CONSTRUCTION OF RESIDENTIAL FLATS, SBILD & OTHER COMMERCIAL OUTFITS AT HINJEWADI, PUNE, MAHARSHTRA, IN EPC MODE

PART E: CHAPTER B (PLUMBING)

SBI

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TECHNICAL SPECIFICATIONS PLUMBING

PROPOSED CONSTRUCTION OF RESIDENTIAL AND COMMERCIAL OUTFITS AT HINJEWADI, PUNE FOR STATE BANK OF INDIA

GENERAL SPECIFICATINS

This General Specification are to be read in conjunction with other documents issued along with tender. In case of any discrepancy between Design drawings, General conditions or Bill of quantity, more stringent of the same shall be applicable.

The contractor shall refer the following drawings while bidding and will read them in conjunction with specifications as well as bill of quantity. A part list of applicable codes & standards is mentioned as Annexure – the compliance and I will be ensured.

WORK DESCRIPTION

The work shall be strictly carried out as per the scope listed in this document and in accordance with the specifications. The equipment & material supplied at site will also be selected out of the list of approved makes. Bill of quantity provided with the document is for contractor guidance. It is expected that after award of work, contractor shall prepare shop drawings for approval by the SBI, PMC's representative and submit Technical documentation duly identifying shortlisted make of material/equipment along with its data sheets. Actual ordering shall be based on approved shop drawings & documents.

The work at site shall comply with the approved shop drawings and will meet the satisfaction of SBI, PMC's representative. The contractor shall be required to demonstrate satisfactory operation of entire system (including client supplied equipment installed by contractor) and furnish the required labour, material & tools to install & commission the system.

The broad scope of work for proposed plumbing and firefighting system covered under this contract shall include supply, installation, testing &commissioning of the following:

Sanitary fixtures and accessories.

C.P. bathroom fittings and accessories.

Soil, waste and vent pipes with fittings

Rain water disposal pipes with fittings

Water supply pipes with fittings

External sewerage system

External Drainage system

External water supply system

Connection to and from municipal mains in case of water, sewer and drain connection including coordination with all other agencies

Fire pumping system, Fire Hydrant including fire extinguishers.

Other Miscellaneous Items.

Wiring & earthing from MCC panels to various firefighting system, control wiring & interlocking.

Any chasing/chipping/civil masonry.

Balancing, testing & commissioning of the entire plumbing system.

Besides above, contractor shall also be required to undertake following:

Obtain approval from Local Authorities prior & post installation for operation of system.

All civil works which include making openings in walls & slabs and making good of the same.

Commissioning of the plant including test reports to demonstrate satisfactory working prior to handing over.

Provide as-built drawings and handing over document Test reports, list of recommended spares, operation & maintenance manual for the entire plumbing system.

Training of Client's staff.

SITE MANAGEMENT

The Contractor shall be required to provide following staffing for the project:

Design Engineer who will work with consultant for getting shop drawings, technical submittal and variation in quantity statement approved.

Procurement team as per tender document.

Full time dedicated Engineer& supervisor posted at site as per tender document.

The contractor shall submit organization chart and CV prior to starting work at site.

The Contractor shall have required stores, tools & plant, security and facility to transport materials to place of installation for speedy execution of work.

REGULATIONS & PERMITS

Prior to starting work at site, the contractor shall obtain required permits/ licenses required for satisfactory execution and operation of the installation.

The executed work shall strictly confirm to applicable laws, regulations and Indian Standards which become applicable. In case the specifications and drawings contained in this document call for higher standard than those required by prevailing regulations, then these specifications & drawings shall become applicable. However, in case of any conflict or violation between the document/drawings and prevailing laws, then the applicable laws & regulations shall be governing & binding.

SHOP DRAWINGS

A set of design drawings listed in this document are available at Consultant office and may be issued with the tender document. These design drawings are for reference of the contractor and indicate

proposed arrangement and the extent of work covered in the contract. The data given in the drawings and specifications is as exact as could be procured, but its accuracy is not guaranteed. The contractor cannot execute work or scale these drawings for reference.

Following shall be the procedure followed by contractor while preparation of shop drawings:

The contractor shall refer the design drawings for understanding the scope and proposed routes to be followed during execution.

Collate latest architectural backgrounds from the SBI, PMC's representative/Architect/Consultant.

Examine all related services drawings but not limited to structural, plumbing, electrical, HVAC, Interior, landscape and others including as-built works before starting the work. Any discrepancy must be report to the SBI, PMC's site representative in writing and obtain approval for go-ahead.

Within one week of award of work, the Contractor shall prepare a list of shop drawing along with submission schedule for approval of SBI, PMC's representative/Consultant. The list of drawings must include layouts for Plant room, Pump room, Typical drawings showing exact location of supports, flanges, bends, tee connections, reducers, detailed piping drawings showing exact location and type of supports, valves, fittings etc; electrical panels inside/outside views, power and control wiring schematics, cable trays, supports and terminations.

Maximum headroom shall be maintained at all points and in case the same is inadequate, then written approval from SBI, PMC's representative must be obtained prior to execution at site.

These shop drawings shall depict information required to complete the Project as per specifications and as required by the Consultant/SBI, PMC's representative. These Drawings shall contain details of construction, size, arrangement, operating clearances, performance characteristics and capacity of all items of equipment, also the details of all related items of work by other contractors. Each shop drawing shall contain tabulation of all measurable items of equipment/materials/works and progressive cumulative totals from other related drawings to arrive at a variation-in-quantity statement at the completion of all shop drawings.

Where the work under this contract is proposed to be installed in close proximity or is interfering with other trades, then based on SBI, PMC's representative/consultant directions, the contractor shall prepare all services coordinated working drawings and sections at a suitable scale (not less than 1:50), clearly showing proposed installed in relation to the work of other trades.

The contractor shall thereafter furnish six sets of detailed shop drawings to SBI, PMC's representative/Consultant for obtaining comments/approval. The Contractor will make unlimited number of re-submissions of shop drawings unless SBI, PMC's representative/Consultant/Architect approval is obtained.

The Contractor will thereafter submit six sets of final shop drawings to the SBI, PMC's representative for their exclusive use and all other agencies.

No material or equipment may be delivered or installed at the job site until the contractor has in his possession, the approved shop drawing for the particular material/equipment/installation.

In case installation is carried out without following above process or obtaining a waiver to follow the procedure from SBI, PMC's representative, the work shall be rejected and contractor shall rectify the same at their own cost.

Shop drawings shall be submitted for approval minimum four weeks in advance of planned delivery and installation of any material to allow SBI, PMC's representative/Consultant ample time for scrutiny. No claims for extension of time shall be entertained because of any delay in the work due to his failure to produce shop drawings at the right time, in accordance with the approved program.

Approval of shop drawings shall not be considered as a guarantee of measurements or of building dimensions. Where drawings are approved, said approval does not mean that the drawings supersede the contract requirements, nor does it in any way relieve the contractor of the responsibility or requirement to furnish material and perform work as required by the contract.

TECHNICAL DOCUMENTATION

The contractor prior to supplying material at site, will submit the following documentation to Consultant/SBI, PMC's representative for approval:

Manufacturers drawings, catalogues, pamphlets and other documents in triplicate. Each item shall be properly labeled, indicating the specific services for which material or equipment is to be used, giving reference to the governing section and clause number and clearly identifying in ink the items and the operating characteristics. Data of general nature shall not be accepted.

Samples of all materials shall be submitted to the SBI, PMC's site representative prior to procurement. These will be submitted in two sets for approval and retention by SBI, PMC's representative and shall be kept in their site office for reference and verification till the completion of the Project. Wherever directed, a mockup or sample installation shall be carried out for approval before proceeding for further installation.

Where the contractor proposes to use an alternate make or model of equipment other than that specified, all new drawings and detailing required thereafter shall be prepared by the contractor at his own expense including any re-design required for other discipline/trade. Any delay on such account shall also be at the cost of and consequence of the Contractor.

Contractor to refer list of approved makes & materials for this project.

QUALITY ASSURANCE

The contractor to ensure that all materials and equipment supplied shall be new and of best available quality conforming to the relevant Indian Standard Specifications and to these specifications. Makes shall be strictly in conformity with list of approved manufacturers. PMC reserve the right to reject any item which in their assessment is second hand

Any deviations from above shall be clearly highlighted prior to supply and shall be brought to the notice of the SBI, PMC's representative/Consultant for further instructions in the matter.

Prior to starting execution work at site, the Contractor shall verify the sufficiency of the size of the shaft openings, clearances and ceiling spaces for proper installation. Failure to communicate insufficiency of any of the above, shall constitute Contractor acceptance of the same. The Contractor

shall locate all equipment in fully accessible locations which can be easily serviced, operated or maintained. Valve or other devices requiring attendance shall be finalized and communicated in sufficient time. Failing this, the Contractor shall make all the necessary repairs and changes at own expense. Access panel shall be marked.

INTEGRATION WITH BUILDING AUTOMATION SYSTEM

The scope of Plumbing and Firefighting Contractor shall include the following for the interface to Building Automation System and no additional cost shall be paid for providing the interface feasibility.

Stop/Manual/ Auto switches along with potential free contacts for monitoring the manual operation status, to be provided for those equipment whose start / stop is controlled by Building Automation System.

Potential free 'NO' contacts for monitoring 'Run' status of equipment wherever required.

Necessary contactor with potential free contacts and Stop/Manual/ Auto switches to be provided for all equipment wherever the starter is not provided and which requires starting / stopping through Building Automation System.

Sockets /Nipples including shut-off valve for mounting sensors/transmitters on pipe lines.

The space provision in all the equipment panel (MCC) for mounting Current/ Potential transformers & transducers and power supply to the transducer shall be provided by the Plumbing and Firefighting contractor. Separate current transformers shall be provided by Plumbing and Firefighting contractor for monitoring current / KWH (wherever required) through BAS.

The installation of current transformer & Transducer along with wiring between Current Transformer & Transducer up to the terminal block shall be provided by the Plumbing and Firefighting contractor. All transducers shall be supplied by BAS contractor.

The low voltage BAS Cables shall be brought upto the electric panel by BAS contractor and all terminations into the electrical panels shall be made by Plumbing and Firefighting contractor after satisfying himself of the wiring system. It is to be clearly understood that the final responsibility for the sufficiency, adequacy and conformity to the contract requirements, of the Plumbing and Firefighting system, lies solely with the contractor.

All necessary Hardware/ Software shall be made available by the Plumbing and Firefighting Contractor on the Microprocessor based panel for the integration of such panel to Building Automation System for remote monitoring / controlling of marking / equipment thru BAS

TESTING, ADJUSTING ANDBALANCING

Balancing of all water systems and all tests as called for the Specifications shall be carried out by the contractor through a specialist group, in accordance with the Specifications and ASPE / ASHRAE Guide lines and Standards. Performance test shall consist of three days of 10 hour each operation of system for each season. Cost of performance witness test of major equipment such as pumps, equipment, panels etc. at factory with two personnel from Owners / Consultant shall be included.

The installation shall be tested again after removal of defects and shall be commissioned only after approval by the Owner's site representative. All tests shall be carried out in the presence of the representatives of the Architect / Consultant and Owner's site representative.

COMPLETION CERTIFICATE

On completion of the installation, a certificate shall be furnished by the contractor, counter signed by the licensed supervisor, under whose direct supervision the installation was carried out. This certificate shall be in the prescribed form as required by the local authority.

The contractor shall be responsible for getting the entire installation duly approved by the local authorities concerned, and shall bear expenses if any, in connection with the same.

AS-BUILT DRAWINGS

Contractor shall submit following as-built drawings as and when work is completed:

Six set of hard copies of all as-built drawings duly corrected and incorporating any modifications during execution.

Two set of pen drive containing the drawings.

Position of all sanitary fixtures.

Runs of all water lines with diameters on all floors and vertical risers / drops.

Runs of all soil, waste, vent & rain water piping with diameters on all floors and vertical stacks.

Position and sizes of all type of control valves and all other plant and equipment.

Position of cleaning eye / access doors and opening panels in soil/waste disposal system.

Original installation and Maintenance manual of all types of equipment.

Location of all mechanical equipment with layout and piping connections.

MAINTENANCE MANUAL

Upon completion and commissioning of works, the contractor shall submit a draft copy of comprehensive operating instructions, maintenance schedule and log sheets for all systems and equipment included in this contract. This shall be supplementary to manufacturer's operating and maintenance manuals. Upon approval of the draft, the contractor shall submit four (4) complete bound sets of typewritten operating instructions and maintenance manuals; one each for retention by Consultant and SBI,PMC'ssite representative and two for Clients Operating Personnel. These manuals shall also include basis of design, detailed technical data for each piece of equipment as installed, spare parts manual and recommended spares for 4 year period of maintenance of each equipment. The manuals shall include

Description of the work carried out / installed.

Operating instructions.

Maintenance instructions including procedures for preventive maintenance.

Manufacturers catalogues.

Spare parts list.

Trouble shooting charts.

Drawings

Type and routine test certificates of major items.

Details of all the bought out item should be part of this maintenance manual.

ON SITE TRAINING

Upon completion of all work and all tests, the Contractor shall furnish necessary operators, labor and helpers for operating the entire installation for such periods so as to enable the Client's staff to get acquainted with the operation of the system. During this period, the contractor shall train the Client's personnel in the operation, adjustment and maintenance of all equipment installed.

DEFECTS LIABILITY PERIOD

Complaints

The Contractor shall receive calls for any and all problems experienced in the operation of the system under this contract, attend to these within 10 hours of receiving the complaints and shall take steps to immediately correct any deficiencies that may exist.

Repairs

All equipment that requires repairing shall be immediately serviced and repaired. Since the period of Mechanical Maintenance runs concurrently with the defects liability period, all replacement parts and labour shall be supplied promptly free-of-charge to the Client.

UPTIME GUARANTEE

The contractor shall guarantee for the installed system an uptime of 98%. In case of shortfall in any month during the defects liability period, the Defects Liability period shall get extended by a month for every month having shortfall and no reimbursement shall be made for the extended period.

PART LIST OF CODES & STANDARDS

LIST OF BUREAU OF INDIAN STANDARDS AND OTHER INTERNATIONAL CODES

All equipment, supply, erection, testing and commissioning shall comply with the requirements of Indian Standards and code of practices given below. All equipment and material being supplied by the contractor shall meet the requirements of IS and other specified.

Tariff advisory committee's regulation (fire insurance), electrical inspectorate and Indian Electricity rules and other Codes / Publications as given below:

1	Pipes and Fittings	
	IS 15905	Centrifugally Cast Iron Hub less pipes & fittings.
	IS:13592	PVC Pipes
	IS:15778	c-PVC SDR 11 Internal Water Supply pipe
	IS 8329 & IS 9523	Ductile iron K-7 & K-9 for External water supply
	IS:458:2003	NP3 Pipe
2.	Valves	
	IS : 778	Specification for copper alloy gage, globe and check valves for water works purposes.
	IS : 780	Specification for sluice valves for water works purposes (50 mm to 300 mm size).
	IS : 1703	Specification copper alloy float valves (horizontal plunger type) for water supply fittings.
	IS : 2906	Specification for sluice valves for water works purposes (350 mm to 1200 mm size)
	IS : 3950	Specification for surface boxes for sluice valves.
	IS : 5312 (Part 1)	Specification for swing check type reflux (non-return) valves: part 2 Multi door pattern.
	IS : 5312 (Part 2)	Specification for swing check type reflux (non-return) valves: part 2 Multi door pattern.
	IS : 12992 (Part 1)	Safety relief valves, spring loaded : Design
	IS : 13095	Butterfly valves for general purposes.
3.	Sanitary Fittings	
	IS : 771 (Part 1 to 3)	Specification for glazed fire clay sanitary appliances.

	IS : 774	Specification for flushing cistern for water closets and urinals (other than plastic cistern)
	IS : 775	Specification for cast iron brackets and supports for wash basins and sinks
	IS : 781	Specification for cast copper alloy screw down bib taps and stops valves for water services.
	IS : 1700	Specification for drinking fountains.
	IS : 2548 (Part 2)	Specification for plastic seats and covers for water closets: Part 1 Thermo set seats and covers.
	IS : 2556 (Part 1)	Specification for vitreous sanitary appliances (Vitreous china) : Part 1 General requirement.
	IS : 2556 (Part 2)	Specification for vitreous sanitary appliances (vitreous china): Part 2 Specific requirements of wash-down water closets.
	IS : 2556 (Part 3)	Specification for vitreous sanitary appliances (vitreous china): Part 3 Specific requirements of squatting pans.
	IS : 2556 (Part 4)	Specification for vitreous sanitary appliances (vitreous china): part 4 specific requirements of wash basins.
	IS : 2556 (Part 6 Sec 2)	Specification for vitreous sanitary appliances (vitreous china): part 6 Specific requirements of urinals, section 2 half stall urinals.
	IS : 2556 (Part 6 Sec 4)	Specification for vitreous sanitary appliances (vitreous china): Part 6 specific requirements of urinals, section 4 partition slabs.
	IS : 2556 (Part 6 Sec 5)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 5 waste fittings.
	IS : 2556 (Part 6 Sec 6)	Specification for vitreous sanitary appliances (vitreous china): Part 6 Specific requirements of urinals, section 6 water spreaders for half stall urinals.
	IS : 2556 (Part 7)	Specification for vitreous sanitary appliances (vitreous china): Part 7 Specific requirements of half round channels.
	IS : 2556 (Part 8)	Specification for vitreous sanitary appliances (vitreous china): Part 8 Specific requirements of siphoning wash

		down water closets.
	IS : 2556 (Part 11)	Specification for vitreous sanitary appliances (vitreous china): Part 11 Specific requirements for shower rose.
	IS : 2556 (Part 12)	Specification for vitreous sanitary appliances (vitreous china): Part 12 Specific requirements of floor traps.
	IS : 2556 (Part 15)	Specification for vitreous sanitary appliances (vitreous china) : Part
		15 Specific requirements of universal water closets.
	IS : 2692	Specification for ferrule for water services
	IS : 2717	Glossary of terms relating to vitreous enamelware and ceramic metal systems
	IS : 2963	Specifications for waste plug and its accessories for sinks and wash basins.
	IS : 3311	Specification for waste plug and its accessories for sinks and wash basins.
	IS : 5961	Specification for SS gratings for drainage purposes.
	IS : 6249	Specification for gel-coated glass fiber reinforced polyester resin bath tubs.
	IS : 6411	Specification for gel-coated glass fiber reinforced polyester resin bath tubes.
	IS : 8931	Specification for copper alloy fancy single taps, combination tap assembly and stop valves for water services.
	IS : 9758	Specification for flush valves and fitting for water closets and urinals.
4.	Water Quality To lerance	
	IS : 3025 (Parts 1 to 44)	Method of sampling and test (physical and chemical) for water and waste water.
	IS : 4764	Tolerance limits for sewage effluents discharged into inland surface waters.
	IS : 10500	Drinking Water
5.	Pumps & Vessels	
	IS : 1520	Specification for horizontal centrifugal pumps for

		clear cold fresh water.
	IS : 2002	Steel plates for pressure vessels for intermediate and high temperature service including boilers.
	IS : 2825	Code for unfired pressure vessels.
	IS : 4648 (Part 1)	Code of practice for lining of vessels and equipment for chemical processes Part 1: Rubber lining.
	IS : 5600	Specification for sewage and drainage pumps
	IS : 8034	Specification for submersible pump sets for clear, cold, fresh water.
	IS : 8418	Specification for horizontal centrifugal self-priming pumps.
6.	General	
	NBCS 2026	
	Uniform Plumbing Code of India 2008	
	SP : 6 (1)	Structural Steel Sections
	IS : 325	Three Phase Induction Motors
	IS: 456	Code of practice for plain and reinforced concrete (3rd rev.) (Amendment 2)
	IS : 554	Dimensions for pipe threads where pressure tight joints are required on the threads.
	IS : 694	PVC insulated cables for working voltages upto & including 1100 V.
	IS : 779	Specification for water meters (domestic type).
	IS : 782	Specification for caulking load.
	IS : 800	Code of practice for general construction in steel
	IS : 1068	Electroplated coatings of nickel plus chromium and copper plus nickel plus chromium.
	IS : 1172	Code of Basic requirements for water supply drainage and sanitation
	IS : 1367 (Part 1)	Technical supply conditions for threaded steel fasteners: Part 1 introduction and general information.

	IS : 1367 (Part 2)	Technical supply conditions for threaded steel fasteners: Part 2 product grades and tolerances.
	IS : 1554 (Part 1)	PVC insulated (heavy duty) electric cables : Part 1 for working voltages up to and including 1100 V.
	IS : 1554 (Part 2)	PVC insulated (heavy duty) electric cables: Part 2 for working voltages from 3.3 KV up to and including 11 KV.
	IS : 1726	Specification for FRP manhole covers and frames.
	IS : 1742	Code of practice for building drainage.
	IS : 2064	Selection, installation and maintenance of sanitary appliance code of practice.
	IS : 2065	Code of practice for water supply in buildings.
	IS : 2104	Specification for water meter for boxes (domestic type)
	IS : 2373	Specification for eater meter (bulk type)
	IS : 2379	Color code for identification of pipe lines.
	IS : 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
	IS : 2629	Recommended practice for hot dip galvanizing on iron and Steel.
	IS : 3114	Code of practice for laying of cast iron pipes
	IS : 4111 (Part 1)	Code of practice for ancillary structures in sewerage system: Part 1 manholes.
	IS : 4127	Code of practice for laying glazed stoneware pipes.
	IS : 4853	Recommended practice for radiographic inspection of fusion welded butt joints in steel pipes.
	IS : 5329	Code of practice for sanitary pipe work above ground for buildings.
	IS : 5455	Cast iron with plastic insulation steps for manholes.
	IS : 6159	Recommended practice for design and fabrication of material, prior to galvanizing.
	IS : 7558	Code of practice for domestic hot water installations.
	IS : 8321	Glossary of terms applicable to plumbing work.

	IS : 8419 (Part 1)	Requirements for water filtration equipment: Part 1 Filtration medium sand and gravel.
	IS : 8419 (Part 2)	Requirements for water filtration equipment: Part 2 under drainage system.
	IS : 9668	Code of practice for provision and maintenance of water supplies and firefighting.
	IS : 9842	Preformed fibrous pipe insulation.
	IS : 9912	Coal tar based coating materials and suitable primers for protecting iron and steel pipe lines.
	IS : 10221	Code of practice for coating and wrapping of underground mild steel pipelines.
	IS : 10446	Glossary of terms relating to water supply and sanitation.
	IS : 11149	Rubber Gaskets
	IS : 11790	Code of practice for preparation of butt-welding ends for pipes, valves, flanges and fittings.
	IS : 12183 (Part 1)	Code of practice for plumbing in multistoried buildings: Part 1 water supply.
	IS : 12251	Code of practice for drainage of building basements.
	IS : 5572	Code of practice for sanitary pipe work.
	BS : 6700	Specification for design, installation, testing and maintenance of services supplying water for domestic use within buildings and their cartilages.
	BS : 8301	Code of practice for building drainage.
	BSEN : 274	Sanitary tap were, waste fittings for basins, bidets and baths. General technical specifications.

SUMMARY OF PLUMBING SPECIFICATIONS

S NO.	ITEMS OF WORK	SPECIFICATIONS

1	Water supply & Sanitary Installation for attached Toilets	Indian Water Closets (WCs): Indian WC (Orissa Pattern) shall be of first quality white vitreous china. Conforming to IS: 2556 (Part 3) – Latest Revision. Integral footrests with anti-slip surface. Trap size: Minimum 100 mm P-trap/S-trap as per layout. Water seal depth: Minimum 50 mm. Flushing: Dual flush concealed cistern (4/2 litres) or 10 litre exposed cistern as per BOQ. Cistern shall conform to IS: 2556. Heavy duty PVC/CP flush pipe (32 mm) Health faucet along with two-way bib cock to be provided. D type SS Handle to be provided for old age Persons Approved Make: Kohler/ Duravit/ Toto
		Wall Hung Water Closets (WCs): European type, wall hung as per drawings. Dual flush system with concealed cistern. Conforming to IS: 2556 (Latest Revision). Cistern shall be fully insulated to prevent condensation. Flush mechanism shall be heavy-duty, suitable for high footfall (commercial use). Seat cover shall be soft-close, antibacterial, heavy-duty thermoset plastic. Health faucet along with two-way bib cock to be provided. Approved Make: Kohler/ Duravit/ Toto
		Wash Basin Over-counter type or Under-counter as per Design & drawings. Made of high-grade vitreous china with uniform glazing and smooth finish.

		Conforming to IS: 2256 (Part 7): 1995 (Latest Revision). Equipped based brass faucets (chrome plated). Taps shall be IP65 protected and suitable for use. Sufficient Height and Length of tap spout shoulder provided as per design and requirement. Automatic Sensor Taps in Commercial Buildings Push Button Taps in Residential Buildings Hot and Cold-water mixer to be provided at Pillar Cock. Waste Coupling along with Bottle trap be provided. SS connector pipes to be provided. Approved Make: Kohler/ Duravit/ Toto
		CP brass fittings for faucets (low flow), angle valve, concealed valve, pillar cock, waste coupling, bottle trap CP/PVC, CP brass soap dish holder, shower rose / Arm as per the Architectural drawings/approved services drawings. Necessary provision of two anglefor Geyser with to be provided
		Urinals: Wall-hung vitreous China urinals. Conforming to IS: 2556 (Latest Revision). Heavy-duty concealed flush valve with anti-splash design. Suitable for continuous public usage. Appropriate Automatic Sensors to be provided as per design and requirement. Infra-red sensor operated flush valve (battery type). Waste Coupling and Bottle trap as per design and requirements. Approved Make: Kohler/ Duravit/ Toto

		Urinal Partitions: Urinal partitions shall be made of 12 mm thick compact laminate (HPL) board, waterproof, termite-proof and anti-bacterial. Density: Minimum 1400 kg/m³. Edges machine polished and rounded. Height: 900 mm to 1200 mm (as per drawing). Fixing with SS 304 grade brackets and fasteners. All hardware shall be rust-proof and concealed where possible.
		Accessible Toilet Water Closet (WC) (As per NBCS provisions): Wall-hung accessible water closet made of first-quality white vitreous china. Conforming to IS: 2556 (Latest Revision). Seat height: 450 ± 10 mm from finished floor level. Extended projection to facilitate side transfer from wheelchair. Concealed dual flush cistern (4/2 litres) or as specified in BOQ. Heavy-duty soft-close seat cover with stainless steel hinges. Flush actuator positioned within easy reach from the WC. Health faucet along with two-way bib cock to be provided. Approved Make: Kohler/ Duravit/ Toto
		Accessible Toilet Wash Basin (As per NBCS provisions): Wall-mounted accessible wash basin with underside clearance for wheelchair approach. Made of high-grade vitreous china with smooth glazed finish. Conforming to IS: 2556 (Part 7) – Latest Revision. Rim height: Maximum 800 mm above finished floor level.

		Infrared sensor-operated or push-button self-closing faucet. Exposed pipes shall be insulated or suitably covered to prevent accidental contact. Sufficient Height and Length of tap spout shoulder provided as per design and requirement. Automatic Sensor Taps in Commercial Buildings Push Button Taps in Residential Buildings Hot and Cold-water mixer to be provided at Pillar Cock. Waste Coupling along with Bottle trap to be provided. SS connector pipes to be provided. Approved Make: Kohler/ Duravit/ Toto
		Grab Bars (As per site requirement): SS 316 grade stainless steel grab bars with satin finish. Outside diameter: 32–38 mm. Minimum wall thickness: 1.5 mm. Horizontal and vertical grab bars shall be provided adjacent to the WC and wash basin as per approved drawings. Capable of safely supporting a minimum load of 150 kg. Fixed using concealed heavy-duty stainless-steel brackets and fasteners
		CP Brass single lever diverter of bath spout, shower rose and hand shower all Approved Make: Kohler/ Duravit/ Toto
		Corner Glass Shelf for shampoo bottles, Looking mirrorof size and shape with Decorative rigid PVCmolded beadings and CP brass towel ring near wash basin as per the Architectural drawings/ approved services drawings.
		Health faucets as per approved make and model Approved Make: Kohler/ Duravit/ Toto
		CP brass/ Stainless steel toilet paper holder with CP flange.

		Approved Make: Kohler/ Duravit/ Toto

		Chrome Fittings: All fittings shall conform to IS: 781-1984 (Latest Revision). Material: Forged brass body (minimum 59% copper content). Chrome plating thickness: Minimum 10-micron nickel + 0.3-micron chromium. Heavy-duty cartridge (minimum 5 lakh cycle tested). Suitable for high pressure. Approved Make: Kohler/ Duravit/ Toto
2	Kitchen Fixtures	Stainless steel kitchen sink made of AISI 316 grade stainless steel, Conforming to relevant IS Standards (Latest Revision). Double bowl with smooth rounded corners for easy cleaning and maintenance. Provided with 40 mm stainless steel waste coupling, strainer, and SS bottle/P-trap. Chrome-plated single lever sink mixer with swivel spout or long body bib tap, Sink fixed on heavy-duty wall brackets with all necessary anchor fasteners. All joints sealed with approved silicone sealant to prevent water leakage. Complete with all necessary accessories and connected to the drainage system as per approved drawings. Installation shall comply with the latest applicable CPWD Specifications, NBCS relevant IS Codes Sink Cock spout size as per of approved design and drawings. Approved Make: Nirali, Carysil, Kohler

3	Internal Water supply pipes	Chlorinated Polyvinyl Chloride (CPVC sdr 11 IS: 15778) pipes, having thermalstability for cold water supply, including all CPVC plain & brass threaded fittings, including fixing the pipe with clamps at 1.00 m spacing all as per the approved services drawings. CPVC sdr 11 IS: 15778 pipes for hot water supply diameter odpipe is as per design and specifications as per CPWD specifications 2019. Approved Make: Astral/ Prince/ Supreme
	External Water supply pipes	Pipes Exposed: diameter as per approved design and specification. CPVC plain (below 80mm) & Ductile iron (above 80mm) pipes as per approved plumbing drawing as per CPWD Specifications/approved servicesdrawings. Approved Make: Astral/ Prince/ Supreme
4	Soil & waste pipes and fittings	Soil waste and vent Hubless Centrifugally Cast (Spun) Iron Pipes and Fittings soil, waste and ventilating pipes, fittings and accessories shall conform to IS 15905. including testing of joints as per approved design and as per the Architectural drawings/approved services drawings. Approved Make: Neco / Bengal Iron/ Jagannath
5	Manhole	Brick masonry in cement mortar 1:4 with common burnt clay FPS (Non-modular) Brick confirming to IS: 12894 of class designation 7.5 with high-strength FRP (Fiberglass Reinforced Polymer) covers at top at required locations as per approved services drawings. Size and shape shall be as per design.
6	Pipe between building manhole& service manhole	Np3 pipe of required size or as approved by Engineer-in-charge along with providing gully trap – as per CPWD Specifications/approved services drawings.
7	Drainage	Diameter as per approved design NP3 class (RCC pipes) and brick masonry manholes for disposal of sewage including testing of joints as per approved design and as per the Architectural drawings/ approved services drawings

		RCC Water storage tank for domestic usage / drinking/ flushing tank capacity as per consultant drawing and separate firefighting tank having suitable size as per NBC 2026 to be provided on terrace. Gun metal Control valve – each tank. Tanks to have CI Doors on top for access to tanks. Betonies based expandable water bar of size 15mmx20mm shall be

8	Overhead terrace tank	provided at every construction joint.Water proofing inside the tanks with Brush bond RFX of approved make of thickness not less than 1.5mm followed by 12mm plaster of CM 1:3 neat cement finished. Applicationof Anti- Fungal paints: Food Grade Epoxy paint over a coatof compatible primer on the finished inner surfaces of thetank to avoid fungal growth on walls.
9	Manholes & Gully trap	Brick masonry Manholes & Gully trap of required dia. as per depth in cement mortar 1:4 (1 cement: 4 with foundation concrete 1:3:6 (1 cement: 3 coarse sand: 6 aggregate 20 mm nominal size stone aggregate) with inside plaster 1:4 (1 cement: 4 coarse sand) with floating coat of neat cement, outside cement plaster 1:4 (1 cement: 4 coarse sand) with SFRC cover 30 ton load capacity at top. In sub-soil or adverse soil conditions, manholes & Gully trap shall be as per approved structural design (to be given by the contactor) to avoid sinking and settlement of lines/manholes. The channels to require shape, size and slope in cement concrete 1:1.5:3 finished with neat cement punning shall also be provided inside themanhole. Manholes, Gully trap pipe line connected to nearest external seaware line/ STP as per direction of Engineer-in- Charge/approved services drawings
10	Footrest	Orange color safety foot rest of minimum 16mm thick plastic encapsulated complete as per IS: 10910 at requiredspacing as per CPWD specifications to be provided in UG sump, terrace water tanks, Deep Manholes.
11	Storm water drains	RCC Grade M-30 storm water drains of size as per design, either constructed as Cast-in-Situ RCC or using Factory-made Precast RCC Drain Units, covered with RCC/Precast RCC cover slabs designed to withstand the design vehicular load along with cow catcher at locations as per design, including Fire Tender Load in fire tender movement areas, as per approved drawings, relevant BIS/CPWD Specifications, and approved by the SBI, PMC & SBI, PMC & engineer-in-charge

BASIS OF DESIGN

The Plumbing, External Drainage and water supply System for the project is designed keeping in view the following:

Requirement of adequate and equal pressure availability of hot and cold-water lines in Toilets, Kitchen and other identified areas.

Adequate storage of water in underground + overhead water tanks.

Levels of roads / pavements and other services in the area.

Landscape layout.

The execution of works and materials used shall be as per the latest relevant I.S. specifications. Wherever reference has been made to Indian Standard or any other specifications, the same shall mean to refer to the latest specification irrespective of any particular edition of such specification being mentioned in the specifications below or Schedule of Quantities.

CONCEPT OF THE SYSTEM

The following services are envisaged for the complex:

It is understood that supply of water to this complex is potable as per IS:10500.

Domestic/Flushing water supply through Hydro pneumatic system.

Sewage and Silage collection system based on IS:1742 and applicable standards for domestic drainage and connected to existing sump.

Storm / Rainwater drainage system from various levels of the building and disposal to Rain Water Harvesting System / storm water drain and connected to existing drain.

WATER STORAGE & DISTRIBUTION SYSTEM

Water Requirement

The water requirement for this project is proposed to be as per the provisions in IS : 1172 and prevalent practices.

Source of Water

It is expected that part of the daily domestic water requirement shall be through central mains supply.

Following components shall be included in the water supply system for efficient functioning:

Automatic air vent

Pressure Gauge.

Water Hammer arrestors.

WORKMANSHIP

The workmanship shall be best of its kind and shall confirm to the specifications, as below or Indian Standard Specifications in every respect or latest trade practices and shall be subject to approval of the SBI, PMC & engineer-in-charge. All materials and/or workmanship which in the opinion of the SBI, PMC & engineer-in-charge are defective or unsuitable shall be removed immediately from the site and shall be substituted with proper materials and/or workmanship forthwith.

MATERIALS

All materials shall be best of their kind and shall confirm to the latest Indian Standards. All materials shall be of approved quality as per samples and origins approved by the engineer-in- charge. As and when required by the SBI, PMC & engineer-in-charge, the contractor shall arrange to test the materials and/or portions of works at his own cost to prove their soundness and efficiency. If aftertests any materials, work or portions or work are found defective or unsound by the engineer-in- charge, the contractor shall remove the defective material from the site, pull down and re-executethe works at his own cost to the satisfaction of the SBI, PMC & engineer-in-charge. To prove that the materialsused are as specified the contractor shall furnish the Owner's Site Representative with original vouchers on demand.

GENERAL INSTRUCTIONS

Scope of Work

The form of Contract shall be according to the "Conditions of Contract". The following clauses shall be considered as an extension and not in limitation of the obligation of the Contractor.

Work under this contract shall consist of furnishing all labour, materials, equipment and appliances necessary and required. The Contractor is required to completely furnish all the Plumbing and other specialized services as described hereinafter and as specified in specification or shown on the Plumbing Drawings.

Without restricting to the generally of the foregoing, the sanitary installations shall include the following: -

Plumbing Works

Sanitary ware Installation

Water Supply System (Hot & Cold).

All Underground and Overhead Water tanks

RO Plant

Solar water heater

Hydro pneumatic pump

Sewerage & Storm water drainage system.

Sewage Treatment Plant.

Water Treatment Plant

Rainwater Harvesting System

Garden Irrigation System.

High side works etc.

Services rendered under this section shall be done without any extra charge.

Specifications

Work under this contract shall be carried out strictly in accordance with Specifications attached with the tender.

Items not covered under these Specifications due to any ambiguity or misprints, or additional works, the work shall be carried out as per Specifications of the latest Central Public Works Department with up to date amendments as applicable in the contract and or as per the instruction of the SBI, PMC & engineer-in-charge.

Works not covered shall be carried out as per relevant Indian Standards and in case of its absence as per Code of Practice.

Execution of Work

The Contractor should visit and examine the site of work and satisfy himself as to the nature of the existing roads and other means of communication and other details pertaining to the work and local conditions and facilities for obtaining his own information on all matters affecting the execution of work. No extra charge made in consequence of any misunderstanding, incorrect information on any of these points or on ground of insufficient description will be allowed.

The work shall be carried out in conformity with the Plumbing drawings and within the requirements of Architectural, HVAC, Electrical, Structural and Other specialized services drawings.

The Contractor shall cooperate with all trades and agencies working on the site. He shall make provision for hangers, sleeves, structural openings and other requirements well in advance to prevent hold up of progress of the construction schedule.

On award of the work, Contractor shall submit a schedule of construction in the form of a PERT Chart or BAR Chart for approval of the SBI, PMC & engineer-in-charge. All dates and time schedule agreed upon should be strictly adhered to, within the stipulated time of completion/commissioning along with the specified phasing, if any.

Drawings

Plumbing drawings are diagrammatic but shall be followed as closely as actual construction permits. Any deviations made shall be in conformity with the Architectural and otherservices drawings.

Architectural drawings shall take precedence over Plumbing or other services drawings as to all dimensions.

Contractor shall verify all dimensions at site and bring to the notice of the SBI, PMC & engineer-in-chargeall discrepancies or deviations noticed. Decision of the SBI/ PMC shall be final.

Large size details and manufacturers dimensions for materials to be incorporated shall take precedence over small scale drawings.

All drawings issued by the EPC Contractor for the work are the property of the SBI and shall not be lent, reproduced or used on any works other than intendedwithout the written permission of SBI.

Inspection and Testing of Materials

Contractor shall be required, if requested, to produce manufacturers Test Certificate for the particular batch of materials supplied to him. The tests carried out shall be as per the relevantIndian Standards.

For examination and testing of materials and works at the site Contractor shall provide all Testing and Gauging Equipment necessary but not limited to the followings:-

Theodolite, Steel tapes

Dumpy level

Weighing machine

Plumb bobs, Spirit levels, Hammers

Micrometers, Tachometers

Thermometers, Stoves

Hydraulic test machine

Smoke test machine

All such equipment shall be tested for calibration at any approved laboratory, if required by the Project Manager.

All Testing Equipment shall be preferably located in a special room meant for the purpose.

Samples of all materials shall be got approved before placing order and the approved samples shall be deposited with the SBI, PMC & engineer-in-charge or kept at site in a sample room. Any materials declared defective by SBI, PMC & engineer-in-charge shall be removed from the site within 48 hours.

Metric Conversion

All dimensions and sizes of materials and equipment given in the tender document are commercial metric sizes.

Any weights, or sizes given in the tender having changed due to metric conversion, the nearest equivalent sizes accepted by Indian Standards shall be acceptable without any additional cost.

Reference Points

Contractor shall provide permanent Benchmarks, Flag Tops and other reference points for the proper execution of work and these shall be preserved till the end of the work.

All such reference points shall be in relation to the levels and locations given in the Architectural and Plumbing drawings.

Reference Drawings

The Contractor shall maintain one set of all drawings issued to him as reference drawings. These shall not be used on site. All-important drawings shall be mounted on boards and placed in racks indexed. No drawings shall be rolled. And one set of drawing should be laminated kept in custody contractor.

All corrections, deviations and changes made on the site shall be shown on these reference drawings for final incorporation in the completion drawings. All changes to be made shall be initialed by the SBI/PMC.

Shop Drawings

The Contractor shall submit to the SBI, PMC & engineer-in-charge three copies of the shop drawings.

Shop drawings shall be submitted under following conditions: -

Showing any changes in layout in the plumbing drawings

Equipment layout, piping and wiring diagram.

Manufacturers or Contractor's fabrication drawings for any materials or equipmentsupplied by him.

The Contractor shall submit two copies of catalogues, manufacturer's drawings,equipment characteristics data or performance charts as required by the SBI, PMC & engineer-in-charge.

Completion Drawings

On completion of work, Contractor shall submit one complete set of original tracings and two prints of "as built" drawings to the SBI/PMC Which were taken from contractor these drawings shall have the following information.

Run of all piping, diameters on all floors, vertical stacks and location of external services.

Ground and invert levels of all drainage pipes together with location of all manholes and connections up to outfall.

Run of all water supply lines with diameters, locations of control valves, access panels.

Location of all mechanical equipment with layout and piping connections.

Completion certificate shall not be issued until and unless the above drawings are submitted.

Contractor shall provide two sets of catalogues, service manuals manufacturer's drawings, performance data and list of spare parts together with the name and address of the manufacturer for all electrical and mechanical equipment provided by him.

All "Warranty Cards" given by the manufacturers shall be handed over to the engineer- in-charge.

Testing

Piping and drainage works shall be tested as specified under the relevant clause(s) of the specifications.

Field tests shall be performed in the presence of the SBI, PMC & engineer-in-charge.

All materials and equipment found defective shall be replaced and whole work tested to meet the requirements of the specifications.

Contractor shall perform all such tests as may be necessary and required by the local authorities to meet Municipal or other bye-laws in force.

Contractor shall provide all labour, equipment and materials for the performance of the tests.

Site Clearance and Cleanup

The Contractor shall, from time to time clear away all debris and excess materials accumulated at the site.

After the Fixtures, equipment and appliances have been installed and commissioned, Contractor shall clean-up the same and remove all plaster, paints stains, stickers and other foreign matter of discoloration leaving the same in a ready to use condition.

On completion of all works, Contractor shall demolish all stores, remove all surplus materials and leave the site in a broom clean condition, failing which the same shall be done at Contractors risk and cost.

License Permits and Authorities

Contractor must keep constant liaison with the Municipal/statutory authority and obtain all approval of all drainage, water supply and other works carried out by him.

Cutting of Water Proofing Membrane

No walls, terraces shall be cut for making and opening after water proofing has been done without written approval of SBI, PMC & engineer-in-charge. Cutting of water proofing membrane shall be done very carefully to ensure that other portion(s) of water proofing is (are) not damaged. On completion ofwork at such place the water proofing membrane shall be made good and ensured that the opening/cutting is made fully waterproof as per specifications and details of water proofing approved by SBI, PMC & engineer-in-charge.

Materials

Unless otherwise specified and expressly approved in writing by the SBI, PMC & engineer-in-charge, only materials of makes and specifications mentioned in the list of approved makes attached with the specifications shall be used.

If required, the Contractor shall submit samples of materials proposed to be used in the works. Approved samples shall be kept in the office of the E.INC. and returned to the Contractor at the appropriate time.

SANITARY FIXTURES

Work under this section shall consist of furnishing all material and labour as necessary and required to completely install all sanitary fixtures, brass and chromium plated fittings and accessories as required by the drawings.

Without restricting to the generally of the foregoing the sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the building.

Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

GENERAL REQUIREMENTS

All fixtures and fittings shall be provided with all such accessories as are required to complete the item in working condition whether specifically mentioned, specifications, drawings or not.

All fixtures and accessories shall be fixed in accordance with a set pattern matching the tiles or interior finish as per architectural/interior designer's requirements. Wherever necessary the fittings shall centered to dimensions and pattern desired.

Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required as per directions of SBI, PMC & engineer-in-charge.

All fittings and fixtures shall be fixed in a neat workmanlike manner true to levels and heights shows on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at contractor's cost.

When directed, contractor shall install fixtures and accessories in a mock-up room for the approval of the Architect. Sample room fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

Indian Water Closet (Orissa Pattern)

Indian Water Closet (Orissa Pattern) shall be of first-quality white vitreous china with smooth glazed finish.

Conforming to IS: 2556 (Part 3) – Latest Revision.

Size shall be as per the approved design

Integral footrests with anti-slip surface.

Trap: 100 mm P-Trap/S-Trap with minimum 50 mm water seal.

Flushing arrangement through 4/2 litre concealed dual flush cistern or 10 litre exposed low-level cistern, as per approved design.

Cistern shall conform to IS: 2556 (Latest Revision).

Heavy-duty 32 mm uPVC/CPVC flush pipe complete with all fittings and clamps.

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connection for water supply to the cistern (where applicable).

75 mm/100 mm soil pipe connection with approved rubber gasket/solvent cement joint, as applicable.

All exposed brass fittings shall be chrome-plated.

The pan shall be fixed true to line and level in a neat and workmanlike manner over a rigid base and set in cement concrete of mix 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate of 20 mm nominal size) or as specified in the latest CPWD Specifications, with proper alignment and finished flush with the floor.

The joint between the W.C. and the flush pipe shall be made watertight using lead and linseed oil, properly caulked, or with an approved rubber joint/coupling, as specified.

The joint between the trap and the soil pipe shall be made completely watertight using approved rubber gasket, solvent cement, or other approved jointing material, as applicable.

The joint between the pan and the finished floor shall be sealed with approved white sanitary-grade silicone sealant.

Complete with all necessary fixing accessories, connectors, fasteners, and making all connections to the water supply and drainage system.

The complete installation shall be tested for proper flushing, alignment, stability, and leak-proof performance.

Installation shall be carried out as per the approved drawings, BOQ, latest CPWD Specifications, relevant BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge

Approved Make: (Kohler, TOTO, Duravit)

Wall Hung Water Closet (WC)

Wall Hung Water Closet (WC) shall be of first-quality white vitreous china with smooth glazed finish.

Conforming to IS: 2556 (Latest Revision).

Size and configuration shall be as per the approved design.

Wall-mounted rimless/rim type bowl with concealed fixing arrangement.

Trap: 100 mm P-Trap with minimum 50 mm water seal.

Flushing arrangement through 4/2 litre concealed dual flush cistern, as per approved design.

Concealed cistern shall conform to IS: 2556 (Latest Revision).

Heavy-duty soft-close thermoset seat cover with stainless steel hinges.

Heavy-duty concealed wall mounting frame/support system suitable for a minimum static load of 400 kg.

Heavy-duty 32 mm uPVC/CPVC flush pipe complete with all fittings and clamps.

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connection for water supply to the concealed cistern.

100 mm soil pipe connection with approved rubber gasket/solvent cement joint, as applicable.

All exposed brass fittings shall be chrome-plated.

The WC shall be fixed true to line and level in a neat and workmanlike manner with heavy-duty concealed mounting brackets/frame, ensuring rigid, vibration-free and leak-proof installation.

The joint between the W.C. and the flush pipe shall be made watertight using approved rubber joint/coupling or other approved jointing materials, as per approved design.

The joint between the trap and the soil pipe shall be made completely watertight using approved rubber gasket, solvent cement, or other approved jointing material, as applicable.

The joint between the WC and the finished wall shall be sealed with approved white sanitary-grade silicone sealant.

Complete with concealed cistern, flush plate, mounting frame, fixing accessories, connectors, fasteners, and all necessary connections to the water supply and drainage system.

The complete installation shall be tested for proper flushing, alignment, stability, load-bearing capacity, and leak-proof performance.

Installation shall be carried out as per the approved drawings, BOQ, latest CPWD Specifications, relevant BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit)

Countertop/Undercounter Wash Basin

Countertop/Under Counter Wash Basin shall be of first-quality white vitreous china with smooth glazed finish.

Conforming to IS: 2556 (Latest Revision).

Size and configuration shall be as per the approved design.

Counter-mounted basin with smooth contours and overflow provision (where applicable).

Basin shall be provided with a 32 mm chrome-plated brass waste coupling with stainless steel strainer and all necessary accessories.

32 mm CP brass bottle trap with wall flange or concealed waste arrangement, as

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connection for water supply.

Infrared sensor-operated chrome-plated brass basin mixer/faucet complete with sensor, solenoid valve, control box, power supply (battery/AC adaptor), and all necessary accessories shall be provided for commercial, hostel areas. Auto-closing (self-closing) chrome-plated brass basin mixer/pillar cock shall be provided for residential buildings, as specified in the approved drawings.

All exposed brass fittings shall be chrome plated.

The basin shall be fixed true to line and level over a polished granite/solid surface/artificial stone counter using the manufacturer's recommended fixing system, ensuring rigid, vibration-free, and leak-proof installation.

The joint between the basin and the countertop shall be sealed with approved white sanitary-grade silicone sealant to prevent water ingress.

The bottle trap/waste pipe shall be connected to the drainage system using approved uPVC fittings with leak-proof joints.

Complete with all necessary fixing accessories, connectors, fasteners, sealants, and making all connections to the water supply and drainage system.

Counter shall be made of granite with double molding as per design and drawings.

The complete installation shall be tested for proper alignment, stability, watertightness, drainage performance, and leak-proof operation.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit)

URINALS

Sensor Operated Urinal

Urinal shall be of first-quality white vitreous china with smooth glazed finish.

Conforming to IS: 2556 (Latest Revision).

Size and configuration shall be as per the approved design.

Wall-mounted urinal with integral spreader or concealed flushing arrangement, complete with all necessary fixing accessories.

Urinal shall be provided with a wall-mounted infrared sensor-operated concealed flush valve complete with sensor, solenoid valve, concealed control box, power supply (battery/AC adaptor), flush pipe, and all necessary accessories. The sensor shall be installed at a suitable height on the wall away from direct water splash to ensure reliable operation and ease of maintenance, as per the approved drawings, approved design.

Flush volume shall be water-efficient and adjustable as per the manufacturer's recommendations.

40 mm CP brass waste coupling with stainless steel grating and all necessary accessories.

32 mm/40 mm CP brass bottle trap or concealed P-trap, as specified in the approved drawings.

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connection for water supply.

All exposed brass fittings shall be chrome plated.

The urinal shall be fixed true to line and level in a neat and workmanlike manner using heavy-duty concealed wall fixing brackets, ensuring rigid, vibration-free, and leak-proof installation.

The joint between the urinal and the finished wall shall be sealed with approved white sanitary-grade silicone sealant to prevent water ingress.

The waste pipe shall be connected to the drainage system using approved uPVC fittings with leak-proof joints.

Complete with all necessary fixing accessories, connectors, fasteners, sealants, and making all connections to the water supply and drainage system.

The complete installation shall be tested for proper flushing, sensor operation, alignment, stability, drainage performance, and leak-proof operation.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit).

Urinal Partitions

Urinal partitions shall be made of 12 mm thick Compact High Pressure Laminate (HPL) board, waterproof, termite-proof, anti-bacterial, impact-resistant, and scratch-resistant.

Compact laminate shall have a minimum density of 1400 kg/m^3 and shall be suitable for wet area applications.

Size and configuration shall be as per the approved drawings and approved design.

All exposed edges shall be machine polished, chamfered/rounded, and moisture sealed.

Partition height shall be 900 mm to 1200 mm, or as specified in the approved drawings.

Partitions shall be fixed using SS 304 grade heavy-duty brackets, support channels, and concealed stainless steel fasteners.

All hardware including brackets, screws, and anchors shall be SS 304 grade, rust-proof, corrosion-resistant, and concealed wherever practicable.

The partitions shall be installed true to line and level, ensuring rigid, stable, and vibration-free installation.

All cut edges, joints, and fixing points shall be properly finished to prevent moisture ingress and ensure durability.

Colour, finish, and texture shall be selected from the manufacturer's standard range and approved by the SBI, PMC & Engineer-in-Charge.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge

Kitchen Sink

Kitchen sink shall be made of AISI 316 grade stainless steel with satin finish.

Conforming to the relevant IS Standards (Latest Revision).

Size, configuration, and bowl arrangement (single/double bowl with or without drain board) shall be as per the approved drawings, approved design, and BOQ.

Minimum stainless steel sheet thickness shall be 1.2 mm or as specified in the approved design.

Double bowl with smooth rounded corners and sound-deadening pads for easy cleaning, durability, and noise reduction.

Sink shall be provided with 40 mm stainless steel waste coupling, removable basket strainer, overflow arrangement (where applicable), and 40 mm uPVC/CP brass bottle trap or P-trap, complete with all necessary fittings.

Chrome-plated single lever sink mixer with swivel spout or long body bib tap, as per the approved drawings, approved design,

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connections for hot and cold water supply (where applicable).

Sink shall be fixed on heavy-duty SS 316 wall brackets or suitable countertop support system with all necessary anchor fasteners, ensuring rigid and vibration-free installation.

All joints between the sink and countertop/wall shall be sealed with approved sanitary-grade silicone sealant to prevent water leakage.

Waste pipe shall be connected to the drainage system using approved uPVC fittings with leak-proof joints.

Complete with all necessary fixing accessories, connectors, fasteners, sealants, and making all connections to the water supply and drainage system.

The complete installation shall be tested for proper alignment, stability, water-tightness, drainage performance, and leak-proof operation.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBCS, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Nirali, Carysil, Kohler).

Toilet Accessories

Toilet accessories including soap dispensers, toilet paper holders, towel rails, towel rings, grab bars, robe hooks, hand dryers, shelf with towel rail (where specified), and other accessories shall be provided as per the approved drawings, approved design.

All accessories shall be manufactured from minimum SS 304 grade stainless steel with mirror or satin finish, unless otherwise specified.

Stainless steel components shall have a minimum thickness of 1.0 mm, wherever applicable.

All accessories shall be rust-proof, corrosion-resistant, tamper-proof, and suitable for heavy-duty residential, commercial, institutional, and hostel applications.

Towel rails with integrated upper storage rack shall be provided in toilet and washroom areas wherever specified, offering convenient towel hanging space along with additional storage for efficient utilization of space.

A stainless-steel towel ring shall be provided adjacent to each wash basin at a convenient and accessible location without obstructing the use of sanitary fixtures.

Soap dispensers shall be wall-mounted, refillable, and of suitable capacity for the intended use.

Hand dryers, wherever specified, shall be wall-mounted, automatic sensor-operated, energy-efficient, and complete with all electrical accessories required for operation.

Grab bars shall be SS 304 grade with concealed fixing and shall conform to the approved accessibility requirements and approved drawings.

All accessories shall be securely fixed using SS 304 grade concealed fasteners, brackets, anchors, and fixing hardware, ensuring rigid, durable, and vandal-resistant installation.

Installation shall be carried out true to line and level, complete with all necessary fixing accessories, and in accordance with the manufacturer's recommendations.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit).

Accessible Wall Hung Water Closet (WC)

Wall Hung Accessible Water Closet (WC) shall be of first-quality white vitreous china with smooth glazed finish.

Conforming to IS: 2556 (Latest Revision).

Size and configuration shall be as per the approved drawings, approved design,

Wall-mounted rimless/rim type bowl with concealed fixing arrangement.

Seat height shall be 450 ± 10 mm above finished floor level (FFL) in accordance with accessibility requirements.

Extended bowl projection to facilitate side transfer from a wheelchair.

100 mm P-Trap with minimum 50 mm water seal.

Concealed dual flush cistern (4/2 litres) complete with flush plate, or as per the approved drawings, approved design.

Concealed cistern shall conform to IS: 2556 (Latest Revision).

Heavy-duty soft-close thermoset seat cover with stainless steel hinges.

Heavy-duty concealed wall mounting frame/support system designed to withstand a minimum static load of 400 kg.

Flush actuator shall be positioned within easy reach of the user and shall comply with accessibility requirements.

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connection for water supply to the concealed cistern.

32 mm uPVC flush pipe complete with all fittings and clamps.

100 mm soil pipe connection with approved rubber gasket/solvent cement joint, as applicable.

All exposed brass fittings shall be chrome-plated.

The WC shall be fixed true to line and level in a neat and workmanlike manner with heavy-duty concealed mounting frame, ensuring rigid, vibration-free, and leak-proof installation.

The joint between the W.C. and the flush pipe shall be made watertight using approved rubber joint/coupling or other approved jointing materials.

The joint between the trap and the soil pipe shall be made completely watertight using approved rubber gasket, solvent cement, or other approved jointing material, as applicable.

The joint between the WC and the finished wall shall be sealed with approved white sanitary-grade silicone sealant.

SS 304 grade grab bars (horizontal and vertical/folding type as applicable) shall be provided around the WC in accordance with the approved drawings and accessibility standards.

Toilet paper holder shall be installed within easy reach of the user as per accessibility requirements.

Complete with concealed cistern, flush plate, mounting frame, fixing accessories, connectors, fasteners, sealants, and making all necessary connections to the water supply and drainage system.

The complete installation shall be tested for proper flushing, alignment, stability, load-bearing capacity, accessibility compliance, and leak-proof performance.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit).

Accessible Wash Basin

Wall-mounted accessible wash basin shall be of first-quality white vitreous china with smooth glazed finish.

Conforming to IS: 2556 (Part 7) – Latest Revision.

Size and configuration shall be as per the approved drawings, approved design.

Wall-mounted basin shall provide adequate knee and toe clearance beneath the basin for unobstructed wheelchair approach, in accordance with accessibility requirements.

Rim height shall not exceed 800 mm above Finished Floor Level (FFL).

Basin shall be provided with 32 mm chrome-plated brass waste coupling with stainless steel strainer and all necessary accessories.

32 mm CP brass bottle trap with protective insulation/cover or concealed waste arrangement to prevent accidental contact.

15 mm CP brass angle valve with chrome-plated flange.

450 mm long stainless steel braided flexible connection for water supply.

Infrared sensor-operated chrome-plated brass basin mixer/faucet complete with sensor, solenoid valve, concealed control box, power supply (battery/AC adaptor), and all necessary accessories. Where specified, a push-button self-closing faucet may be provided, as per the approved drawings, approved design.

All exposed brass fittings shall be chrome-plated.

All exposed water supply and waste pipes shall be insulated or suitably covered to prevent accidental contact and injury to wheelchair users.

The basin shall be fixed true to line and level using heavy-duty concealed wall brackets and anchor fasteners, ensuring rigid, vibration-free, and leak-proof installation.

The joint between the basin and the finished wall shall be sealed with approved white sanitary-grade silicone sealant.

The waste pipe shall be connected to the drainage system using approved uPVC fittings with leak-proof joints.

Mirror shall be installed at an accessible height and suitably inclined where specified to facilitate use by wheelchair users.

Complete with all necessary fixing accessories, connectors, fasteners, sealants, and making all connections to the water supply and drainage system.

The complete installation shall be tested for proper alignment, stability, accessibility compliance, water-tightness, drainage performance, sensor operation (where applicable), and leak-proof performance.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit).

MIRRORS

Mirror shall be of high-quality 5 mm thick float glass with copper-free, moisture-resistant silver backing.

Conforming to the relevant IS Standards (Latest Revision).

Size and configuration shall be as per the approved drawings, approved design.

The mirror shall have machine-polished edges with safety backing film to minimize the risk of injury in case of breakage.

Mirror shall be fixed using SS 304 grade concealed clips/brackets or approved adhesive fixing system, ensuring rigid and secure installation.

In Accessible Toilets, the mirror shall be installed with the bottom edge not more than 900 mm above Finished Floor Level (FFL) and the top edge at least 1800 mm above FFL, or alternatively shall be tilted (5°–10°) to provide clear visibility for wheelchair users, as per accessibility requirements.

All exposed fixing hardware shall be SS 304 grade, corrosion-resistant, and concealed wherever practicable.

The perimeter between the mirror and the wall shall be sealed with approved clear sanitary-grade silicone sealant to prevent moisture ingress.

Mirrors in commercial, hostels, area washrooms shall be of factory-fitted integrated LED illuminated type (backlit/front-lit), complete with built-in LED lighting system, moisture-resistant construction, and suitable power supply, as per the approved drawings, approved design

Complete with all necessary fixing accessories, brackets, fasteners, and supports.

The complete installation shall be tested for proper alignment, rigidity, safety, and finish.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Shower Set with Diverter and Hand Shower

Shower set shall be of premium quality, chrome-plated brass, complete with overhead shower, hand shower, diverter, shower arm, flexible hose, and all necessary accessories.

All components shall conform to the relevant BIS Standards (Latest Revision).

Size, configuration, and installation shall be as per the approved drawings, approved design.

Overhead shower shall be wall-mounted, rain-type or conventional type, with anti-clog silicone nozzles, chrome-plated finish, and minimum 200 mm diameter (or as specified in the approved design).

Hand shower shall be chrome-plated ABS/Brass with anti-clog nozzles, complete with wall hook, 1.5 m long stainless steel braided flexible hose, and all necessary fittings.

Single lever concealed diverter (2-way/3-way as specified) shall be of heavy-duty brass construction with ceramic cartridge, enabling smooth operation between overhead shower, hand shower, and bath spout (where applicable).

Concealed body of the diverter shall be of forged brass with all necessary concealed fittings and protective cover.

15 mm hot and cold water inlet connections shall be provided complete with CP brass angle valves, chrome-plated flanges, and 450 mm long stainless steel braided flexible connections, where applicable.

All exposed brass fittings shall be chrome-plated with mirror finish.

Shower arm shall be SS 304/CP brass, complete with wall flange and suitable projection as per the approved design.

All threaded joints shall be sealed using approved PTFE tape or equivalent sealing material to ensure leak-proof performance.

All concealed pipe connections shall be pressure-tested before closing the wall chasing.

Complete with all fixing accessories, connectors, fasteners, sealants, and making all necessary hot and cold water supply connections.

The complete installation shall be tested for proper water flow, diverter operation, shower spray pattern, leak-proof performance, and overall functionality.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit).

Premium Shower Panel (For CGM VIP Room)

Shower Panel shall be of premium quality SS 304 stainless steel or high-quality aluminium body with chrome/brushed finish.

Size and configuration shall be as per the approved drawings, approved design.

Shower panel shall be complete with thermostatic mixer, rain shower, multi-function hand shower, body massage jets (minimum 4 nos.), diverter, flexible hose, shower arm, and all necessary accessories.

Rain shower shall have anti-clog silicone nozzles with a minimum size of 250 mm × 250 mm (or as per approved design).

Hand shower shall be chrome-plated with anti-clog nozzles, complete with 1.5 m long SS braided flexible hose and wall holder.

Thermostatic mixer shall maintain a constant water temperature and include a safety stop at 38°C to prevent scalding.

Body jets shall be adjustable and designed to provide a uniform massage spray.

All exposed brass fittings shall be chrome-plated, and all stainless steel components shall be of SS 304 grade.

Concealed pipework and connections shall be pressure-tested before completion of wall finishing.

All threaded joints shall be sealed using approved PTFE tape or equivalent sealing material to ensure leak-proof performance.

Complete with all fixing accessories, connectors, fasteners, sealants, and making all necessary hot and cold water supply connections.

The complete installation shall be tested for proper water flow, thermostatic mixer operation, diverter operation, shower functions, body jet performance, and leak-proof operation.

Installation shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

Approved Make: (Kohler, TOTO, Duravit, Grohe).

HUBLESS CENTRIFUGALLY CAST (SPUN) IRON PIPES AND FITTINGSSOIL,

WASTE, VENT PIPES & FITTINGS

Hubless Centrifugally Cast (Spun) Iron Pipes and Fittings soil, waste and ventilating pipes, fittings and accessories shall conform to IS 1590

The hubless centrifugally cast (spun) iron pipes shall have plain both ends (spigot type), without sockets. The pipes and fittings shall be true to shape, smooth and cylindrical, their inner and outer surface being as nearly as practicable concentric. They shall be sound and shall be free from cracks, taps, pinholes and other imperfections and shall be neatly dressed and carefully fettled. All pipes and fittings shall emit a clear ringing sound when struck with a light hand hammer.

The ends of pipes and fittings shall be reasonably square to their axis. The hubless centrifugally cast iron pipes shall be 3.0 metre or more in length.

All pipes and fittings shall be coated internally and externally with the epoxy coating material at the factory, the fitting being preheated prior to total immersion in a bath containing a uniformly heated composition. The coating material shall have good adherence and shall not scale off.

The tolerance in diameter of pipes shall be as prescribed in Table

Table-1

External Diameters and Tolerances

Sl. No.	Nominal size DN (in mm)	External Diameter DE (in mm)	Tolerance on External diameter DE (in mm)
(1)	(2)	(3)	(4)
1	50	58	+2

			-2
2	75	83	+2 -2
3	100	110	+2 -2
4	150	160	+2 -2
5	200	210	+2.5 -2.5

The thickness of fittings and spigot dimensions shall conform to the thickness and dimensions specified for the corresponding sizes of straight pipes. The nominal & minimum thicknesses of pipes & fittings shall be as per Table-2

Table-2

Nominal & Minimum Thickness of Pipes & Fittings

Sl. No.	Nominal size DN (in mm)	Thickness 'e' mm Pipe			
		Pipe		Fittings	
		Nominal	Minimum	Nominal	Minimum
(1)	(2)	(3)	(4)	(5)	(6)
i	50	3.5	3.0	4.2	3.0
ii	75	3.5	3.0	4.2	3.0
iii	100	3.5	3.0	4.2	3.0
iv	150	4.0	3.5	5.3	3.5
v	200	5.0	4.0	6.0	4.0

The access door fittings shall have no dead spaces in which filth may accumulate. Doors shall be provided with 3 mm rubber insertion packing and when closed and bolted, these shall be watertight.

Joints:

The pipes and fittings may assembled using various types of joints, The joints are intrinsic components of the drainage, whose characteristics and tolerances shall be specified in the manufactures catalogues.

Taking into account the different applications of cast iron pipe work systems, various joint designs arepermitted provided that they satisfy the requirement to this standard. The joints shall incorporate one or more EPDM rubber gasket(s) to ensure leak tightness and prevent direct contact between the ends of pipes, fittings and accessories.

Materials for coupling of clamping components shall usually be made from:

Ductile iron of grade 500/7 as per IS 1865,

or

(b) Stainless steels in accordance with IS 1570 (Part 5) in order to ensure resistance to corrosion and a stabilization against the austenitic stainless steel with at least 17 percent chrome and 9 percent nickel of equivalent, or from material of comparable resistance.

(c) Ductile iron couplings of clamping components shall be coated internally and externally.

(d) All parts of the joints shall free from defects likely to compromise their suitability for use.

Floor Traps & Urinal Traps

Floor traps shall be SS, deep seal with an effective seal of 50 mm. The trap and waste pipes shall be set in cement concrete blocks firmly supported on the structural floor. The blocks shall be in 1:2:4 mix (1 Cement: 2 Coarse sand: 4 stone aggregate 20 mm nominal size) and extended to 40 mm below finished floor levels. Contractor shall provide all necessary shuttering and centering for the block. Size of the block shall be 30 x 30 cms of the required depth.

All pipes shall be fixed in gradient towards the connection to stack or drains. Pipes inside all toilets room shall be in chase unless otherwise shown on drawings. Where so required and shown on drawings or directed by the SBI, PMC & engineer-in-charge.

(a)UPVC Pipes (Where specified or required at site for sump drainage only)

Pipes shall UPVC Pipes grade conforming to IS:13592 and quality certificates shall be furnished. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, Plugs. All UPVC. waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter. Linear Traps to be provided in all Executive/VIP bathrooms in Hostel Block.

Rainwater Pipes

All open terraces shall be drained by rainwater down takes. Rainwater down takes are separate and independent of the soil and waste system and will discharge into the underground storm water drainage system of the campus. Rainwater in open courtyards shall be collected in catch basins and connected to the storm water drains.

Upvc Rain water Fittings

Pipes shall be uPVC confirming to IS: 4985-2000 (quick fit type) and quality certificates shall be furnished as required. Pipes shall be provided with all required fittings e.g. Tees, Couplings, Bends, Elbows, Unions, Reducers, Nipples, and Plugs. All waste pipes shall be terminated at the point of connection with the appliance with an outlet of suitable diameter.

Rain Drainage under floor/above floor (service floors.)

All rainwater drainage lines passing under building, in exposed position above ground e.g. service floors, basement ceiling etc. shall be Multilayered as per details given in sub-clause 3.10 shall be as per details given below. Position of such pipes shall generally be shown on the drawings.

CUTTING HOLES IN WALL UPTO 30 × 30 CM

Square holes up to 300 mm × 300 mm or as required shall be carefully cut in brick masonry/RCC walls, floors, slabs, or ceilings for installation of pipes, sleeves, ducts, or other services, as shown in the approved drawings or as directed by the SBI, PMC & Engineer-in-Charge.

Cutting shall be carried out using approved mechanical tools to avoid unnecessary vibration, cracks, or damage to the surrounding structure and finishes.

After installation of the services, all openings shall be properly packed and sealed with cement mortar (1:3), non-shrink grout, or M-20 grade micro-concrete, as applicable, ensuring complete filling of all voids.

Openings in RCC members shall be repaired using non-shrink grout or approved polymer-modified repair mortar, as directed by the SBI, PMC & Engineer-in-Charge.

In wet areas such as toilets, kitchens, terraces, and shafts, the repaired portion shall be finished with approved waterproofing compound/coating matching the surrounding waterproofing system to maintain complete watertightness.

Where pipes or conduits pass through fire-rated walls or floors, the annular space shall be sealed with an approved fire-stop system having a fire resistance rating equal to or greater than that of the wall/floor.

All exposed surfaces shall be finished flush with the surrounding surface and restored to the original finish, including plastering, putty, tiles, stone cladding, painting, or other architectural finishes, as applicable.

Any damaged reinforcement, finishes, waterproofing, or adjacent work shall be repaired and reinstated to the satisfaction of the SBI, PMC & Engineer-in-Charge.

All dismantled materials and debris shall be removed from the site, and the work area shall be cleaned after completion.

The complete work shall be carried out in accordance with the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charg

CUTTING HOLES IN R.C.C. FLOORS (UPTO 15 × 15 CM)

Circular/Core holes up to 150 mm × 150 mm (or as specified in the approved drawings) shall be made in R.C.C. floors/slabs using a diamond core cutting machine only. Hammering or chiselling shall not be permitted.

Core cutting shall be carried out without causing vibration, cracks, or damage to the existing reinforcement, structural members, waterproofing, or adjoining finishes.

After installation of the pipe/sleeve, the annular gap around the pipe shall be cleaned and sealed using approved non-shrink cementitious grout or polymer-modified non-shrink repair mortar.

In toilet, washroom, kitchen, and other wet areas, the pipe penetration shall be provided with an approved polyurethane (PU) sealant or equivalent flexible waterproof sealant at the top surface and integral crystalline/cementitious waterproofing treatment around the penetration to ensure complete watertightness.

The repaired portion shall be finished flush with the surrounding slab and the waterproofing layer shall be reinstated to match the existing waterproofing system.

Where required, an approved puddle flange or pipe sleeve shall be provided around the pipe penetration to enhance waterproofing performance.

After completion of sealing and waterproofing, the treated area shall be subjected to a minimum 24-hour ponding (flood) test by retaining water to verify that there is no leakage or seepage through the slab.

Any leakage observed during the test shall be rectified, and the waterproofing treatment shall be repeated until a satisfactory leak-proof result is achieved.

The complete work shall be carried out as per the approved drawings, latest CPWD Specifications, relevant NBC, BIS Standards, and as approved by the SBI, PMC & Engineer-in-Charge.

WATER SUPPLY SYSTEM

Scope of Work

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the water supply system as required by the drawings, specified hereinafter and given in the Schedule of Quantities.

Without restricting to the generality of the foregoing, the water supply system shall include the following:-

Distribution system from main supply headers to all fixtures and appliances for cold/hot water.

Cold water supply lines from tube-wells and city water connections to fire and underground water tanks.

Municipal water and Bore-well connections to U.G. water tanks.

Garden Irrigation system

Excavation and refilling of pipes trenches.

Pipe protection and painting.

Control valves, masonry chambers and other appurtenances.

Connections to all plumbing fixtures, tanks, appliances and Municipal mains

Inserts for RCC tank.

All visible connecting pipes of distribution system on terrace should be avoided. If required, it should be fixed along parapet wall by making suitable arrangements for maintenance purpose.

General Requirements

All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Project Manager.

Pipes and Fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.

Short or Long bends shall be used on all main pipelines as far as possible. Use of Elbows shall be restricted for short connections.

Pipes shall be fixed in a manner so as to provide easy accessibility for repair and maintenance and shall not cause obstruction in shafts, passages etc.

Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.

Clamps, hangers and supports on RCC walls, columns and slabs shall be fixed only by means of approved made of expandable metal fasteners inserted by use of power drills.

All pipe clamps, supports, nuts, bolts, washers shall be MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.

Valves and other appurtenances shall be so located as to provide easy accessibility for

Ball Valve (Brass)

The ball valve shall be of Brass or Gunmetal as specified conforming to IS 1703 the ball valve shall be of following two classes:

High Pressure:

High pressure float valves are indicated by the abbreviation ‘HP’ and are designed for use on mains having pressure of 0.175 MPa or above.

Low Pressure:

Low Pressure float valves are indicated by the abbreviation ‘LP’ and are designed for use on mains having a pressure up to. 0.175 MPa.

Bib Taps and Stop Valve (One way and Two way as per requirement)

A bib tap is a draw off tap with a horizontal inlet and free outlet and a stop valve is a valve with suitable means of connections for insertion in a pipe line for controlling or stopping the flow. They shall be of specified size and shall be of screw down type and shall conform to IS 781. The closing device shall work by means of disc carrying a renewable non-metallic washer which shuts against water pressure on a seating at right angles to the axis of the threaded spindle which operates it. The handle shall be either crutch or butterfly type securely fixed to the spindle. Valve shall be of the loose leather seated pattern. The cocks (taps) shall open in anti-clockwise direction.

Gate Valve - Gun Metal

These shall be of the gun metal fitted with wheel and shall be of gate valve type opening full way and of the size as specified. These shall generally conform to IS 778

Butterfly Valves – Slim Seal Type

Valves 65 mm dia and above shall be GI 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.

Non Return Valve (Dual Slim Type)

Where specified, non return valve shall be provided through which flow shall occur in one direction only. 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 nuts, bolts and washers of correct length.

Union Valve

Union valves shall be of approved quality, suitable for isolation and maintenance purposes. The valves shall be provided with union connections at both ends for easy dismantling and maintenance. The valves shall be suitable for the specified pressure and temperature conditions and shall conform to relevant IS standards. The valves shall be of approved make.

Pressure Reducing Valve (PRV)

Pressure reducing valves shall be of approved quality, suitable for automatic reduction and regulation of downstream pressure. The valve shall maintain a constant preset outlet pressure under varying flow conditions and shall be suitable for the specified pressure and temperature conditions. The valve shall be complete with all necessary accessories and shall conform to relevant IS standards. The valve shall be of approved make.

Float Valve

Float valves shall be of approved quality, suitable for automatic control of water level in tanks. The valve shall provide smooth operation and shall be suitable for the specified pressure conditions. The valve shall conform to relevant IS standards and shall be of approved mak

Water Meter

Water meters shall be selected according to flow to be measured and not necessarily to suit a certain size of main. The following points shall govern the selection of meters:

a. The maximum flow shall not exceed the nominal capacity of the meter.

b. The continuous flow shall be not greater than the continuous running capacity rating.

c. The minimum flow to be measured shall be within minimum starting flows.

Inferential water meter has the same accuracy as the semi -positive type at higher flows; it passes unfiltered water better than a semi-positive meter and is lower in cost.

Special care is necessary in selecting the most suitable meter where large rates of flow may exist for short periods. The normal working flow shall be well within the continuous running capacity specified in IS 779, as high rates of flow over short period may cause excessive wear if the meter chosen is too small for the duty

Owing to the fine clearances in the working parts of meters, they are not suitable for measuring water containing sand or similar foreign matter, and in such cases a filter or dirt box of adequate effective area shall be fitted on the upstream side of the meter. It shall be noted that the normal strainer fitted inside a meter is not a filter and does not prevent the entry of small particles, such as sand

Water meters and their parts, especially parts coming in continuous contact with water shall be made of materials resistant to corrosion and shall be non -toxic and non-training. Use of dissimilar metals in contact under water shall be avoided as for possible in order to minimise electrolytic corrosion.

Water meters shall be provided as per the requirements of IGBC (Indian Green Building Council) guidelines for water monitoring and conservation

Strainers

Strainers shall be provided at pump room section pipe. Strainers shall be of a material which is not susceptible to electrolytic corrosion. They shall be of SS or other corrosion-resistant materials for both Type A and Type B meters. They shall be rigid, easy to remove and clean, and shall be fitted on the inlet side of the water meter. It shall be possible to remove and clean the strainer in such a way as not to permit disturbing the registration box or tampering with it. The strainer shall have a total area of holes not less than twice the area of the nominal inlet bore of the pipe to which the meter is connected however, in the case of meters provided with internal strainer involving opening
of the registration box for cleaning, an additional external strainer shall be fitted on the inlet side satisfying the above requirements.

Hydrostatic Tests

After a new pipe has been laid, jointed and back filled (or any valved section thereof), it shall be subjected to the following two tests:

Pressure test at a pressure of at least double the maximum working pressure-pipe and joints shall be absolutely water tight under the test.

Leakage test (to be conducted after the satisfactory completion of the pressure test) at a pressure to be specified by the authority for duration of two hours.

CP BRASS BIB COCK (One way and Two Way as per requirement)

The CP brass bib cock shall be conforming to IS : 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the bib cocks are normally fitted. The dimensions of body for Bib Cock shall be as per table given to IS : 8931. Each bib cock shall be legibly marked with the Manufacture's name and trade mark. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS LONG NOSE BIB COCK

The CP brass long nose bib cock shall be conforming to IS standards. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the bib cocks are normally
fitted. The weight of long nose Bib Cock shall be less than 810 grams. Each bib cock shall be legibly marked with the Manufacture's name and trade mark. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS LONG BODY BIB COCK

The CP brass long body bib cock shall be conforming to IS standards. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the long body bib cocks are normally fitted.
The weight of long body Bib Cock shall be less than 690 grams. Each bib cock shall be legibly marked with the Manufacture's name and trade mark. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS STOP COCK (CONCEALED)

The CP brass stop cock shall be conforming to IS : 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore shall be designated by the nominal bore of the pipe outlet to which the stop cocks are

normally fitted. The dimensions of body for stop Cock shall be as per table given to IS : 8931. Each stop cock shall be legibly marked with the Manufacture's name and trade mark. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS ANGLE VALVE

A valve with the inlet and outlet at right angles to each other and is intended to facilitate servicing of water fittings or appliances. The CP brass angle valve shall be conforming to IS: 8931. The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The 15mm nominal bore
shall be designated by the nominal bore of the pipe outlet to which the angle valves are normally fitted. The dimensions of body for angle valve shall be as per table given to IS: 8931. Each angle valve shall be legibly marked with the Manufacture's name and trade mark. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS HEALTH FAUCET

A health faucet is a hand-held water spray fitting provided adjacent to a water closet for personal hygiene purposes. The health faucet assembly shall consist of a chromium-plated brass spray head with trigger mechanism, flexible stainless steel braided hose, wall hook, and angle valve complete with all necessary accessories for proper installation.

The spray head shall be manufactured from high-quality brass with a durable chrome-plated finish conforming to relevant Indian Standards. The trigger mechanism shall operate smoothly and provide leak-proof performance under normal working pressure. The nozzle shall be designed to deliver a controlled and uniform water spray.

The flexible hose shall be 1.0–1.2 m long, made of stainless steel braided construction with an EPDM inner tube capable of withstanding a minimum working pressure of 10 kg/cm². The hose connections shall be compatible with 15 mm (½") BSP threaded fittings.

The wall bracket (hook) shall be chromium-plated brass or high-quality engineering polymer with a matching chrome finish. The complete assembly shall be suitable for operation with a 15 mm CP brass angle valve and shall include all washers, nipples, connectors, and fixing accessories required for installation.

The exposed surfaces shall have a smooth, bright, and corrosion-resistant chrome finish free from pits, blisters, cracks, or other manufacturing defects. The complete health faucet assembly shall be tested for leakage and satisfactory operation before dispatch and installation.

Each health faucet shall be legibly marked with the manufacturer's name or trademark, and the product shall conform to the relevant provisions of IS 8931 (for angle valve), IS 410 (for brass material where applicable), and other applicable BIS standards for sanitary fittings. The complete fitting shall be of approved make and quality, suitable for long-term use in residential, commercial, buildings. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS TWO WAY BIB TAP (TWO WAY ANGLE COCK / TWO WAY TAP)

A two-way tap is a plumbing fitting designed to provide two independent water outlets from a single water supply connection. It is commonly used for simultaneously connecting a health faucet and a flushing cistern or other sanitary fixtures. The CP brass two-way tap shall conform to the relevant provisions of IS: 8931 and applicable BIS standards for sanitary fittings.

The body shall be manufactured from high-quality forged brass with a heavy-duty construction and shall have a durable chromium-plated finish. The external and internal surfaces shall be clean, smooth, and free from casting defects, pits, cracks, or other imperfections. The chrome plating shall be uniform, corrosion-resistant, and capable of retaining its finish under normal service conditions.

The tap shall be of 15 mm nominal bore (½") with one inlet and two independently controlled outlets. Each outlet shall be provided with a smooth-operating quarter-turn or screw-down mechanism fitted with suitable ceramic disc cartridges or high-quality spindle assemblies to ensure leak-proof performance and long service life.

The inlet and outlet threads shall be compatible with 15 mm BSP threaded pipe connections. The tap shall be capable of withstanding a minimum working pressure of 10 kg/cm² without leakage or malfunction.

The complete fitting shall include wall flange (if applicable), sealing washers, and all accessories required for proper installation. The exposed surfaces shall be polished to a bright chrome finish and shall be free from visible defects.

Each two-way tap shall be legibly marked with the manufacturer's name or trademark, and the complete assembly shall be tested for leakage and satisfactory operation before installation. The fitting shall be of approved make and suitable for use in residential, commercial, buildings. Approved Make: (Kohler, TOTO, Duravit)

CP BRASS EXTENSION NIPPLE

The body shall be of chromium plated copper alloy and external and internal surfaces shall be clean, smooth and free from sand. The size of CP brass extension nipple shall be 15mm x 50mm.

CPVC WATER SUPPLY PIPE

Chlorinated Polyvinyl Chloride (CPVC) pipes, having thermal stability for hot & cold water supply pipe use for internal and external water supply below 80 mm dia

NOTE: All above mentioned taps/cocks/valves etc. shall be of Approved make: Kohler/Duravit/TOTO.

INSTALLATION

Visually inspect pipe ends before making the joint. Use of a chamfering tool will help identify and crakes, as it will catch on to any crack

Pipe may be cut quickly and efficiently by several methods. Wheel type plastic tubing cutters are preferred. Ratchet type cutter or fine tooth saw are another options. However, when using the ratchet cutter be certain to score the exterior wall by rotating the cutter blade in circular motion around the pipe. Do this before applying significant downward pressure to finalize the cut. This step leads to a square cut. In addition, make sure ratchet cutter blades are sharp. Cutting tubing as squarely as possible provides optimal bonding area within a joint.

Burrs and filings can prevent proper contact between the tube and fittings during the assembly, and should be removed from the outside and inside of the tube. A chamfering tool is preferred, but a pocket knife or file is also suitable for this purpose.

Use only CPVC cement jointing. Use CPVC cement, which is fully recommended by the manufacturer.

When using adhesive solution/solvent cement be certain of proper ventilation.

When making a join, apply a heavy, even coat of cement to the pipe end. Use the same applicator without additional cement to apply a thin coat inside the fitting socket. Too much cement can cause clogged waterways. Do not allow excess cement to puddle in the fitting and pipe assembly. This could result in a weakening of the pipe wall and possible pipe failure when the system is pressurized.

Rotate pipe one-quarter to one-half turn while inserting it into the fitting socket and remove the excess adhesive solution/solvent cement from the joint with clean rag.

When making a transition connection to metal threads, use a special transition fitting or CPVC male threaded adapter whenever possible. Do not over-torque plastic threaded connections. Hand tight plus one-half turn should be adequate.

Hang or strap CPVC systems loosely to allow for thermal expansion. Do not use metal straps with sharp edges that might damage the tubing.

CPVC stub outs for lavatories, closets and sinks are appropriate. However, on areas where there is a likelihood that movement or impact abuse will occur, metal pipe nipples may be a more appropriate stub-out material. Showerheads, tub spouts and outside still cocks are examples.

When connected to a gas water heater, CPVC tubing should not be located within 50 cm of the flue. For water heaters lacking reliable temperature control, this distance may be increased up to 1 m a metal nipple or flexible appliance connector should be utilized. This measure eliminates the potential for damage to plastic piping that might result from excessive radiant heat from the flue.

DI WATER SUPPLY PIPE

Ductile iron pipe is pipe made of ductile cast iron commonly used for domestic water transmission and distribution.

Push-on joints

The Contractor shall source the push-on-joint gaskets only from the pipe manufactures. In turn the pipe manufacturer shall supply at least 10% additional quantity of gaskets over and above the requirement to the Contractor at no extra cost. The gasket used for joints shall be suitable for natural and purified water conveyance. In jointing DI pipes and fittings, the Contractor shall take into account the manufacturer's recommendations as to the methods and equipments to be used in assembling the joints. In particular the Contractor shall ensure that the spigot end of the pipe to be jointed is smooth and has been properly chamfered, so that once the rubber ring is correctly positioned before the joint is made, does not get damaged by friction or sharp edges of the spigot Chamfer. The rubber rings and the recommend lubricant shall be obtained only through the pipe manufacturer. Rubber ring bundles form every lot shall carry with them manufacturers test certificate for the following mechanical properties.

1. Hardne ss

2. Tensile strength

3. Compression set

4. Accelerated again test

5. Water absorption test

6. Stress relaxation test

Rubber rings shall be clearly labeled in bundles to indicate the type of ring, the type of joint, the size of the pipe with which they are to be used, the manufacturer's name and trade mark, the month and year of manufacture and the shelf life.

TESTING OF PIPE

The main test among others to be conducted shall be as per IS: 8329-2000 or with its latest revision/amendments.

Mechanical Tests

Mechanical tests shall be carried out during manufacture of pipes as specified in the Standards. The frequency and sampling of tests for each batch of pipes shall be in accordance with IS 11606-1986. The test results so obtained for all the pipes and fittings of different sizes shall be submitted to Engineer. The method for tensile tests and the minimum tensile strength requirement for pipes and fittings shall be as per IS; 8329/EN 545 for pipes and IS: 9523/EN 545 for fittings.

Brunel Hardness Test

For checking the Brielle hardness the test shall be carried out on the test ring or bars cut from the pipes used for the ring test and tensile test in accordance with IS:1500. The test shall comply with the requirements specified in IS: 1500/ISO 6506.

Re-tests

If any test piece representing a lot fails in the first instance, two additional tests shall be made on test pieces selected from two other pipes from the same lot. If both the test results satisfy the specified requirements the lot shall be accepted. Should either of these additional test pieces fall to pass the test, the lot shall be liable for rejection.

For hydrostatic test at works, the pipes and fittings shall be kept under test pressure as specified in the standard for a period of minimum 15 seconds during which the pipes shall be struck moderately with a 700 g hammer for confirmation of satisfactory sound. They shall withstand the pressure test without showing any leakage, sweating or other defect of any kind. The hydrostatic test shall be conducted before surface coating and lining.

QUALITY ASSURANCE

The manufacturer shall have a laid down Quality Assurance Plan for the manufacture of the products offered which shall be submitted along with the tenders.

DI Specials:

DI Specials with all types of diameters suitable of K9 grade pipes with inner cement mortal lining the necessary DI Specials required during the lowering & lying of Ductile Iron Pipe shall be supplied by the agency and shall be as per standard specification. And per IS specification It shall be of best quality as per requirement Rate shall be including loading, unloading, carting, insurance and Labor charge etc

Painting

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 color code given inthis document or specified by SBI/PMC.

Storage tanks Underground & Overhead Tank. (Accessories & Connections)

Storage tanks for water supply shall be in reinforced cement concrete built by the EPC contractor.

Each tank shall be provided with a 560mm Dia Heavy-Duty Cast-Iron manhole frame and cover.

Storage Tanks (Including Fire, Raw water, Treated Water as Underground water tanks and Overhead Water tanks)

Underground storage/ Overhead water tanks for water supply shall be reinforced cement concrete built by the EPC contractor.

Each tank shall be provided with a 560mm Dia Heavy-Duty Cast-Iron manhole frame and cover or as approved by local municipal authority.

Outlets and overflow

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor or as given in the Schedule of Quantities, further connections and accessories shall be provided under this contract.

Testing

All pipes, fittings and valves, after fixing at site, shall be tested by hydrostatic pressure of 1.5 times the working pressure or 7 kg / sq.cm 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 Project Manager.

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.

Hot water pipes chased into the walls shall be provided with a 6mm thick insulation with elastic flexible material having hermetic closed cell structure of expanded synthetic material rated for 60ºC hot water supply.

DRAINAGE WORK

Scope of Work

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to completely install the drainage system as required by the drawings, specified here in after and given in the Schedule of Quantities.

General Requirements

In designing a drainage system for building(s), the aim shall be to provide a self-cleansing conduit for the conveyance of soil, waste, surface or sub-surface waters and for the removal of such wastes speedily and efficiently to a sewer or other outlet, without risk of nuisance and hazard to health.

The discharge of water through a domestic drain is intermittent and limited in quantity and therefore, small accumulations of solid matter are liable to form in the drains between the building and the public sewer. There is usually a gradual shifting of these deposits as discharges take place. Gradients shall be sufficient to prevent these temporary accumulations building up and blocking the drains.

Normally, the sewer shall be designed for discharging three times the dry weather flow flowing half-full with a minimum self-cleansing velocity of 0.75 metre per second. The approximate gradients which give this velocity for the sizes of pipes likely to be used in building drainage and the corresponding discharges when flowing half-full are given in Table. The sizes and slopes shall conform to Local Municipal Bye-laws.

In cases, where it is practically not possible to conform to the minimum gradients, a flatter gradient may be used but the minimum velocity in such cases shall on no account be less than 0.61 metres per second.

On the other hand, it is undesirable to employ gradients giving velocity of flow greater than 2.4 metres per second. Where it is unavoidable, cast iron pipes shall be used. The approximate gradients which give a velocity of 2.4 metres per second for the various sizes of pipes and the corresponding discharge when flowing half-full are given in Table

Gradients for table

Diameter mm	Minimum gradient		Maximum gradient	
	Gradients	Discharge cum/min	Gradients	Discharge cum/min
100	1 in 57	0.18	1 in 5.6	0.59
150	1 in 100	0.42	1 in 9.7	1.32
200	1 in 145	0.73	1 in 14	2.4
230	1 in 175	0.93	1 in 17	2.98
250	1 in 195	1.10	1 in 19	3.60
300	1 in 250	1.70	1 in 24.5	5.30

Glazed Stone Ware Pipes and Fittings

All pipes with spigot and socket ends and fittings shall conform to class SP1 of IS 651. These shall be sound, free from visible defects such as fire cracks or hair cracks. The glaze of the pipes shall be free from crazing. The pipes shall give a sharp clear tone when struck with a light hammer. There shall be no broken blisters. Only For gully trap to manhole

S.W. Gully Trap

Gully traps shall conform to IS 651. These shall be sound, free
from visible defects such as fire cracks, or hair cracks. The glaze of the traps shall be free form crazing. They shall give a sharp clear tone when struck with light hammer. There shall be no broken blisters. Each gully trap shall have one C.I. grating of square size corresponding to the dimensions of inlet of gully trap. It will also have a water tight C.I. cover with frame inside dimensions 300 x 300 mm the cover weighing not less than 4.50 Kg and the frame not less than 2.70 Kg. The grating, cover and frame shall be of sound and good casting and shall have truly square machined seating faces.

EXCAVATION:

The excavation for gully traps shall be done true to dimensions and levels as indicated on plans or as directed by the SBI, PMC's Engineer in-charge.

FIXING:

The gully trap be fixed over cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 40 mm nominal size) foundation 650 mm square and 100 mm thick. The jointing of gully outlet to the branch drain shall be done similar to jointing of S.W. pipes as described above.

BRICK MASONRY CHAMBER:

After fixing and testing gully and branch drain, a brick masonry chamber 300 mm x 300 mm (in side) with bricks in cement mortar 1:5 (1 cement : 5 fine sand) shall be built with a 100 mm brick work round the gully trap from the top of the bed concrete upto ground level. The space between the chamber walls and the trap shall be filled with cement concrete 1:5:10 (1 cement: 5 fine sand: 10 graded stone aggregate 10 nominal size). The upper portion of the chamber i.e. above the top level of the trap shall be plastered in side with cement mortar 1:3 (1 cement : 3 sand), finished with a floating coat of neat cement. The corners and bottoms of the chamber shall be rounded off so as to slop towards grating.

FRP cover with frame 300 mm x 300 mm (inside) size small then be fixed on the top of the brick masonry with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 graded stone aggregate 20 mm nominal size) 40 mm thick and rendered smooth. The finish top of the cover shall be left about 40 mm above the adjoining ground level so as to exclude the surface water from entering the gully trap.

MANHOLES

GENERAL:

Manholes of different types and sizes specified shall be constructed in the sewer line at such places and to such levels and dimensions as shown in the drawing or as directed by the SBI/ PMC's engineer in-charge. The size specified shall indicate the inside dimensions (between wall faces) of the manholes. The branch sewer should deliver sewage in the manhole in direction of main flow and the junction must be made with case so that flow in the main is not impeded.

No drain from house fitting i.e. gully traps or soil pipes etc. to manholes shall normally exceed a length of 6 meter unless it is unavoidable.

At every change of alignment, gradient or diameter of a drain, there shall be a manhole or inspection chamber. Bends and junctions in the drains shall be grouped together in manhole as far as possible. The maximum distance between manholes shall be 45 m for up to 300 mm dia, 75 meter for 350 to 500 mm dia and 90 meter for 600 mm dia and above.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the manhole chamber.

Manholes shall be built to the following specifications:-

Bed concrete :

The manhole shall be built on a bed of cement concrete 1:4:8 (1 cement : 4 coarse sand: 8 graded stone aggregate 40 mm nominal size) The thickness of Bed Concrete shall be 150 mm upto 0.90 meter depth, 200 mm thick for manholes from 0.90 meter to2.25 meter depth and 30 mm for manholes of above 2.25 meter depth.

Walls:

The walls of the manholes shall be of brick masonry. The brick masonry shall be with bricks in cement mortar 1:4 (1 cement: 4 coarse sand) of brick work shall be carefully built in English bond. The jointing face of each brick being well buttered with cement mortar before laying so as to ensure a full joint.

The thickness of wall shall not be less than 230mm upto 2.25 meter in depth, 345 mm thick for depth 2.25 to 3.0 meter, 460 mm thick for depths 3.0 m to 5.0 meter and 575 mm thick for 5.0 to 8.0 meter depth. For greater depths and for subsoil water conditions the exact thickness of wall shall be governed by the structural design & site conditions.

Plaster:

The inside of wall shall be plastered by 12 mm thick with cement mortar 1:3 (1 cement: 3 coarse sand) and finished with a floating coat of neat cement. All angle shall be rounded to 7.5 cm. radius and all rendered internal surfaces shall have impervious finish obtained by using a steel trowel.

Where the saturated soil is met with, also the external surface of the walls of the manhole shall be plastered with 12 mm thick cement plaster 1:3 (1 cement : 3 coarse sand) finished smooth upto 30 cm above the highest sub-soil water level with the approval of the SBI,PMC's Engineer in-charge. The plaster shall further be water proofed with addition of approved water proofing compound in a quantity as per manufacturer's specifications

Channels and benching:

Channels shall be semicircular in the bottom half and of diameter equal to the sewer. Above the horizontal diameter, the sides shall be extended vertically to the same level as the crown of the outgoing pipe and the top edge shall be suitably rounded off. The branch channels shall also be similarly constructed with respect to the benching but at their junction with the main channel on appropriate shall suitably rounded off in the direction of flow in the main channel shall be given.

The channels and benching shall be done in cement concrete 1:2:4 (1cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) rising at a slope of 1 in 6 from the edges of channel. The channels of the bottom of the chamber shall be finished with the floating coat of neat cement.

Footrests:

All manholes deeper than 0.8 m shall be provided with plastic coated C.I. footrests. The foot rests shall be embedded 20 cm deep in 20 x 20 x 10 cm cement concrete blocks of 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate of 20 mm nominal size). The concrete block with C.I. foot rest placed at its centre shall be cast in situ along with masonry and finished with 12 mm thick cement plaster in 1:3 mix (1 cement : 3 coarse sand), finished smooth.

Footrests shall be made of 20 x 20 mm square C.I. bars, provided at 30 cm vertical spacing, staggered laterally, and shall project 10 cm beyond the inner surface of the manhole wall. The top footrest shall be provided 45 cm below the manhole cover.

The footrests shall be provided with factory applied plastic coating/encapsulation for corrosion protection. The embedded portion shall be coated with thick cement slurry before fixing to ensure proper bonding with the concrete block.

Footrests shall be of approved quality and conform to relevant IS standards.

Cover slabs:

These shall be of R.C.C. 1:1.5:3 (1 cement: 1.5 coarse sand: 3 graded stone aggregate 20 mm nominal size) 15 cm thick with surface and edge finished fair. Full bearing equal to the width of the wall shall be given to the slab on all sides. The frame of the manhole cover shall be embedded firmly in the

R.C.C. slab so that the top of the frame remains flush with the top of the R.C.C. slab. Where the opening of manhole is only 560 mm dia, the MH cover shall be fixed in 150 mm thick PCC (1:2:4).

TESTING:

Manholes shall be tested by filling with water to a depth not exceeding 1.2 meter as directed by the SBI, PMC's Engineer in-charge.

After completion of the work manhole covers shall be sealed by means of thick grease.

CONNECTION TO EXISTING SEWER:

The connection to an existing sewer shall, as far as possible, be done at the manholes. Where it is unavoidable to make connection in between two manholes, the work of breaking into the existing sewer and forming the connection shall be carried out under the supervision Administrative Authority.

Breaking of sewer shall be effected by the cautions enlargement of sewer hole and every precaution shall be taken to prevent any material from entering the sewer. No connection shall be former in such a way so as to constitute a projection into the sewer or to cause any diminutions in its effective size.

EPC contractor has to connect Main sewer to Municipal Corporation sewer and has to bear all necessary charges.

DROP CONNECTIONS:

Where it is uneconomic or impracticable to arrange the connection within 600 mm height above the invert of the manhole, the connection shall be made by constructing a vertical shaft outside the manholes chamber. If the difference in the levels between the incoming drain and the sewer does not exceed 600 mm and there is sufficient room in the manhole, the connection pipe may be directly brought through the manhole wall and the fall accommodated by constructing a ramp in the benching of the manhole.

FRP MANHOLE COVERS

FRP manhole covers and frames intended for use in sewerage, drainage and water supply works shall be of high strength Fiberglass Reinforced Polymer (FRP) composite material and shall be suitable for the required loading conditions. The covers shall be corrosion resistant, lightweight, non-corrosive, impact resistant and maintenance free.

FRP manhole covers and frames shall generally conform to relevant IS standards / applicable specifications and shall be of approved make. The covers shall be provided with suitable anti-skid surface finish and shall be complete with matching FRP frames.

GRADES: TYPES & USES

FRP manhole covers and frames shall be provided in the following grades as per required loading conditions

Grade	Load Capacity	Type / Shape of Cover
Light Duty	LD – 2.5	Rectangular, Square, Circular

Medium Duty	MD – 10	Rectangular, Circular
Heavy Duty	HD – 20	Circular, Square, Rectangular
Extra Heavy Duty	EHD – 35	Circular, Square, Rectangular

The different grades and types of manhole covers may be used as follows :

LD – 2.5 Rectangular, Square or Circular types:

These are suitable for use within all building / areas with pedestrian but occasional LMV traffic. These covers may also be used for inspection chambers.

MD – 10:

These are suitable for use in service lanes / roads, car parking areas etc.

MD – 20:

Suitable for use in institutional/commercial areas / carriage ways with heavy duty vehicular traffic like buses, trucks, etc. for a wheel load between 50 to 100 KN.

EHD – 35: Circular, square, or rectangular (scrapper manhole) types -

These are suitable for use on carriage way in commercial industrial / port areas / near warehouses / godowns where frequent loading and unloading of trucks / trailers are common, with slow to fast moving vehicular traffic of the types having wheel loads upto 115 KN, irrespective of the location of the manhole chambers.

ROAD GULLY CHAMBER WITH GRATING

The chamber shall be of brick masonry of specified class and shall have a C.I. grating with frame fixed in 15 cm thick cement concrete 1:2:4 (1 cement: 2 coarse sand: 4 graded stone aggregate 20 mm nominal size) at the top. The size of the chamber shall be taken as the clear internal dimensions of the C.I. frame. The chamber shall have a connection pipe, the length of which in metre between the road gully chamber and the manhole of the drain shall not be less than one by forty (1/40) times the nominal diameter of pipe in mm (i.e. for 150 mm connection pipe, length shall not be less than 3.7 m and for 250 mm connection pipe length shall not be less than 6.25 m). The chamber shall be built at the location fixed by the SBI,PMC & engineer-in-charge. Generally the spacing of the chambers shall be 18 to 36 m depending upon the grading of the road channel and the area of the drainage. R.C.C. gully grating shall be fixed in cement mortar 1:2 (1 cement: 2 coarse sand)

INSPECTION CHAMBER

At every change of alignment, gradient or diameter of drain, their shall be a inspection chamber. Bends and junctions in the drain shall be group together in inspection chamber as far as possible. The maximum distance between chambers shall be 30m.

Inspection chambers of different types and sizes as specified shall be constructed in the drainage line at such places and to such levels and dimensions as shown in the drawings or as directed by the

Engineer-in Charge. The size specified shall indicate the inside dimensions between brick faces of the inspection chamber.

Where the diameter of the drain is increased, the crown of the pipe shall be fixed at the same level and necessary slope given in the invert of the inspection chamber. In exceptional cases and where unavoidable, the crown of the branch drainage may be fixed at lower level but in such cases the peak flow level of the two drainage shall be kept the same.

Drainage of unequal sectional area shall not be joined at the same invert in a inspection chamber. The invert of the smaller drainage at its junction with main shall be at least 2/3 the diameter of the main above the invert of the main. The branch drainage shall deliver drainage in the inspection chamber in the direction of main flow and the junction must be made with care so that flow in main is not impeded.

Inspection chamber of 455 ×610 mm and 45 cm deep for single pipe line, 500 × 700 mm and 45 cm deep for one or two inlets and 600 × 850 mm and 45 cm deep for three or more inlets are generally constructed for drainage line.

Excavation

The excavation for inspection chamber shall be true to dimensions and levels shown on the plans or as directed by the SBI,PMC & engineer-in-charge.

Bed Concrete

The inspection chambers shall be built on a bed of cement concrete 1:5:10 (1 cement: 5 coarse sand: 10 graded stone aggregate 40 mm nominal size) unless required by local authorities. The thickness of the bed concrete shall be 15 cm unless otherwise specified or directed by the Engineerin-Charge and 40 mm thick cement concrete 1:2:4 (1 cement: 4 coarse sand: 4 grade stone aggregate 40 mm nominal size).

Brick Work

The brick work shall be with class 75 bricks in one brick thickness in cement mortar 1:4 (1 cement: 4 coarse sand). The external joints of the brick masonry shall be finished smooth, and the joints of the pipes with the masonry shall be made perfectly leak proof.

Plaster and Pointing

The walls of the inspection chambers shall be plastered inside including bed with 12 mm thick cement plaster 1:3 (1 cement: 3 coarse sand) finished smooth. For earth work excavation, bed concrete, brick work, plaster and pointing, R.C.C. work and refilling of earth, respective specifications shall be followed.

Inspection Chamber Covers and Frames

The frame of inspection chambers shall be firmly embedded to correct alignment and levels in R.C.C. slab or plain concrete as the case may be on the top of the masonry. After completion of the work, inspection chambers covers shall be sealed by means of thick grease.

Measurements

Inspection chambers shall be enumerated under relevant items. The depth of the inspection chambers shall be reckoned from the top level of C.I. cover to the invert level. The depth shall be measured correct to a cm. The extra depth shall be measured and paid as extra over the specified depth.

NON PRESSURE NP-3 CLASS (MEDIUM DUTY R.C.C. PIPES)

All NP2 / NP3 RCC pipes shall be spigot and socket end pipes. The ends shall be suitable for rubber ring joints. The pipes shall be ISI marked as per IS:458:2003. The rubber rings shall confirm to IS 5382.

MATERIAL:

General - The pipes shall be with reinforcement and shall be of the specified class. These shall conform to IS : 458 amended up to date. The reinforced cement concrete pipes shall be manufactured by centrifugal (or spun) process. All pipes shall be true to shape, straight, perfectly sound and free from cracks and flaws. The external and internal surface of the pipes shall be smooth and hard. The pipes shall be free from defects resulting from imperfect grading of the aggregate mixing or moulding.

Concrete – The concrete quality shall be as per IS: 456 for at least very severe environmental exposure condition. Concrete used for the manufacture of reinforced concrete pipes shall have minimum cement content of 450 kg/cum and a compressive strength not less than 35N/sq.mm at 28 days.

Aggregates – The aggregate shall confirm to 3 of IS : 383. The maximum size of aggregate should not exceed one third of the thickness of the pipe or 20 mm whichever is smaller for pipes above 250 mm dia and 10 mm size for pipe dia from 80 to 250 mm.

Reinforcement - The reinforcement shall confirm to mild steel grade 1 or medium tensile steel bars confirming to IS:432 (part 1) or hard drawn steel wire confirming to IS : 432

(part 2) or structural steel (standard quality) bars confirming to IS : 2062. The reinforcement in the reinforced concrete pipes shall extend throughout the length of the pipe. The circumferential and longitudinal reinforcements shall be adequate to withstand the specified hydrostatic pressure and further bending stresses due to the weight of water when running full across a span equal to the length of pipe plus three times its own weight.

CLASS NP3 – REINFORCED CONCRETE MEDIUM DUTY, NON PRESSURE PIPES

Internal Diameter of Pipes (mm)	Barrel Wall Thickness (mm)
150	25
200	30
225	30
250	30
300	40

350	75
400	75
450	75
500	75
600	85
700	85
800	95
900	100
1000	115
1100	115
1200	120
1400	135
1600	140

TRENCHES :

The trenches shall be so dug that the pipes may be laid to the required alignment and at required depth.

Cover shall be measured from top of pipe to the surface of the ground.

The width of the trench shall be D+400 mm with a minimum of 750 mm. (D= External diameter of pipe). Note: The width should not be more than the mentioned for structural safety of the pipes.

The bed of the trench, if in soft or made up earth, shall be well watered and rammed before laying the pipes and the depressions, if any, shall be properly filled with earth and consolidated in 20 cm layer.

If the trench bottom is extremely hard or rocky or loose stony soil, the trench shall be excavated at least 150 mm below the trench grade. Rocks, stone or other hard substances from the bottom of the trench shall be removed and the trench brought back to the required grade by filling with selected fine earth or sand (or fine moorum if fine soil or sand is not available locally) and compacted so as to provide a smooth bedding for the pipe.

After the excavation of the trench is completed, hollows shall be cut at the required position to receive the socket of the pipes and these hollows shall be of sufficient depth to ensure that the

barrels of the pipes shall rest throughout their entire length on the solid ground and that sufficient spaces left for jointing the underside of the pipe joint. These socket holes shall be refilled with sand after jointing the pipe.

Roots of trees within a distance of about 0.5 meter from the side of the pipe line shall be removed or killed.

The excavated materials shall not be placed within 1 meter or half of the depth of the trench, whichever is greater, from the edge of the trench. The materials excavated shall be separated and stacked so that in refilling that may be re-laid and compacted in the same order to the satisfaction of the SBI,PMC's Engineer in-charge.

The trench shall be kept free from water. Shoring and timbering shall be provided wherever required. Excavation below water table shall be done after rewatering the trenches.

Where the pipe line or drain crosses an existing road, the road crossing shall be excavated half at a time, the 2nd half being commenced after the pipes have been laid in the first half and the trench refilled. Necessary safety measures for traffic as directed shall be adopted. All types, water main, cables, etc. met within the course of excavation shall be carefully protected and supported. Care shall be taken not to disturb the electrical and communication cable met with during course of excavation, removal of which, if necessary, shall be arranged by the SBI,PMC's Engineer in-charge.

LAYING:

Pipes shall be lowered into the trench carefully. Mechanical appliances may be used, where necessary, pipes shall be laid in straight lines or with easy curves and true to line and gradient as specified. Laying of pipes shall proceed upgrade of a slope. In the pipes spigot end socket joints, the socket ends shall have face up stream. In the case of pipes with joints to be made with loose collars the collars shall be slipped on before the next pipe is laid.

The Cement Concrete bedding shall be provided below RCC pipes as per tender and drawings.

When the pipe is laid in a trench in rock hard clay, shale or other hard material the space below the pipe shall be excavated and replaced with an equalizing bed of concrete, sand or compacted earth. In no place shall pipe be laid directly on such hard material.

JOINTING:

SPIGOT AND SOCKET JOINT:

The spigot of each pipe shall be slipped home well into the socket of the pipe previously laid and adjusted in the correct position. The jointing of pipe shall be done by rubber ring method. The rubber rings shall confirm to IS : 5382.

A rubber ring shall be placed on the spigot which shall be forced into the socket of pipe previously laid. This compresses the rubber ring as it rolls into the annular space formed between the two surfaces of the spigot and socket, stiff mixture of cement and mortar 1:2 (1 cement : 2 fine sand) shall then be filled into the remaining annular space and rammed with a caulking tool. After days

work any extraneous material shall then be removed from inside of the pipe and the newly made joint shall be cured,

TESTING OF JOINTS:

HYDRAULIC TEST:

The pipes shall be subjected to a pressure of at least 2.5meter head of water at the highest point of the section under test. The test shall be carried out by suitably plugging the low end of the drain and the ends of the connection, if any and filling the system with water. A knuckle bend shall be temporarily jointed in at the top end and a sufficient length of vertical pipe jointed to it so as to provide the required test head; or the top end may be plugged with a connection to a hose ending in a funnel which could be raised or lowered till the required head is obtained and fix suitably for observation.

Subsidence of the test water may be done to one or the more of the following causes

Absorption by pipes and joints;

Sweating of pipes or joints;

Leakage at joints or from defective pipes and

Trapped air.

Allowance shall be made for (i) above by adding water until absorption has ceased after which the proper test should commence if any leakage is visible the defective part of the work should be made good. A slight amount of sweating which is uniform may be over looked but excessive sweating from a particular pipe or joint shall be watched for as taken as indicating a defect to be made good

RECTIFICATION OF FAULTY JOINTS:

Any joint leaking or sweating shall be rectified or embedded into into 150mm layer of cement concrete (1:2:4) 300mm in length and the section retested.

RAINWATER HARVESTING

Rainwater harvesting is the process of collecting and conveying rainwater from rooftops and other suitable catchment areas for groundwater recharge. The collected rainwater shall be passed through a desilting chamber and filtration unit before being discharged into recharge pits/recharge wells to replenish the groundwater table.

The primary objective of the rainwater harvesting system is to enhance groundwater recharge, improve groundwater levels, reduce surface runoff, and promote sustainable water conservation.

A typical rooftop rainwater harvesting system shall consist of the following components:

a. Collection Area (Roof Surface)

b. Conveyance System (Gutters and Downpipes)

c. Desilting Chamber / First Flush Arrangement

d. Filtration Unit

e. Recharge Pit / Recharge Well

The collection area shall generally comprise the roof of the building. The effective roof area and roofing material shall ensure maximum collection efficiency and good water quality.

The conveyance system shall consist of gutters and downpipes made of chemically inert materials such as UPVC, HDPE, aluminium, or other approved materials. Rainwater shall pass through a desilting chamber and filtration unit before entering the recharge pit/recharge well.

The design of various components of the Rainwater Harvesting System shall conform to the provisions of the CPWD Rainwater Harvesting and Conservation Manual and other relevant Indian Standards.

The specifications of piping systems, desilting chambers, filters, manholes, manhole covers, recharge pits, recharge wells, open drains, road gully chambers, soak pits, and dispersion trenches shall conform to the CPWD Specifications under the Drainage Sub-Head.

Recharge pits/recharge wells shall be designed with suitable filter media to facilitate the percolation of filtered rainwater into the aquifer for effective groundwater recharge.

The recharge pits/recharge wells shall be designed and constructed to ensure efficient infiltration of rainwater into the ground, thereby maintaining and improving the groundwater table.

DESIGN AND LOWERING OF PIPE ASSEMBLY

The length and diameter of the casing pipe is selected on basis of static water level, the draw down, the discharge expected from the well and the size of pump to be installed. The size and length of slotted/strainer pipes are selected according to the actual requirement according to the strata met with the expected discharge end the depth of tubewell, the casing pipes shall generally conform to IS 4270: 1983, the slotted/strainer pipes shall conform to -IS 8110 : 1985 and the u-PVC casing pipes and screen shall conform to IS 12818 : 2010.

The entry of water in the tube well shall be either through screens or slotted pipes. Following are the various types of well screens and slotted pipes used in water wells depending upon the type and size of well:

Plain slotted pipe.

U-pvc pipe

The design, selection and type of screen or slotted pipe size and distribution of slots shall be as specified in IS 8110: 1985.

GRAVEL PACKING

All gravel to be used as pack in tube well construction for water supply shall be as specified in IS 4097: 1967. The thickness of the gravel shroud around the screen shall generally be not less than 10 cm

The gravel selected for packing tube wells shall consist of hard quartz (about 96 percent SiO2) or other suitable material, with an average specific gravity of not less than 2.5. Not more than 10 percent by weight of the material shall have a specific gravity of less than 2.25. The gravel shall

contain not more than two percent by weight of thin flat or elongated pieces. In the case of such pieces, the larger dimensions shall not be more than 3 times the smallest dimensions. The quartz shall be of sub-rounded to rounded grains with minimum angular features.

The gravel for use as pack shall be free from impurities, such as shale, mica, feldspar, clay, sand, dirt, loam, and hematite and organic materials.

The porosity of the gravel when laid as a pack shall not be less than 25 percent.

Gravel Sizes:- The gravel conforming to this standard as per IS 4097 : 1967 shall be of the following grades:

SI.NO.	Grade	Pack	Particle Size Range mm	IS Sieves (see IS: 460-1962
1	A	Fine Gravel	Over 2.0 to 3.35	2.0 , 3.35
2	B	Fine Gravel	Over 3.35 to 4.75	3.35 , 4.75
3	C	Medium Gravel	Over 4.75 to 6.3	4.75 , 6.3
4	D	Medium Gravel	Over 6.30 to 8.0	6.3 , 8.0
5	E	Coarse Gravel	Over 8.0 to 12.5	8.0 , 12.5

The particle size distribution of gravel shall be determined by screening through standard sieves in accordance with IS: 460-1985. The percentage distribution of the sizes shall be determined from a graph in which the percentage of material passing through each sieve is plotted against the standard aperture of that sieve. Any size, say D20, will thus indicate that the cumulative weight of all the grains smaller than this size is 20 percent of the total weight of the test sample. The uniformity coefficient of the gravel, that is, the ratio of its D20to D10sizes shall not exceed 2. A material with uniformity coefficient less than 2 shall be classified as uniform and if greater than 2 it shall be taken as non-uniform. The limiting sizes given in above table are the minima and maxima, and the stacks containing smaller or bigger sizes as shown by sieve analysis shall be rejected.

The gravel shall have a hardness of not less than 5 in Moh's scale.

The pack aquifer ratio (P/A ratio) is defined as the ratio of 50 percent size (D30) of the gravel pack to the 50 percent size of the aquifer. The size of gravel when used as pack in tube wells shall be decided in accordance with the size of the aquifer material proposed to be tapped. The gravel size shall be limited as below:

Uniform aquifer with uniform gravel pack

Pack aquifer ratio — 9 to 12.5

Non-uniform aquifer with uniform gravel pack.

Pack aquifer ratio — 11 to 15.5

The thickness of gravel pack shall be limited to 13 to 18 cm

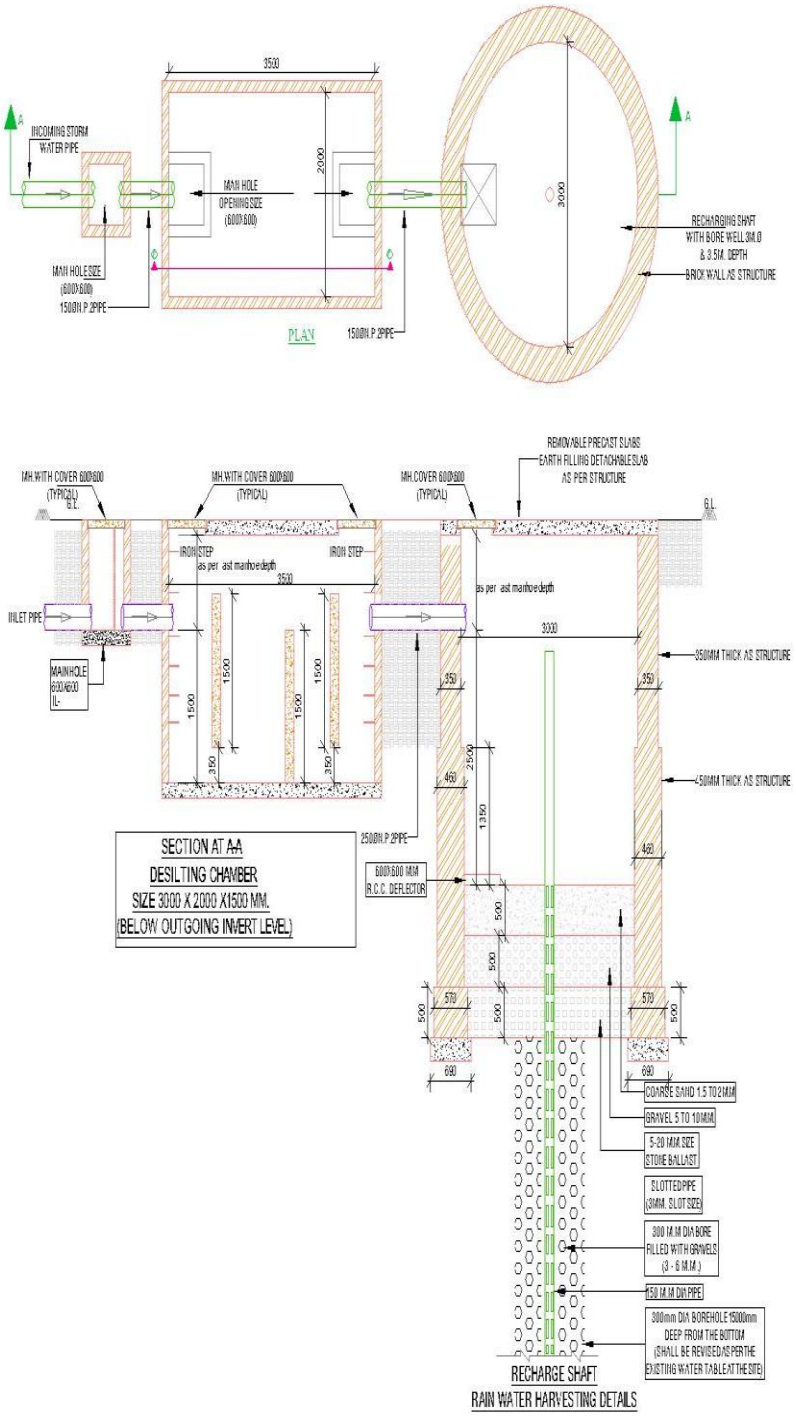
However, artificial gravel pack may not be necessary if the effective size (D10) of the aquifer is greater than 0.3 mm and its uniformity coefficient is greater than 5. For artificial gravel pack For sampling and packing, corresponding provisions of IS 4097:1967 may be referred.

In percussion method of drilling, .gravel is fed into the annular space between the casing pipe and the assembly pipe up to 3 m above the bottom of the slotted pipe. The well is developed using compressed air or by bailers and as the water becomes clear, surging or backwashing is done to make the development more perfect. More gravel is fed, if necessary, and when the water becomes free from sand, the casing pipe is jacked up to some height, and the process is repeated until all the aquifers are gravel packed.

In rotary method, the pipe -assembly is lowered into position and gravel packing may be done up to a suitable depth below the bottom of the housing pipe in the first instance. There after the gravel packing up to the required depth is completed after keeping the housing pipe vertical within limits. To achieve uniform gravel packing around the pipe assembly inverted cones should be used.

A provision for a well base to eliminate the possibilities of subsidence of the well structure may be incorporated. If the bottom of the well is in a soft formation, the well should be provided with an artificial base for the casing and screen by over drilling the hole about 1 to 2 m and filling the extra depth with concrete or gravel.

SINGLE LINE DIAGRAM OF RAINWATER HARVESTING SYSTEM (INDICATIVE ONLY)


INCOMING STORM WATER PIPE
MAN HOLE OPENING SIZE (600*600)
MAN HOLE SIZE (600*600)
150Ø H.P.RPIPE
PLAN
RECHARGING SHAFT WITH BORE WELL 9M.Ø & 9.5M. DEPTH
BRICK WALL AS STRUCTURE
REMOVABLE PRECAST SLABS
EARTH FILLING DETACHABLE SLAB AS PER STRUCTURE
MH WITH COVER 600*600 (TYPICAL)
G.L.
IRON STEP
as per ast manhole depth
INLET PIPE
MAINHOLE 600*600 I.L-
350MM THICK AS STRUCTURE
450MM THICK AS STRUCTURE
250Ø H.P.RPIPE
600*600 MM R.C.C. DEFLECTOR
SECTION AT AA
DESILTING CHAMBER
SIZE 3000 X 2000 X1500 MM.
(BELOW OUTGOING INVERT LEVEL)
COARSE SAND 1.5 TO 2MM
GRAVEL 5 TO 10MM
5-20 MM SIZE STONE BALLAST
SLOTTED PIPE (3MM. SLOT SIZE)
300 M.M DIA BORE FILLED WITH GRAVELS (3 - 6 M.M.)
150 M.M DIA PIPE
300mm DIA BOREHOLE 15000mm DEEP FROM THE BOTTOM (SHALL BE REVISED AS PER THE EXISTING WATER TABLE AT THE SITE)
RECHARGE SHAFT
RAIN WATER HARVESTING DETAILS

DEVELOPMENT OF TUBE WELL

Trial bore of 300 mm dia upto 200 mtr depth below ground level in any kind of soil strata including hard stone/boulder.

Trial bore of 300 mm dia exceeding 200 mtr depth below ground level and up to 400 RM in any kind of soil strata including hard stone / boulder.

Trial bore of 300 mm dia exceeding 400 mtr depth below ground level and up to 500 RM in any kind of soil strata including hard stone / boulder.

Development of trial bore well by reaming in the following steps-

Reaming up to 675 mm For 170 RM from ground level including casing pipe of 350 mm dia and thickness 8 mm and pea gravel.

Reaming upto 525 mm from depth exceeding 170 mtr to 300 mtr including casing pipe of 250 mm dia and thickness 8 mm and pea gravel

Reaming upto 525 mm from depth exceeding 300 mtr to 400 mtr including casing pipe of 250 mm dia and thickness 8 mm and pea gravel

Reaming upto 525 mm from depth exceeding 400 mtr to500 mtr including casing pipe of 250 mm dia and thickness 8 mm and pea gravel

slotted pipe of 250 mm dia in lieu of caseing pipe of 250 mm dia

GI Air Valves with two air Outlets, bore and fixing Up in GI water supply mains

Development of tube well with compressed air and after 25% extra capacity pump by pumping muddy water

Yield test for the bore well by continuously pumping for for 16 hours to determine safe pump yield

Submersible pump electric driven 415 Volt, TP suitable for 200/250 dia bore well (casing pipe size 200/250 mm supplied and installed complete upto suitable WHP. (Note : Actual capacity of submersible pump will be designed on the base of yeald available)

MS reducer, bail plug, well cap, MS Strip for centering, MS iron clamps, electric logging and sample strata box

Valve reflux, with bypass Arrangement, 100 mm(6") dia

Strainer Y type conforming to IS

Earthling of machinery/ equipment installed at power house/ substation using 32 x6 mm galvanized MS strip and MS galvanized plate of size 600 x600x6mm as earth electrode

MS ERW flange pipe 150(6")dia for RM column pipe

LT panel 415 Volt, 4 wire AC, 50 HZ factory made indoor type, panel CPRI approved, made out of MS sheet of size 2.0 mm thick duly with powder coated & mounted on an angle iron frame made out of 50 x 50 x 6 mm angle iron frame, 90 cm high, duly fixed with PCC etc. complete with following accessories(Pump house bldg)

4 Nos Al bus bars of rating 200 Amp mounted on heavy duty rubberized porcelain support-01 set

MCCB 125 Amp rating, 25 KA, four pole Adjustable type(for incoming)-01No

©Space for starter for submersible pump suitable HP-01 No

MCCB 100 Amp 25 KA, 4 pole Adjustable type for outgoing-02 Nos(One no spare) for panel No.2

MCCB 40 Amp, 25 KA, 3 pole adjustable type for outgoing-01Nos. For submersible pump

MCB SPN 40 Amp, 10 KA, outgoing-01 no. for pump house building

Ammeter (0 to 150), Digital type with selector switch and CT's-01 set

Voltmeter (0to 500V) Digital type with selector switch-01 set

Indicator lamp LED Cluster type(set of 3)-1 set

S/F time switches 250 V, Single phase of 20 Amp rating with contactor fitted inside steel enclosure-01 Nos

Ammeter(0 to 150), Digital type with selector switch and CT's-01 Set

Voltmeter (0 to 500V) Digital type with selector switch-01 Set

Indicator Lamp LED Type(Set of 3)-1 set

MCB SPN 20 Amp, 230 Volt-01 No

Labour, Installation/ Connecting/ transportation etc

Pipes Galvanized, " Medium class" supplied and laid complete including fittings in trenches/ on walls/ on floors etc as required for following sizes all as specified & directed

40 mm bore

50 mm bore

Colum pipe & valve

Ductile iron, S/S pipe including special class "K-9" 100 mm (4") dia

Ductile iron, S/S including special class "K-9" 150 mm (6") dia

Sluice valve both ends flanged of class 1.6 PN of size 100 mm bore

Sluice valve both ends flanged of class 1.6 PN of size 150 mm bore

Brick masonry valve pit chamber of following sizes(internal dimensions) with MS sheet cover 6 mm thick and angle iron 40x 40x 6 mm frame duly painted with two coat of synthetic enamel over one coat of red oxide primer including locking arrangement, necessary earth work etc complete of following sizes:-

Size 1050x 1050x1050 mm

Size 900x 900x 900 mm

M & L for cutting of existing CI/DI for inserting new TEE/ Connected items of following sizes

100 mm bore

Valves, sluice, flanged of class 1.6 PN supplied and installed complete ISI marked with high tensile brass spindle etc complete, of following sizes:-

150 mm bore

100 mm bore

Valve, stop, screwed, supplied and installed complete, ISI marked for pipe of following complete all as specified and directed

40 mm bore

50 mm bore

DI Fitting bend tapers tee pieces single & double branch any type and angle/ radius and straight connecting piece but all end flanged up to 150 mm

HYDRO- PNEUMATIC PUMP SYSTEM FOR WATER SUPPLY

Scope (Item Description) –

The item includes the Pumps (Vertical/Horizontal centrifugal type), Pressure vessels, pressure switches, gauges, pressure transmitter on delivery manifold, pump suction & delivery piping, manifolds & valves, flexible bellows, Fixed speed/ variable frequency drive, control panels, Microprocessor based operation) and all accessories including installation, testing & commissioning.

Pump –Motor Set Design & Construction Features

Two types of pumps i.e. inline vertical multistage or horizontal type centrifugal pump shall be provided. Variable frequency drive shall be provided with one of the installed pump – if specified in Schedule of quantity.

The pump motor set and shall be suitable for 3 Ph., 415 V, 50 Hz. AC power supply. The pump shall be installed with isolation gate/ butterfly valve, non-return valve, etc. The detailed specification for pump & motor is as below.

The design and manufacture of the pump shall comply with all currently applicable statutes, regulations and safety codes in the locality where the equipment will be installed.

The pump shall be capable of developing required total head at rated capacity. Impeller shall be closed type and shall be dynamically balanced. The pump shall have non overloading characteristics.

The casing shall be of rigid construction and shall have side suction and side delivery in case of vertical multistage pump and side suction and central delivery in case of horizontal centrifugal pump.

The pump shall have very small length suction and delivery pipe connections which will result in minimum friction loss.

Impeller shall be of one piece and shall be of SS CF8 M.

The shaft shall be of S.S. and its surface shall be properly finished. Shaft sleeves shall be provided to protect shaft from any damage

Bearing shall be ball or roller type.

Mechanical seal shall be provided to avoid any leakage.

Pump shall be mounted on a concrete foundation, projecting at least 15 CM above finished floor level. The pumps base shall be set on an anti vibration pad.

All the parts of the pumps that are in contact with water e.g. shaft, impeller etc. shall be hot dip galvanized or of stainless steel construction.

Pumps shall be so selected that the design duty point is within 5% of the maximum efficiency point. Shut off head shall be 120% of duty point head.

All pumps and motors shall be of minimum vibration and noise level during operation. Vibration isolators shall be provided for all pump sets.

Facilities shall be provided to prevent starting of pumps when the water tank is at low water level. An indicator for this low water level alarm shall be provided.

Facilities to select which pump to be duty pump and standby pump shall be provided and be interchangeable.

Leakage from pump gland shall be drained to the nearest floor waste.

Pump shall be driven by directly coupled squirrel cage induction motor having TEFC enclosure, IP 55 protection & shall be of Class F insulation.

Pump motors above 7.5 kW shall be equipped with a spacer coupling which allows changing of shaft seals without removing the motor.

Inspection & Testing

The pump shall be offered for visual inspection before dispatch.

Material test certificates for the various pump components shall be furnished for purchaser's approval.

System Description

The system operation will be such that the initial small water demand shall be met by the charged diaphragm pressure vessel. When the water demand continue the system pressure will dip to a preset pump cut-in point when the lead pump starts to operate at reduced speed through the variable speed drive. However, if the system pressure be still below the pre-set value, the controller continuously increases pump speed to meet the system demand. When the lead pump is not able to meet the system pressure at full speed, the second pump also starts to operate.

At peak demand all the pumps operate, similarly, if there is a drop in water demand the duty pump speed starts to reduce, then standby pumps cuts-off, followed by stopping of the duty pump.

The closed diaphragm pressure vessel shall be of polyethylene material with a pressure gauge and isolating valve. The interior shall be of non-toxic lining suitable for use with potable water. The vessel shall be manufactured to conform to ASME pressure vessel code/ standards.

The system shall be under the control of a microprocessor based control panel.

A pressure transmitter shall detect the pressure at the delivery manifold and feedback to the microprocessor control panel via control circuit.

The system shall incorporate a frequency converter or frequency converter motors on the pumps and the pressure transmitter shall register the actual pressure on the discharge side.

The variable frequency drive pumping system shall maintain a constant pressure regardless of the system demand. If there is a drop in pressure outside the preset point, the Variable Frequency Drive (VFD) pump shall start to run until the pressure increases to the preset limit, or it will continue to increase the pump speeds to the upper limit of the frequency. If the water system demand still cannot be met, the second pump shall be called in to run, the VFD will then alter the pump speed to meet the preset pressure point. If the set point is still unable to be met, the third pump is then activated to run (in case of 3 pumps units).

This shall be achieved by continuously varying the motor speed of the duty pump according to the demand up to a maximum designed capacity.

Under decreasing hydraulic demand the reverse sequence to the above description shall apply. Alternatively pumping system shall be with fixed speed drive motor. By getting the signal from microprocessor based control panel through pressure transmitter, pumps will operate in sequence & vice a versa.

The frequency converter shall be linked to the motor of the duty pump for continuous speed

adjustment and ultimately the water delivery shall be maintained at constant pressure at the pre-set value.

Control Panel

The motor control panel shall be equipped with all the necessary electrical components including a microprocessor control unit and a frequency drive. The control panel and the microprocessor shall cover the followings functions.

Flexibility and simplicity in allowing the necessary re-adjustment of the pumping system pre-set delivery pressure to operate the pumps within the specified maximum and minimum delivery ranges.

Automatic changeover of the pumps to be controlled by the microprocessor which dictates the duty and standby pumps.

When the system has not been operated for more than 24 hours, it shall automatically start the pumps for a few seconds/ day to ensure the pumps readiness at all times. The standby pumps shall be activated upon failure of duty pump(s).

In event of control failure, the pumps shall be able to be start/ stopped manually at the local panel by means of pressure switches.

The microprocessor control panel shall be able to cut-off the pumping system when excess pressure is registered in the discharge common manifold.

The system shall have the capability of receiving input signal concerning reduced water level in suction tanks and shall have control mechanisms to prevent the pumps form running dry.

Automatically starting the pumps when the water level is back to normal.

In case of pump failure due to motor overload, the standby pump is switched on automatically. Alarm signal is displayed on the LCD Display unit and alarm lights are activated.

Functions to limit the no. of start/ stop of pumps per hour. The system control panel shall incorporate LCD Display.

Electrical Component

All circuit breakers, thermal overloads and contactors shall be of reputable make acceptable to the architect. Electrical supply to the pump controller shall be protected using an isolating circuit breaker

Method of Starting

The panel shall be built to start the pumps in suitable starting modes, i.e. D.O.L., Star/ Delta, using Soft Starters

Pump Pressure Vessel

Diaphragm type pressure vessels shall be provided as shown on the drawings. They shall be incorporated into the system so that during normal operation the pump shall not need to be start within 30 seconds of it switching off in order to prevent the pump hunting.

The pressure vessel shall be of adequate capacity to accommodate a considerable fluctuation in water demand by the system with minimum start/ stop cycles of the pumps. The vessel shall be constructed of steel plate built to ASME Standards for Unfired Pressure Vessel. A rubber diaphragm shall be provided in the vessel for separating the water and pre-charge nitrogen. The pre-charge pressure shall be adjustable and charging port with non-return device shall be provided. The adjustable cut-in and cut-off pressure unit for the pumps shall be built-in at the vessel to suit the system.

Accessories

The system shall be provided with all accessories such as base plate, mounting pads, foundation bolts, foot valves, pressure gauge, pressure switches, pressure transmitter, level indicator, isolation valve for pressure vessel, etc. all accessories required for proper and safe operation shall be furnished with the pumps.

Suction & Delivery Pipe Fitting, Flange & Valves

All suction, delivery and header pipe shall be GI & shall conform to IS: 1239, medium/ heavy duty. Fittings shall be as per the pipe thickness. All pipes shall have flanges connection & pipe shall conform to BS 10, Table - D. All hardware shall be zinc plated. The system shall be equipped with suction & delivery valves flanged valves. On suction side ball/gate valve shall be provided while on delivery side ball/ butterfly valves shall be provided. Also, spring operated check valves shall be provided on delivery side of each pump & on delivery header. In case of negative suction foot valve shall be provided for each pump suction or suction header as specified in data sheet. Flexible bellows shall be provided on suction & delivery side of each pumps.

SPECIFICATION OF SOLAR WATER HEATING SYSTEM

This specification covers Design, Engineering, Manufacture, Assembly, Installation, Testing and Commissioning of Solar Water Heating System. However, the minimum, Solar Water Heating System of as per demand shall be provided for buildings, Canteen and other utilities comprising of solar flat

plate collector, collectors stand assembly, SS316 Stainless Steel insulated hot water storage tank with closed circuit heat exchanger and various other components.

Suitable Number of fat Plate should be installed for each Solar Water Heating system. Each Flat Plate collector should be of at least 100 LPD capacity. The outlet water temperature required at tap location shall be 60 degree C.

a) Solar Flat Plate Collector:

Solar flat plate collector shall be with BIS approval and as per to IS: 12933 (Part-1 & 2) with up to date amendments and various components shall be as under:

b) Cover plate

Cover plate shall be tempered/ toughened glass and thickness of 4.0mrn (min) conforming to section-1 of IS: 12933 (Part-2)/2003. The solar transmittance of the cover plate shall be minimum 82 percent at near normal incidence. The glass shall be free from bubbles and rough surface.

c) Collector Box:

Collector box shall be made of Aluminum sections only. Type grade, size, workmanship and finish of the material used shall be as per section 2 of IS. 12933 (Part-2)/2003. The minimum thickness of Aluminum shall be as under:

i) Channel section for sides: 1.6mm

ii) Support for glass retaining: 1.2mm

iii) Sheet for entire body: 1.0mm

d) Absorber:

Absorber shall consist of riser, header and sheet for absorber. Type, grade, size, workmanship and finish of the material used shall be as per section-3 of IS: 12933 (Part- 2) 2003. Sheet for absorber shall be made of copper only. Riser and header assembly designed for working pressure up to 2.5kg/ Square cm, shall be tested for leakage at a minimum hydraulic pressure of 5 kg/ Square cm.

e) Collector box insulation:

Insulation shall be provided at back and sides. Thermal resistance (R) of insulation material shall be minimum 0,96 square meter. degree C/W for back insulation and minimum 0.48 square meter. degree C/W for side insulation. This shall be derived after determining thermal conductivity (K) value at 100 degree C mean temperature in accordance with IS: 3346. Collector box insulation shall conform to sec.4 of IS: 12933 (Part-2)/2003.Aluminium foil shall be used for covering the back as well as side installation. Aluminum foil shall be used for covering the back as well as side insulation.

f) Gaskets and Grommets:

Gaskets and Grommets shall conform to sec.5 of IS: 12933 (Part-2)/2003.

Insulated hot water storage tank:

The thickness of the water storage tank shall be uniform.

a) Material:

Insulated hot water storage tank shall be non-pressure type and made of SS 316 grade stainless steel of IS:1570 (Part-5)/1985) (Reaffirmed 2004), TIG/MIG welded, minimum sheet thickness shall be 16 SWG. The storage tank shall be well insulated and large enough to hold/store about two days supply of hot water.

b) Insulation:

Solar water heating system shall be insulated with 100 mm thick Rock wool, 48 Kg/m3 density, 22 SWG Aluminum cladding. Alternatively, 50 mrn thick CFC free thermal grade PUF insulation, 32Kg/m3 or higher density may be used. PUF insulation could be pre-extruded type fitted with FRP exterior cladding or alternatively injection molded in a twin walled steel tank and PPE end cap.

c) Tank stand assembly & Collector stand assembly:

Shall be made of MS angle of size (min) 40 rnm x 40 mm 5 mm duly pre-treated and stove enameled with black colour paint. Alternatively, tubular structure with powder coating could also be provided. The structure should be designed in such a way that it will take less space and will withstand wind load up to 200 kilometer/hour

System interconnection piping:

a)Providing and fixing Polyethylene-Aluminum-Polyethylene PE-ALPE Composite Pressure Pipes conforming to IS - 15450, U.V. stabilized with carbon black having thermal stability for hot & cold-water supply, capable to withstand temperature up to 80°C, including all special fittings of composite material (engineering plastic blend and brass inserts wherever required) e.g., elbows, tees, reducers, couplers & connectors, accessories, fittings etc., for hot water piping at terrace and clamps at 1.00 meter spacing. This includes testing of joints complete as per direction of the SBI,PMC & engineer-in-charge.

b) ISI marked, medium class GI pipes of IS:1239 of suitable size inclusive of all accessories, fittings and necessary supports for connecting Cold water tank with Solar Water Heating System. ISI marked valves shall be of gun metal.

6) Suitable capacity SS304 makeup water tank along with piping and valves as required shall be provided.

7) Temperature Gauge: Dial type, duly calibrated and suitable for temperature range from 0 degree C to 120 degree C and shall be provided.

8) Other component essential for completeness of the system as per tender specifications.

9) Contractor shall submit general arrangement drawings within 15 days from the date of start. General arrangement drawing shall clearly show all the parts of the system (such as solar flat plate

collectors, collectors stand assembly, internal and external piping, tank stand assembly, various valves, pressure gauges, temperature gauges, water meter etc.) and their fixing arrangements.

10)The contractor shall supply two sets of instruction manual without any extra cost. Instruction manual shall contain the following details

a) Schematic diagram of the solar collector, Instruction manual and list of service centers.

11)The supplier firm shall furnish complete and satisfactory type test reports for each size / type of solar flat plate collector as per contract specification from any govt. laboratory. Type test reports shall be complete with authenticated drawing giving complete details of the various component used in the solar flat plate collector. Type test reports shall include all the tests listed in IS. 12933 (Part-1) with amendment No. 1 (excluding test requirements as per clause 7.2.7 and 7.2.8 of IS) and also the tests included on various components of solar flat plate collector as per IS: 12933 (Part-2) I 2003 amended update. All leaks & defects in different joints noticed during the testing & commissioning shall be rectified to the satisfaction of the Engineer-in charge.

12) Civil work for foundation, grouting etc. of the system complete as required is in the scope this work. The foundation shall be carried out with 1:2:4 PCC. While erecting the equipment at terrace, contractor shall make sure no damage is done to water proofing and civil structure, location at which grouting is required shall be sealed with high quality water proofing compound. Installation shall be as per guideline issued by MN RE/Manufacturer's standards, whichever is stringent.

13) Warranty

All the solar water heating systems shall be warranted for a minimum period of 5 years from the date of installation and commissioning against any manufacturing and design defects. Consumables such as rubber parts etc. shall also be warranted for a minimum period of 5 years from the date of installation and commissioning.

SPECIFICATION OF RO PLANT SYSTEM

RO SYSTEM

Tenderer must inspect the site and the quality of raw water. He shall be at liberty analyses the raw water characteristics from any Lab to his satisfaction and to examine and satisfying himself with the process and detail provided in tender document in obtaining treated water quality as specified in tender document no claim on whatsoever account regarding raw water characteristics and treated water parameters thereon shall be entertained.

Contractor shall submit with the Tender, General Arrangement (GA) layout and hydraulic drawing of plant giving all major dimensions, design parameters, sizes of units and equipment and pipes, H.P. of motors and all other pertinent information for assessment of the tender.

Contractor shall submit with the Tender all the detailed specifications of proposed electromechanical part of work described herein.

The contractor shall arrange all T&P, Manpower, and chemicals/ consumables like RO anticipant chemical, pH correction agent, chlorine, CEB & CIP chemicals, micro cartridge filters, reducing agents, POL etc. specified in the tender document for commissioning and maintaining the plant under warrantee period of 12 months for which nothing extra shall be paid. v. The raw water characteristics

have been indicated from the sample which got tested however the values can be different. The tenderer shall consider his quote considering the quality of treated water which ultimately required by the department on satisfactory installation of plant, complete with the prescribed technology and treatment process.

The main components in the scope of supplier shall be as under: RO System Components, Instrumentation & Controls.

RO System	To design with minimum recovery of 70% for all time from commissioning of plant.
(i) Inlet Pump	(ii) Pressure Gauges, Instrumentation & Controls
(iii) Anti Scalent Dosing System	(iv) Flow indicators
(v) Fully Automatic Ultra filtration Unit	(vi) Liquid level controllers in storage
(vii) High Pressure Pump	(viii) Ball valves at inlet and outlet piping
(ix) Pressure Vessel	(x) Timer for auto flash
(xi) Membrane	(xii) High pressure switch and low-pressure switch
(xiii) pH correction system	(xiv) Auto flushing system with solenoid valve
(xv) Ultra Violet System	(xvi) Electric control panel with " A" meter, Voltmeter indicators, on off switch
(xvii) Cleaning in place system	(xviii) Pressure Control Valve
(xix) Micron cartridge filter	(xx) Digital conductivity or TDS Meter
(xxi) 1000 Litres capacity treated water tank	(xxii) Piping from raw water tank to RO System and RO System to outlet pipe

Note: The R.O Plant should have control instrument i.e., flow meter for permeate and reject, pressure gauge so that the department may able to visualize the rejection percentage of water.

RO System Requirements

The capacity of the plant shall be the output water capacity of RO in litres per hour (LPH). The technical specifications of each component of RO system shall be for its output capacity of as per demand. The output water quality characteristics are given. However, the total dissolved solids (TDS) of output water obtained from RO plant shall range between 100 to 250 mg per litre in any case. The other chemical parameters of treated Water shall be within limits mentioned in this document. The contractor shall design the R.O keeping in view recovery of treated water minimum 70% and shall provide the required digitized gauge so as to ascertain the percentage of treated and rejected water. In any case the rejected water should not be more than 30%. In the event if it is noticed that during running and operating of R.O. Plant the treated water recovery and quality is not in terms of NIT in

such case the department shall forfeit the performance guarantee and can also claim damages on a/c of breach. The bidder shall analyse the water sample for parameters as per BIS norms at least once in a month from approved laboratory and maintain proper record as per the directions of SBI,PMC & engineer-in-charge. In addition to this the bidder shall make available at plant site, all the times, a digital TDS meter for on-the-spot for testing of R.O. Water. The system should be able to adopt the variable feed water characteristics such as varying amount of fine particulate / silt etc. in the raw water and varying TDS levels throughout the design. The use of cleaning chemicals in the system should be minimal. The system should ensure prevention of fouling of the downstream RO membranes caused by the presence of organic and microbiological coolants in the raw water. The system should ensure prevention of a majority of physical foul ants from entering into RO membranes so as to ensure clean RO membranes delivering consistent performance. The system should generate minimal amount of effluents thus giving an environment- friendly solution. The dependence on operator for day-to-day functioning should be minimal. The Bidders should provide automated system so that manual monitoring is minimal.

Making connection for raw water: - The bidder shall be responsible for executing works for making connection for raw water from the source provided by the department including cost of all material and labour etc.

GENERAL REQUIREMENTS:

The bidder shall perform all routine maintenance to ensure proper operation. The bidder shall provide training to the system operator. The bidder shall ensure routine inspection of the equipment by the equipment supplier. The bidder shall provide trained manpower to maintain the equipment, change filters, and refill chemical storage tanks. Maintaining the required uptime of all the systems to ensure the provisions of quality services. The bidder shall be responsible for the supply of consumables and chemicals, and any other material required essentially to provide effective services. The bidder shall install the equipment at the locations specified by SBI, PMC & engineer-in-charge.

OTHER REQUIREMENTS:

The record containing hours of operation and quality of water etc. shall be maintained by the bidder, The record should always be updated, legible and be produced for inspection as and when asked for. Frequency of replacement of membrane shall invariably be mentioned in the offer. The minimum guaranteed period of membrane should not be less than 6 years and in case if the water quality is deteriorating and membrane is required to be changed before 6 years it shall be replaced by the bidders at his own cost. Any deviation from the proposed design needs to be approved by the Department.

PACKING, FORWARDING AND TRANSPORTATION

All accessories which are likely to get damaged as an assembly/ unit during transit, shall be removed and adequately packed and shipped separately. All inlet and outlet flanges shall be blanked with thick bolted wooden planks. Packing shall be sturdy and adequate to protect all assemblies, components and accessories by damage, corrosion, dampness, heavy rains breakage and vibration encountered during transportation, handling and storage at the plant site.

TESTING AND INSPECTION

Pre dispatch inspection

All equipment covered under R.O. Plant may require pre dispatch inspection, if so, required by the department during the course of execution. The pre- dispatch inspection may be carried out by Department or its accredited agencies/third party as approved by the department. The charges for third party inspection, if any, would be borne by the contractor wherever pre dispatch inspection is required, the bidder should produce all the documentary evidences having procured and used new and quality components which go into the total system. These documents including guarantee/ warrantee / test certificate of the component manufacturer will be verified and authenticated by the inspection agencies. Such authenticated document should form a part of the total document required for clearing the bill for payment as per the schedule of payment.

Site tests

After erection at site, all components, equipment as described shall be tested to prove satisfactory performance and /or fulfilment of functional requirements without showing any sign of defect as individual equipment and as well as a system. All rotating components of the system as applicable shall run at the rated speed for a period of 7 (Seven) Days. During this period, all the components shall function smoothly without any undue deflection; unbalance vibration, flutter, slipping or sticky motion, excessive play & overheating at bearing parts, sparking etc.

Tests for R.O. Plant system on commissioning

All equipment covered under R.O. Plant shall be subjected to inspection testing by Department on completion & commissioning.

ERECTION AND COMMISSIONING (E & C)

The Supplier shall be responsible for satisfying himself and the Department as to the correctness of the electrical and mechanical connections between all equipment in his supply

TREATMENT PROCESS

SCHEME OF TREATMENT

Sand Bed Filter

Outlet of Iron removal filter shall be passed through Sand Bed for removal of suspended solids to produce clear filtrate.

Activated Carbon Filter

Filtered water after removal of iron and suspended solids shall be passed through Activated carbon filter to remove colour, odour and residual oxidizing agent. Operation of all the filtration units (viz. iron removal, sand bed and activated carbon filter) shall be on automatic mode for service and

regeneration. Raw water pumps will operate automatically as per the requirement of water level in tanks.

pH Correction unit

Perfect pH of Membrane feed water not only ensures better performance of membranes also reduce the dose of costly anti-scalant chemical. Suitable chemical shall be dosed to maintain the appropriate Langelier Saturation Index (LSI). pH shall be constantly checked and monitored.

Anti-scalant Dosing unit

To prevent scale formation and fouling of membranes, measured quantity of suitable chemical shall be dosed in membrane feed water. The dosing pump shall be electronic metering type having proper arrangement of level controller and alarm for accurate and consistent dosing.

Fine Filtration unit

After dosing of required chemicals, water is passed through micron cartridges filtration unit of rating 5 microns to avoid the possibility any residual carryover in membranes.

DESALINATION BY REVERSE OSMOSIS UNIT with post pH correction

Ultra-Filtered and properly conditioned water shall be pumped to membranes at high pressure over osmotic level to separate the concentrate and dilute water stream. The membranes selected shall be energy efficient, high rejection type and will be designed on safe flux rate 13 GFD to produce purified water having TDS below 100 mg/L and pH neutral (7.0 - 7.5) after correction. The vendor shall guarantee that the RO system produces rated output on 75 % recovery and specified parameters (TDS, Total hardness, Total alkalinity, chlorides etc) shall not exceed the limit as specified in treated water table. Besides, it will conform to IS - 10500:1991 protocol of drinking water specified by Bureau of Indian Standards

Treated water for Domestic, drinking and cooling

RO permeate water after pH correction shall be ideal/ suitable for domestic, drinking and cooling and major quantity of this water shall be utilized for such applications of following parameters.

Other parameters and E. Coli, coil forms shall confirm to the standard IS: 10500

Storage and pumping of water for domestic, drinking and cooling

Purified water of above specifications shall be collected in storage tank in pump house area.

General Design Data for R.O. Plant

2 Ground Water:

Inspect and verify site before tendering.

3 Soil Characteristics

Inspect and verify site before tendering.

4 Influent Characteristics

Type of Feed Water: Feed water is from water softening plant which treats ground water. The water softening plant shall be provided by the main contractor.

Note: - The raw water characteristics has been indicated from the sample which got tested however the values can slightly be different. However, the tenderer shall consider his quote considering the treated water quality (output water from R.O. plant)

Input Water, Treated Water Characteristics and Technical Specifications of Electrical & Mechanical Equipment.

Space Availability & Proposed Height

All the three plants shall be installed on the terrace of each block i.e., one plant for each block. Contractor shall require to plan and coordinate within the space only for which he shall require to get approve the exact space, location and area from the Department.

Scope of Work

1. Design and Drawings for complete plant.

a. Preparation and submission of process and instrumentation drawings

b. Preparation and submission general arrangement drawings

c. Preparation and submission of equipment/system layout drawings

d. Preparation and submission of civil construction drawings for foundation work/ raised platform to install pumps & motors. Civil work is also included in the scope of this contract for which nothing extra shall be paid.

e. Preparation and submission of detailed engineering drawings.

f. Preparation and submission of as built drawings

2. Making out/ linking proper drainage, so that any leaked water from joints, couplings etc. may not flow on floor of the service block.

3. Providing complete layout plan duly laminated with glass panel showing complete system flow and discharge also necessary guidelines for the operator for day-to-day running of plant, in case the plant is run in manual mode and regarding periodical service of plant.

4. Supplying, installation and commissioning of all electro-mechanical equipment's as per the approved specifications, design.

5. Providing and fixing of all interconnecting pipe works starting from inlet chamber to final delivery outlet pipe.

6. Testing and commissioning of plant to produce output of specified parameters as well as specified water quality and quantity.

The following routine tests which shall be required to carry out on day to day basis as per IS: 10500.

a. COLOUR

b. TURBIDITY

c. pH

d. TOTAL DISSOLVED SOLIDS

e. IRON

f. CHLORIDES

g. CARBONATES

h. BICARBONATES

i. TOTAL HARDNESS

j. CALCIUM HARDNESS

k. RESIDUAL CHLORINE

I. e-COLI

m. COLIFORM

Balance tests as per IS: 10500 shall be carried out from the outside NABL accredited Lab as approved by SBI, PMC & engineer-in-charge. The contractor shall bear all incidental charges for cartage, storage and safe custody of materials brought to site.

PERIODICAL TESTING AND MAINTENANCE SCHEDULE

S.No.	System Component	Activity	Periodicity
1	Sand Filter	Back Wash	Daily
		Rinse	Daily
		Replacement (Filter + Filter Sand)	Once in a Year
2	Carbon Filter	Back Wash	Daily
		Rinse	Daily
		Replacement (Filter + Carbon)	Once in a Year
3	Micron Filters		
3.1	Micron Filter	Replacement	Once in every month
3.2	Micron Filter	Replacement	Once in every month

4	Cleaning	Membrane Chemical Cleaning	Every Month
		SS Water Tank Cleaning	Every 15 Days
5	Dosing	Anti Scalant Dosing	During Operation of Plant
6	Anti Scalant Chemical	Adding	every month
7	Dosing	Anti Scalant Dosing	During Operation of Plant
8	Water Testing	Chemical Testing	Every Three Months
		Bacterial Test	Every Three Months

Note: - The Make and Model shall be got approved from the SBI,PMC & engineer-in-charge before use on work. The decision of the SBI,PMC & engineer-in-charge regarding the model and make shall be final and binding based on the prevailing models at the time of execution.

SEWAGE TREATMENT PLANT (STP) (300 KLD INDICATIVE)

Moving Bed Bio-film Reactor (MBBR) is an aerobic attached biological growth process. It does not require primary clarifier and sludge recirculation. Raw sewage, after screening and de gritting, is fed to the biological reactor. In the reactor, floating plastic media is provided which remains in suspension. Biological mass is generated on the surface of the media. Attached biological mass consumes organic matter for their metabolism. Excess biological mass leaves the surface of media and it is settled in clarifier. Usually a detention time of 5 to 12 h is provided in the reactors.

Sewage water from Toilets, Bathrooms, Canteen, Pantry, washrooms etc. is fed into the Sewage Treatment Plant.

The contractor shall set out the works in relation to original points, lines and levels of reference required for execution of work. The contractor shall be responsible for the correct positions of all parts of the works and shall rectify any error in the positions, levels, the dimensions, or alignment of works. Carrying out & confirming the detailed topographical survey along finalized Gravity main/Rising main alignment and treatment plant site, disposal of treated water and sludge and establishing benchmarks at least two locations within the site and one at pumping station site.

Supply, erection, testing & commissioning of all the piping, valves and specials etc. as per detailed technical specification.

Water tightness (seepage)/ testing of all the water retaining structures as required.

Trail Run: The contractor shall initially operate the STP for a period of one month, after completion of work, for start-up/stabilization and for satisfactory performance, by deploying experience staff in two

shifts a day and the staff of the user department shall be trained for operation of plants for which nothing extra shall be paid.

The designs of Civil/ Electrical/ Mechanical portion shall be based on the latest relevant IS codes, CPWD specifications, PH Engg. Manual, Indian Electricity Rules. Norms of pollution control board, Local By – laws and WHO standards with up-to-date amendments and correction slips and sound engineering practice. Each and every step of the design calculations should be self-explanatory. Wherever formulae are adopted, they may be printed clearly. Each factor/ parameter contained in the formula has to be stated in clear terms regarding what for they stand/ their representation in the formula. Side references along with calculations are to be given regarding adoption of references from books/ manuals/ IS codes etc., including their page numbers.

The characteristics given are indicative and subject to change. The Effluent treatment should be based on MBBR Technology. The treated effluent shall be subjected to tertiary treatment. Quality of effluent after tertiary treatment shall be in conformity with the standards laid down by Pollution Control Board for discharge in to a stream.

The tenderers are free to adopt the sizes to suit the design requirements for final approval from State Pollution Board/ Local authorities.

The Sewage treatment plant shall follow satisfy the following requirements.

Efficient

Low power consumption.

Minimum maintenance.

Minimum space requirement.

Self-operating system.

The scheme proposed shall be free from environmental hazard to the occupants and neighboring tenants.

The tenderer shall obtain No-Objection Certificate from Pollution Control Board before and after execution of work.

Characteristics

Flow	300 m3/day
Discharge period	24 hrs
Peak Duration	3.0 hrs

Outlet parameters STP

(As Per NGT Norms)

Temperature 25°	Not exceed 5°c above
Color	Colorless
Odor	Nil
TSS	<20mg/ltr
PH	6.5 to 9
Oil and grease	<10mg/ltr
`BOD	<10mg/ltr
COD	<50mg/ltr
Total Nitrogen	<10mg/ltr
Total Phosphorus	<1mg/ltr
Total Coli forms	100-230

To treat the Sewage, the following treatment philosophy is adopted:-

Bar Screen : To trap any free floating debris.

Oil & Grease removal tank : To trap free & floating oil if any.

Equalization tank : To equalize the sewage quantitatively & qualitatively.

MBBR-1 : Moving bed bioreactor tank 1

MBBR-1 : Moving bed bioreactor tank 2

Tube settler tank : For solids liquid separation.

Chlorine contact tank : For polishing & disinfection.

Filter Feed tank : For Feeding to Filters.

MGF, ACF, and SF : Polishing Units.

CWT : Clear water tank

UF : Ultra filtration plant

TWT : Treated water tank

Sludge Tank : For storage & digestion of Sludge.

PROCESS DESCRIPTION

Bar Screen:-

Raw sewage from the source is usually received into the bar screen chamber by gravity. Screen provided will remove all floating and big size matter, which may otherwise choke the pipeline and pumps.

Type -1	Manually cleaned with Handrake
Construction	In SS flats of size 25 x 5 not more than 10mm with necessary SS flat stiffeners. 1 No. hand rake shall also be provided with GI pip rod.
Type – 2	Mechanically cleaned automatic system.
Construction	In SS flats with opening not more than 4-5 mm with automatic cleaning system based on head loss.

Mechanical Oil Skimmer:

Material of Construction	CI
Type	Belt type of 2-4" belt width and belt length suitable for chamber depth below Liquid in O&G Tank. Skimmer shall be Motor driven type with suitable Motor and suitable speed reduction arrangement.

Equalization Tank: -

Usually, Sewage generation is more during peak hours. Visually no Sewage is generated during shift change hours. Any biological system needs constant feed for bacteria to work efficiently. Hence, it is important to put an equalization tank to collect the excess flow during peak hours and feed Sewage in lean hours. Equalization tank shall have a capacity of 8-12 hours of average flow rate. Provision of air grid shall be made for thoroughly mixing the sewage to make it of homogenous quality and to keep the suspended matter in suspension and to avoidseptic conditions. The well mixed sewage is then pumped into the Rotary FAB reactor with the help of pumps.

Raw Effluent Transfer Pump:

Non-Clog, Self-Priming, raw Effluent transfer pump suitable capacity to pump Effluent from equalization tank to Aeration tank No.1 & 2(MBBR Tank 1 & 2) suitable for handling 25 mm to 30 mm solid particles and liquid discharge.

Air Blower:

Twin lobe rotary type air blower capable of delivering suitable capacity of Air at designed pressure, driven through "V" belt or directly coupled/ through flexible coupled to a suitable TEFC motor with accessories. The pressurized air from blower shall be fed to Equalization tank, MBBR Tank-1, MBBR Tank-2.

MBBR Tank (Aeration tank):

The process at MBBR tanks under aerobic conditions is that the rising buoyancy of air bubbles generated during aeration and oxygenation can promote the flow of the filler and surrounding water. When the airflow passes through the water flow and the gap of the filler, it is blocked by the filler and divided into small bubbles. In this process, the filler is fully stirred and mixed with the water flow, and the air flow is fully divided into fine bubbles, which increases the contact and oxygen transfer efficiency of the biofilm with oxygen. Under anaerobic conditions, the water flow and the filler are fully fluidized under the action of a submersible mixer to achieve the purpose of full contact and degradation of biofilm and treated pollutants.

Polypropylene MBBR Media:

MBBR media is one kind of new bioactive carrier as a house for attached growth bacteria in MBBR process. It works as carrier for the growth and attachment of microorganisms and are directly put into the MBBR system, the wastewater go through the suspended carriers in MBBR reactor, Kaldnes media adopt scientific formula and blend some micro-elements in the high polymer material, which microorganisms attach themselves to submerged moving biofilm carrier, forming a biofilm. Air is transferred into the water, mixing the media and water and providing oxygen to the bacteria. The MBBR media biofilm absorbs oxygen and reduces organic and inorganic material thus providing treatment.

Tube Settler tank:

The aerated mixture shall be transferred from MBBR tank to RCC Tube settler Tank. The aerated mixture shall be passed through tube settler media before it reaches to the bottom of the tube settler tank.

Flocculation–Diffusers &Tube Settler:

Suitable size and quantity, Coarse & fine bubble disc type diffusers, with necessary accessories, of EPDM/Silicon with anti-fungal treatment, to provide clog free oxygen for aeration at Equalization tank, sludge holding tank, treated water tank and aeration tanks.

Suitably designed UV treated PVC tube deck settling media to be installed in Tube Settler Tank along with retainer plates and suitable sludge removal arrangement either by pumps or any other suitable arrangement.

Polyaluminium chloride (PAC) dosing & Polymer (PE) dosing shall be done at Tube settler media.

Sludge Holding Tank:

The sludge from the Tube Settler tank is to be removed from bottom of tank and transferred to RCC Sludge Holding Tank (SHT). SHT shall have 6 days sludge holding capacity. The sludge collected at bottom of sludge holding tank shall be fed to filter press.

Filter Press:

Filter press suitable for dewatering the sludge and making its cakes with moisture contents of 75% to 80% complete as required, Suitable for operation on 415 ± 10% volts, 3 phase, 50 cycles A/. Supply.

Clear water tank:

The sewage water from tube settler tank is transferred to RCC clear water tank of suitable capacity, for chlorination.

Disinfection:

The clear sewage water is then added with chlorine using chlorination pump to kill the pathogens / E-Coli coliforms. The chlorinated sewage water becomes clear water and now it is substantially free from organic contamination, free from coliform bacteria.

Multi Grade Filters

Multi Grade Filters (MGF) are used in water treatment and waste water treatment to remove suspended solids, dust and dirt present in the water.

The raw water flows down from the filter inlet through the media bed. The media bed consists of multiple layers of sand, pebbles and gravels arranged according to size and density. As the raw water passes through different layers of the media, filtration takes place in each media layer. The media bed retains all the suspended solids, dust and dirt present in the water and the clear filtered water flows through the outlet of the filter.

Activated Carbon Filter :

Activated Carbon filtering is a method of filtering that uses a bed of activated carbon to remove contaminants and impurities, using chemical adsorption. Each particle/granule of carbon provides a large surface area/pore structure, allowing contaminants the maximum possible exposure to the active sites within the filter media. Granular activated carbon (GAC) is commonly used for removing organic constituents and residual disinfectants in water supplies. This not only improves taste and minimizes health hazards; it protects other water treatment units such as reverse osmosis membranes and ion exchange resins from possible damage due to oxidation or organic fouling.

An activated carbon filter (ACF) works on the principle of adsorption; filter medium adsorbs or reacts with a pollutant molecules then filtered water is drained out. Activated carbon which is used as medium to remove contaminants is natural material derived from coconut shell, lignite, bituminous coal etc. further, activated by chemical or steam under absence of oxygen with high temperature around 1000°C. Specific contaminants can be removed by employing blends of various carbons.

Softener Filter :

A water softener removes calcium and magnesium from water through a process called ion exchange. When the hard water enters into the mineral tank, it flows through a bed of spherical resin beads. These plastic beads, usually made from polystyrene, are charged with a sodium ion. The resin beads are anions, meaning they have a negative charge. The calcium and magnesium minerals have a

positive charge, making them cations. Since opposite charges attract, the negative charge of the minerals is attracted to the positive charge of the resin beads. As the hard water passes through the resin, the beads grab ahold of the mineral ions and remove them from the water. When the bead seizes the mineral ion, the sodium ion is released. The column of resin strips all the hardness out of the water as it passes through the mineral tank, and softened water flows out

Clear water tank:

The sewage water from tube settler tank is transferred to RCC clear water tank of suitable capacity, as per sld

Basket Filter :

The main function of the basket filter is to install on the pipeline to effectively filter out the dirt, dust, pipe scale and other solid impurities in the gas and liquid. It will protect the metering, pressure regulating equipment and instruments in the pressure regulating station can work normally. Besides, it ensures the safe production. The basket filter has a larger dirt volume and a smaller resistance loss, which can extend the maintenance period.

The basket filter is mainly composed of a tube, a cylinder, a filter basket, a flange, a blind plate cover, and fasteners. The basket filter has high reliability and safety. The filter basket can be cleaned, which is convenient for maintenance. It shortens the equipment maintenance cycle and saves the high cost of replacement parts. The filter is a clamp-type quick start structure.

Basket filter working principle: when the liquid through the barrel into the filter basket, solid impurities particles are blocked in the filter basket, and clean fluid through the filter basket discharged from the filter outlet. When it needs to be clean, unscrew the bottom of the main screw plug, discharge fluid, remove the flange cover, and reload after cleaning.

Ultra filtration

Ultrafiltration (UF) is a membrane filtration process similar to Reverse Osmosis, using hydrostatic pressure to force water through a semi-permeable membrane. The pore size of the ultrafiltration membrane is usually 103 - 106 Daltons. Ultrafiltration (UF) is a pressure-driven barrier to suspended solids, bacteria, viruses, endotoxins and other pathogens to produce water with very high purity and low silt density.

Ultrafiltration (UF) is a variety of membrane filtration in which hydrostatic pressure forces a liquid against a semi permeable membrane. Suspended solids and solutes of high molecular weight are retained, while water and low molecular weight solutes pass through the membrane. Ultrafiltration is not fundamentally different from reverse osmosis, microfiltration or nanofiltration, except in terms of the size of the molecules it retains.

A membrane or, more properly, a semi permeable membrane, is a thin layer of material capable of separating substances when a driving force is applied across the membrane. Once considered a viable technology only for desalination, membrane processes are increasingly employed for removal of bacteria and other microorganisms, particulate material, and natural organic material, which can

impart color, tastes, and odors to the water and react with disinfectants to form disinfection byproducts (DBP).

HCL Dosing System

HCL Dosing System are available in varied specification depending on several applications and features embedded. The HCL Dosing System is consisting of solution preparation tank with dosing tank. The compatible material is provided to transfer the Highly Corrosive/Concentrated fluid. It is energy efficient And ensures Good Performance.

CAUSTIC DOSING SYSTEM

Unique dosing system offers the best pump for caustic transfer requirement. Caustic Dosing System is available in various designs to meet client's requirement. This system is equipped with motor and water tank of various capacities and widely used in small, medium, and large industries for dosing of caustic

Ultraviolet (UV) Disinfection Unit:

Ultraviolet dis-infection unit shall have over 99.9 % bacterial reduction from inlet to outlet. The dis-infection chamber shall be constructed of SS 316L steel. The UV lamp shall be of low pressure mercury vapor type with hard glass enclosure, the sockets shall be water tight & vibration resistant. The lamp life shall be rated for 6000 hours.. The UV unit shall have reactor, cabinet housing, cabinet cooling, treatment chamber, electrical panel, temperature safety control, lamp out alert, UV radiometer along with UV monitoring system and UV monitoring readout panel. The UV lamp shall be easily replaceable type. The lamps should be selected based upon the flow requirement of respective unit.

Treated water Tank:

The treated water from UV Disinfection unit shall be led to treated water tank before its disposal. The capacity of treated water tank shall be designed accordingly.

SCADA Systems

The beauty of modern plumbing is that when we turn on our faucet, we can reasonably expect freshwater to come pouring out. There are few places left in the country that are untouched by the advancements and regulations of public water. So when the *Washington Post* published an article in 2016 about researchers finding unsafe levels of industrial chemicals in the drinking water of 6 million Americans, wastewater treatment plants and water management services took notice.

The report cited in the Post article found that “194 of 4,864 water supplies across nearly three dozen states had detectable levels of the chemicals.” Of those water supplies, 66 services had at least one sample that exceeded the EPA’s recommended safety limit for two types of chemicals. That ratio might not seem like a high number, but 66 water services affect six million Americans, so it’s clearly not a small issue.

Water treatment plants and water usage facilities can do their part by making sure their monitoring equipment is up-to-date and as accurate as possible. While SCADA (supervisory control and data

acquisition) systems are more commonplace in modern operations, an updated version exists and is proving to a more reliable and better solution: a cloud-based SCADA system.

A cloud-based SCADA system allows water management plants to not only monitor levels of specific chemicals and toxins but to have precise records accessible from anywhere. No longer are digital read-outs only available at a fixed point on the SCADA unit. Instead, any manager or operator who needs data can access it from their own satellite- or WIFI-enabled device.

In the contaminated water study, the EPA sought to mitigate the ramifications until stricter guidelines could be drawn up. When it comes to healthy drinking water, Americans don't want to waste time in the bureaucratic process of defining regulations.

Unfortunately, Congress mandates that before the EPA imposes new limitations on the nation's water utilities, it has to prove that there is a meaningful opportunity to improve public health. It is a long, arduous process that takes years; officials have not successfully regulated any new contaminant in two decades because the process is complicated and contentious.

Another benefit of a cloud-based SCADA system is that data collected in real-time from the contaminated areas can be studied, compared, and shared with researchers in a faster, more efficient, digital manner. By comparing the data points, researchers can have the most accurate knowledge from which to draw, and that hopefully can lead to quicker results and faster action.

Because of our industrial advancements, the environment is changing faster than we can understand. However, because of our technological advancements, we can use the digital tools available, like a cloud-based SCADA solution, to monitor, record, and support research for improvements.

List of Civil works:

S.No.	Item	Qty.	Material of construction
1.	Bar screen pit	1 No.	RCC
2.	Oil & Grease Trap pit	1 No.	RCC
3.	Equalization tank	1 No.	RCC
4.	MBBR tank	2 Nos.	RCC
5.	Tube settler tank	1 No.	RCC
6.	Sludge Tank (For 6 days storage)	1 No.	RCC

7.	Clear water tank	2 No.	RCC
8.	Treated water tank	1 No.	RCC
9.	Platforms for Dosing Tank and foundation for equipment.	1 Lot.	RCC

List of E & M Works:

S.No.	Item	Qty.	Material of construction
1.	Bar screener	1 No. Manual type 1No. Mechanical type	MS-EP
2.	Mechanical Oil Skimmer	2 Nos.(1 W + 1 S)	MS-EP
3.	Raw Effluent Transfer Pump:	2 Nos. (1W+1S)	Impeller – CI Body – CI
4.	Air Blower for EQT & FABX	2 Nos. (1W+1S)	CI
5.	MBBR media	1 Lot.	PP
6.	FABX-Air Distribution grid	1 Lot.	UPVC
7.	Sludge Transfer Pumps	2 Nos. (1W+1S)	Impeller – CI Body – CI
8.	Filter Feed Pump	2 Nos. (1w + 1s)	Impeller – CI Body – CI
9.	Screw pump for dewatering of sludge	2 Nos. (1W+1S)	Impeller – CI Body – CI
10.	Filter Press, Centrifuge type	2 Nos. (1W+1S)	Basket –SS304 Body - MS
11.	Air grid for Equalization Tank & SHT.	1 lot.	UPVC
12.	PAC Dosing Tank	1 No. (1w)	LDPE
13.	PAC Dosing Pump	1 No. (1w)	PP
14.	PE Dosing Tank	1 No. (1w)	LDPE
15.	PE Dosing Tank Agitator	1 No. (1w)	SS304

16.	PE Dosing Pump	1 No. (1w)	PP
17.	Tube Settler Media	1 Lot.	PVC
18.	Collection Trough	1 Lot.	MS-EP
19.	Sodium Hypochlorite Dosing Tank	1 No. (1w)	LDPE
20.	Sodium Hypochlorite Dosing Pump	1 No. (1w)	PP
21.	Chlorine Contact Tank	1 No.	MS-EP
22.	Dual Media Filter.	1 No. (1w)	MS - Bituminous
23.	Activated Carbon Filter.	1 No. (1w)	MS - Bituminous
24.	Air grid – Sludge tank Coarse Bubble aeration without Diffuser.	1 lot. (1w)	uPVC
25.	DWPE Dosing Tank	1 No.	LDPE
26.	DWPE Dosing Pump	1 No.	PP
27.	Agitator for DWPE Dosing Tank.	1 Lot.	SS304
28.	Interconnecting piping- Air blower line (B-Class - Confirming to IS1239)	1 Lot.	MS
29.	Interconnecting valves -- Air blower line	1 Lot.	CI
30.	Interconnecting piping -- Sewage line.	1 Lot.	uPVC
31.	Interconnecting Valves -- Sewage line	1 Lot.	PP
32	Ultra filtration plant	1 No.	

Plumbing, Interconnecting Pipes and Valves:

All the plumbing works including interconnecting pipelines, fittings and valves shall be done. The pipelines to be used shall be of HDPE / MS/ G.I/ /CPVC/UPVC material of construction based on the application.

Control Panel and Cabling:

Separate Electrical control panels shall be provided for STP & ETP. Indoor control Panel shall be made out of 14 SWG CRCA sheet duly powder coated. The panel shall be having PVC heat shrinkable sleeved and 4 strip (3 phase + 1neutral) copper bus bar of suitable size and copper interconnections etc. complete as required along with suitable rated MCCBs/ MCBs for incoming and outgoing, Starters, O-

L relay, Single Phase Preventer, Dry run preventer, LED Indication Lamps, Digital Ammeters and Volt meters with selector switch. The Panel shall function in complete Auto Mode / Manual Mode.

Supplying and providing all inter-connecting cabling with XLPE insulated PVC sheathed unarmored copper conductor cables of 1.1 KV grade conforming to IS: 7098 with up to date amendments and of suitable sizes with ISI mark, including connections, lugging, testing, i/c laying UG cable along with earth wires from panel board to all the Equipment / Pumps of STP &ETP in suitable size GI pipes below ground/G. I. tray on surface including supply of suitable size of GI pipe/G. I tray.

Electrical supply shall be tapped from nearest feeder through XLPE insulated PVC sheathed Aluminum/ Copper conductor cable, 1.1 KV grade.

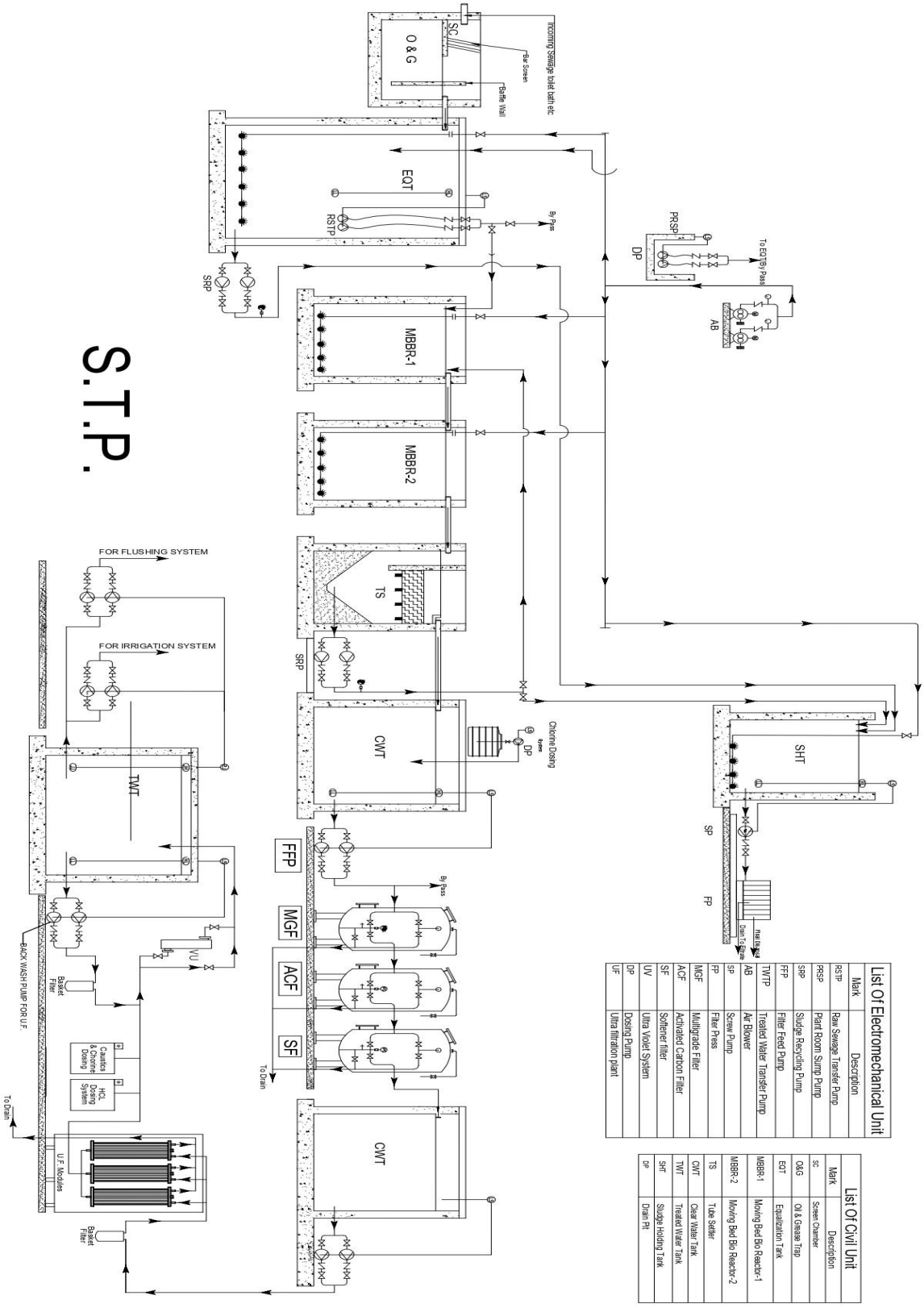
Motors

Motors shall be as per IS 325, TEFC squirrel cage induction motors. Degree of protection shall be IP55. Motors shall be suitable for supply voltage of 415 volts +/- 10%, 50 Hz, A.C. Supply. Insulation Class 'F' considering temperature Rise as Class 'B'. Efficiency Class IE2

Earthing:

All the Panels, pumps and other current carrying items shall be properly earthed. Sizes of earth strips, wires shall be as per calculations and shall be of Copper only. All the copper earth strips, copper earth wires shall be connected to main earth grid at suitable points.

PROCESS BLOCK DIAGRAM (INDICATIVE)



Water Treatment Plant (WTP) (250kld INDICATIVE ONLY)

It is proposed to provide Water Treatment Plant of suitable Capacity to meet the specified outlet parameters of water. The system shall consist of following components

Water supply /filter feed pumps/ MoC preferably should be -SS-304/C.I casing, SS-304 /Brass /Bronze impeller & SS shaft suitable for operation 400/440 volts, 3 phase, 50 Hz, 2900 rpm, TEFC electric motor with best efficiency class preferably IE-3 complete with all accessories like flexible rubber bellows, strainers, valves, pressure gauges etc. Suitable PCC/RCC foundation with plaster, MS channel plate with primer and two coats of paint, Anti-vibration arrangement of cushy foot mountings should be provided. Multi grade filter/dosing unit/activated carbon/ Softeners sized for optimum working pressure etc. Panels, Allied Equipment & Accessories (level controllers, probes, vibration eliminators, starters, valves, pressure gauges etc.)

All equipment shall be installed on suitable foundations underground pump house

Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.

Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.

The water treatment process shall be designed depending upon the quality of water. pH, TDS, Turbidity, Total Hardness & other biological factors shall conform to latest IS Codes/GRIHA Norms. Suitable nos. of Filters/Softeners shall be considered & sized taking into consideration the diameter, OBR, depth of filter media, backwash arrangement, interconnecting pipes of suitable material (GI/CPVC/UPVC/PVC) & grade, instruments, valves etc. One standby pump shall be provided considered for each type

• Sufficient maintenance space shall be provided inside the water treatment plant room for accessibility of various pumps, panels etc. during repair & maintenance activities.

• Water Treatment Plant Room shall be suitably ventilated considering adequate ACPH as per NBCS 2026code.

• Water treatment Pump Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.

It is proposed to provide all sanitary engineering services and specification which are:

• High standards of materials and workmanship.

• Provide leak proof plumbing.

• Reliable and dependable engineering systems.

• Provide adequate safety and means to egress easily in case of fire.

• To plan the system in such a way as to minimize the energy requirements.

• To create minimum nuisance and disturbance to the environment

Sizing of Pumps

The Flow Rate of Pumps shall be suitably selected to meet building‘s water demand & of Sufficient Head depending upon Building Height , Pipe Friction losses, Bends etc. and other relevant Site

Conditions. One Standby Pump to be considered in each & every variant. The Pumps shall be sized so as to ensure approximately 4 hours of operation time to fill the treated water tank

Multi grade filter (Pressure Sand Filter - Dual Media Filter)

the water treatment technology, a Multi Grade Filter consists of vertical or horizontal pressure sand filters that contain multiple layers of coarse and fine sand (pebbles and gravels) in a fixed proportion. It is a kind of a deep filter bed with adequate pore dimensions for retaining both large and small suspended solids and un-dissolved impurities like dust particles. As compared to conventional sand water filter, this multigrade filtration system works on higher specific flow rates. It is also a low cost pre-treatment system for ion exchangers (deionizer and softener) and membrane systems such as reverse osmosis etc. With high throughputs, high dirt-holding capacity and capacity to reduce turbidity and TSS (< 5ppm) from water, it protects ion-exchange resins and membranes from physical fouling due to suspended impurities present in the water.

The working principle of a multigrade filter is quite straight forward. In a multigrade filter or pressure sand filter, water is passed through multi layers of filter media consisting graded sand, pebbles and gravels layers. The contaminants in the water are captured in the media bed and filtered water passes into the discharge manifold at the bottom of the tanks. The next and last step is backwashing, a process of effectively removal of captured contaminants from the media bed. After back-washing the filter is rinsed with raw water and after the required quality of water is achieved the filter is put back into service.

Dosing unit

Chemical dosing unit processes are always used with physical operations and may also be used with biological treatment processes. Chemical processes use the addition of chemicals to the raw water to bring about changes in its quality.

Example: pH control, coagulation, chemical precipitation and oxidation.

Chemical coagulation and Flocculation:

Coagulation refers to collecting the minute solid particles dispersed in a liquid into a larger mass. Chemical coagulants like Al2 (SO4)3 {also called alum} or Fe2 (SO4)3 are added to raw water to improve the attraction among fine particles so that they come together and form larger particles called flocs.

A chemical flocculent (usually a polyelectrolyte) enhances the flocculation process by bringing together particles to form larger flocs , which settle out more quickly.

Flocculation is aided by gentle mixing which causes the particles to collide.

Activated Carbon Filter

Activated Carbon Filter is widely accepted system in water filtration techniques. The treated water is free from chloramines (chlorine and ammonia mixture) and organic compounds; therefore, best for discharge and production use. Activated Carbon Filter is also utilized in pre-treatment for ro water plant and dm plant as the treated water keeps these systems safe from oxidation or organic fouling.

An activated carbon filter (ACF) works on the principle of adsorption; filter medium adsorbs or reacts with a pollutant molecules then filtered water is drained out. Activated carbon which is used as medium to remove contaminants is natural material derived from coconut shell, lignite, bituminous coal etc

There are some limitations of activated carbon filters (ACF); uses are limited to wastes with low organic concentrations (< 5%) and very low inorganic concentrations (< 1%). Removing highly soluble organics or those with low molecular weights are also out of their capabilities. An activated carbon filtration system is unable to remove all of contaminants; such as, microbes, sodium, fluoride and hardness from water; however, special activated carbon water treatment is necessary for removing lead and other heavy metals. In addition, disposal process of contaminated carbon is complicated if not regenerated.

Water Softener with Brine tank

Water softeners work through a process called ion exchange which eliminates calcium and magnesium from the water. When the hard water enters into the mineral tank, it flows through a bed of spherical resin beads. These plastic beads, usually made from polystyrene, are charged with a sodium ion. The resin beads are anions, meaning they have a negative charge. The calcium and magnesium minerals have a positive charge, making them cations. Since opposite charges attract, the negative charge of the minerals is attracted to the positive charge of the resin beads. As the hard water passes through the resin, the beads grab a hold of the mineral ions and remove them from the water. When the bead seizes the mineral ion, the sodium ion is released. The column of resin strips all the hardness out of the water as it passes through the mineral tank, and softened water flows out into your treated water tank

A water softener is made up of three components: a control valve, a mineral tank, and a brine tank. These three work in conjunction to remove the minerals from hard water, monitor the flow of water, and periodically clean the system through a regeneration process.

Mineral tank

The mineral tank is the chamber where the hard water is softened. The water supply line feeds the hard water into the tank. The water seeps through the bed of resin beads, depositing the water-hardening calcium and magnesium ions. The water exits the tank soft and flows through your pipes and out to your household appliances.

Control valve

The control valve measures the amount of water passing through the mineral tank and into your house. The valve houses a meter that tracks the volume of water entering the mineral tank. As hard water flows through the mineral tank, the resin beads exchange their sodium ions for hardness ions. Over time, this depletes the capacity of the resin to continue to effectively soften water. Before the beads become too burdened with mineral content to continue removing calcium and magnesium ions, the control valve automatically initiates a regeneration cycle. This maximum capacity is pre-programmed into the control valve's onboard computer and is based on a range of factors, like the size of your house, the number of occupants, and the hardness of your water. Control valves are demand-initiated controllers, which allow water softening units to be extremely efficient.

Brine tank

The brine tank aids the water softening system in regeneration. It is a shorter tank that sits adjacent to the mineral tank. The brine tank holds a highly concentrated solution of salt (or sometimes potassium) to restore the resin beads' positive charge. Salt is manually added to the brine tank in the form of pellets or blocks. These dissolve in the water at the bottom of the tank. When the control valve registers the softening capacity of the resin is diminishing, the heavy brine solution is drawn out of the tank and flushed through the resin in the mineral tank. If the brine tank runs out of salt, the water passing through the unit will no longer be softened.

Regeneration cycles inundate the resin beads with a highly concentrated brine solution, washing off the hardness minerals and draining them out of the system. The resin beads are recharged and primed to again eliminate the hardness minerals. Resin beads are extremely durable and can effectively soften your water for twenty years or longer. Water softeners regenerate by one of two methods: co-current or counter-current regeneration (also referred to as downflow brining and upflow brining.

Expected Treated Water Characteristics after Filtration (Domestic Water Requirements for all Buildings)		
SL NO	Parameters	Characteristics
1	pH	6. 5 – 8.5
2	Total Dissolved Solids	Less than 500 ppm
3	Suspended solids	< 1 mg/ litre
4	Turbidity	Nil
5	Total Hardness	Less than 150 ppm

Expected Treated Water Characteristics after Filtration (Domestic Water Requirements for all Buildings)		
SL NO	Parameters	Characteristics
1	pH	6. 5 – 8.5
2	Total Dissolved Solids	Less than 500 ppm
3	Suspended solids	< 1 mg/ litre
4	Turbidity	Nil
5	Total Hardness	Less than 40 ppm

GENERAL REQUIREMENTS

All materials shall be new and of the best quality conforming to specifications and subject to the approval of Engineer.

1. All equipment shall be of best available make manufactured by reputed firms.

2. All equipment shall be installed on suitable foundations, true to level and in a neat work-man-like 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 houses 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 valve and a flap type non-return valve on the delivery side.

The contractor shall submit the following documents:

a. Process and hydraulic design calculations for all units.

b. Civil, Structural arrangement, design calculations if included in the scope of work.

c. Plant sld drawings

d. Process flow sheet

e. Design Philosophy

f. All technical brochures,

g. Operation and maintenance manuals and other details of the system offered.

h. Equipment's listing & list of consumables.

Plumbing Tests

Sr. No.	Test Name	Applicable For	Acceptance Criteria
1	Hydrostatic Pressure Test	Domestic Water Supply, Hot Water Lines	No leakage and no pressure drop during the specified test period.
2	Leakage Test	Complete Water Supply System	All joints, valves and fittings shall remain leak-free.
3	Pipeline Flushing Test	Water Supply Lines	Water shall run clear without dirt, debris or rust particles.

Sr. No.	Test Name	Applicable For	Acceptance Criteria
4	Disinfection / Chlorination Test	Potable Water System	Chlorination completed successfully and residual chlorine within permissible limits after flushing.
5	Water Tightness Test	Underground Water Tank (UGT), Overhead Tank (OHT), Sumps	No seepage, leakage or visible drop in water level during the specified observation period.
6	Pump Performance Test	Domestic, Transfer, Booster Pumps	Pump shall achieve the specified discharge, head and operating current.
7	Automatic Pump Operation Test	Pumps with Level Controllers	Pump shall start and stop automatically at the designated water levels.
8	Flow & Pressure Test	Water Supply System	Required flow and pressure shall be available at the remotest plumbing fixture.
9	Drainage Water Test (Water Test)	Soil, Waste & Rainwater Pipes	Pipeline shall convey water without leakage or blockage.
10	Air Test	Drainage System (where specified)	No pressure loss during the test period.
11	Smoke Test	Vent Pipe System	Smoke shall not escape from pipe joints, indicating an airtight vent system.
12	Ball Test	Vertical Soil & Waste Stacks	Test ball shall pass freely through the stack without obstruction.
13	Manhole Water Tightness Test	Inspection Chambers & Manholes	No leakage through walls, joints or base.
14	Fixture Functional Test	WC, Wash Basin, Sink, Shower, Urinal, etc.	All fixtures shall operate correctly without leakage and drain efficiently.
15	Rainwater Downpipe Test	Rainwater Drainage System	Water shall flow freely without leakage or overflow.
16	Rainwater Harvesting System Test	Harvesting Pit, Filter, Storage Tank	Water shall pass through desilting chamber, filter and storage/recharge system without obstruction.

Sr. No.	Test Name	Applicable For	Acceptance Criteria
17	Integrated System Trial Run	Complete Plumbing System	Entire plumbing system shall operate satisfactorily under normal operating conditions.

Note:

The following Plumbing Testing & Commissioning activities represent the minimum mandatory tests to be carried out before final inspection and handover of the plumbing works. These tests are generally adopted for Residential, Commercial, Developments in accordance with good engineering practices and the requirements of applicable standards such as CPWD General Specifications for Civil & Electrical Works (Internal Water Supply, Sanitary Installations and Drainage Works), NBC 2016, CPHEEO Manual on Water Supply & Sewerage, IGBC Green Building Rating Systems, approved project specifications and relevant Indian Standards (IS Codes).

The Contractor shall successfully complete all applicable tests, rectify any defects observed during testing, and submit the required test reports, inspection records and commissioning documents for review and approval by the Engineer/Consultant/PMC prior to final handover. No plumbing system shall be considered complete until all specified tests have been witnessed (where required), accepted and documented.

PLUMBING MAKE LIST

	Water closet	Kohler/ Duravit/ Toto
	Wash basin	Kohler/ Duravit/ Toto
	Urinal	Kohler/ Duravit/ Toto
1..	Sink with drain board	Nirali/ Hindware/ Neelkanth

2.	Bibcock	Kohler/ Duravit/ Toto
3.	AngleValveforbasinmixer& gyser	Kohler/ Duravit/ Toto
4.	Wallhung/ExtendedWallhung WaterCloset	Kohler/ Duravit/ Toto
7.	Hand Shower(Health Faucet)	Kohler/ Duravit/ Toto
8.	Bottle Trap	Kohler/ Duravit/ Toto
9.	Toilet Paper Holder	Kohler/ Duravit/ Toto
10.	Towel Ring	Kohler/ Duravit/ Toto
11.	Hook	Kohler/ Duravit/ Toto
12.	Soap Dispenser	Kohler/ Duravit/ Toto
13.	Sink Mixer	Kohler/ Duravit/ Toto
14.	Elbow action bib cock for Lab Sink	Kohler/ Duravit/ Toto

15.	Emergency Shower	Kohler/ Duravit/ Toto
16.	Eye Wash Fountain	VIJAY Cat. No. 1036, Euronics EWW 05S, OASIS
17.	Auto self-closing pillar cock for Wash Basin	Kohler/ Duravit/ Toto
18.	Air-Purifier container	Kohler/ Duravit/ Toto
19.	Straight / offset type flexible single body push fit type WC pan connector	Kohler/ Duravit/ Toto
20.	Floor mounted water closet including exposed cistern	Kohler/ Duravit/ Toto
21.	Lab Sink	Kohler/ Duravit/ Toto

HYDRO PNEUMATIC SYSTEM		
22	Hydro Pneumatic system	Kirlosker/CRI/KSB /LUBI
23	STP/ETP APROVED MAKE	
A	STP/ETP	Tanisq Ion/ BS ENVIRO / Eureka Forbes/Venza/Greko technologies /water vision
B	Pump & its accessories	Kilosker /WLO/KSB/ Crompton/ Mather Plate/lubi
24	PIPEs & FITTING	
C	MS Pipe	Jindel/ TATA /Sail/
D	MS Pipe Fittings	Zoloto /Sant /jindal
E	CPVC Pipe & Fitting	Supreme / Prince / Astral
F	UPVC Pipe & Fitting	Supreme / Prince / Astral
	Caste Iron Pipes	Neco/ SKF brand/ Tata
	PE-AL-PE Composite pipes	Durianec/ Nexgen /Jindal
	G I Pipes	TATA/ Swastik/ Jindal

	G I Pipe fittings	Zoloto/ Unik/ Sant

	PVC/HDPE water storage tanks	Sintex/ Waterwell/ Supreme
	D I Pipes & fittings	Jindal/ Tata Ductura/ Kapilansh
	Air release valve	Castle/ Zoloto / Sant / Honeywell
	RCC Pipes	Hitech/ Nu-TEC/ KMC Group/ Bharat Hume Pipes
	CI Manhole cover	Neco/ Dudhi / Swastik/ BIC
	SFRC Cover and grating	KK / Advent/ Hitech/ Nu-TEC
	Flushometer	Kohler/ Duravit/ Toto
	S.S. pipe & fittings	Tata Steel/ Jindal Stainless /Venus Pipes / APL Apollo
	HDPE Pipes & fittings	Supreme /Price / Astral Silencio / AKG
	Water Meters	Castle/ Zoloto / Sant / Honeywell
	Pressure Reducing Valve	Castle/ Zoloto / Sant / Honeywell
	Pipe Supports / Clamps / Hangers	Hilti/ Unistrut/ V-Mark
	Hand Dryer	Kohler/ Duravit/ Toto
G	MBBR Reactor	Tanisq Ion/ Thermax / Eureka Forbes/Venza
H	Ball Valve, Butterfly valve, Non Return Valve, Motorised valve PRV	Castle/ Zoloto / Sant / Honeywell
I	MS tank/ Filters	IEI / Thermax / Tanisq Ion/ Eureka Forbes/Venza
J	Sludge Transfer / Sludge re-Circulation / Disposal pumps	Grundfos / Wilo / Kirloskar / CRI Mather Plate
K	Pressure Switch	Indofas / System sensor / Danfos
L	Pressure Gauge OilTypeWith SS dial	H GurU / Feibig / Gluck
M	Chemical Doser	Asia Lmi / Prominent/ E - Dose

N	Air Blower	Everest / Blowvace / Airvacc / Beta
O	Flow Meter	Zest / Adept /Aster/Honeywell
P	Oil & Grease Skimmer	Akar Impex / W2p Tek / Tanisq Ion / Eureka Forbes / Venza
Q	pH Sensor	W2P Tek / Aster/ Volant/ Digital
R	FRP Filters	Aventura/Aquanomics/Pentair/Thermax/W2P
S	MBBR Media	PP Aqua / W2p Tek// Tanisq Ion / Eureka Forbes / Venza
T	Filter Press	Pharmatec / W2p Tek//Tanisq Ion / Eureka Forbes / Venza
24	RO WATER MAKE	
A	R.O. Water purifier	Thermax / Eureka Forbes / Venza / Pretc - Aqua/Oasis
C	PRESSURESANTFILTER	STARLIT /WASTECH/ Pretc - Aqua/Oasis
D	Dual media filter	Aventura / Pentair / Oasis
E	Automatic Valves	Midas / Initiative/ Oasis
F	ACTIVATEDCARBONFILT ER	STARLITE/WASTECH / Aventura / PENTAIR
G	ANTISCALANTDOSINGSY STEM	E-DOSE /GRUNDFOS / MINIMAX dOSING
H	MICRONFILTER	FILTERMATION/AMETEK/ HITEC/ Dorsan
I	HIGHPRESSUREPUMP	Grundfos/LEO/ CRI / CNP
J	ROMEMBRANE	DOW/HydrANAUTICS/ FILMTEC
K	PHCORRECTIONSYSTEM	ASIALMI/E-DOSA/AQUA-ITALY
L	ROTAMETER	FLOWTECH / ASTER/ EWP / OHMTECH
M	PRESSURESWITCH	INDOFOS / DENFOSS / BAUMER
N	PRESSURE GAUGES	MASS / GURU / EWP / ANALOG

0	Water cooler	Oasis/Filtrin/EurekaForbes

P	RO PRESSURE TUBE	EWP / PENTIAR / AVENTURA
Q	pH meter	Aster/H GURU/ INFINITY
R	ORP METER	Aster/ H GURU/ INFINITY
S	Storagetank	Naptune/Nector /DBS/SS Oasis/Purever
25	MODULAR RAINWATER HARVESTING SYSTEM	Retas Enviro Solution /Bantair/Rehau/Polypipe
26	SOLAR WATER HEATER	V-Guard /Racold/Supreme Solar