water supply to cater Landscape irrigation system and amenities

The Contractor shall make all necessary application and arrangements for his work to be inspected by the Local Authorities.

The Contractor shall be solely responsible for obtaining the Authorities approval of his works prior to the handing over of the complete water supply / distribution installation to the Owner.

B.3.1 PIPING MATERIALS

The sizes and makes is specified in the Schedule of Quantities.

For any internal works, the CPVC pipes and fittings shall be embedded in the wall chase or run on the floor/ceiling unless otherwise specified.

All the pipes used for external water supply purposes as in Pump rising mains, ring mains, buried lines etc, shall be of CPVC. All the CPVC pipes shall be of Approved Make. They shall be sound with good surface finish, mechanical strength and capacity. They shall be of the diameter (nominal bore) as specified in the items specification / as directed by the consultants, nominal bore, of the pipes for which they are intended.

B.3.2 PIPES & FITTINGS

The pipes shall be CPVC (Chlorinated Poly Vinyl Chloride) material for hot & cold water supply piping system with pipes as per CTs SDR -11 at a working pressure of 320 PSI at 23 deg C and 80 PSI at 82 deg.C, using solvent welded CPVC fittings i.e. Tees, Elbows, Couples, Unions, Reducers, Brushing etc. including transition fittings (connection between CPVC & Metal pipes / GI) i.e. Brass adapters (both Male & Female threaded and all conforming to ASTM D-2846 with only CPVC solvent cement conforming to ASTM F-493, with clamps / structural metal supports as required /directed at site including cutting chases & fitting the same with cement concrete / cement mortar as required, including painting of the exposed pipes with one coat of desired shade of enamel paint. All termination points for installation of faucets shall have brass termination fittings. Installation shall be to the satisfaction of manufacturer & Project Manager.

B.3.3 JOINING PIPES & FITTINGS

- Cutting:

Pipes shall be cut either with a wheel type plastic pipe cutting or hacksaw blade and care shall be taken to make a square cut which provides optimal bonding area within a joint.

- Deburring:

Burrs and fittings should be removed from the outside and inside of pipe with a pocket knife or file otherwise burrs and fittings may prevent proper contact between pipe and fittings during assembly.

- Fitting preparation:

A clean dry rag/cloth should be used to wipe dirt and moisture from the fitting sockets and tubing end. The tubing should make contact with the socket wall 1/3 or 2/3 of the way into the fitting socket.

- Solvent Cement Application:

Only CPVC solvent cement confirming to ASTM-F493 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, otherwise too much of cement solvent can cause clogged water ways.

- 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.

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

Set & Cure times:

Solvent cement set and cure times shall be strictly adhered to as per the below mentioned table. Special care shall be exercised when assembling flow guard systems in extremely low temperature (below 4°C) or extremely high temperature (above 45°C) In extremely hot temperatures, make sure that both surfaces to be joined are still wet with cement solvent when putting them together.

AMBIENT TEMP DURING CURE PERIOD	PIPE SIZE ($\frac{1}{2}$ " - 1")	PIPE SIZE (1 $\frac{1}{4}$ " - 2")
Above 15 deg. C	1 Hr	2 Hrs
4 – 15 deg. C	2 Hrs	4 Hrs
Below 4 deg. C	4 Hrs	8 Hrs

- Testing

Once an installation is completed and cored as per above mentioned recommendations, 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 and replacing the same with new one by using couplers.

- Transition of CPVC to 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 torqued Hard tight puts one half turn should be adequate.

- Threaded Sealants: Teflon tape shall be used to make threaded connections leak proof.
Solvent Cement

Only CPVC solvent cement conforming to ASTM F 493 should be used for joining pipe with fittings and valves. Flow guard CPVC cement solvent have a minimum shelf life of 1 year. Aged cement solvent will often change colour or being to thicken and become gelatinous or jelly like and when this happens, the cement should not be used. The cement solvent should be used within 30 days after opening the company's seal and tightly close the seal after using in order to avoid its freezing. The freezed cement solvent should be discarded immediately and fresh one should be used. The CPVC solvent cement usage should be adhered to as given in table below:

DIAMETER OF PIPE IN INCH	½"	¾"	1"	¼"	1½"	2"
Approx. nos. of joints which can be made per litre of solvent cement.	200 Nos	180 Nos	150 Nos	130 Nos	100 Nos	70 Nos

- Hangers and supports

For Horizontal runs, support should be given at 3 foot (90 cm) intervals for diameters of one inch and below and at 4 foot (1.2m) intervals for larger sizes. Piping support and distance should be approved with Consultant prior to execution.

Hangers should not have rough or sharp edges which come in contact with the tubing.

Insulated piping shall be supported in such a manner as not to put undue pressure on the insulation. 14 gauge metal sheet shall be provided between the insulation and the clamp, saddle or roller, extending at least 15 cm. on both sides of the clamps, saddles or roller.

All pipe work shall be carried out in a proper workman like manner, causing minimum disturbance to the existing services, buildings, roads and structure. The entire piping work shall be organized in consultation with other agencies work, so that area can be carried out in one stretch.

Pipe sleeves, larger diameter than pipes, shall be provided wherever pipes pass through walls and slab and annular space filled with fiberglass and finished with retainer rings.

The contractor shall make sure that the clamps, brackets, saddles and hangers provided for pipe supports are adequate or as specified / approved by Consultants. Piping layout shall take due care for expansion and contraction in pipes and include expansion joints where required.

All pipes shall be accurately cut to the required sizes in accordance with relevant BIS codes and burrs removed before laying. Open ends of the piping shall be closed as the pipe is installed to avoid entrance of foreign matter. Where reducers are to be made in horizontal runs, eccentric reduces shall be used for the piping to drain freely. In other locations, concentric reduces may be used.

All buried pipes for CWS shall be cleaned and coated with two coats of bitumen and then wrapped with two layers of 400 micron polythene sheet coating.

Automatic air valves shall be provided at all high points in the piping system for venting. All valves shall be of 15mm pipe size and shall be associated with an equal size isolation ball valve. Discharge from the air valves shall be piped through a galvanized steel pipe to the nearest drain or sump. All pipes shall be pitched towards drain points.

Pressure gauges shall be provided as shown on the approved drawings and include in Bill of Quantities. Care shall be taken to protect pressure gauges during pressure testing.

Ferrules for connection with main shall generally conform to IS:2692. It shall be of non-ferrous materials with a bell mouth cover and shall be of nominal bore as specified. The ferrule shall be fitted with a screw and plug or valve capable of completely shutting of the water supply to the communication pipe, as and when required.

B.3.4 WATER METERS

Water meters of approved make and design shall be supplied for installation at locations as shown. The water meters shall meet with the approval of local supply authorities. Suitable valves and chambers or wall meter box to house the meters shall also be provided along with the meters.

Digital smart Water meter with RS 485 / RS232 Port two way communication with Publicly available standard protocol and register maps, Support to GRIHA IT platform, conforming to IS and tested by Municipal Board complete with bolts, nuts, rubber insertions etc. :

Communicable Smart metering and monitoring system capable of tracking water consumption through a web hosted portal and (also capable of the list mentioned in Appraisal 28.1.3), for at least all meters mentioned in Appraisal 28.1.1 in GRIHA

Connect to GRIHA IT platform (linked to smart metering) to allow for two way communication.

The meters shall conform to Indian Standard IS: 779 and IS:2373. Calibration certificate shall be obtained and submitted for each water meter.

Installation of Water Meter and Stop Cock

The G.I. lines shall be cut to the required lengths at the position where the meter and stop cock are required to be fixed. Suitable fittings shall be attached to the pipes. The meter and stop cock shall be fixed in a position by means of connecting pipes, jam nut and socket etc. The stop cock shall be fixed near the inlet of the water meter. The paper disc inserted in the ripples of the meter shall be removed. And the meter installed exactly horizontal or vertical in the flow line in the direction shown by the arrow cast on the body of the meter. Care shall be taken that the factory seal of the meter is not disturbed. Wherever the meter shall be fixed to a newly fitted pipe line, the pipe line shall have to be completely washed before fitting the meter.

B.3.5 TESTING

The Contractor shall notify the Architect/PMC three days in advance of any test so that the Architect/PMC can witness the tests if he so wishes.

All water supply system shall be tested to hydrostatic pressure test of at least one and a half (1.5) times the maximum pressure but not less than 10Kg/Sq.cm for a period of not less than 8 hours. All leaks and defects in joints revealed during the testing shall be rectified and got approved at site by retest. Piping required subsequent to the above pressure test shall be retested in the same manner.

System may be tested in sections and such sections shall be entirely retested on completion.

The Contractor shall make sure that proper noiseless circulation of fluid is achieved through the entire piping network of the system concerned. In case of improper circulation, the contractor shall rectify the defective connections. He shall bear all expenses for carrying out the above rectifications including the tearing up and refinishing of floors and walls as required.

In addition to the sectional testing carried out during the construction, contractor shall test the entire installation after connections to the overhead tanks or pumping system or mains. He shall

rectify all leakages and shall replace all defective materials in the system. Any damage done due to carelessness, open or burst pipes or failure of fittings, to the building, furniture and fixtures shall be made good by the contractor during the defects liability period without any cost.

After commissioning of the water supply system, contractor shall test each valve by closing and opening it a number of times to observe if it is working efficiently. Valves which do not effectively operate shall be replaced by new ones at no extra cost and the same shall be tested as above.

A test register shall be maintained and all entries shall be signed and dated by Contractor(s) and Owner's site representative.

B.3.6 DISINFECTION OF PIPING SYSTEM AND STORAGE TANKS

Before commissioning the water supply system, the contractor shall arrange to disinfect the entire system as described in the succeeding paragraph, in notice to PMC/Engineer.

The water storage tanks and pipes shall first be filled with water and thoroughly flushed out. The storage tanks shall then be filled with water again and disinfecting chemical containing chlorine added gradually while tanks are being filled to ensure thorough mixing. Sufficient chemical shall be used to give water a dose of 50 parts of chlorine to one million parts of water.

If ordinary bleaching powder is used, the proportions will be 150 gm of powder to 1000 liters of water. The powder shall be mixed with water in the storage tank. If a proprietary brand of chemical is used, the proportions shall be specified by the manufacturer. When the storage tanks is full, the supply shall be stopped and all the taps on the distributing pipes are opened successively working progressively away from the storage tank. Each tap shall be closed when the water discharged begins to smell of chlorine. The storage tank shall then be filled up with water from supply pipe and added with more disinfecting chemical in the recommended proportions. The storage tank and pipe shall then remain charged at least for three hours. Finally the tank and pipes shall be thoroughly flushed out before any water is used for domestic purpose.

The pipe work shall be thoroughly flushed before supply is restored.

B.3.7 STERILIZATION OF MAIN

After the pipe work has been tested and approved, but before it is coupled, it shall be sterilized with a solution of chloride of lime.

B.3.8 CUTTING CHASES IN MASONRY WALLS

Cold water distribution pipes to fixtures and equipment exposed to view in the bathrooms, kitchens, and sanitary compartments shall be chased into walls or floors or placed in wall cavities. The Contractor shall be responsible for cutting all notches, chases, and recesses in walls and floors and only a diamond cutter shall be used. The maximum size of conduit or pipe permitted to be concealed in floor slabs shall be 32 mm diameter unless otherwise approved by the Architect/PMC.

The chases up to 7.5 x 7.5 cm shall be made in the walls for housing GI pipes etc. These shall be provided in correct positions as shown in the drawings or directed by the Architect/PMC. Chases shall be made by chiselling out the masonry to proper line and depth. After the pipes are fixed in chases, the chases shall be filled with cement mortar 1:2:4 or as may be specified, and made flush with the masonry surface. The concrete surface shall be roughened with wire brush to provide a key for plastering.

Where pipes pass through beams or structural walls, subject to the approval of the Structural Consulting Engineer, the Contractor shall ensure that sizes and locations of openings required are formed in when the relevant beams or walls are cast.

B.4 VALVES (ITEM -110,111)

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

Sluice valves, where specified shall be flanged sluice valves of cast iron body. The spindle, valve seat and wedge nuts shall be gunmetal. They shall generally have non-rising spindle and shall be of the particular duty and design as specified. The valves shall be supplied with suitable flanges, non-corrosive bolts and asbestos fibre gaskets. Sluice valves shall conform to Indian standard IS:780 and IS:2906.

Float valve to be fixed in storage tanks shall consist of cast brass lever arm having copper balls (26 SWG) screwed to the arm integrally. The copper ball shall have bronze welded seams. The closing/opening mechanism incorporating the piston and cylinder shall be non-corrosive metal and include washers. The size and construction of ball valves and float shall be suitable for desired working pressure operating the supply system. Where called for brass valves shall be supplied with brass hexagonal back nuts to secure them to the tanks and a socket to connect to supply pipe.

Globe valves on Hot-water line shall be union bonnet with stem/disc and body seat ring of SS. Suitable for temperature up to 80° C. All valves shall be suitable for the working pressure involved.

Table 1. Type of valves

S.NO	TYPE OF VALVE	CONSTRUCTION
a.	Ball valve	CPVC
b.	Sluice and Butterfly valve	Cast Iron
c.	G.M. non return valve	Gun Metal
d.	Flap Type – Non return valve	Cast Iron

B.4.1 PRESSURE GAUGE

The pressure gauge shall be constructed of die cast aluminium and stove enamelled. It shall be weather proof with an IP 55 enclosure. It shall be a stainless steel Bourden tube type pressure gauge with a scale range from 0 to 16 Kg / cm square and shall be constructed as per IS:3524. Each pressure gauge shall have a siphon tube connection. The shut off arrangement shall be by Ball Valve. Calibration certificate shall be obtained for each pressure gauge.

B.4.2 WATER FITTINGS

Unless otherwise specified all Gunmetal fittings such as gate, globe, check & safety valves shall be fitted in pipe line in workman like manner. Necessary unions shall be provided on both ends of the valves for easy replacement. The joints between fittings and pipes shall be leak-proof when tested to desired pressure rating. The defective fittings and joints shall be replaced or redone.

B.4.3 CONNECTIONS TO MECHANICAL EQUIPMENT SUPPLIED BY OTHER AGENCIES

All inlets, outlets, valves, piping and other incidental work connected with installation of mechanical equipment supplied by other agencies all be carried out by the contractor in accordance with the drawings, requirements for proper performance of equipment, manufacturer's instructions and the directions of the Owner's site representative / Architect/PMC. The work of connections to the various equipment's shall be effected through proper unions and isolating valves. The work of effecting connections shall be executed in consultation with and according to the requirement of equipment suppliers, under the directions of the Owner's site representative / Architect/PMC. The various aspects of connection work shall be executed in a similar way to the work of respective trade mentioned elsewhere in these specifications.

B.4.4 CONNECTIONS TO RCC WATER TANKS

The contractor shall provide all inlets, outlets, washouts, vents, ball cocks, overflows control valves and all such other piping connections including level indicator to water storage tanks as called for. All pipes crossing through RCC work shall have puddle flanges fabricated from MS/GI pipes of required size and length and welded to 6/8 mm thick MS plate. All puddle flanges must be fixed in true alignment and level to ensure further connection in proper order.

Full way gate valves of a approved make shall be provided as near the tank as practicable on every outlet pipe from the storage tank except the overflow pipe. Overflow and vent pipes shall terminate with mosquito proof grating.

The overflow pipe shall be so placed to allow the discharge of water being readily seen. The overflow pipe shall be of size as indicated. A stop valve shall also be provided in the inlet water connection to the tank. The outlet pipes shall be fixed approximately 75mm above the bottom of the tank towards which the floor of the tank is sloping to enable the tank to be emptied for cleaning.

B.4.5 MEASUREMENTS

The length above ground shall be measured in running meter correct to a cm for the finished work, which shall include pipe and fittings such as coupling , bends, tees, elbows, reducers, crosses, plugs, sockets, nipples and nuts, unions. Deductions for length of valves shall be made. Rate quoted shall be inclusive of all fittings, clamps, cutting holes chased and making good the same and all items mentioned in the specifications and Bill of Quantities.

All pipes below ground shall be measured per linear meters (to the nearest cm) and shall be inclusive of all fittings e.g. coupling, tees, bends, elbows, unions, deduction for valves shall be made rate quoted shall be inclusive of all fittings, excavation, back filling and disposal of surplus earth, cutting holes and chase and making good all item mentioned in Bill of Quantities.

B.4.6 PIPE PROTECTION (FOR COLD WATER PIPES BURIED IN TRENCHES / EARTH)

All buried pipes shall be cleaned with zinc chromate primer and bitumen paint, wrapped with three layers of fibber glass tissue, each layer laid in bitumen and placed on concrete blocks with PUF saddles dipped in bitumen at every 2 meters. The pipes where laid under floor shall be encased with 100 mm thick Jamuna sand all around in addition to protective coating as described above. Alternatively pype coat / coatek insulation for protection of pipe would also be acceptable as per final approval of project engineer / consultant.

B.4.7 THRUST BLOCKS

In case of bigger pipes (80 mm diameter and above), thrust blocks of cement concrete 1:2:4 (1 cement: 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size) shall be constructed on all bends as directed by the Owner's site representative.

B.4.8 MASONRY CHAMBER

- All masonry chambers for stop cocks, sluice valves and meter etc. shall be built as per supplied drawings.
- The excavation for chambers shall be done true to dimension and level indicated on plans or as directed by the Owner's site representative.
- Concrete shall be of cement concrete 1:3:6 (1 cement: 3 coarse sand : 6 graded stone aggregate 40 mm nominal size).
- Brick shall be of class designation 75 in cement mortar 1:5 (1 cement : 5 fine sand)
- Inside Plastering not less than 12 mm thick shall be done in cement mortar 1:3 (1 cement : 3 fine sand) finished with a floating coat of neat cement.

B.6 LEVEL SWITCH IN WATER TANKS (ITEM -108)

The Contractor shall supply and install float less type switch probes in the water tanks as indicated below and shown on the drawings.

- Water Tanks at Basement
- High level alarm (over-flow);
- Low level alarm;
- Low level cut-out for raw water pumps;
- Earthing probe.

Each probe shall be of the correct length for the particular application and tank location. Electrodes shall be of polished stainless steel 20 mm OD. Electrode holders shall be weatherproof in all respect.

The earthing probes shall be connected and wired to the building earth systems of the building.

Each set of electrodes shall be installed inside a 230 mm diameter PVC pipe acting as a wave barrier.

The level switch set shall operate with a stepped down voltage at 24V maximum. Stepped down transformers shall be provided for each set of control probes and shall be installed inside centralised control cubicles inside pump room.

Mechanical steel stuffing boxes shall be used.

- Control of Duty / Standby Pumps

Operation of the duty and standby pumps shall be carried out by the following method:

- Automatically by means of pressure sensor (i.e. pressure switches);
- Manually by means of a local start/stop push buttons on pump local motor control panel and emergency stop switch.
- The pressure switch shall be installed next to the manual release valve. When the pressure drops to the pre-determined level, a signal will be sent to the pump local motor control panel to start the pump.

Automatic controls shall be operated by electronic, float less type level switches.

- Pump Indicator

Audible and visible indication shall be provided at the pump local control panels as applicable:

B.7 PUMP (ITEM 106,107,109)

B.7.1 SUBMERSIBLE

These pump shall be fully submersible motor. The pumps shall be provided with an automatic level controller and all interconnecting power and control cabling which shall cause the pumps to operate when the water level in the sump rises to a preset level and stop when the preset low level is reached.

Pumps for drainage shall be single stage, single entry. Pump shall be C.I. casing and C.I. two vane open type with a dynamically balanced impeller connected to a common shaft of the motor. The vane for sewage pump will be open type, while for drainage pump, etc. it will be of semi open type. The MOC of the sump shall be in accordance to schedule of quantity.

Stuffing box shall be provided with mechanical seals.

Each pump shall be provided with a suitably rated induction motor suitable for 415 volts, 3 phase, 50 Hz A.C. power supply.

Each pump shall be provided with in built liquid level controller for operating the pump between predetermined levels.

The pumping set shall be for stationary application and shall be provided with pump connector unit. The delivery pipe shall be joined to the pump through a rubber diaphragm, and bend and guide pipe for easy installation.

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

Sump pump shall be complete with level controllers, power and control switch gear, Auto/off/Manual switches, pumps priority selections and control and power cabling up to motor and controller/probes etc. (Including earthing). Level control shall be such that one pump starts on required level, 2nd pump cuts in at high level and alarms is given at extra high level. All level controllers shall be provided with remote level indications.

B.7.2 MOTOR DESIGN

The pump motor shall be a squirrel cage induction, housed in air filled water-tight enclosure. Oil filled motors are not acceptable. The stator windings shall be Class "F" insulation (155 degree C or 311 degree F) for general usage and class 'H' insulation (180 degree C or 317-8 grade 2) for submersible type.

The stator shall be heat shrunk fitted into the enclosure and shall not use bolts, pins or other fasteners that penetrate through the stator enclosure. The starter shall be equipped with a thermal switch embedded in series in the coils of the stator windings to protect the stator from wheel.

The motors shall be designed for continuous running duty type at 415 volts, 3 phase, 50 Hz power supply and capable of sustaining a minimum of 20 starts/stops per hour.

Between stator housing and pump, a tandem seal arrangement will be provided with an oil barrier. Both seals run in oil, allowing dry running without seal damage. Both seals shall be of the rubber bellows or metallic bellow type with positive drive between shaft and rotating seal face.

B.8 ELECTRICAL INSTALLATION

The scope of this section comprises of fabrication, supply, erection, testing and commissioning of Motor Control Centre (MCC), wiring and earthing of all equipment, components and accessories , It shall be in accordance to “Technical Specifications of Electrical System” as specified in Tender MEP Specifications documents.

Motor shall be energy efficient as per Griha V-2015.

B.9 TESTING & COMMISSIONING

Work under this section shall be executed without any additional cost. The rates quoted in this tender shall be inclusive of the works given in this section.

Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.

On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.

All tests shall be made in the presence of the Architect/PMC or his representative or any inspecting authority. At least five working days' notice in writing shall be given to the inspecting parties before performing any test.

Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.

Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rotameters. Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Project Manager.

Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

B.9.1 PRECOMMISSIONING

On completion of the installation of all pumps, piping, valves, pipe connections, insulation etc. the Contractor shall proceed as follows:

- Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fitments and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.
- All strainers shall be inspected and cleaned out or replaced.
- When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:
 - Remove oil, grease and foreign residue from the pipe work and fittings;
 - Pre-condition the metal surfaces to resist reaction with water or air.
 - Establish an initial protective film;
 - After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.
 - Details and procedures of the pre-treatment shall be submitted to the Architect/PMC for approval.
- Check all clamps, supports and hangers provided for the pipes.
 - Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

B.9.2 STATUTORY AUTHORITIES' TESTS AND INSPECTIONS

As and when notified in writing or instructed by the Architect/PMC, the Contractor shall submit shop drawing and attend all tests and inspections carried out by Local Fire Authorities, Water Authority and other Statutory Authorities, and shall forthwith execute free of charge any rectification work ordered by the Architect/PMC as a result of such tests and inspections where these indicate non-compliance with Statutory Regulations. Some of these tests may take place after the issue of

Practical Completion of the Main Contract and the Contractor shall make all allowances in this respect.

The Contractor shall be responsible for the submission of all necessary forms and shop drawings to the Statutory Authorities which shall conform in layout to the latest Architect/PMC plans submitted to and kept by these Authorities.

The submission shall comply with the requirements set forth in the current Codes of Practice and circular letters of the Statutory Authorities. The shop drawings to be submitted shall be forwarded to the Architect/PMC for checking before submission.

The Contractor shall allow for at least two submissions of complete sets of shop drawings to the Authorities, one to be made within six months after the award of the Contract but not less than six weeks before the inspection. The Architect/PMC may at his discretion instruct the Contractor for additional submissions to the Local Authorities whenever necessary.

The Contractor shall notify the Architect/PMC at least seven days in advance of his application for local Authority tests and inspections. On receipt of a confirmed date for test and inspection the Contractor shall inform the Architect/PMC without delay.

B.9.3 FINAL ACCEPTANCE TESTS

Following commissioning and inspection of the entire installation, and prior to issue of the Completion Certificate, the Contractor shall carry out final acceptance tests in accordance with a programme to be agreed with the Architect/PMC.

Should the results of the acceptance tests show that plant, systems and/or equipment fail to perform to the efficiencies or other performance figures as given in this Specification, the Contractor shall adjust, modify and if necessary replace the equipment without further payment in order that the required performance is obtained.

Where acceptance tests are required by the relevant Authorities having jurisdiction, these tests shall be carried out by the Contractor prior to the issue of Completion Certificate to the acceptance of the Authorities.

Any item of plant or system or component which fails to comply with the requirements of this Specification in any respect whatsoever at any stage of manufacture, test, erection or on completion at site may be rejected by the Architect/PMC either in whole or in part as he considers necessary/appropriate. Adjustment and/or modification work as required by the Architect/PMC so as to comply with the Authority's requirements and the intent of the Specification shall be carried out by the Contractor at his own expense and to the satisfaction of the Authority/Architect/PMC.

After works have been accepted, the Contractor may be required to carry out assist in carrying out additional performance tests as reasonably required by the Architect/PMC/Employer.

B.9.4 WARRANTY AND HANDOVER

The Contractor shall warrant that all plant, materials and equipment supplied and all workmanship performed by him to be free from defects of whatsoever nature before handover to the Owner.

B.9.5 HANDING OVER OF DOCUMENTS

All testing and commissioning shall be done by the Contractor to the entire satisfaction of the Owner's site representative and all testing and commissioning documents shall be handed over to the Owner's site representative.

The Contractor shall also hand over all maintenance and operation manuals, all certificates and all other documentation as per the terms of the contract to the Owner's site representative.

B.9.6 CHECK LIST FOR COMMISSIONING

B.9.7 WATER SUPPLY, DRAINAGE AND OTHER EQUIPMENT

- Operate each and every valve on the system to see if the valves are functioning properly.
- Check all clamps, support and hangers provided for the pipes.
- Check rotation of each motor and correct the same if required.
- All the pumps shall run continuously for one hour. Record the pressure and motor current and voltage readings.
- Check all annunciations by simulating the alarm conditions if any at site.
- Performance test to be carried out and recorded for the pumps.
- Simulate low level in the domestic water tanks to trip domestic Filter Feed Pumps. Simulate high level in treated water tanks to trip softener feed pumps. Simulate low level in treated water tanks to trip treated water hydro-pneumatic pumps.

B.9.8 SUBMERSIBLE PUMPS

- Fill the sump with water, while observing the level.
- Keep the pump starter switch on 'OFF' position to check for start of pump.
- By keeping the starter switch on 'Auto' position, both the pumps should start. As the water level starts receding, one pump should switch off by itself. The second pump should switch off on further reduction in water level.
- Fill the sump with a little water and check both the pumps in 'Manual' position momentarily.
- Leave the switches in 'Auto' position for both the pumps.

B.9.9 CONTROL PANEL / GENERAL

- Check whether the drawings for electrical SLD, plant room layout, schematic, etc. are installed in the plant room duly framed.
- Rubber mat provision in front of panel.
- Check whether the names of the equipment and flow directional arrows are painted.

C. TECHNICAL DATA SHEETS

Table 2. DATA SHEET FOR PUMP

SR. NO.	DESCRIPTION	DATA SHEET TO BE FILLED BY VENDOR
1	Pump Make / Model	
2	Type	
3	Make	
4	Quantity	
5	Flow Rate	
6	Head	
7	Electric Motor	
8	Full Load Current (Amp)	
9	Rated Voltage (Volts)	
10	Phase / RPM / Hz	
	MATERIAL OF CONSTRUCTION	
1	Impeller	
2	Delivery Casing	
3	Motor Body	
4	Shaft	
5	Seal	
6	Suction Pipe Size (mm)	
7	Delivery Pipe Size (mm)	
8	Direct Online Starter with Level Switch	