

**D. DESIGN BASIS REPORT- PLUMBING
(Water Supply, RO System, WTP and Sanitary Installation)**

1. Basic Objectives

The EPC Contractor shall provide all sanitary engineering services as per specifications in relation to:

- i. Leak proof plumbing
- ii. High standards of materials and workmanship
- iii. Reliable and dependable engineering systems
- iv. Plan the system in such a way as to minimize the energy requirements
- v. Create minimum nuisance and disturbance to the environment
- vi. Integration with existing infrastructure

2. List of Codes and Manuals

The following codes of practice and design manuals are being referred for designing the Water Supply, Sanitary and Drainage Systems:

S. No.	Description
i)	National Building Code 2016 Handbook on Water Supply & Drainage (with Special Emphasis to Plumbing)
ii)	Bureau of Indian Standards SP-35
iii)	Manual on Water Supply & Treatment (Ministry of Urban Development)
iv)	Manual on Sewerage & Sewage Treatment (Ministry of Urban Development)
v)	CPWD Specifications

3. General:

- i) The EPC Contractor shall carry out design, supply, installation, testing & commissioning of the water supply system, water treatment plant, sanitary installations and drainage system and integration with the existing system, all complete to meet the functional requirements.
- ii) The raw/ domestic/ flushing water supply system shall be hydro-pneumatic/gravity based system. Raw/ domestic/ flushing water supply shall comprise pumps, pneumatic tank, microprocessor based control panel, VFD, interconnecting pipes, valves, cabling, switchgear etc. as required for all buildings. For flushing water, gravity based system shall be provided for all buildings. For continuous water supply at adequate pressure, complete water supply system shall be designed. The sanitary installations systems and drainage systems shall be designed as per relevant BIS Codes and in conformance with the CPWD specification and the guidelines given in the DBR.
- iii) The work shall in general conform to the latest CPWD Specifications. The water supply and sewerage demand shall be estimated by EPC Contractor based on the population as required by NBC norms, Local bye Laws & statutory norms. The different components related to plumbing services are listed as below:

3.1. Internal Plumbing Works

- i. Sanitary fixtures & C.P brass fittings
- ii. Soil, waste & rain water piping system
- iii. Internal domestic and flushing water supply system
- iv. Hot water supply system
- v. Disposal of soil, waste & rain water pipe to 1st manhole

3.2. External Water Supply System

The tapping of water supply shall be done from existing Water Supply Line and New Bore wells as per requirement.

- i. Suitable capacity bore well, one number each shall be provided in the AllMS, Institute Campus (for Academic Block) and in Residential Campus at a location as directed by Engineer-In-Charge
- ii. Storage of Water to achieve daily requirements shall be met with underground and overhead storage tanks.
- iii. Raw/ Domestic/ Flushing water distribution System
- iv. Rain water shall be discharged in existing municipal lines/existing drainage system as per NBC norms.

3.3. Bore Well:

The bore well, one number each, shall be provided with suitable submersible pump in the AllMS, Institute Campus and Residential Complex up to adequate depth as per CPWD specifications. The yield of the bore well shall be minimum **500 Liters per Minute** (considering 10 hrs operations per day). The bore well shall be provided as per detailed design distribution and requirement at the location as directed by Engineer-In-Charge and as marked in Site Layout Plan. The EPC Contractor shall, at his own cost, duly obtain all statutory approval/ No Objection Certificate (NOC) etc. from Central Ground Water Authority (CGWA) and other statutory bodies, as applicable. Pipes & fittings shall be used in bore well as per CPWD specifications and water supply pipes & fittings with necessary gate valves shall be provided as per requirements from bore wells to the overhead/ underground tanks, as per site requirements.

Drilling shall be done with minimum 150 mm dia upto required good quality water table. Bore hole in soft land for installation of pump set with Hydraulic DTH rig machine. Same shall be including supplying all materials tools drilling rig and Air compressor and equipment as well as fuel, lubricants and cost of transportation or Rig machine and other vehicles up to the site including flushing charges, Geological investigation etc. all complete.

Bore well work shall also include the following:

- ISI marked PVC tube well casing pipe as per IS: 12818, suitable for medium well application with threaded joints.
- ISI marked PVC tube well screen / slotted pipe as per IS: 12818, with threaded joints.
- Chemical and bacteriological examination of water.

- Sanitary sealing, disinfection of tube well as required.
- Submersible pump of suitable capacity motor having **500 liter per minute** discharge at required head (Minimum 60 meter) as per water table including electrical control panel with S/D starter, ammeter, voltmeter, single phasing preventer and all motor protection arrangement complete in all respects for erection and lowering of submersible pump, column pipe, valves, submersible cable up to the control panel, Starter, supporting clamps, cable clips, pressure gauge, connection line up to UG tank, Level controller interconnection to fill the tank, and all other accessories required for the proper completion of the work as desired on the site and by the Engineer-In-charge.
- 3" dia (88 mm OD) uPVC submersible column pipe (Standard duty, min walls thickness = 5.2 mm at mid-point) with coupler, pipe fittings such as bends, tee, sockets, clamps, nipple, elbow, nut bolts, rubber packing etc as required to complete threaded joints complete
- Water meter/ pressure gauge/Valve/Cables complete as required

3.4. Sewerage & Effluent Treatment:

1200 KLD STP & 100 KLD ETP are existing in AIIMS Complex with underground DI pipe lines. Effluent & Sewage generated in Academic Building shall be connected and discharged to existing STP/ ETP as per requirements. All sewage/ effluent lines and manholes etc required for this purpose shall be provided by EPC Contractor.

For Residential Complex, new Sewage Treatment Plant with MBR Technology having capacity of **250 KLD** shall be constructed by EPC Contractor to meet the sewage treatment requirements of all existing as well newly proposed Type-V buildings in the residential complex. Sewage generated from all existing residential buildings as well as new proposed Type-V Residential Buildings shall be suitably connected and discharged to new STP as per requirements. All sewage lines and manholes etc required for this purpose shall be provided by EPC Contractor.

3.5. Storm Water Drainage System

The rainwater for all buildings shall be collected in separate catch basin /Manholes and shall be discharged in the existing municipal drain lines/campus drains.

3.6. Garden Hydrant System

Gardens and lawns shall be irrigated in combination of Garden Hydrant System and Sprinkler Irrigation System as per site requirement.

In the institute complex, external gardening hydrants system is already available at site. The requirements of external gardening for the proposed buildings shall be met by taking connections from suitable locations of the existing external gardening hydrants system.

In the residential complex, the external gardening hydrants system is partially available. The requirements of external gardening for the proposed residential blocks, and other buildings including sports complex shall be designed and provided by taking connections from suitable locations of the existing external gardening hydrants system and for buildings, where no external gardening hydrants system is available, additional gardening hydrants system shall be designed and provided.

Irrigation hydrant (water pipe) system shall be of UPVC of required grade/class, 10

kg/sq.cm pressure rating conforming to relevant IS codes.

3.7. Hot Water, Solar Hot Water & RO Water:

The EPC Contractor shall carry out design, planning, supply, installation, testing & commissioning of Hot Water System, Solar Hot Water System and Centralized RO Water system for the proposed Academic Block. Hot Water, Solar Hot Water and Centralized RO System capacity calculations shall be prepared & submitted to HITES by EPC Contractor for prior approval before commencement of works at site. Relevant standards, IS codes & NBC 2016 norms amended up to date shall be followed by EPC contractor for this purpose.

Centralized Reverse Osmosis (RO) System shall be provided on terrace of Academic Building and suitably covered with 16 mm thick polycarbonate sheet along with suitable MS support structure, duly painted as per directions of Engineer-In-Charge.

For Academic Building, floor wise hot water and RO water distribution system shall be provided. RO Water distribution shall be carried out through SS 304 pipelines on various floors and locations of Academic Building. Hot Water requirements of Academic Block campus shall be met with Solar Hot Water System and electrical geysers as per requirements. Hot water @ 20% of total hot water requirement shall be met through Solar Hot Water System as per MoEF guidelines. Solar Hot Water System with required capacity electrical back up for minimum 20 % of total hot water requirement or as per NBC/ GRIHA Norms shall be provided.

4. Water Supply System

The water supply system shall include the hydro-pneumatic/gravity based water supply system for domestic water supply consisting of pumps, pneumatic tank, microprocessor based control panel, VFD, interconnecting pipes, valves, cabling, switchgear etc as required for all buildings. Suitable Hydro-pneumatic system shall be provided for pumping domestic water from UG domestic water Tanks upto Overhead tanks of each building. From domestic overhead tank onwards, domestic water distribution shall be done in each building through gravity based system.

Suitable Hydro-pneumatic system shall be provided for pumping flushing water from flushing water Tanks upto Overhead tanks of each building. For flushing water, gravity based system shall be provided for further distribution in all buildings. For continuous water supply at adequate pressure, complete water supply system shall be designed with following type of pipe-lines.

For tapping of domestic water and flushing water from the respective existing UG water tanks for Academic Block and new UG water Tanks in Residential Quarters, the Hydro-pneumatic pumping system with water transfer pumps (1W+1S) of suitable capacity shall be provided in WTP Plant area. Domestic & Flushing Water shall be tapped from respective UG Tanks water header and water distribution lines upto respective Blocks shall be provided with all accessories as required to meet the functional requirements.

Suitable water level controllers/sensors/probes along with required cabling, microprocessor control panels with all accessories shall be provided in the overhead domestic water tanks & overhead flushing water tanks of all buildings for automatic water level control to avoid water overflow depending on low/high water level conditions.

Scope of work for Water supply distribution system includes all pipes, valves, bends,

pressure gauges, fittings, electrical works and all other accessories etc. and liaisoning with client for shut down, as required.

- 4.1. The existing main incoming water supply lines and inside building shall be connected with designed pipeline grids for buildings which shall be DI Pipe conforming to IS 15778 (for Internal Water Supply Pipe.) & GI pipes', conforming to the requirements of IS 1239 Part-I (for dia. 80 mm & above and For External Water Supply). The water supply lines have been designed with CPVC & G.I pipes of different diameters with push on joints for (CPVC), as per requirements. All the operational valves/fittings also designed with same Specials of class as per I.S 15778 & 1239 material as per IS Code and shall be fixed in clay bricks masonry chambers as per specification.
- 4.2. Water supply pipe from buildings to overhead tanks, ring main at terrace, down take from ring mains (in the shaft) up to the entry into the floors shall be with GI pipe (medium class). The water supply pipes from the shaft inside the floors concealed piping and to other end points shall be of C-PVC pipes of required grade/class, conforming to the requirements of IS 15778 Codes. To regulate the water supply, valves and fittings, at required places, shall be fixed as per specification. Laying of these pipe lines up to building shafts shall be underground and in shafts, supported with standard clamps up to the overhead's tanks complete as per CPWD specification.
- 4.3. Flushing water pipe shall be of DI/GI/c-PVC pipes in line with the requirements as above, from Existing/New STP/Rain water tanks to overhead tanks, inside shaft & concealed areas.
- 4.4. Flushing Water Overhead Tanks shall be fed with flushing water as well as domestic water with suitable pipes, valves, NRV, fittings etc. as per direction of Engineer In-charge. Flushing water shall be fed to Flushing Tanks in normal case. However in case of non-availability of flushing water, provision for domestic water feed to flushing tank shall be made.
- 4.5. The R.O water point shall be provided in each Quarter of proposed residential block at suitable location as per direction of Engineer In- charge.

5. Sanitary Works

The amenities for the residential buildings have been separately detailed and shall be provided for. As regards, buildings in the institute complex, and, buildings other than the residential units in the residential complex, following, in general, shall be governing the guidelines for providing the plumbing and sanitary requirements.

5.1. Sanitary Fixtures & C.P Brass Fittings

Plumbing fixtures, Chrome Fittings and accessories will be as per IS: 781-1984 and shall be of premium quality of approved make as per requirement of space, location complete in all respect including all accessories. Colour, shade, shape, size shall be selected and approved by Engineer-in charge. All appliances, fixtures and fittings shall be tested before and after installation.

5.2. Porcelain fixtures of fairly high quality as given below.

- i. **WCs** –In all attached toilets, Wall hung WC with concealed system (Low volume dual flushing system) shall be provided. For general toilets/ other toilets, floor mounted WCs with low volume dual flushing system (PVC cistern) shall be provided.

- ii. **Lavatory Basins** in size and shapes including wall hung, over or under counter types etc. shall be provided. In attached toilets the taps with infra-red sensor shall be provided. In other locations prismatic / pillar cocks, as per requirement shall be provided.
- iii. **Urinals** with Infra-red sensor (without battery) shall be provided. Adequate electrical power points shall be provided for operating the urinal sensors. The partitions between the urinals shall be of granite of required thickness and size.
- iv. **Accessories:** Soap dispensers, toilet paper holders, Towel rail, hand drier (one each in common toilets) etc. shall be of Stainless Steel of approved make.
- v. **Chrome Fittings:** Provision for additional and special fittings where required shall be made as per IS: 781 - 1984.
- vi. **Sinks:** Provision of Stainless Steel Sinks in Pantry/ kitchen/ Laboratories with all fittings/fixtures.

5.3. Soil, Waste Pipe System

5.3.1. General: -

- i. Above ground piping shall be designed on the basis of two pipe system as recommended in code of practice for soil and waste. Soil pipes shall carry the wastes from WC's & urinals etc. Soil pipes shall connect directly to the 1st manhole outside the building.
- ii. Internal buildings sanitary disposal system will be under the RCC slab (By core cutting RCC slab and suspended at bottom) for Academic Building.
- iii. Internal buildings sanitary disposal system in the residential complex shall be by conventional methodology or as specified.
- iv. Waste pipes shall carry the wastes from waste appliances (lavatory basins, kitchen sinks etc.). Waste pipes shall connect to Gully Traps outside the buildings and shall be connected to the external manholes.
- v. Soil/ Wastewater pipe from building to 1st manhole shall be Hub less centrifugally cast (Span) iron pipes epoxy coated in sides and outside as per IS code 15905. From 1st manhole till STP/Existing Lines/Manholes, pipe shall be of RCC (NP2/NP3).

5.3.2. Design Parameters

- i. Piping system shall be designed in accordance with Code of Practice for Installation of Soil & Waste Pipes.
- ii. All vertical stacks will terminate as vent pipes at terrace level.
- iii. All Vertical Stacks in the buildings will terminate at the ground floor level and connected to the external sewer. Pipe dia. and slope will be as per connected load.

5.3.3. Pipe Work

- i. All vertical stacks will be installed in pipe shafts on the external face of the buildings or in internal shafts within the building according to the architectural planning of the toilets.
- ii. Provision shall be made to provide cleanout doors and plugs for Roding and maintenance where necessary and required.

5.3.4. Materials for Soil, Waste & Vent Pipe System

Pipes used for Soil, Waste and Vent system shall be Hub less centrifugal cast (Span)

iron pipes epoxy coated in-sides and out-side as per IS:- 15905. The pipes and fitting are jointed with SS 304 grade coupling with EPDM rubber gasket joints as per requirement and specifications. Pipe fittings viz. P or S Trap shall be provided as per requirement and specifications.

5.3.5. Sand Cast Iron Floor Trap or Nahani Trap

Sand cast Iron Floor trap or Nahani trap shall be 'P' or 'S' type with minimum 50 mm seal. However, if the plumbing is in two pipe system and with a gully trap at the ground level the minimum water seal shall be 35 mm. The traps shall be of self-cleansing design and shall have exit of same size as that of waste pipe. These shall conform to IS 1729.

6. Sewerage System

6.1. Design Parameters

a) Velocity		
Minimum velocity at peak	=	0.60 m/sec
Maximum velocity at peak	=	3.00 m/sec
b) Peak Factor	=	3 times the average flow c)
Interception factor	=	0.80
d) Manning Constant	=	0.011 (for uPVC pipes)
e) Design Equation	=	Manning Equation.

6.2. Flow conditions in pipe

Pipes up to 250 mm dia	=	50% full running.
Pipes from 400-900 mm dia	=	67% full running.

6.3. Min. depth for sewers

For branches	=	1 M.
For lateral, main & trunk sewers	=	1.5 M. / as per required gradient

a. Type of Distribution

Sewer flow shall be by gravity up to the final disposal point. The external sewer shall be connected to distribution system of the existing centralized sewage treatment plant/ proposed sewage treatment plant.

b. Kitchen Effluent

Kitchen waste shall be passed through grease trap / oil separator before discharging into the external sewer line, as required.

c. Manholes

The manholes are to be constructed with brick masonry as per standard specifications of NBC 2016 and shall have details as follows:

- i. Rectangular manhole of size 900 x 800 mm up to 0.89 mtr depth.
- ii. Circular manhole of size 910 mm dia for 0.9 to 1.64 mtr depth.
- iii. Circular manhole of size 1220 mm dia for above 1.65 to 2.29 mtr depth
- iii. Circular manhole of size 1520 mm dia for above 2.3 mtr depth.

- d. **Spacing of Manholes**
 - i. Manhole shall be provided with all the junctions, change of directions, change in diameters and as per connection requirement from every units.
 - ii. A distance of 20 meters (maximum) on the main sewer line depending on dia of pipes and local conditions.
- e. **Manholes Covers**
 - i. Medium duty S.F.R.C. manhole covers for manholes on service roads, gully traps and manholes / chambers not following in the road / pedestrian ways/side berms/lawn area.
 - ii. Heavy duty S.F.R.C. manhole covers for manholes /service chambers/gully traps falling on main roads & service roads.
 - iii. Shape and dimensions of Manhole covers shall conform to CPWD specifications & IS 12592
- f. **Storm Water Drainage System**

6.4. General:

- i. The rainwater from the terraces, open surface areas, as per design, shall be collected in the clay brick masonry chambers, collection chambers and shall be taken through the internal rain water system (RCC Pipe) & connected to the existing storm water system of the respective campus.
- ii. The network of storm water system shall be mostly catch basins and RCC pipe network, as per requirements.
- iii. All paved/road/green areas, the runoff shall directly connect to the main storm water drains.
- iv. Storm water pipe/Rainwater pipe from inside the building to the 1st manhole outside the building shall be of UPVC of required grade/class, 6kg/sq cm pressure rating conforming to relevant IS codes. The network system from 1st manhole onwards shall be NP2/NP3 pipes as required.

6.5. Design Parameters

- i. The rainfall intensity as per IMD data to be considered for designing of system.
- ii. Minimum Pipe diameters for Rainwater Pipes from Terraces shall be 110mm and maximum 160 mm dia.
- iii. All construction specifications with respect to the manhole sizes etc. will be respected and followed and as per CPWD specification.
- iv. The complete campus storm water drainage system for AIIMS Patna designed with RCC pipes, RCC open drain with cover system, clay brick masonry chambers and manholes etc.

7. Water Storage & Fire Water Storage Tanks:

The Overhead and Underground Tanks are to be provided of adequate capacity. The storage capacity of firefighting tanks shall be strictly as per NBC Code 2016, local bye-laws provisions and as per specific provisions of this DBR in the respective head. Internal walls and floors of RCC water storage tanks are to be finished with ceramic glazed tiles. The minimum capacity of various overhead water tanks is mentioned here as under:

Underground Water Storage Tank Capacity:

Underground New Water Storage Tank Capacity (in Liters)			
Description	Fire Water Storage Tank	Raw Water Storage Tank	Domestic Water Storage Tank
Residential Campus	-----	50000	50000

Also suitable arrangements are to be made to inter connect the existing bore well with new proposed bore well with required pipe line, valves and fixtures pumps etc. complete as per direction of Engineer In charge in AIIMS, Campus (Academic Block) and Residential Campus.

Overhead Water Storage Tank Capacity:

Overhead Water Storage Tank Capacity (in Liters)				
S No.	Description	Fire Water Storage Tank	Raw & Domestic Water Storage Tank	Flushing Water Storage Tank
I	Academic Block Building	20000	80000 (Raw Water - 40000 + Domestic Water - 40000)	30000
S No.	Description	Fire Water Storage Tank	Domestic Water Storage Tank	Flushing Water Storage Tank
II	Residential Blocks (Type V)			
a	Type-V, Tower -1, S+10, 40 Units	25000	15000	8000
b	Type-V, Tower -2, S+9, 54 Units	25000	20000	10000
c	Type-V, Tower -3 S+9, 18 Units	25000	8000	5000

The capacity of the overhead tanks mentioned above is indicative only. However, during detailed designing, if required and found necessary to meet functional & statutory requirements, the capacity / rating of the tanks/ equipment shall be upgraded/ revised by EPC Contractor without extra cost subject to concurrence of Engineer-In-Charge.

8. WATER TREATMENT PLANT SYSTEM

- a. Water Treatment Plants shall be provided to meet the specified outlet parameters of water for Academic Building & Residential Type –V Buildings. Suitable civil works for Water Treatment Plants shall be provided by EPC Contractor without any extra cost.
- b. Capacity of water treatment plant for Academic Block shall be 80 KLD. (Location- Terrace floor). The water treatment plant equipment shall be suitably covered with 16 mm thick polycarbonate sheet along with suitable MS support structure, duly painted as per directions of Engineer-In-Charge.
- c. Capacity of water treatment plant for residential block shall be 100 KLD. (Location- Ground/Stilt floor)

- d. The Water Treatment Plant shall consist of following components but not limited to:
- i. Water supply/Lifting Pumps/filter feed pumps/Non-Clogging type submersible sump pumps etc. – MoC preferably should be - SS-304/C. I casing, SS-304 /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 one coat of paint, Anti-vibration arrangement of cushy foot mountings should be provided.
 - ii. Water treatment filter and transfer pumps shall be provided as per requirements.
 - iii. MSFRP Filters (dual media/activated carbon/pressurized sand/multi grade), Softeners shall be sized for optimum working pressure etc.
 - iv. Panels, Allied Equipment & Accessories (level controllers, probes, starters, valves, pressure gauges etc.
 - e. Water Treatment Plant components mentioned as above. shall be provided in 2 Sets (1 working + 1 standby). One standby pump shall be provided considered for each type.
 - f. All equipment shall be installed on suitable foundations true to level and in a neat workman ship.
 - g. Equipment shall be so installed as to provide sufficient clearance between the end walls and between equipment to equipment.
 - h. Piping within the pump house shall be so done as to prevent any obstruction in the movement within the pump house.
 - i. The water treatment process shall be designed depending upon the quality of the raw water. pH, TDS, Turbidity, Total Hardness & other biological factors of treated water 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 GI pipe of heavy grade, instruments, valves etc.
 - j. The entire water treatment plant shall be designed based on water quality parameters available at site.
 - k. The expected Treated Water Characteristics after filtration & Softener shall be as under:

Treated Water Characteristics for all Buildings		
Sr.	Parameters	Characteristics of Treated Water
1	pH	6.5 – 8.5
2	Total Dissolved Solids, mg/l, Max	500
3	Suspended Solids	< 1 mg/ liter
4	Turbidity, NTU, Max	1
5	Total Hardness (as CaCO ₃),	200

	mg/l, Max	
6	Colour, Hazen Units, Max	5
7	Odour	Agreeable
8	Taste	Agreeable

Method of Test shall be as per IS: 3025, latest amended up to date.

8.1. Pumps & Water Treatment Equipment

- a. It is proposed to provide all type of pumps including that for filter feed pumps, domestic water supply pumps, Rain water Transfer pump, flushing water supply pumps (For flushing pumps will be installed in STP), make up pump to STP treated tank from raw water (in case of failure/maintenance of STP), Plant Room Sump Pump etc. catering to All Buildings.
- b. Water Treatment Plant shall be provided with various types of Filters and Softening Plant to ensure proper quality of water within acceptable limits of hardness, as well as bacteriological limits.
- c. Activated Carbon Filter/Pressurized Sand Filter/Dual Media Filters / Chlorinators for catering Domestic Water Requirements for all Buildings. Softeners will be installed only where soft water requirement is there for other critical areas etc.
- d. Sufficient maintenance space shall be provided inside the water treatment plant room for accessibility of various pumps, panels etc. during repair & maintenance activities.
- e. Water Treatment Plant Room shall be suitably ventilated considering adequate ACPH as per NBC 2016 code, preferably 15 ACPH.
- f. Suitable size Sumps with sufficient sized submersible pumps & level indicators to be considered in plant room for drainage. Also, proper slope to be provided in Water Treatment Pump room so that there is no stagnancy of water during any leakage & it is properly channelized to nearest drainage sump.
- g. Water treatment Pump Room shall be provided with safety equipment/items like suitable elastomeric mat (as per relevant IS codes) for Panels, fire buckets, fire extinguishers, hand gloves, safety charts, framed Schematic/SLD etc.
- h. Water test has to be conducted for detection of parameters like TDS, sulphate, chloride, pH, Total hardness, Calcium, magnesium, Alkalinity etc.
- i. In addition to above tests, for detecting presence of toxic /heavy elements like lead, arsenic, uranium, zinc, fluoride, boron, barium, nickel, chromium, mercury, cyanide, molybdenum, cadmium etc. in raw water which are detrimental to human health, shall be carried out required laboratory tests to ascertain presence of such elements beyond acceptable/permissible limits as per relevant IS 10500 codes/WHO standards & other norms as applicable. In case any toxic/heavy element is found to be beyond permissible/acceptable limits, suitable remedial measures have to be taken while designing the water treatment plant especially for Domestic & RO water.

8.2 Centralized Reverse Osmosis (RO) Plant

The Centralized RO Plant (**5000 LPH capacity**) shall comprise of RO High Pressure Feed Pumps (HPP), RO Raw Water Pumps (RWP) of Vertical multistage centrifugal type and suitable head to generate permeate flow as per requirements. The pump casing construction

shall be preferably of SS-316 & impeller shall be also SS 316. The motor shall be TEFC with min. IE-2/IE-3 efficiency suitable for a supply of 415V / 3 Phase at 50 Hz. Supply. The pump shall be supplied complete with base channel, coupling foundation bolts, pressure gauge, valves at inlet and outlet of each pump. One standby pump needs to be considered for each type. Centralized R.O Plant shall be placed at Academic Building Terrace. Capacity of Centralized R.O Plant shall be selected based on meeting functional requirement (RO water demand of Academic building/day) as stated above within minimum operating hours (preferably 10 hrs. /day).

It shall consist of Package type RO module capable of giving a net treated water output as per requirement, Special Anti-scalant dosing system consisting of suitable no. HDPE tank of capacity as per requirement with a positive displacement diaphragm dosing pump having variable flow rate, Micron cartridge filter (shall be made of FDA compliant high quality poly propylene or some other suitable material) suitable for a flow rate as per requirements, CIP system (Cleaning in Place) consisting of HDPE tank with agitator complete with inlet/outlet, drain overflow etc. along with SS pump of capacity and cartridge filter of 10 micron, PH correction dosing system consisting of one HDPE tank with a positive displacement diaphragm dosing pump having variable flow rate, High pressure side piping from the RO high pressure pumps to the rejects stream control valves shall be of SS 316 using all SS fittings ball valves of suitable pressure rating shall be used till 50 mm size, above 50 mm, flanged globe / water butterfly valves in SS construction shall be used. Rejects pressure control valves shall be globe valve and feed flow control valve shall be of SS 316, SS 316 RO Water storage tank (Capacity as per requirements) of required thickness. Tank shall be provided with water flow meter at inlet & outlet, inlet / outlet valves, overflow / drain connection with MH cover. All RO distribution pipes shall be with SS 304 with press fittings. Centralized control panel made out of CRCA sheet min. 2mm thick having main contactors for all pumps.

All control and power cabling along with double earthing between the panel shall be provided. An emergency stop push button shall be provided in the panel.

Portable RO water unit shall be with water Cooler shall be of S.S construction of 80 Lit. (Approx.) Storage capacity & water flow rate 50 LPH through faucets including RO membranes, pumps, motors, cartridge filters, interconnecting pipes, valves, cables etc. or as per OEM standards meeting each building's drinking water requirement & as per directions of E-I.C. The R.O Units shall be placed at different locations with minimum two Units on each floor or as per requirement. It should be complete with all interconnecting piping, valves, cartridge filters, diaphragm type pumps, RO membranes, cable, drain pipe & other related accessories. It shall be with UV unit. The system shall be suitable for a supply of 240 V AC / 50 Hz.

RO capacity (portable & centralized) mentioned above indicative only. During detailed designing, if required and found necessary, the capacity / rating of the equipment may be upgraded/ revised subject to concurrence of Engineer-In-Charge.

1. Design Basis (RO Plant)

Expected Treated Water Characteristics after RO (Reverse Osmosis Plant)	
Parameters	Characteristics
PH	6.0 – 7.0
Total Dissolved Solids	<50 ppm
Suspended solids	Nil

Turbidity	Nil
Iron as Fe	Nil
Total Hardness	Less than 5 ppm

The Output of RO Water should comply with the BIS 10,500 for Drinking Water.

2. Instruments List including but not limited to (Provision to be considered in the Centralized R.O Plant)

Sr. No.	INSTRUMENT
1	Flow Indicator
2	Pressure Gauge
3	Pressure Switch (Low & High)
4	Conductivity Indicator
5	PH Meter etc.

Water Coolers of S.S construction of 80 Lit. (Approx.) Storage capacity & water flow rate 50 LPH through faucets including interconnecting pipes, valves, cables etc. shall be provided at various floors and locations meeting Academic Building's drinking water requirements as per directions of E-I.C. RO Units shall not be provided for Residential Quarters.