

## **A) DESCRIPTION OF THE PROJECT**

**Proposed Construction of Fire station cum Training & Classroom, Industrial Training Tower, Rescue Tower ,Change room & Visitor Gallery, B.A. Training Gallery and Simulation Building for Fire Training Institute at Bihta and other infrastructure including Parade Ground and Fire Hydrant facilities in the state of Bihar.**

## **B) LOCATION :**

Bihta (Patna) is on the southern bank of the river Ganges. The total area of Bihta, (Patna) is 250 km<sup>2</sup> (97 sq mi). A characteristic feature of the geography of Bihta, (Patna) is its confluence of major rivers.

## **C) RAINFALL AND CLIMATE:**

Bihta, (Patna) has a humid subtropical climate with extremely hot summers from late March to June, the monsoon season from late June to late September and chilly winter nights and foggy or sunny days from November to February.

|                             |    |  |
|-----------------------------|----|--|
| Hottest Months              | -- | May, June  |
| Coldest Months              | -- | December, January                                |
| Rainy Season                | -- | June to September                                |
| Average Annual Rainfall     | -- | 1,145.8mm (45.11 inch)                           |
| Average rainy days (Annual) | -- | 54.2 Days  |
| Temperature                 | -- | Max. 46 <sup>0</sup> C and Min. 1 <sup>0</sup> C |

## **D) Plumbing Services (Water Supply and Sanitary Installation):**

### **1. Code & Regulation be followed for design:**

- a) National Building code of India- 2016
- b) Local by laws for fire.
- c) CPHOO Manual for Water supply & Treatment
- d) CPHOO Manual for Sewerage & Sewerage Treatment
- e) SP 35 - Handbook on water supply and drainage with special emphasis on plumbing
- f) BIS 1172 - Code of basic requirements for water supply drainage and sanitation
- g) Uniform Code of Plumbing Latest Edition.
- h) Manual on water supply and treatments published by Central Public Health and Environment Engineering Organization Ministry of Urban Development, Govt. of India.
- i) Manual of sewerage and sewage treatment published by Central Public Health and Environment Engineering Organization Ministry of Urban Development, Govt. of India.
- j) Relevant BIS Codes.
- k) Good Engineering Practice.
- l) BIS 13039:2014 External Hydrant system
- m) BIS 15105 : 2016 Design & Installation of sprinkler system
- n) BIS 12469 :- Firefighting pumping system

## **2. Basis of calculation:**

- a) Type: Mixed use campus.
- b) Population data – As per calculation sheet.

### **Water supply design parameter:**

- c) Water consumption – As per calculation sheet.
  - 1. 25 lpd per head domestic water & 20 lpd per head flushing water for Office staff.
  - 2. 10 lpd per head domestic water and 5 lpd flushing water for visitors.
  - 3. 55 lpd per head domestic water & 15 lpd per head flushing water for Mess.
  - 4. Water Supply for Landscape use : 6 Ltrs/Sqm
- d) Water efficiency fixture will be used for reducing water consumption.
- e) Minimum pressure considers in designing of water supply system will be 1.25 Kg/cmsq and Maximum pressure restricts to 2.5kg/cmsq in line.
- f) Storage of water: 1-day water requirement for Underground tank (UGT) & 1/2 day of water required for Over head tank (OHT).
- g) For water supply design calculation **Hazzan William's** equation should be used.

### **Sewerage design parameter:**

- h) Sewage flow
  - 1. 80% of domestic & 100% of flushing water requirement. (Except water used for gardening & Irrigation).
  - 2. Peak factor – 3 x Average flow
  - 3. Subsoil infiltration 25% of sewage av flow
  - 4. Minimum velocity – 0.75m/sec
  - 5. Maximum velocity – 3m/sec
  - 6. Minimum dia of sewer pipe shall be 200mm dia for branch line and 250mm dia for main line
- i) Flow condition of pipe
  - 1. Pipe up to 250 dia – flow ½ full run
  - 2. Above 250mm dia – 1/3 full run.
- j) Manholes: The manholes are to be constructed with brick masonry as per standard specifications of NBC 2016 and shall have details as follows:
  - 1. Type 'A'- Rectangular of size 900x800 mm up to 900mm depth.
  - 2. Type 'B'- Rectangular of size 1200x900 mm from 900 mm & up to 2.45 m depth.
  - 3. Type 'C'—Circular Manhole of Size 910 mm dia for depth up to 1.67m. Circular Manhole of Size 1220 mm dia for depth above 1.67m & depth up to 2.30m. Circular Manhole of Size 1520 mm dia for depth above 2.30m.
  - 4. Rectangular road gully chamber of size 500 x 450 mm.

### **Spacing of Manholes**

- 5. Manhole shall be provided in all the junctions, change of directions, change in diameters and as per connection requirement from every units.

- 6. Distance between manholes should be maintained as per the NBC-2016 for different dia of pipes.
- 7. Kitchen Effluent : Proper Oil and Grease trap (Modular type) to be consider before disposal to main sewer line.
- k) For drainage design calculation Manning's Formula should be used.

### **Storm Water Design Parameters**

- l) Rain fall data consider @ 100mm/hr designing the Rain water Harvesting and 50mm/hr design for external storm water design. However, The EPC contractor shall verify and in case, the rain fall intensity is higher, same shall be adopted.
- m) Minimum Pipe diameters for Rainwater Pipes from Terraces shall be 110mm and maximum 160 mm dia.
- n) All construction specifications with respect to the manhole sizes etc. will be respected and followed and as per NBC-2016/BCD//CPWD specification.
- o) The complete campus storm water drainage system designed with underground RCC pipe line with clay brick catch basin and manholes etc.

### **3. Scope of contractor (designing & built):** The EPC Contractor shall provide all sanitary engineering services and specification in relation to:

- a) High standards of materials and workmanship.
- b) Leak proof plumbing.
- c) Reliable and dependable engineering systems.
- d) Plan the system in such a way as to minimize the energy requirements.
- e) Create minimum nuisance and disturbance to the environment.

#### **3.1. General:**

- i) The EPC Contractor shall carry out design, supply, installation, testing & commissioning of the water supply, sanitary installations and drainage system and integration with the existing system, all complete.
- ii) The water supply system shall be gravity based and water supply system for domestic water supply shall consist of interconnecting pipes, valves etc. as required for new 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 NBC-2016/BCD//CPWD specification and the guidelines given in the DBR.
- iii) The work shall in general conform to the Latest NBC-2016/BCD//CPWD specification.

#### **3.2. Specific:**

##### **Plumbing Services (Water Supply and Sanitary Installation):**

- 1. Survey of the Site to know the topography
- 2. Source development i.e. bore well & connection from municipal line

3. Water testing and providing treatment system based on water test report.
4. Pumping system to all required place through variable speed hydro pneumatic system.
5. Water treatment plant
6. Water distribution system through hydro pneumatic system
7. Hot water system through heat pump/Geysers. (As per the utilization)
8. Sewage disposal system
9. All internal toilet including its soil & waste pipe and water supply pipe
10. Storm water management
11. Rain water harvesting (Modular system)
12. Preparation of all drawing for PHE Services
13. Taking approval of the design and drawing before start of work.
14. Taking approval of drawing and design from concern authority / consultant
15. Carrying out ground water survey and taking approval of digging bore well from concern authority.

#### **4.SYSTEM DETAILS:**

##### **4.1.WATER SUPPLY SYSTEM:**

###### **4.1.1.SOURCE**

The project shall be served with Municipality as the main source of water supply. The alternate source may be water from the Bore well /brought out water. The quality of water will be assured. Suggestion for the water treatment can be given from the water test report for available water. It is proposed to connect the entire water source to the underground tank located within the premises. In case of failure of either source, provision will be made to use water from any other water source.

###### **4.1.2.WATER REQUIREMENT**

Plumbing fixtures, devices and appurtenances shall be supplied with water in sufficient volume and at pressures adequate to enable them to function properly and without undue noise under normal conditions of use. Domestic water requirement for the proposed project is envisaged in Table. Domestic water requirement for the proposed project is calculated based on domestic & flushing water requirement per person.

**Table-P1**

###### **4.1.3.WATER STORAGE & DISTRIBUTION**

|                          |
|--------------------------|
| <b>Water tank sizing</b> |
|--------------------------|

| Project: |                                 | FTA          |                 |           |
|----------|---------------------------------|--------------|-----------------|-----------|
| Sr. No   | Description                     | Compartments | Capacity in cum | Remarks   |
|          | <b>Under ground water tanks</b> |              |                 |           |
| 1        | Fire tank                       |              | 50              | In ground |
| 2        | Raw water tank                  |              | 50              | In ground |
| 3        | Domestic water tank             |              | 50              | In ground |
| 4        | Flushing water tank             |              | 50              | IN STP    |

The water Storage is designed for 1.5 days Storage. The water from Bore wells, bought out water and municipal supply shall be collected in a sump designed for 1 day storage capacity and Over Head Tank is designed for 0.5 days Storage. Water stored in sump shall be pumped to the overhead tank by a set of pumps. Pumps will operate automatically with level switches. The water storage tank shall be provided with three compartments to store Fire, Raw & Domestic water. Besides underground sumps Domestic water shall also be stored in overhead tanks.

The municipal/bore well water from main shall be supplied to the Fire tank overflow of fire tank will go to raw water tank which will prevent stagnation, from the raw water tank it is pumped through a water treatment plant and stored in the Domestic water tank. Each reserve is independent and comprise of:

- Supply by valve-controlled float
- Emergency supply delivered from outside through valve
- Drain at lowest point and bypass to allow for cleaning
- Level monitors with ball valve
- External digital level indicator
- Vent with anti-mosquito grill
- Low voltage illumination
- Access for maintenance (manhole and ladders)

The domestic water is then pumped through hydro pneumatic pumping system to overhead tank, which has a capacity to store half-day requirement of water & treated water will be supplied by gravity flow system.

#### **4.1.4.WATER TREATMENT**

##### **4.1.4.1.Water Treatment System:**

In order to decide the exact treatment to be adopted, it is essential to know the chemical composition of raw water as per IS 10500. Efforts should be made by the contractor to get the water samples tested from all the possible sources. Following test of the existing tube well water will be required.

| SI No. | Characteristic | Requirement (Acceptable Limit) | Permissible Limit in the Absence of Alternate Source |
|--------|----------------|--------------------------------|--|
|--------|----------------|--------------------------------|--|

| (1)    | (2)   | (3)       | (4)           |
|--------|---|-----------|---------------|
| i)     | Color, Hazen units, <i>Max</i>                      | 5         | 15            |
| ii)    | Odour   | Agreeable | Agreeable     |
| iii)   | pH value  | 6.5-8.5   | No relaxation |
| iv)    | Taste   | Agreeable | Agreeable     |
| v)     | Turbidity, NTU, <i>Max</i>                          | 1         | 5             |
| vi)    | Total dissolved solids, mg/l,                       | 500       | 2,000         |
| vii)   | Aluminum (as Al), mg/l, <i>Max</i>                  | 0.03      | 0.2           |
| viii)  | Ammonia (as total ammonia-N), mg/l, <i>Max</i>      | 0.5       | No relaxation |
| ix)    | Anionic detergents (as MBAS) mg/l, <i>Max</i>       | 0.2       | 1.0           |
| x)     | Barium (as Ba), mg/l, <i>Max</i>                    | 0.7       | No relaxation |
| xi)    | Boron (as B), mg/l, <i>Max</i>                      | 0.5       | 1.0           |
| xii)   | Calcium (as Ca), mg/l, <i>Max</i>                   | 75        | 200           |
| xiii)  | Chloramines (as Cl <sub>2</sub> ), mg/l, <i>Max</i> | 4.0       | No relaxation |
| xiv)   | Chloride (as Cl), mg/l, <i>Max</i>                  | 250       | 1,000         |
| xv)    | Copper (as Cu), mg/l, <i>Max</i>                    | 0.05      | 1.5           |
| xvi)   | Fluoride (as F) mg/l, <i>Max</i>                    | 1.0       | 1.5           |
| xvii)  | Free residual chlorine, mg/l, <i>Min</i>            | 0.2       | 1             |
| xviii) | Iron (as Fe), mg/l, <i>Max</i>                      | 0.3       | No relaxation |
| xix)   | Magnesium (as Mg), mg/l, <i>Max</i>                 | 30        | 100           |

|         |   |       |               |
|---------|---|-------|---------------|
| xx)     | Manganese (as Mn), mg/l, Max  | 0.1   | 0.3           |
|         | Mineral oil, mg/l, Max  | 0.5   | No relaxation |
| xxi)    | Nitrate (as NO <sub>3</sub> ), mg/l, Max                            | 45    | No relaxation |
| xxii)   | Phenolic compounds (as C <sub>6</sub> H <sub>5</sub> OH), mg/l, Max | 0.001 | 0.002         |
| xxiii)  | Selenium (as Se), mg/l, Max   | 0.01  | No relaxation |
| xxiv)   | Silver (as Ag), mg/l, Max   | 0.1   | No relaxation |
| xxv)    | Sulphate (as SO <sub>4</sub> ) mg/l, Max                            | 200   | 400           |
| xxvi)   |   |       |               |
| xxvii)  | Sulphide (as H <sub>2</sub> S), mg/l, Max                           | 0.05  | No relaxation |
| xxviii) | Total alkalinity as calcium carbonate, mg/l, Max                    | 200   | 600           |
| xxix)   | Total hardness (as CaCO <sub>3</sub> ), mg/l, Max                   | 200   | 600           |
| xxx)    | Zinc (as Zn), mg/l, Max   | 5     | 15            |

**In general practice following water treatment system will be adopted:**

The water from the source will be brought into the underground fire water tank from this water will be over flow to the underground raw water tank. From this water shall be treated in the water treatment plant, consisting of chlorination, filtration (DMF - Dual Media Filter) and optional softening units, located in the plant room depending upon the final water test report. Domestic water shall be supplied after chlorination and filtration. A certain amount of water may also be softened and blended with the domestic water to reduce the water hardness to permissible levels. The domestic water shall be stored in the domestic water tank. Municipal connection shall be directly brought into the domestic water tank (If available).

**4.1.4.2. Disinfection of the System**

The water distribution networks will be designed to prevent any risk of polluted water returning into the system. The distribution system shall include disconnections and / or non-return valves at different levels and the showers shall be equipped with anti-siphoning valves.

#### **4.1.4.3.Pumping & Distribution System:**

##### **i.Domestic Water:**

- a.**Domestic water from domestic water tank shall be transmitted via domestic pumping system (HPN) to the overhead fire water tank from this water will be over flow to the domestic water over head tank of the building and from this water shall be supplied by gravity to all user points. The system shall be designed to take care of peak demand of water and a residual pressure at the ground floor users point shall be minimum 1.25 kg/cm<sup>2</sup>. Water supply system will be completely automatic through level controller.
- b.** The sizing of the entire distribution network is based on the simultaneous use of fixture unit's demand.
- c.**A shut off valve is provided within the battery limit of each sub branch, which serves for the purpose of maintenance of any utility.
- d.**Individual toilets will be provided with main control valve for isolation and maintenance of the same.
- e.**Air release valve and water hammer arrester shall be provided as per requirement of the design.

##### **ii.Flushing Water:**

For pumping and distribution of flushing water, the gravity system is being proposed. The flushing water from STP treated water tank shall be transmitted via f to the overhead flushing water over head tank of the building and from this water shall be supplied by gravity to all user points. The system shall be designed to take care of peak demand of water and a residual pressure at the ground floor users point shall be minimum 1.25 kg/cm<sup>2</sup>. Water supply system will be completely automatic through level controller.

##### **iii.Water for Irrigation/ Horticulture:**

Water to the garden hydrants shall be supplied through a separate garden pump, which shall be supply water From STP Treated water tank.

#### **4.2.SEWERAGE SYSTEM:**

##### **4.2.1.Concept:**

The sewerage system of the project is designed as separate sanitary sewer concept, separating the storm water.

##### **4.2.2.Estimation of Sanitary Sewage:**

The estimation of sanitary sewage is based on the per capita sewage flow. Although the entire used water from the buildings should contribute to the total flow in sanitary sewer, generally about 80 % of water supply is expected to reach the sewers/STP.

**Table-P4**

| <b><u>STP SIZING CALCULATION</u></b> |              |                            |
|--------------------------------------|--------------|----------------------------|
| <b><u>Project:</u></b>               | <b>FTA</b>   |                            |
| <b>Description</b>                   | <b>Units</b> | <b>Quantity in<br/>LPD</b> |



|   |                |              |
|---|----------------|--------------|
| Total volume of water required  |                | 50000        |
| <b>Less</b>   |                |              |
| Water used for gardening and irrigation   | (-)            | 10000        |
| <b>Total Volume of water entering sewerage system</b>                                 |                | <b>40000</b> |
|   |                |              |
| <b>Volume of water entering STP @ 80% of the total water entering sewerage system</b> | <b>80%</b>     | <b>32000</b> |
| <b>That means,</b>  |                |              |
| <b>Considering 100% load condition, capacity of STP required</b>                      | <b>cum/day</b> | <b>32</b>    |
| <b>Volume of recycled water generated @ 95% of the total plant capacity</b>           |                |              |
| <b>For, 100% Load condition</b>   | <b>95%</b>     | <b>30</b>    |

#### 4.2.3.Sewage Collection:

The sewerage system shall be designed as two pipe system as per IS specifications, with ventilating the soil stack separately. The waste stack taken to roof acts as vent through roof. Deep seal traps i.e. 65mm water seal shall be provided for floor drains and urinal traps.

#### 4.2.4.Sewerage Disposal :

3. Separate networks for soil and waste shall be worked out. Soil pipes from top most floors shall be vertical H.C.I soil stack in the shaft. Similarly the waste outlets from the washbasin, bathtub and shower drain shall be H.C.I.
4. The soil and waste stacks connect to soil and waste headers. The soil headers are to be taken down to ground and connected directly to STP. The waste headers are connected to STP through Gully traps.
5. The system would be designed as two-pipe system with separate networks for wastewater and sewage. The wastewater from toilets, kitchen etc. shall however be taken separately.
6. Vent pipes on the terrace would be grouped together and extended above terrace level at limited points.

#### 4.2.5.Sewage treatment:

##### 1. Effluent Characteristics:

The effluent generated during activities contains mainly:

1. Suspended / colloidal organic components like food waste, toilet flushing etc.
2. Dissolved organic components

3. Dissolved inorganic solids of cleaning chemicals:

**2. Basic data / observation:**

✓ It is proposed that treated sewage is to be reused for flushing / gardening.

|              |                   |
|--------------|-------------------|
| BOD          | 250-300 Mg/Ltr.   |
| COD          | 400-500 Mg/Ltr    |
| TSS          | 400 to 500 Mg/Ltr |
| PH           | 7.5 to 8.5        |
| Oil & Grease | 30 mg/Ltr.        |

✓ The design influent and desired sewage standards for S.T.P. would be as follows

**3. Characteristics of treated effluent:**

**Table-P6**

|                   |                |
|-------------------|----------------|
| BOD5              | <10 Mg /Ltr.   |
| COD               | < 40 Mg / Ltr. |
| TSS               | <5 Mg / Ltr.   |
| PH                | <6.5 to 7.5.   |
| Oil & Grease      | <5 Mg / Ltr.   |
| Turbidity         | <2 NTU         |
| E-Coli            | Nil            |
| Residual Chlorine | >=1 mg/l       |

**4. Sewage treatment plant:**

**Proposed scheme:**

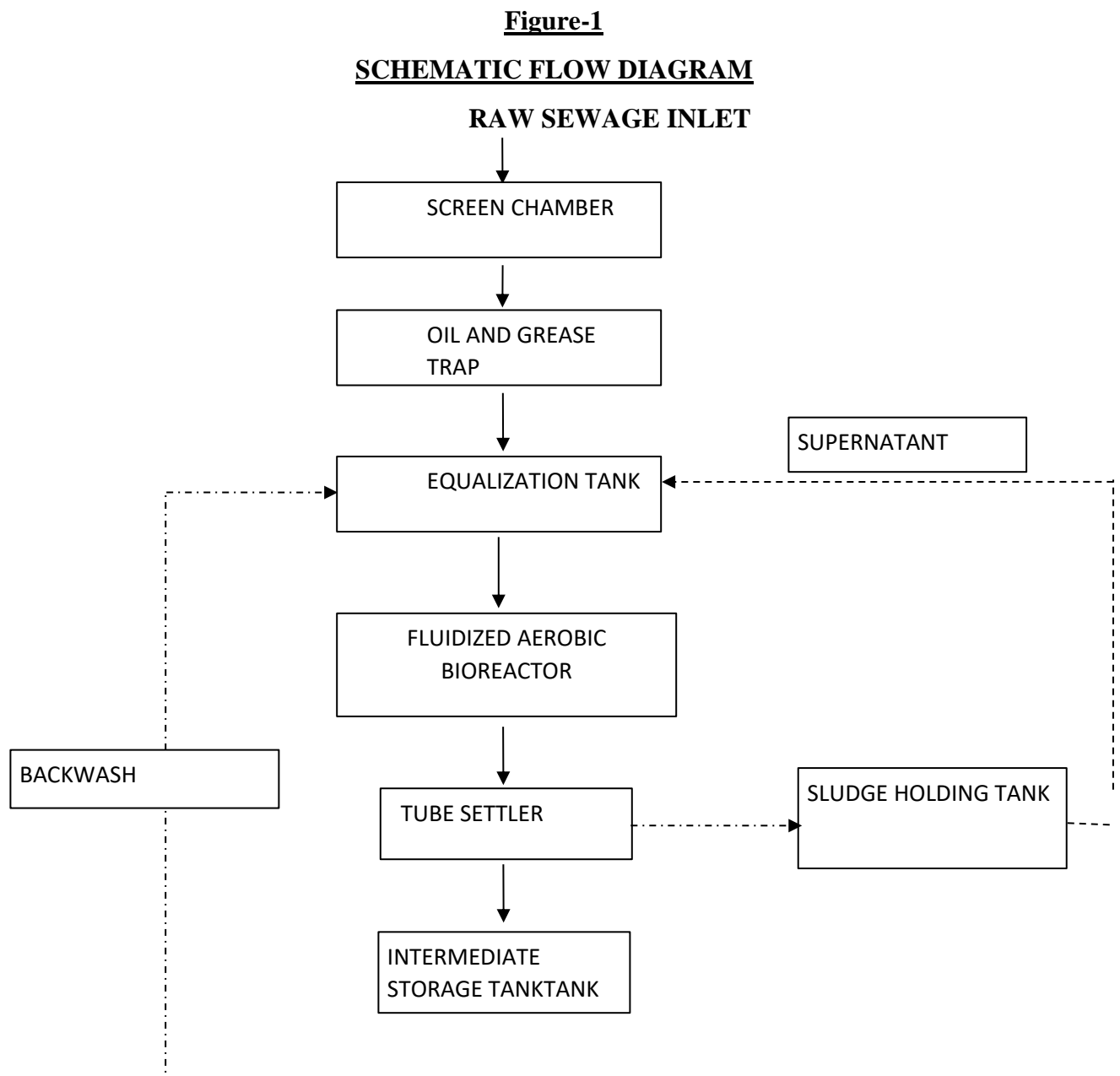
**Process - fluidized aerobic bio-reactor (FAB):**

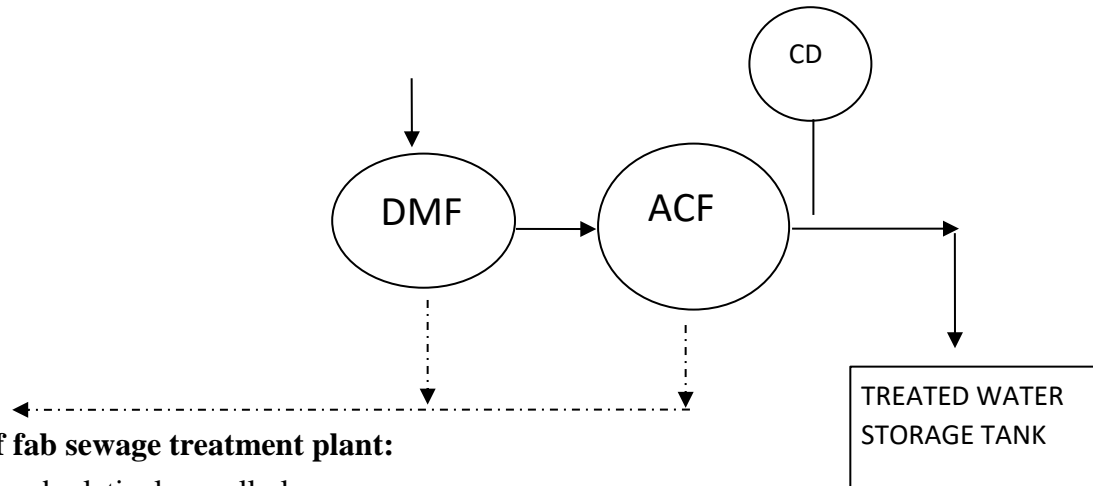
The domestic sewage generated from complex will be collected in existing **Equalization tank** after passing through **Screen Chamber (SC)** and **Oil and Grease trap (O&G)**. Floating oil will be removed

manually and collected in oil collection tank by gravity. From equalization tank oil free raw sewage will be pumped to **Fluidized Aerobic Bioreactor (FAB)** tank.

The **FAB** consists of tank filled with special media. These media are made of specially developed material of control density such that they can be fluidized using an aeration device. A bio film develops on the media which moves along with the effluent in the reactor. The movement within the reactor is generated by providing aeration with the help of air grids placed at the bottom of the reactor. The thin bio film on the media enables the bacteria to act upon the bio degradable matter in the effluent and reduce BOD/COD content in the presence of oxygen from the air that is used for fluidization.

The aerated liquid will overflow to **Tube Settler (TS)** for separation of solids from liquid. The settled sewage will be collected in **Intermediate Storage Tank (IST)** & then will be pumped through **Dual Media Filter (DMF)**, **Activated Carbon Filter (ACF)**, **Chlorine Dozer (CD)** to **Treated water storage tank (TWST)**. The sodium hypochlorite solution will be added as disinfectant. From storage tank, treated sewage can be reused for gardening/ Flushing. The excess sludge from tube settling tank will be pumped to **sludge holding tank (SHT)**. The supernatant from here will be sent back to Equalization Tank.





**Advantages of fab sewage treatment plant:**

- ✓ Compact - need relatively small place.
- ✓ Minimal & unskilled operation.
- ✓ Low energy input.
- ✓ Built in capacity to absorb shock loads.
- ✓ No odour nuisance.
- ✓ Useful end products.
- ✓ Highest efficiency.
- ✓ Negligible excess sludge production.
- ✓ Better option to both septic tank and conventional Sewage Treatment Plant.

**4.3.STORM WATER DISPOSAL SYSTEM:**

**4.3.1.Design Criteria**

- a) Maximum intensity of rainfall is assumed as 100 mm/hr.
- b) Co-efficient of Run-off is taken as per NBC-2016.
- c) Road camber is taken as 1:100 for concrete roads starting from center.
- d) Surface slope as minimum 1:500.

**4.3.2.Disposal System**

- a) Rain water pipes / spouts will be provided in terrace for taking out rainwater.
- b) Slope of natural ground and infiltration capacity of open ground within the plot will not be sufficient to absorb / dispose off surface water. Percolation wells will be provided for rainwater harvesting and to raise subsoil water level. Excess rain water will be disposed to the available storm water drain.
- c) The rainwater will be disposed off into percolation / rain water harvesting pits. The overflow from the percolation / rainwater harvesting pits will be connected to the nearby storm water drain available from local public body.
- d) A grating at the main entrance will be provided to prevent entry of outside rainwater to the premises.

- e) All road crossings for services shall be provided with RCC pipe and manholes for the ease of maintenance and to avoid any digging of roads.
- f) Ground shall have minimum 1:500 surface slopes towards storm water collection system.
- g) The storm water collected from the terraces of the buildings can be used to recharge the ground water by providing a network of rainwater recharge pits at suitable intervals.

#### 4.3.3.Rain Water Disposal:

The rain water system is separated from sewage system. Separate down takes and collectors provided for rainwater disposal from terrace. The down takes are designed for maximum intensity of rainfall as 50mm/hr. (for 15minutes storm). Horizontal pipes running in ground ceiling shall be designed to take discharge from these down take pipes. Rain water pipes from the ground ceiling would be collected in Rain Water Harvesting pits and overflow shall be connected to external storm water drain. Rain Water from all the landscaped areas would be collected by suitable underground drain to Rain Water Harvesting pits and disposed off to the external storm water drain.

#### 4.3.4.Storm Water Disposal:

The entire storm water from the campus would be disposed by suitable drainage system to the rainwater harvesting system and excess is disposed off to the existing storm water drain outside the campus. The RCC drains channel shall be provided at the road ends to collect the Rain Water in Harvesting Sump and overflow shall be connected to external storm water drain & recharge soak pits at suitable intervals as per landscaping layout

| RWH SIZING CALCULATION |                                     |                |      |                    |                               |  |                                |
|------------------------|-------------------------------------|----------------|------|--------------------|-------------------------------|--|--------------------------------|
| <u>Project:</u>        |                                     | <u>FTA</u>     |      |                    |                               |  |                                |
| S.No.                  | Type of Surface                     | Catchment Area |      | Run off Coeff. [C] | Intensity of Rainfall (mm/hr) | Discharge (Run Off) [Q=10CIA] m <sup>3</sup> /hr | Total (m <sup>3</sup> /hr) [Q] |
|                        |                                     | sq.m           | Hect |                    |                               |  |                                |
|                        | Total Area                          | 101133         |      |                    |                               |  |                                |
| 1                      | Building (Terrace/ Hard Paved Area) |                |      |                    | 100                           |  |                                |
|                        | Area                                | 31944          | 3.19 | 0.9                | 100                           |  | 2875                           |
|                        | Say of (1)                          |                |      |                    |                               |  | 2875                           |
| 2                      | Paved Surface/Roads                 |                |      |                    |                               |  |                                |
|                        | Area                                | 58990          | 5.90 | 0.8                | 100                           |  | 4719                           |
|                        | Say of (2)                          |                |      |                    |                               |  | 4719                           |
| 3                      | Natural Ground                      |                |      |                    |                               |  |                                |
|                        | Area                                | 10199          | 1.02 | 0.15               | 100                           |  | 153                            |

|                            |   |  |     |            |  |  |                |
|----------------------------|---|--|-----|------------|--|--|----------------|
|                            | Say of (3)  |  |     |            |  |  | 153            |
| <b>Grand Total (1+2+3)</b> |   |  |     |            |  |  | <b>7747</b>    |
|                            |   |  |     |            |  |  |                |
| 4                          | Volume of Storm water   |  |     |            |  |  |                |
|                            | Considering approx 10% loss including evaporation loss                          |  |     |            |  |  |                |
|                            | Total Storm water Flow  |  |     | =          |  |  | 6972.3         |
|                            |   |  | Say | =          |  |  | 6972           |
|                            | Considering 10 Min (0.167 Hr) Retention Period                                  |  |     |            |  |  |                |
|                            | Volume Required   |  |     | =          |  |  | 1164           |
|                            | <b>VOLUME</b>   |  |     | <b>Say</b> |  |  | <b>1164.00</b> |
|                            |   |  |     |            |  |  | Cum            |
| <b>5</b>                   | <b>Considering Rain Water harvesting Pit of Size 5.0m Dia &amp; 6.0 m Depth</b> |  |     |            |  |  |                |
|                            | Volume of 1 Rain Water harvesting pit   |  |     |            |  |  |                |
|                            | DIA. of pit (d) in Mtr.   |  |     | =          |  |  | 5              |
|                            | Depth of pit (D) in Mtr.  |  |     | =          |  |  | 6              |
|                            | Volume of 1 Pit in Cum  |  |     | =          | $(\pi \times d/2 \times d/2 \times D)$ |  |                |
|                            |   |  |     | =          |  |  | <b>118</b>     |
|                            | <b>Say</b>  |  |     | =          |  |  | <b>118</b>     |
|                            |   |  |     |            |  |  | <b>Cum</b>     |
| <b>6</b>                   | <b>Total Nos of Rain Water Harvesting Pits</b>                                  |  |     |            |  |  |                |
|                            | <b>Volume</b>   |  |     | =          | <b>1164</b>                            |  |                |
|                            | <b>Volume Of Unit Harvesting Pit</b>  |  |     | =          | <b>118</b>                             |  |                |

|  |                         |  |  |          |           |  |  |
|--|-------------------------|--|--|----------|-----------|--|--|
|  | <b>Total No of Pits</b> |  |  | <b>=</b> | <b>10</b> |  |  |
|--|-------------------------|--|--|----------|-----------|--|--|

## **5. MATERIAL SPECIFICATIONS:**

### **1. CP & SANITARY FIXTURES:**

#### **1. SCOPE OF WORK**

- 1.1.1. 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 and specified hereinafter or given in the schedule of quantities.
- 1.1.2. Sanitary fixtures shall include all sanitary fixtures, C.P. fittings and accessories etc. necessary and required for the project.
- 1.1.3. Whether specifically mentioned or not all fixtures and appliances shall be provided with all fixing devices, nuts, bolts, screws, hangers as required.

#### **2. GENERAL REQUIREMENTS**

1. All fixtures and fittings shall be provided with all such accessories as required to complete the item in working condition whether specifically mentioned or not in the schedule of quantities, specifications, drawings.
2. 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.
3. Fixing screws shall be half round head chromium plated brass with C.P. washers wherever required or as per directions of Architect/Engineer-in charge.
4. All fittings and fixtures shall be fixed in a neat workmanship manner true to levels and heights shown on the drawings and in accordance with the manufacturer's recommendations. Care shall be taken to fix all inlet and outlet pipes at correct positions. Faulty locations shall be made good and any damage to the finished floor, tiling or terrace shall be made good at contractor's cost.
5. When directed, contractor shall install fixtures and accessories in a mock-up room for the approval of the Architect/Engineer-in charge. Sample room fixtures may be reused on the works if undamaged, but no additional payment for fixing or dismantling shall be admissible.

### **3. MATERIALS:**

#### **a) INDIAN W.C.**

- I. Indian W.C. pan shall be White Vitreous china Orissa pattern W.C. pan of size 580x440 mm with integral type foot rests. Each W.C. shall be provided with a 100mm dia cast iron or porcelain P or S trap with or without vent horn.
- II. W.C. shall be flushed by means of a 10 litre low level white P.V.C. flushing cistern, including flush pipe, with manually controlled device (handle lever) conforming to IS : 7231. complete with accessories.
- III. The W.C. shall be fixed in level in a neat workmanlike manner. The W.C. and trap shall be set in cement concrete 1:2:4 mix (1 cement: 2 coarse sand: 4 stone aggregate 20mm nominal size). Joints between W.C. and flush pipe shall be made with a putty or white lead and linseed oil and caulked well or with an approved rubber joint.

#### **b) EUROPEAN W.C.**

- I. European W.C. shall be white vitreous china wall hung water closet (European type W.C. pan) with seat and lid, 10 litre low level white P.V.C. concealed flushing cistern, including flush pipe, with

manually controlled device (flush plate), conforming to IS : 7231, with all fittings and fixtures complete, including cutting and making good the walls.

II. Each W.C. seat shall be so fixed that it remains absolutely stationary in vertical position without falling down on the W.C.

### **c) URINALS**

i. Urinals shall be 580x380x350 mm with white PVC automatic flushing cistern, with fittings, standard size C.P. brass flush pipe, spreaders with unions and clamps (all in C.P. brass) with waste fitting as per IS : 2556, C.I. trap with outlet grating and other couplings in C.P. brass, including painting of fittings

### **d) LAVATORY BASIN**

i. wash basin shall be with C.I. brackets, 15 mm C.P. brass pillar taps, 32 mm C.P. brass waste of standard pattern, including painting of fittings and brackets, cutting and making good the walls wherever required: 17.7.1 White Vitreous China Wash basin size 630x450 mm with a pair of 15 mm C.P. brass pillar taps. (A, B & C type quarters, Admin, Audi, Mess, Training Blocks, Dispensary, Barrack, QRT, Substation Etc.)

ii. wash basin with C.I. brackets, 15 mm dia CP Brass single hole basin mixer of approved quality and make, including painting of fittings and brackets, cutting and making good the walls wherever required:- (a) White Vitreous China Wash basin size 550x400 mm with a 15 mm CP Brass single hole basin mixer. (D, E, F type quarters)

iii. Basins shall be fixed at proper heights as shown on drawings. If height is not specified, the rim level shall be 79 cms above the floor or as directed by Architect/Engineer in charge.

### **e) SHOWER SET**

The shower set shall with shower rose of chromium plated brass of 100mm/150mm diameter. It shall have uniform perforations. The inlet size shall be 15 mm or 20 mm as required with Single lever diverter/wall mixer complete with all accessories.

### **f) SINKS**

Kitchen sink shall be with drain board 510x1040 mm bowl depth 250 mm with C.I. brackets, C.P. brass chain with rubber plug, 40 mm C.P. brass waste complete, including painting the fittings and brackets, cutting and making good the walls wherever required.

### **g) MIRRORS**

i. Bevelled edge mirror of superior glass (of approved quality shall be electro coated copper 6mm thick of guaranteed reputed make. The size shall be 600x450 mm or as per the interior design. The image shall be clear and without waviness at all angles of vision.

ii. Mirrors shall be provided with backing of 12mm thick marine plywood sheet fixed with C.P. brass semi-round headed screws and cup washers or C.P. brass clamps as per the interior design.

### **h) ACCESSORIES**

i. All chromium plated and porcelain accessories as shown on the drawings or directed by Architect/Engineer in charge.

ii. All C.P. accessories shall be fixed with C.P. brass half round head screws and cup washers in wall with rawl plugs or nylon sleeves and shall include cutting and making good as required or directed by



Architect/Engineer in charge.

iii. Porcelain accessories shall be fixed in walls and set in cement mortar 1:2 (1 cement: 2 coarse sand ) and fixed in relation to the tiling work.

#### **i) URINAL PARTITIONS**

Urinal partitions shall be of high pressure laminates (HPL) of very good quality (Greenlam or equivalent) fixed at proper heights with C.P. brass bolts, anchor fasteners and M.S. clips as recommended by the manufacturer and directed Architect/Engineer in charge.

**Following are the brief requirements of CP/Sanitary fittings, different buildings types as equivalent to GPRA norms & Recommended ref. models of one of the competent manufacture.**

## **2. SOIL, WASTE, VENT & RAINWATER PIPES & FITTINGS**

### **2.1. Scope of Work**

2.1.1. Work under this section shall consist of furnishing all labour, materials, equipments and appliances necessary and required to completely install all soil, waste, vent and rainwater pipes and fittings as required by the drawings, and given in the Schedule of Quantities.

2.1.2. Without restricting to the generally of the foregoing, the soil, waste, vent pipes system shall include the followings: -

2.1.3. Vertical and horizontal soil, waste and vent Pipes, and fittings, joints, clamps, connections to fixtures.

2.1.4. Connection of pipes to sewer lines as shown on the drawings at ground floor levels.

2.1.5. Floor and urinal traps, cleanout plugs, inlet fittings and rainwater heads /Khurras.

2.1.6. Testing of all pipe lines.

### **2.2. General Requirements**

2.2.1. All materials shall be new of the best quality conforming to specifications and subject to the approval of Architect/Engineer in charge

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

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

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

2.2.5. Access doors for fittings and cleanouts shall be so located that they are easily accessible for repair and maintenance. Any access panel required in the Civil structure, false ceiling or marble cladding

etc. shall be clearly reported to the Owner in the form of shop drawings so that other agencies are instructed to provide the same.

## **2.3.Piping System**

### **2.3.1.Soil, Waste and Vent Pipes**

- a) The soil and waste pipe system above ground has been planned as a “Two pipe system” having separate pipes for waste for kitchen sinks, wash basins, AHU’s, condensate drains and floor drains and soil from the WCs and Urinals.
- b) All waste water from AHU’s plant and pump rooms, floor channels in basements (if any) will be provided with a deep seal trap before connecting to the main drain or vertical stack.
- c) Vertical soil and waste stacks shall be connected to a common sewer chamber. Gully trap should be installed in waste pipe before connecting to sewer chamber.
- d) Toilet layouts have been so arranged that the W.C outlets shall be with “P” trap above ground level.
- e) Head (Starting point) of drains and sewage/waste water sumps (as and where applicable) having a length of greater than 4m upto connection to the main drain or manhole shall be provided with a 80/100 mm vent pipe terminating above roof.

### **2.3.2.Rainwater Pipes**

- a) All open terraces shall be drained by rain water down takes.
- b) 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 premises.
- c) Rainwater in open courtyards shall be collected in catch basins and connected to the storm water drains.
- d) Any dry weather flow from waste appliances e.g. AHU’s, Parking and Drainage Sumps shall connected to the Storm Water Network and Sewerage Sumps will be connected to the Sewerage System.

### **2.3.3.Balcony/Planter Drainage**

Wherever required, all balconies, terraces, planters and other formal landscape areas will be drained by vertical down takes or other type of drainage system.

## **2.4.Materials:**

### **Soil Waste and Vent Pipes and Fittings : (Above Ground)**

#### **a) Centrifugally Cast Iron Hubless Pipes & Fitting as per IS 15905:**

##### **Technical specifications & product characteristics:**

Hubless Centrifugally Cast (Spun) Iron Pipes and Fittings soil, waste and ventilating pipes, fittings and accessories shall conform to IS 15905. 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 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 water tight.

The pipes and fittings may be assembled using various types of joints. The joints are intrinsic components of the drainage, whose characteristics and tolerances shall be specified in the manufacturers catalogues. Taking into account the different applications of cast iron pipe work systems, various joint designs are permitted 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 or clamping components shall be made from 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.

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

Floor trap or Nahani trap shall be 'P' or 'S' type with minimum 50 mm seal. The traps shall be of self cleansing design and shall have exit of same size as that of waste pipe.

**Encasing in Cement Concrete:** Encasing of pipes is required to provide stability to the line and prevent its damage during construction.

#### **Soil and waste pipes under floor**

Pipes laid in sunken slabs and in wall chases (when cut specially for the pipe) shall be encased in cement concrete 1:2:4 mix (1 cement : 2 coarse sand : 4 graded stone aggregate 12mm size) 75mm in bed and all round. When pipes are running well above the structural slab, the encased pipes shall be supported with suitable cement concrete pillars of required height at intervals of 1.8m. All drainage pipes except when fixed above ground or in exposed locations shall be encased in cement concrete as specified above for soil and waste pipes. The bed and encasing thickness shall however be 150mm in bed and all round.

#### **Painting:**

Paints used shall be of approved quality and shade. Where directed pipes shall be painted in accordance with approved pipe color code.

#### **Cutting and Making Good:**

Contractor shall provide all holes cut outs and chases in structural members necessary and required for the pipe work as building work proceeds. Wherever cut outs, holes are left in the original construction, they shall be made good with cement concrete 1:2:4 (1 cement : 2 coarse sand : 4 stone aggregate 20mm nominal size) or cement mortar 1:2 (1 cement : 2 coarse sand) and the surface restored as in original condition.

#### **Sleeves/Cutouts:**

Contractor shall utilize all cutout and sleeves provided during construction to prevent breaking. The annular space between the pipe and the sleeve shall be filled up with approved type of fire hydrant sealant. When sleeves are misplaced or inaccurately located contractor shall make the holes in the wall

or structural members at his own cost but only with the prior permission of the Architect/Engineer in charge

**Testing:**

Entire drainage system shall be tested for water tightness and smoke tightness during and after completion of the installation. No portion of the system shall remain untested. Contractor must have adequate number of expandable rubber bellow plugs, manometers, smoke testing machines, pipe and fitting work test benches and any other equipment necessary and required to conduct the tests.

**The smoke test shall be carried out as under :**

Smoke shall be pumped into the pipe at the lowest end from a smoke machine, which consist of bellow and a burner. The materials usually burnt is greasy cotton based which gives but a clear pungent smoke which is easily detectable by sight as well as by smell if there is leaking at any point of the drain.

All materials obtained and used on site must have manufacturers hydraulic test certificate for each batch of materials used on the site.

**3. WATER SUPPLY SYSTEM:**

**3.1.Scope of Work**

3.1.1.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.

3.1.2.Water supply system shall include the following: -

- a) Distribution system from main supply headers to all fixtures and appliances for cold/hot water.
- b) Cold water supply lines from tube-wells and city water connections to fire and underground water tanks.
- c) Municipal water and Bore-well connections to U.G. water tanks.
- d) Garden Irrigation system
- e) Excavation and refilling of pipes trenches.
- f) Pipe protection and painting.
- g) Control valves, masonry chambers and other appurtenances.
- h) Connections to all plumbing fixtures, tanks, appliances and Municipal mains
- i) Inserts for RCC tank.

**3.2.General Requirements**

3.2.1.All materials shall be new of the best quality conforming to specifications. All works executed shall be to the satisfaction of the Architect/Engineer in charge

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

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

3.2.4.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.

- 3.2.5. Pipes shall be securely fixed to walls and ceilings by suitable clamps at intervals specified.
- 3.2.6. 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.
- 3.2.7. All pipe clamps, supports, nuts, bolts, washers shall be galvanized MS steel throughout the building. Painted MS clamps & MS nuts, bolts and washers shall not be accepted.
- 3.2.8. Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.
- 3.2.9. 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 60°C hot water supply.

### **3.3.Materials:**

#### **i.Pipes & Fittings:**

The water supply system shall include the gravity-based water supply system for water supply consisting of interconnecting pipes, valves, pump etc. as required for new buildings. For continuous water supply at adequate pressure, complete water supply system shall be designed with following type of pipe-lines.

The water supply lines and inside building shall be connected with designed pipeline grids for buildings which shall be CPVC Pipe conforming to IS 15778 code (for Internal Water Supply Pipe.) & GI pipes', conforming to the requirements of IS 1239 Part-I (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 as per relevant IS code latest amended as on date and shall be fixed in clay bricks masonry chambers as per specification.

Water supply pipe from existing water supply to overhead tanks, ring main at terrace, down take from ring mains up to the entry into the floors shall be with GI pipe (medium class). The water supply pipes from the 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 shall be underground and in shafts/ building, supported with standard clamps up to the overhead's tanks complete as per NBC-2016/BCD//CPWD specification.

#### **Pipe Supports:**

All pipes clamps, supports, hangers, rods, pipe supports, nuts and washers shall be factory made galvanized MS steel or alternatively galvanized after fabrication to suit site requirements.

pipes in shafts and other locations shall be supported by galvanized M.S clamps of design approved by pipes in wall chases shall be anchored by G.I hooks, pipes at ceiling level shall be supported on structural clamps fabricated from M.S structural steel. Pipes in typical shafts shall be supported on Galvanized slotted angles/channels as specified elsewhere.

#### **Clamps**

G.I. pipes in shafts and other locations shall be supported by M.S. clamps of design approved by Architect/Engineer in charge Pipes in wall chases shall be anchored by iron hooks, Pipes at ceiling level shall be supported on structural clamps fabricated from M.S. structural steel as described above. Pipes in typical shafts shall be supported on slotted angles/channels as specified.

### **Anchor Fasteners**

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

### **Unions**

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

### **Flanges**

Flanged connections shall be provided on pipes as required or where shown on the drawings, all equipment connections as necessary and required or as directed by connections shall be made by the correct number and size of GI nuts, bolts & washers with 3 mm thick gasket. Where hot water or steam connections are made insertion gasket shall be of suitable high temperature grade and quality approved by Bolt hole dia for flanges shall conform to match the specification for C.I. sluice valve to I.S.780. and C.I. butterfly valve to IS: 3095.

### **Trenches**

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

| <u>Dia of pipe</u> | <u>Width of Trench</u> | <u>Depth of Trench</u> |
|--------------------|------------------------|------------------------|
| 15mm to 50mm       | 30 cms                 | 75cms                  |
| 65mm to 100mm      | 45 cms                 | 100 cms                |

### **Sand filling**

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

### **ii.Valves**

#### **Ball Valves**

Valves upto 50 mm dia. shall be screwed type Ball valves with stainless steel balls spindle teflon seating and gland packing tested to a hydraulic pressure of 20 kg/sq.cm., and accompanying couplings and steel handles.( to BIS 5351 )

#### **Butterfly Valves – Slim Seal Type**

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

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

#### **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.

#### **iii.Storage tanks Underground & Overhead Tank. (Accessories & Connections) :**

Storage tanks for water supply shall be in reinforced cement concrete built by the building contractor. Each tank shall be provided with a Heavy Duty Cast Iron manhole frame and cover.

#### **Outlets and overflow**

All nozzles for puddle flanges in RCC tank for inlet, outlet, overflow and scour etc. shall be provided by civil contractor., 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 Architect/Engineer in charge

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.

### **4.DRAINAGE (Sewers & Storm Water Drains)**

#### **4.1.Scope of work**

4.1.1.Work under this section shall consist of furnishing all labour, materials, equipment and appliances necessary and required to completely install all the drainage system as required by the drawings and specified hereinafter or given in the Schedule of Quantities.

4.1.2.Drainage system shall include: -

4.1.2.1.Sewer lines including excavations, pipelines, manholes, drop connections and connections to the existing sewer.

4.1.2.2.Storm water drainage, excavation, pipelines, manholes, catch basins, drain channels and connections to the existing storm water drain.

#### **4.2.General requirements**

4.2.1.All materials shall be new of the best quality conforming to specifications and subject to the approval of the Architect/Engineer in charge

4.2.2.Drainage lines and open drains shall be laid to the required gradients and profiles.

4.2.3. All drainage work shall be done in accordance with the local municipal bye-laws.

4.2.4.Contractors shall obtain necessary approval and permission for the drainage system from the municipal or any other competent authority.

4.2.5.Location of all manholes, etc. shall be got confirmed by the Contractor from the Architect / Landscape Architect. As far as possible, no drains or sewers shall be laid in the middle of road unless otherwise specifically shown on the drawings or directed by the Architect/Engineer in charge

#### **4.3.Excavation**

##### **4.3.1.Alignment and grade**

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

##### **4.3.2. Excavation in tunnels**

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

##### **4.3.3. Opening out trenches**

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

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

##### **4.3.4.Obstruction of roads**

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

##### **4.3.5.Removal of filth**

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

##### **4.3.6.Excavation to be taken to proper depths**



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

#### **4.3.7. Refilling**

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

#### **Contractor to restore settlement and damages**

The contractor shall, at his own costs and charges make good promptly during the whole period the works are in hand, any settlement that may occur in the surfaces of roads, berms, footpaths, gardens, open spaces etc. Whether public or private caused by his trenches or by his other excavations and he shall be liable for any accidents caused thereby. He shall also at his own cost and expenses and charges, repair any make of any damage done to the buildings and other property.

#### **Disposal of Surplus Earth**

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

#### **Timbering of sewer and trenches**

- a) The contractor shall at all times support efficiently and effectively the sides of the sewer trenches and other excavations by suitable timbering, piling and sheeting and they shall be closed, timbered in loose of sandy strata and below the surface of the sub soil water level.
- b) All timbering, sheeting and piling with their walling and supports shall be of adequate dimensions and strength and fully braced and strutted so that no risk of collapse or subsidence of the walls of the trench shall be take place.
- c) The contractor shall be held responsible and will be accountable for the sufficiency of all timbering, bracings, sheeting and piling used as also for, all damage to persons and property resulting from improper quality, strength, placing, maintaining or removing of the same.

#### **Shoring of Buildings**

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

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

- a) The Contractor shall at all times during the progress of the work keep the trenches and excavations free from water which shall be disposed of by him in a manner as will neither cause injury to the public health nor to the public or private property nor to the work completed or in progress nor to the surface of any roads or streets, nor cause any interference with the use of the same by the public.
- b) If any excavation is carried out at any point or points to a greater width than the specified cross section of the sewer with its envelope, the full width of the trench shall be filled with concrete by the Contractor at his own expenses.

#### **Width of trench**

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

- |                       |        |
|-----------------------|--------|
| ✓ 100 mm dia pipe     | 55 cms |
| ✓ 150 mm dia pipe     | 55 cms |
| ✓ 225-250 mm dia pipe | 60 cms |
| ✓ 300 mm dia pipe     | 75 cms |

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

#### **4.4.Materials:**

##### **a) Foamcore pipes (Below plinth from upto external chamber of respective block/building):**

Foamcore pipes as per IS 16098:1 are basically multilayer pipes having outer and inner layers of conventional PVC and middle layer of foamed PVC. Outer and inner layers are designed to take the load while the middle layer of foamed PVC gives rigidity while maintaining the shape of the pipe under load. It reduces total weight of pipe and makes it light when compared to solid wall PVC pipes. The pipe is typical of solid wall PVC under load and the type of distortion is normally expected.

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

#### **Testing**

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

Sewer lines shall be tested for straightness by:

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

The Contractor shall give a smoke test to the drains and sewer at his own expense and charges, if directed by the Architect/Engineer in charge

A test register shall be maintained which shall be signed and dated by Contractor.

**b) Reinforced cement concrete pipes (For outer drainage from building chamber to STP & Storm water):**

All underground storm water drainage pipes and sewer lines where specified (other than those specified cast iron) shall be RCC pipes of specified class as per IS 458: 2003. Pipes shall be true and straight with uniform bore, throughout. Cracked, warped pipes shall not be used on the work. All pipes shall be tested by the manufacturer and the Contractor shall produce, when directed a certificate to that effect from the manufacturer.

**Laying**

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

**Jointing**

After setting out the pipes the socket shall be centered over the spigot and filled in with tarred gaskin, so that sufficient space is left on either side of the collar to receive the mortar. The space shall then be filled with cement mortar 1:2 (1 Cement: 2 fine sand) and caulked by means of proper tools. All joints shall be finished at an angle of 45 degrees to the longitudinal axis of the pipe on both sides of the collar neatly.

**Testing**

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

**c) Cement Concrete and masonry works (For Manholes and Chambers) Materials**

**a) Water**

Water used for all the construction purposes shall be clear and free from Oil, Acid, Alkali, Organic and other harmful matters, which shall deteriorate the strength and/or durability of the structure. In general, the water suitable for drinking purposes shall be considered good enough for construction purpose.

**b) Aggregate for Concrete**

The aggregate for concrete shall be in accordance with I.S. 383 and I.S. 515 in general, these shall be free from all impurities that may cause corrosion of the reinforcement. Before actual use these shall be washed in water, if required as per the direction of Architect/Engineer in charge. The size of the coarse aggregate shall be done as per I.S.383.

**c) Sand**

Sand for various constructional purposes shall comply in all respects with I.S 650 and I.S. 2116. It shall be clean, coarse hard and strong, sharp, durable, uncoated, free from any mixture of clay, dust, vegetable matters, mica, iron impurities soft or flaky and elongated particles, alkali, organic matters, salt, loam and other impurities which may be considered by the Architect/Engineer in charge

**d) Cement**

The cement used for all the constructional purposes shall be ordinary Portland cement or rapid hardening Portland cement conforming to I.S. 269.

**e) Mild Steel Reinforcement**

The mild steel for the reinforcement bars shall be in the form of round bars conforming to all requirements of I.S. 432 (Grade I).

**f) Bricks**

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

**g) Other Materials**

Other materials not fully specified in these specifications and which may be required in the work shall conform to the latest I.S. All such materials shall be approved by the Project Manager before use.

**Cement concrete (plain or reinforced)**

- a) Cement concrete pipes bedding, cradles, foundations and R.C.C. slabs for all works shall be mixed by a mechanical mixer where quantities of the concrete poured at one time permit. Hand mixing on properly constructed platforms may be allowed for small quantities by the rate for cement concrete shall be inclusive of all shuttering and centering at all depth and heights.
- b) Concrete work shall be of such thickness and mix as given in the Schedule of Quantities.
- c) All concrete work shall be cured for a period or at least 7 days. Such work shall be kept moist by means of gunny bags at all times. All pipes trenches and foundations shall be kept dry during the curing period.

**Masonry**

Masonry work for manholes, chambers, septic tanks, and such other works as required shall be constructed from 1st class bricks or 2nd class as specified in the Schedule of quantities in cement mortar 1:5 mix (1 cement: 5 coarse sand). All joints shall be properly raked to receive plaster.

**Cement concrete for pipe support**

Wherever specified or shown on the drawing, all pipes shall be supported in bed all round or haunches. The thickness and mix of the concrete shall be given in the Schedule of Quantities.

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

| upto 1.5 m<br>depth                   | upto 3 m<br>depth | beyond 3 m<br>depth |           |
|---------------------------------------|-------------------|---------------------|-----------|
| -----                                 |                   |                     |           |
| Stoneware pipes                       | All round         | Haunches            | All round |
| In open ground<br>(no sub soil water) | (1:4:8)           | (1:4:8)             | (1:4:8)   |

|                     |           |           |           |
|---------------------|-----------|-----------|-----------|
| R.C.C or SW         | All round | Haunches  | Haunches  |
| (In sub soil water) | (1:3:6)   | (13:6)    | (1:3:6)   |
| C.I Pipes           | All round | Haunches  | Haunches  |
| (In all conditions) | (1:3:6)   | (13:6)    | (1:3:6)   |
| R.C.C Pipes         | All round | All round | All round |
| Or C.I Pipes        | (1:3:6)   | (13:6)    | (1:3:6)   |

Under or building

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

R.C.C pipes or C.I. pipes may be supported on brick masonry or precast R.C.C or in situ cradles. Cradles shall be shown on the drawings. Pipes in loose soil or above ground shall be supported on brick or stone masonry pillars as shown on the drawings.

### **Manholes**

The manholes are to be constructed with brick masonry as per standard specifications of NBC 2016.

### **Manholes Covers**

- i. Medium duty S.F.R.C. manhole covers/ RCC grating 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/ RCC grating for manholes /service chambers/gully traps falling on main roads & service roads.
- iii. Shape and dimensions of Manhole covers/ RCC grating shall conform to NBC-2016/BCD//CPWD specification. & IS 12592

### **Making connections**

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

## **5. PUMPING AND WATER TREATMENT PLANT SYSTEM**

### **5.1.SCOPE OF WORK**

Work under this section shall consist of furnishing all labour, materials equipment and appliances necessary and required to completely install all works described hereinafter and shown on the drawings.

The system shall include the following:

- a. Raw water, Treated water, Soft water and drainage pumps.
- b. Water filtration plant with pressure filter and chlorination plant.
- c. Water Softening plant.

### **5.2.GENERAL REQUIREMENT**

- i.All materials shall be new as per approved makes complying with the appropriate Indian Standards.
- ii.All equipment other than specified in approved makes shall be of the best available make manufactured by reputed firms to the entire satisfaction of Resident Engineer.

- iii. The sample of the items shall be provided on the request of engineer-in-charge.
- iv. All equipment shall be so installed on suitable existing foundations, true to level and in a neat workman like manner.
- v. Equipment shall be installed so as to provide sufficient clearance between the end walls & between equipment to equipment.
- vi. Shop drawings for equipment layout with associated piping, control panels and wiring of equipment showing the route of conduit / cable from equipment to control panel shall be submitted by the Contractor for approval to engineer-in-charge before starting the fabrication of panel and starting the work. On completion of the works, four sets of "As-installed" drawings incorporating all details like equipment layout, piping routes, location of panels etc. shall be furnished by the contractor.

### **5.3.WATER SUPPLY PUMPS**

#### **5.3.1.HYDROPNEUMATIC SYSTEM – Fresh Water Supply**

- a) Hydro pneumatic system pumps shall be multistage stage, vertical stainless steel pumps, having stainless steel casing, stainless steel pump foot and diffusers, stainless impeller, stainless steel shaft, ceramic bearings, tungsten carbide shaft protection bushes and hydro pneumatic pump make to mechanical seal driven by 2900 RPM, 220 Volts, 50 Cycles, AC 3 –phase TEFC vertical flange motor. Each pump shall be capable of operating within a performance pressure characteristics range sufficient below and above the required working pressure.
- b) Diaphragm tank fabricated from prime quality steel for long life the tanks are long lasting epoxy paint treatment for greater protection against atmospheric elements.
- c) Pumps and motors shall be mounts on a common MS structural base plate.
- d) Each pump shall be provides with a totally enclosed fan cooled induction motor of H.P and R.P.M specified in schedule of quantities.
- e) Each pumping set shall be provides with a Gun Metal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping and also with pressure switch for its operation controlling.
- f) Appropriate vibration eliminating pads shall be provides with each pump.
- g) The pump set shall be provided with gun metal gate valve of appropriate sizes on delivery. a non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line.
- h) Suction and delivery lines of the pumps shall be provided with double flanged reinforced Neoprene flexible pipe connectors. Connectors shall be suitable for a working pressure of each pump as specified in Schedule of Quantities.
- i) Mega Control Device with one number variable frequency drive.

#### **5.3.2.WATER TREATMENT PLANT FEED PUMPS**

- a) Treatment plant feed pumps shall be single stage, vertical stainless steel pumps, having stainless steel casing, stainless steel pump foot and diffusers, stainless impeller, stainless steel shaft, ceramic bearings, tungsten carbide shaft protection bushes and mechanical seal driven 2900 RPM, 220 Volts, 50 Cycles, AC 3 –phase TEFC vertical flange motor. Each pump shall be capable of operating within a performance pressure characteristics range sufficient below and above the required working pressure.
- b) Pumps and motors shall be mounted on a common MS structural base plate.
- c) Each pump shall be provided with a totally enclosed fan cooled induction motor of H.P and R.P.M specified in schedule of quantities.
- d) Each pump shall be provided with a Gun Metal “Bourden” type pressure gauge with gunmetal isolation cock and connecting piping.
- e) Appropriate vibration eliminating pads shall be provided with each pump.
- f) The pump set shall be provided with gun metal gate valve of appropriate sizes on delivery. a non-return valve of appropriate size and a pressure gauge with cock shall be provided on the delivery line along with suitable size of Y- strainer at suction side.
- g) Suction and delivery lines of the pumps shall be provided with double flanged reinforced Neoprene flexible pipe connectors. Connectors shall be suitable for a working pressure of each pump as specified in Schedule of Quantities.

### **5.3.3.SUMP PUMPS**

- a) Pumps shall be submersible type.
- b) Pump shall be integral with submersible motor on a common shaft. The pumps shall have 2900 rpm synchronous speed unless stated otherwise in the data sheets.
- c) The pump set shall be installed in vertical position in sumps with level controller cum operated float switches.
- d) Pump casings shall be aluminum and impellers of SS. All pumps shall have combination ball and roller bearings and shaft seals should be mechanical. Motor shall be submersible and shall be rated for minimum hp specified or the BHP absorbed in the operating range of the pump.

### **5.3.4. DOSING PUMP**

- a) Dosing Pump shall be provided for the working pressure of System where the solution is to be dosed.
- b) Metering Pump shall be provided for operation on 220 V, 50 Hz., AC Power Supply.
- c) Piping from the Main Water Supply Line to the doser shall be PVC flexible pipe branded.
- d) All parts of the metering/dosing pump coming in contact with solution shall be of stainless steel of grade SS-304.

### **5.3.5. LEVEL CONTROLLER**

Contractor shall provide and install low voltage transistorized level controllers as specified in Schedule of Quantities. Each level controller shall be provided with required number of PVC sheathed stainless steel probes with necessary wiring and conducting.

#### **For filter feed pumps**

To cut off water treatment plant feed pumps on low water level in raw water tanks and high water level in ground floor treated water tank. To start pumps on low water level in treated water tanks.

#### **For softener feed pumps**

To cut off water treatment plant feed pumps on low water level in Treated water tanks and high water level in ground floor Soft water tank. To start pumps on low water level in soft water tanks.

#### **Treated water transfer pumps**

To cut off treated water transfer pumps on low water level in treated water tank and high water level in overhead treated water tank and start sump on low water level in overhead treated water tank.

#### **Irrigation water transfer pumps**

To cut off soft water transfer pumps on low water level in soft water tank and high water level in overhead soft water tank and start sump on low water level in overhead soft water tank.

#### **For hydropneumatic system**

To cut off hydro-pneumatic system pumps on low water level in ground level treated water tanks. To start pumps on opening of any taps.

### **5.4.WATER FILTRATION & SOFTENING PLANT**

#### **5.4.1. WATER FILTERS:**

Water filters shall be sand / gravel pressure filters downward or upward flow type suitable for a rate of filtration given in schedule of quantities.

Filter shall be vertical type of required diameter. The shell shall be fabricated from M.S. plate suitable to withstand a working pressure given in schedule of quantities. The minimum thickness of shell will be 8 mm and dished ends shall be 10 mm. The filter shall have at least one pressure tight manhole cover. Each filter shall be provide with screwed or flanged connections for inlet, outlet individual drain connections and all other connections necessary and required. Filter shall be painted inside with two or more coats of non- toxic corrosion resistant paint and one coat of red oxide primer outside.

#### **5.4.2.UNDER DRAIN SYSTEM:**

Each filter shall be provides with an efficient under drain system comprising of collecting pipes, gunmetal / poly propylene nozzles of manufacturer's design. The entire under drain system shall be provides on M.S. plate cement concrete supports.

#### **5.4.3. FACE PIPING:**

Each filter shall be provides with interconnecting face piping comprising of inlet, outlet, and backwash complete with valves. Piping shall be cast iron double flanged to I.S.1536-1967 and C.I. Double flanged fittings to I.S. 1537-1967. Sluice valves 65 mm dia. and above shall be cast iron Double flanged sluice



valves to I.S. 780. Valves 50 mm and below shall be screwed type gunmetal full way gate valves. Water softener must be of multiport valve.

#### **5.4.4. ACCESSORIES:**

Each filter shall be provided with following accessories:

- a) Air release valve with connecting piping.
- b) 100 mm diameter dial Bourden type gunmetal pressure gauges with gunmetal isolation cock and connecting pipes.
- c) Sampling cocks on raw water inlet and filtered water outlet.
- d) Individual drain connection with gunmetal full way valve.
- e) Connection with valve for air scouring.
- f) Flow meter or water meter (if required).

#### **5.4.5. FILTER MEDIA**

Each filter shall be provided with clean and washed filter media. Following is recommended:

|                  |                                  |
|------------------|----------------------------------|
| Pebbles          | 13.6mm size (100mm deep)         |
| Gravel           | 6-2.5mm size (100mm deep)        |
| Coarse sand      | 2.5-.25mm size (100 mm deep)     |
| Fine sand        | 1.25-.08mm size (650-750mm deep) |
| Activated carbon | 600mm                            |

The above filter media arrangement may be altered to suit contractor's own design for the most efficient performance.

#### **5.4.6. CHEMICAL DOSER:**

(Alum Doser, chlorinator)

- a) Chemical doser shall be displacement type complete with rubber bag in vessel duly painted of 50 liters capacity or as mentioned in the schedule of quantities.
- b) Doser shall be suitable for working pressure mentioned in the schedule quantities.
- c) Each doser shall be provided with orifice plate assembly injection and corrosion proof piping. Piping from the main water supply line to the doser shall be G. I. pipes to IS : 1239 (heavy class).

#### **5.4.7. WATER SOFTNER:**

- a) Softener vessel shall be designed in accordance with the code of unfired pressure vessel conforming to BIS.
- b) Softeners shall be designed to give 'Soft Water' of quality of Commercial Zero i.e. hardness less than 5 ppm for soft water tanks and less than 150 ppm for treated water tank. Softener shall provide with suitable grade of CATION exchange resin in quantity to be considered by the Contractor at the time of quoting.
- c) Softener shall be fabricated out of mild steel and suitable for self-supporting arrangement.

- d) Softener shall have a set of face piping for inlet, outlet brine injection with all valves. Suitable drain shall be provided (with multiport valve preferably).
- e) One set of hydraulic injector with control valve and brine delivery pipes.
- f) One cylindrical PVC/HDPE brine saturator and mixing tank, provided with brine delivery piping with adjustable level indicating clamp and control valves complete. The tank shall be of capacity as given in the schedule of quantities.
- g) The first charge of resin, chemicals, media & consumables shall be included in the cost of water softening plant.

#### **5.4.8.INSTALLATION AND TESTING**

All pumps, water treatment equipments, R.O. plants and solar heater shall be laid out generally in accordance with the shop drawings (submitted by contractor and approved by engineer-in-charge / consultant / architect) achieving economy of space and piping.

All pumps, water treatment equipments, R.O. plants and solar heater shall be tested for the rated performance in the presence of the employer's representative and got approved.

#### **5.4.9.CATALOGUES & MANUAL**

The Contractor shall furnish the operation & maintenance manual/ technical literatures in duplicate to engineer-in-charge.

### **5.5.GARDEN IRRIGATION SYSTEM**

#### **5.5.1. Scope of Work**

Work under this section consists of furnishing all labour, materials equipment and appliances necessary and required to install garden hydrants and sprinklers and drip

Irrigation water supplies system as required by the drawings, specified hereinafter and as given in the Schedule of Quantities (BOQ) submitted by EPC contractor's consultant.

- a) Connections from the water supply system to all hydrants, sprinklers and drip irrigation points.
- b) Garden hydrants, surface sprinklers & pipe emitters.
- c) Excavation and refilling of pipes trenches.
- d) Control valves, masonry chambers and other appurtenances.
- e) Connections to all pumps & appliances.

#### **5.5.2. The System**

- a) The garden hydrant and sprinkler irrigation system will be new and fully working system in the complex.
- b) System components shall be pipes, valves, controllers, various types of sprinklers and drip irrigation lines with emitters as approved by the Project Manager.

#### **5.5.3. General requirements**

- a) All materials shall be new of the best quality conforming to specifications. All works executed

shall be to the satisfaction of the Project Manager.

- b) Pipes and fittings shall be fixed truly vertical, horizontal or in slopes as required in a neat workmanlike manner.
- c) Short or long bends shall be used on all main pipe lines as far as possible. Use of elbows shall be restricted for short connections.
- d) Pipes shall be laid in a manner as to provide as far as possible easy accessibility for repair and maintenance. Pipes under roads shall be laid in RCC pipe sleeves.
- e) Valves and other appurtenances shall be so located as to provide easy accessibility for operations, maintenance and repairs.

#### **5.5.4. HDPE Pipes and Fittings.**

- a) Garden hydrant mains shall be HDPE pipes conforming to IS: 4984 of class specified. If class is not mentioned in the schedule of quantities the same shall be Material Grade PF100.
- b) Fittings for HDPE pipes shall be injection molded fitting suitable for thermal weld joints. Fittings must have suitable provision for expansion and shall be rated for the same working pressure as the pipeline.
- c) Electro fusion joints shall be made in an approved manner as recommended by the manufacturer.
- d) Provide flanges at intervals of 20-25 m. for all pipes 65 mm dia and above.
- e) Provide suitable adapters for connection between pipes & valves.
- f) Provide cement concrete supports and anchor blocks at all bends, tees and other locations as directed by the Project Manager. Connections at garden hydrant outlet, near valves must also be anchored.

#### **5.5.5. Drip Irrigation Pipes**

Pipes shall be LLDPE pipes of UC 7510 resin conforming to ASAE S-435 standard.

### **1. G.I. Pipes & Fittings**

Vertical connection for garden hydrant points shall be galvanised steel tubes to IS12:1239 (medium class) with matching malleable iron fitting of approved make.

### **2. Sprinklers**

Pop-up Sprinklers Pop-up sprinklers shall be underground with rugged plastic high impact case with precision jet spray guide arm control with brass head, Sprinklers shall be suitable for pressure and coverage given in the schedule of quantities.

## **6. COMMISSIONING & GUARANTEE**

### **1. SCOPE OF WORK**

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

- a) Contractor shall provide all tools, equipment, metering and testing devices required for the purpose.
- b) On award of work, Contractor shall submit a detailed proposal giving methods of testing and gauging the performance of the equipment to be supplied and installed under this contract.
- c) All tests shall be made in the presence of the Architect or his representative or any inspecting authority. At least five working days notice in writing shall be given to the inspecting parties before performing any test.

- d) Water flow rates of all equipment and in pipe lines through valves shall be adjusted to design conditions. Complete results of adjustments shall be recorded and submitted.
- e) Contractor shall ensure proper balancing of the hydraulic system and for the pipes / valves installed in his scope of work by regulating the flow rates in the pipe line by valve operation. The contractor shall also provide permanent Tee connection (with plug) in water supply lines for ease of installing pressure gauge, temperature gauge & rotameters. Contractor shall also supply all required pressure gauge, temperature gauge & rotameter for system commissioning and balancing. The balancing shall be to the satisfaction of Consultant / Architect/Engineer in charge
- f) Three copies of all test results shall be submitted to the Engineer in A4 size sheet paper within two weeks after completion of the tests.

## **2 PRECOMMISSIONING**

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

Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fittings and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.

- a) All strainers shall be inspected and cleaned out or replaced.
- b) Check all clamps, supports and hangers provided for the pipes.
- c) Check all the equipment, piping and valves coming under hot water system and operate each and every valve on the system to see if the valves are functioning properly. Thereafter conduct & hydro test of the system as for (b) above.
- d) Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

## **FINAL ACCEPTANCE TESTS**

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

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

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

## **REJECTION OF INSTALLATION / PLANT**

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

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

## **WARRANTY AND HANDOVER**

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

## **HANDING OVER OF DOCUMENTS**

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

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

## **MAKE LIST FOR PLUMBING**

**Table-P9**

| <b>Sl No</b> | <b>Item / Material</b>   | <b>Make</b>                      |
|--------------|--|----------------------------------|
| 1.           | Sanitary & CP Fittings   | Jaquar/Kohler/Grohe/Duravit/Toto |
| 2.           | Miscellaneous Items i.e. shop dish, Hand dryer, soap dish Etc. | Hindware / Euronics / Jaquar     |
| 3.           | SS Sink  | Jayna / Nirali/Cera/Elica        |
| 4            | Insulation   | Therma Flax / Careflex/Armaflex  |
| 7            | GI Pipes as per IS:1239  | Surya Prakash/ Jindal Hisar/Tata |
| 8            | GI Fittings (Malleable Cast Iron) as per IS:1879               | Drp-M/Unik /Zoloto / Ss          |

|     |   |  |
|-----|---|--|
| 8   | Centrifugally Cast Iron Hubless Pipes & Fitting as per IS 15905 | Neco/Kapilans/Bic  |
| 9   | Valves  | Zoloto/ Leader / Sant / Kartar   |
| 12  | Water Meter   | Kranti / Kent  |
| 15  | CPVC /uPVC/SWR/ Foam core Pipes & Fittings                      | Ashirwad/Astral/Supreme/Prince   |
| 18  | DWC Pipe  | Astral/Supreme/Prince  |
| 19  | Oil & Grease separator  | Kessel /Supreme  |
| 20  | Hydro pneumatic domestic pump                                   | Grundfos/Wilo/Xylem  |
| 22  | Filter / Softer   | Brisanzia /Ion Exchange/Pentair  |
| 23  | Solar water heater  | V-Guard/Havells/Racold   |
| 23  | Storage/ Instant Geyser   | AO Smith/Racold/Crompton/Bajaj/Havells   |
| 14  | NP2/NP3 Pipe  | Local As Per IS-458  |
| 11  | Cables  | Gloster / Finolex/Havells/Polycab  |
| 17. | Pressure Switch   | Indfoss / Switzer/ Vermatrafaq   |
| 18. | Pressure Gauges   | Brc/ H.Guru/ Well Will / Bell/ Gic   |
| 19. | Fasteners   | Hilti/ Fischer   |
| 20. | Weld Rods   | Advani / ESAB  |
| 26. | Mechanical seal   | Durametallic / Sealol  |
| 27. | Strainer  | Emerald / Grandprix  |
| 36. | Glazed Stone Ware Pipes & Fittings                              | RK Stone Ware Pvt Ltd/ Oriental Ceramics Refactors Pvt Ltd/ M/S Lal Chand & Sons, Ghaziabad,/ Supertach Ceramics Pvt Ltd, Rajkot/Approved ISI Mark |

|     |   |                                       |
|-----|---|---------------------------------------|
| 45. | FRP Manhole cover & frame and FRP Grating | Thermodrain /Pooja/Fibrocast          |
| 46. | SFRC Manhole COVERS ETC                   | Kk/Pragati/Super Wire/Isi             |
| 47. | Anti-corrosive tape for pipe protection   | Pypkote/Makpolykote                   |
| 57. | Vibration Eliminator Pads & Connections   | Resistoflex                           |
| 58  | Suction Strainer/Pot Strainer             | Venus/Leader/Emarald/Zoloto           |
| 59. | Forged Steel Fittings                     | Drp /Vs / Zoloto                      |
| 60. | Pressure Gauge                            | Fiebig/Guru                           |
| 61  | Air Admittance valves                     | Studor/Mc Alpine                      |
| 62  | Automatic Air Vent                        | Danfoss/Ibp                           |
| 63  | Water level indicator & controller        | Ital/Technika                         |
| 64  | Pipe Clamps / Hangers / Support           | Camry/Chilly                          |
| 65  | Clamps & Support                          | Camry/Chilly                          |
| 66  | Paint                                     | Shalimar/Asian                        |
| 67  | STP and ETP Plant                         | Eureka Forbes / Ps Aqua/ Ion Exchange |

## **E) FIRE FIGHTING & FIRE DETECTION & ALARM AND P.A. SYTEM**

### **a. Reference Standards**

The design and planning of Fire Protection System shall be done keeping in view the following criteria:

- National Building Code 2016: Part IV for Fire & Life safety

- Local Bye-Laws.
- Relevant BIS codes: Specifically IS: 3044, IS: 5290 and IS: 5312, IS: 908 and IS: 2190, IS: 3844, IS: 15105.
- NFPA & TAC Manual (for reference and guideline).
- Consultation with local Chief Fire Officer.

#### **b. Basis/ Concept of Design**

The fire fighting arrangement shall be designed as per the requirement of local guidelines, NBC-2016 & engineering design standard.

The entire fire safety installation shall be compliant with the most stringent codes / standard for the entire building/Campus to ensure the highest safety standard and uniformity of system. Further, before property is opened to public, the fire protection shall be fully operated and tested under simulated conditions to demonstrate compliance with the most stringent standards, codes and guidelines.

Following functional system shall be provided; strictly in compliance with the listed reference standards:

**Table-F-1**

|    |  |   |   |
|----|--|---|---|
| a. | Piping System                          | : | Piping system confirming to IS: 1239 .  |
| b. | Fire water static Storage              | : | Fire water static storage has been provided in accordance to NBC-2016 requirement.                            |
| c. | Fire Pumping system                    | : | Pumping system comprising of independent pumps for hydrant, sprinkler & jockey application has been provided. |
| d. | Hydrant system                         | : | External & internal hydrant complete with hose reel.  |
| e. | Sprinkler system                       | : | Sprinkler rating and type shall be selected for respective areas.   |
| f. | Kitchen hood & fire suppression system | : | water mist system compliance NFPA requirement.  |
| g. | Trolley mounted CO <sub>2</sub> system | : | For Transformer Room / LT Panel Room / DG Room, all as per local bye-laws.                                    |
| h. | Hand held fire extinguishers           | : | Strategically placed at designated areas.   |



**c. Scope of contractor (designing & built):**

**Fire Fighting, Fire Alarm & Detection & Public Address System:**

1. Preparing all firefighting drawing as per NBC 2016 and implementation of the same after approval from consultant.
2. Hydrant system
3. Sprinkler system
4. Fire pumps and equipment
5. Fire detection & alarm system
6. Fire suppression system
7. Public address system
8. Gas flooding system
9. Panel protection system
10. All miscellaneous work completes in all respect.

**d. System Description :**

**1. Fire fighting:**

**I. Fire water storage**

Static fire water storage tank for Fire Protection System has been provided at Ground level of **200** cum capacity. Fire department connection shall also be provided on the external wall of the property near the main entrance. These shall comprise of 4 Nos. 63 mm dia male outlets capable of directly feeding the ring mains through non return valves or directly filling the static fire storage tanks. These shall be mounted in specially identified boxes.

**II. Fire pumping system**

The fire pumping system shall comprise of independent electrical pumps for hydrant and sprinkler system, diesel engine driven pump & jockey pump for hydrant & sprinkler system.

- |                             |                              |
|-----------------------------|------------------------------|
| a. Electric pump            | Capacity 2280 LPM -- Mt head |
| b. Diesel engine drain pump | Capacity 2280 LPM -- Mt head |
| d. Jockey pumps             | Capacity 180 LPM -- Mt head  |

Electrical pump shall provide adequate flow for catering requirement of hydrant system. Diesel engine driven fire pumps shall be provided for ensuring operation & performance of the system in case of total electrical power failure. Jockey pumps shall compensate for pressure drop and line leakage in the hydrant and sprinkler installation. Provision of PRS/ orifice plate shall be made in sprinkler riser to restrict pressure on sprinkler system.

Individual suction lines shall be drawn from the fire reserve tank and connected to independent fire suction header. The electric fire pumps, diesel engine driven fire pumps and the jockey pumps shall all draw from this suction header. Delivery lines from various pumps shall also be connected to a common header in order to ensure that maximum standby capacity is available. The sprinkler pump shall be isolated from the main discharge header by a non return valve so that the hydrant pump can also act as

standby for the sprinkler system. The ring main shall remain pressurized at all times and Jockey pumps shall make up minor line losses. Automation required to make the system fully functional shall be provided.

### **III. Fire hydrant system**

Internal and external stand pipe fire hydrant system shall be provided with landing valve, hose reel, first aid hose reels, complete with instantaneous pattern short gunmetal pipe in the building. The internal diameter of inlet connection shall be at least 80/100 mm. The outlet shall be of instant spring lock type gunmetal ferrule coupling of 63 mm dia for connecting to hose pipe. Provision of flow switch on riser shall be made for effective zone monitoring. The flow switch shall be wired to FAP and shall indicate water flow on hydrant of the identified zone. Recessed cupboard/ fire hydrant cabinet shall be strategically located for fire fighting requirement. Location of cabinets shall be accessed as per compartmentation plan in consultation with the Architect. Provision of fire man's axe shall be made for internal hydrant. External hydrant shall be located within 2 m to 15 m from the building to be protected such that they are accessible and may not be damaged by vehicle movement. A spacing of about 45-50 m between hydrants for the building shall be adopted.

### **IV. Sprinkler system**

Elaborate automatic sprinkler system shall be provided. The system shall be suitably zoned for its optimum functional performance. The sprinkler system shall be provided with control valves, flow and tamper switches at suitable location and shall be connected to control module of the fire alarm system for its monitoring and annunciation in case of activation. Sprinkler type along with its bulb rating shall be selected based on the requirement of the space and shall be specified accordingly. Inspector's test valve assembly with sight glass shall be provided at remote end with discharge piped to drain outlet / pipe.

### **V. Clean agent fire protection system**

Clean agent suppression system shall be provided for EPABX & Server Rooms. The system shall comprise of the FM 200 / NAF S III gas module containing required quantity of gas which shall be released when the actuator output is enabled by the fire alarm panel. As per the design concentration, release of the gas shall be within 15 seconds time elapsed from the actuation to put out the fire. The room shall be ventilated completely after the release of FM 200 gas/ NAF S III gas, before personnel can enter and work in the area.

### **VI. CO<sub>2</sub> Extinguishing system**

Trolley mounted carbon-di-oxide extinguishing system shall be provided in accordance with local Bye-Laws for transformer room, LT panel room and other critical areas.

### **VII. Hand held fire extinguishers**

Portable fire extinguishers of water (gas pressure), Carbon-di-oxide and foam type shall be provided as first aid fire extinguishing appliances. These extinguishers shall be suitably distributed. The appliances shall be so distributed over the entire floor area, that a person is not required to travel more than 15 m to reach the nearest extinguisher.

These shall be placed or hanged on wall in a group on several suitable places. Classification of extinguishers shall be as per the following table:

**Table-F-2**

| <b>Class of Fire</b> | <b>Description</b>  | <b>Suitable Type of Appliances</b>                                     |
|----------------------|---|--|
| a.                   | Fire in ordinary combustibles (wood, fibres, rubber plastics, paper and the like)                                     | Gas Expelled Water Type  |
| b.                   | Fires in flammable liquids, paints, grease, solvents and the like   | Chemical extinguishers of carbon dioxide, dry powder type and buckets. |
| c.                   | Fire in gaseous substances under pressure including liquefied gases (Class C fire-Not Gases but Electrical Equipment) | Chemical extinguishers of carbon dioxide and dry powder type           |

Further, for rooms containing electrical transformers, switchgears, motors and of electrical apparatus, minimum 2 Nos. dry powder or carbon di oxide type/sand buckets extinguishers shall be additionally provided within 15 m of the apparatus.

### **VIII. Brief for Major Equipment**

#### **Piping**

Galvanized steel pipes (heavy class) as per IS:1239 shall be provided throughout the Complex. Pipes buried below ground shall be suitably protected with anti-rust treatment. All pipe clamps and supports shall be fabricated from MS steel sections and shall be factory galvanised before use at site. Welding of galvanised clamps and supports shall not be permitted. Pipes shall be hung by means of expandable anchor fastener of approved make and design. The hangers and clamps shall be fastened by means of galvanised nuts and bolts. The size/diameter of the anchor fastener and the clamps shall be suitable to carry the weight of water filled pipe and dead load normally encountered.

Hangers and supports shall be thoroughly galvanised after fabrication. The selection and design of the hanger & support shall be capable of carrying the sum of all concurrently acting loads. They shall be designed to provide the required supporting effects and allow pipeline movements as necessary. All guides, anchors, braces, dampener, expansion joint and structural steel shall be attached to the building/structure.

Flanged joints shall be used for connections for vessels, equipment, flanged valves and also on two straight lengths of pipelines of strategic points to facilitate erection and subsequent maintenance work.

#### **Fire Hydrants**

##### **External Hydrants**

External hydrants shall be provided all around the Complex. The hydrants shall be controlled by a cast iron sluice valve or butterfly valve. Hydrants shall have instantaneous type 63mm dia outlets. The

hydrants shall be double outlet with CI duck foot bend and flanged riser or required height to bring the hydrant to correct level above ground.

For each external fire hydrant two numbers of 63mm dia. 15 m long controlled percolation hose pipe with gunmetal male and female instantaneous type couplings machine wound with GI wire, gunmetal branch pipe with nozzle shall be provided.

Each external hydrant hose cabinet shall be provided with a drain in the bottom plate.

Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

### **Internal Hydrants**

Internal hydrant shall be provided on each landing and other locations as required by NBC-2016 with double headed gunmetal landing valve with 100 mm dia inlet, with shut off valves having cast iron wheels. Landing valve shall have flanged inlet and instantaneous type outlets.

Instantaneous outlets for fire hydrants shall be standard pattern and suitable for fire hoses.

For each internal fire hydrant station two numbers of 63 mm dia. 15 m long rubberized fabric lined hose pipes with gunmetal male and female instantaneous type coupling machine wound with GI wire, fire hose reel, gunmetal branch pipe with nozzle shall be provided.

Standard fire hose reels of 20mm dia high pressure rubber hose 36 m long with gunmetal nozzle, all mounted on a circular hose reel of heavy duty mild steel construction having cast iron brackets shall be provided. Hose reel shall be connected directly to the wet riser with an isolating valve. Hose reel shall be mounted vertically.

Each internal hydrant hose cabinet shall be provided with a drain in the bottom plate. The drain point shall be led away to the nearest general drain.

Each internal hydrant hose cabinet containing items as above shall also be provided with a nozzle spanner and a Fireman's Axe. The cabinet shall be recessed in the wall.

Each hose cabinet shall be conspicuously painted with the letters "FIRE HOSE".

### **Hose Reel**

Hose reel shall be heavy duty, 20 mm dia length shall be 36 metre long fitted with gun metal chromium plated nozzle, mild steel pressed reel drum which can swing upto 170 degree with wall brackets of cast iron finished with red and black enamel complete.

### **Sprinkler System**

#### **Quartzoid Bulb Automatic Sprinkler**

Sprinkler heads shall be made of brass/ quartzoid bulb sufficiently strong, in compression to withstand any pressure, surge or hammer likely to occur in the system. The yoke & body shall be made of high quality gun metal brass with arms streamlined to ensure minimum interference with the spread of water. The deflector of suitable design shall be fitted to give even distribution of water over the area commanded by the sprinkler.

The bulb shall contain a liquid having a freezing point below any natural climatic figure and a high coefficient of expansion. The temperature rating of the sprinkler shall be stamped on the deflector & the

colour of the liquid filled in the bulb shall be according to the temperature rating as per NFPA standard. The sprinkler heads shall be of type & quality approved by the local fire brigade authority. The inlet shall be screwed.

The sprinklers shall have 15 mm nominal size of the orifice for ordinary hazard. The orifice size shall be marked on the body or the deflector of the sprinkler. Metal guards for protection of sprinkler against accidental or mechanical damage shall be provided.

### **Sprinkler Installation**

Sprinkler heads (fully recessed or semi-recessed) shall be quick response type, located in positions shown on the drawings. The maximum spacing between sprinkler heads and coverage area shall not exceed those stipulated in the NFPA 13 Rules.

The Fire Protection Services Trade shall co-ordinate with the ceiling Trade to set out the sprinkler locations to suit the site location of the unit grid. Chrome plated wire mesh guards shall be used to protect the sprinkler heads which are liable to accidental or mechanical damage.

### **Flow Requirements:**

The flow requirement for sprinkler heads shall be specifically approved for the designated area of installation to ensure compliance to AMAO based upon hazard classification.

### **Orifice Plates**

For restricting pressure at lower levels in the sprinkler system, orifice plates of appropriate sizes shall be fitted at different floor levels, at the branching points from Riser Main.

The Diameter of such orifice shall not be less than 50% of the dia of pipe into which it is to be fitted, which shall not be less than 50mm dia. These orifice plates must be of stainless steel with plain central hole without burrs, and the thickness shall be 3mm for pipe size upto 80 mm, 6 mm for pipes from 80 to 125 mm dia and 9 mm for pipes greater than 125 mm dia. Such orifice plate must have a projecting identification tag.

The orifice plate shall be fitted not less than two pipe internal diameters downstream of the outlet from any elbow or bend.

### **Installation Control Valves**

Each installation shall be provided with a set of installation control valves comprising: -

- An Alarm Valve.
- A Water Motor Alarm & Gong.
- Installation valves shall be installed on the sprinkler circuits as shown on the drawings.
- Installation valve shall comprise of a cast iron body with gunmetal trim, and double seated clapper check valves, pressure gauges, test valve and orifice assembly and drain valve with pressure gauges, turbine water gong including all accessories necessary and required and as supplied by original equipment manufacturer and required for full and satisfactory performance of the system. A cast iron isolation valve with lock and chain at the inlet of the installation valve shall be provided.

- Inspection and Test Valve Assembly

Inspection and testing of the automatic starting of the sprinkler system shall be done by providing an assembly consisting of gunmetal valves, gunmetal sight glass, bye-pass valve and orifice assembly.

### **Flow Switch**

Flow switch shall have a paddle made of flexible and sturdy material of the width to fit within the pipe bore. The terminal box shall be mounted over the paddle/ pipe through a connecting socket. The Switch shall be potential free in either NO or NC position as required. The switch shall be able to trip and make / break contact on the operation of a single sprinkler head. The terminal box shall have connections for wiring to the Annunciation Panel. The flow switch shall have connections for wiring the seat shall be of S.S to the Annunciation Panel. The flow switch shall have IP: 55 protection.

The flow switches work at a triggering threshold bandwidth (flow rate) of 4 to 10 GPM. Further, it shall have a 'Retard' to compensate for line leakage or intermittent flows.

### **Fire Pump**

The fire pump shall be horizontally mounted, variable speed type. It shall have a capacity to deliver and developing adequate head so as to ensure a minimum pressure at the highest and the farthest outlet.

The pump shall be capable of giving a discharge of not less than 150 per cent of the rated discharge, at a head of not less than 65 per cent of the rated head. The shut off head shall be within 120 per cent of the rated head.

The pump casing shall be of cast iron and parts like impeller, shaft sleeve, wearing ring etc. shall be of non-corrosive metal like bronze/brass/gun metal. Provision of mechanical seal shall also be made.

Bearings of the pump shall be effectively sealed to prevent loss of lubricant or entry of dust or water. The pump shall be provided with a plate indicating the suction lift, delivery head, discharge, speed and number of stages. The pump casing shall be designed to withstand 1.5 times the working pressure.

Wet riser system shall be connected with the fire pumps, which will be operated automatically. Therefore, entire system will remain pressurized all the time, so that water is always available with required pressure, for firefighting purpose. There shall be a provision for the fire brigade inlet connection with non-return valves to the fire ring main for emergency purpose. Considering the various sensitive activities to be conducted in the campus and importance of the safety of the life of the users, it is proposed to provide a proper firefighting system, keeping in mind the likely loss of human life and colossal damage to sensitive equipment's in the event of fire.

### **Fire Extinguishers:**

The following type of portable fire extinguishers shall be provided at all levels of the towers, at strategic locations as per requirements, generally to follow IS – 2190: 1992)

**Table-F-3**

| <b>Location</b>             | <b>Type Of Fire Extinguisher</b> |
|-----------------------------|----------------------------------|
| Main Gate (Security Gate/s) | Multipurpose 6kg ABC             |

|                         |   |
|-------------------------|---|
| Every Floor             | Multipurpose 6 kg ABC & 4.5 Kg CO <sub>2</sub> Type |
| Electric room/Pump room | 4.5 Kg CO <sub>2</sub> gas type                     |
| Parking Area            | Multipurpose 6kg ABC Type                           |

## 2. Fire Alarm System

The design shall generally confirm to IS 2189:2008 (Selection, Installation and maintenance of automatic fire detection and Alarm System – Code of practice) & National Building Code 2016.

- I. Fire alarm system consist of a multi loop analogue addressable fire alarm panel located in the main fire Control room in ground floor level.
- II. Multi Criteria detectors shall be provided in Basement (If Any).
- III. Fault Isolators shall be provided after every 20 Detectors.
- IV. Heat Detectors shall also be provided above false ceiling in common area on each Floor wherever the void exceeds 800mm.
- V. Spacing between detectors shall be restricted to IS guidelines. Each Loop shall have Approx. 100 Addressable Detectors & 100 addressable Devices.
- VI. Response Indicator shall be provided outside of every closed room for indication.
- VII. Hooter & manual call point shall be provided near fire staircases at ground level and upper floors as well as in Basements (If any).
- VIII. Addressable Control Module shall be provided for hooters and addressable Monitor Modules for Flow Switches. 6. Fire Detection/Alarm System Addressable Intelligent fire detection and Alarm system of latest technology with Fire alarm panels, multi-Sensor detectors, smoke detectors, heat detectors, beam detectors, response indicators, manual call point and hooters, light strobe etc. shall be provided. It shall meet the requirement of NBC 2016/NFPA/CPWD Specifications/ State By laws. License/Approval of Local Fire Authorities shall be provided for the complex. There shall be the proper Zoning of the building considering the Non-Critical & Critical areas of buildings. Repeater panels shall be provided in various buildings as required.
- IX. There shall be independent fire panel for Buildings as per the requirements. and all fire control panels shall be interconnected with each other.
- X. Fire Detectors and devices of different buildings/ blocks shall be connected to Fire Control Panel of the Admin building through necessary cables in DWC HDPE pipes.
- XI. The monitoring of whole complex shall be in the Main Fire Control Room of Admin Building.
- XII. For Central Monitoring of all the Fire Panels, necessary devices like PC, Printer, modules & Software etc. of latest technology with minimum 1 TB hard disk shall be provided in the Control room.

XIII. Fire Alarm control Panel shall not have more than 100 devices and 100 detectors in one loop.

The details of the system proposed shall be as follows:

- a) Addressable intelligent dual type Fire Detectors is suggested.
- b) Detectors should be with inbuilt short circuit isolator & automatic addressing. Detectors should be installed as per coverage defined in NFPA 72.

It should include all areas as per the requirements of NBC-2016 i.e., rooms, halls, storage areas, basements (if any), attics, lofts, and spaces above suspended ceilings including plenum areas utilized as part of the HVAC system. In addition, coverage should include all closets, elevator shafts, enclosed stairways (Directional Sounder), dumbwaiter shafts, chutes, and other subdivisions and accessible spaces.

- c) Each detector & devices shall have integrated short circuit isolator.
- d) Suitable numbers of input/ output (C/M) relay modules are suggested for connecting other equipment like Electrical Panels, lifts, firefighting system, AHUs etc.
- e) Spacing between two detectors shall not be more than 8 Mtrs. or it shall be as per relevant code & manufacture standards.
- f) Cabling shall be with Fire Survival Armoured copper cable.
- g) Suitable addressable loop powered sounders/ hooters for 100db sound level are suggested.
- h) Addressable manual call boxes shall be provided near all exits; stair cases lift lobbies etc. as per relevant Norms.
- i) The Response Indicators shall be used in the waiting areas, Corridors, Common Area conference Hall or in large rooms etc.

Microprocessor IP based fire alarm control panel (fully redundant) for number of required loops with 24 hrs. Battery backup with LCD display, printer etc. shall be located in the fire control room.

- k) Fire Alarm Panels shall be integrated with PA system and with BMS also.
- l) Two Way communication Fire Fighters Telephone Jack & Handset with necessary accessories are to be provided in all the buildings as required.
- m) Addressable Monitor Module for Sprinklers, Panic Bars & other Third Party Inputs. The monitor module shall monitor potential free contacts. The device shall have an LED which shall blink in normal state & gets tea donatives action to monitor the heath status of the device. Addressing shall be with use friendly rotary decimal switches. Module shall be supplied with mounting plate from OEM fore as of installation & maintenance.
- n) Addressable Isolator Module for isolating short/de-wired/loose circuits with automatic resetting arrangement. Isolator Base can also be proposed, however in that case needs to be considered with each detector & module. The device shall have an LED which shall blink in normal state & get steady on activation to monitor the heath status of the device. Addressing shall be with user friendly rotary decimals witches. Module shall be supplied with mounting plate from OEM for ease of installation & maintenance.

**Talk Back System**



Talk Back System / Fire Fighter Telephone System shall be provided on all landings of Fire Staircase for use by security and fire personnel for communication with Security Room located in ground floor.

### **Control & Monitoring of Miscellaneous Services**

In case of fire, Fire Alarm Panel shall be equipped to control and monitor other services of the building like necessary annunciation for control of Smoke Exhaust and Pressurization Fans, Monitoring of Flow Switches for Sprinkler System and Activation of Clean Agent Fire Suppression Systems.

The Fire Alarm Panel shall also provide signal for controlled operation of elevators through potential free contact.

### **Wiring**

Wiring to detectors shall be carried out with PVC insulated FRLS (IS-964:1990) copper conductor wires / FR screened & shielded copper conductor wires in MS conduits.

Wiring to Critical Loads viz. Ventilation Fans Panels, Pressurization Fan Panels, Fire Pump Panels shall generally be carried with XLPE Insulated Aluminum Conductor Armored Cables.

## **3. Fire Suppression System**

Tube based Fire suppression system is proposed in following panel i.e Fire panel, Plumbing Panel, LT Panel, HT Panel all other small panel used for electrical.

For tube based fire suppression system Clean agent storage system will be considered with Novac 1230.

All other accessories to be planned to operate the system smoothly.

Electrical Panel Protection System:

This includes Supply, Installation, Testing and Commissioning of FK-5-1-12 (Dodecafluoro-2-Methylpentan-3-one) / Novec-1230 or equivalent gas Suppression system in accordance with the Contract Documents. Main Elec. Panels , APFC Panels, Fire Pump Panel, Plumbing Panels, HVAC Panels, External Lighting Panels and other selective panels if required.

### **I. Scope of Work:-**

- a) Supply, Installation, Testing and Commissioning of clean Agent (Novec 1230/ FK5-1-12 or equivalent) Fire Suppression system designed to provide a uniform concentration within the electrical panels in accordance with NFPA 2001 and requirements of the contract documents).
- b) Provide all engineering design and materials for a complete agent suppression system including FK-5-1-12 storage cylinders with steel bracket, extinguishing agent, detection tube, cylinder valve and associated accessories including but not limit to; adaptors, pressure switch, tube fittings etc, required for complete operation of system.
- c) All necessary safety requirements such as warning signs, discharge alarm shall be part of system.
- d) The necessary nomenclature such as pressurization level, agent volume, gross/net weight of cylinder shall be clearly marked on cylinder.
- e) Prior to supply of material at site. Contractor must submit following documents for approval of Engineer-in-charge.

f) Drawing in A-3 size, clearly showing the panel, routing of tube inside the panel, location and fixing arrangement of cylinder & system components.

g) All doors and holes in the enclosed/equipment's should be closed or sealed to maintain the tightness of enclosure.

## **II. System Description:-**

a) The detection tube shall be fixed with cylinder valve at top of cylinder. The tube shall be pressurized with dry nitrogen. In case of reach of pre-determined temperature (100-120oC), the tube shall rupture gas shall be released from tube over the protected area.

b) Pressure Gauge with dual Pressure Switch points, one for leakage and another for discharge to be provided for automatic signals in case of system pressure falls at 9 bar (leakage) and 5bar(Discharge) .This system to give output to stand alone hooter cum flasher.

c) The Extinguishing Agent shall be stored in cylinder as liquefied compressed gas, super Pressurized with dry nitrogen at 15 Bar.

d) The stainless steel cylinder shall be equipped with brass valve, pressure gauge (to monitor agent pressure) and isolation valve for maintenance purposes. The cylinder bracket shall be of steel Construction with quick release clamp.

e) The detection tube shall be installed throughout the compartments of panel. The location and spacing of tube shall be above the hazard, to be protected.

f) In case of fire, the tube shall rupture at a point. The rupture of tube shall result in formation of discharge point and release the agent in uniform pattern.

g) With system activation, a signal should be generated via Audio Visual Alarm installed at convenient location as per Engineer-in-Charge.

h) The system must be service for minimum of 5 years.

## **III. System Components:-**

The bidder shall provide an under taking from Principle Manufacturer of CE marked product they intent to install, that manufacturer will fully support the bidder for this specific project.

a) Cylinder of stainless steel construction. Cylinders shall be accompanied by original manufacturers test certificate confirming the contents of the cylinder and must have CE and serial no punched on the cylinder body. Cylinders shall be super pressurized with dry nitrogen to an operating pressure and temperature as per manufacturer recommendations. Furnish a welded steel bracket with each cylinder assembly for holding the cylinders in a saddle with a front bracket piece that secures the cylinders. Cylinder shall be provided with a certificate provided by the company who charge with the FK-5-1-12 gas mixture. The certificate shall be secured around the cylinder with chain fastener.

i) The cylinder should be manufactured as per TPED directives of EN 3 specifications and tested for

ii. Corrosion test as per BS EN 3-8

iii. Hydraulic Burst Strength BS EN3-7

b) Pressure Monitoring Device - Each cylinder shall have pressure gauge integrated dual low pressure switch to provide visual and electrical supervision of the cylinder pressure. The low pressure switch shall be wired to the Audio Visual Alarm to provide audible and visual trouble alarm in the event of

drop of pressure. The pressure gauge shall be color coded to provide an easy, visual indication of cylinder pressure.

c) Detection Tube - LPCB/UL/CE approved to be Red Colour and pressurized at 15 Bar. The Detection Tube to rupture between (100-120°C). The Tube should pass following test as per ISO 62

I. Moisture Absorption 23°C Celsius at 50% Relative humidity = less than 1

II. Water absorption immersion at 23°C Celsius = less than 2

III. Hydraulic Burst Strength of the Tube must be = 50 bar.

d) Extinguishing Agent - FK-5-1-12 (Decafluoro-2-Methylpentan-3 One –  $\text{CF}_2\text{CF}_2\text{C}(\text{O})\text{CF}(\text{CF}_3)_2$ )

I. The agent shall not contain any Hydro fluocarbons (HFC).

II. The ozone depletion potential should be zero.

III. The Global warming potential should be equal to or less than 1.

IV. The Extinguishing Agent should be UL Listed & FM approved

V. The extinguishing agent should be filled in an UL Listed or FM or PESO approved filling station.

VI. The extinguishing agent must not be in touch with any corrosive metal to avoid corrosion in long run.

e) Valve - Valve must be brass forged or Stainless Steel. The valve must be approved from Pic/BAM Europe/UL/VDS/LPCB. It should have pressure relief device set at 30 bar, port for pressure gauge with dual pressure switch.

#### **IV. Installation:-**

a) The system shall be installed on basis of approved drawing with no more than 40 meters of tube in one system complying to no more than 10 meter of single largest length of tube end from valve.

b) Maximum 4 Tee connections are allowed in one system.

c) The installation / final connections shall carry out in direct supervision of representative of Manufacturer/authorized distributors.

d) The installation contractor should be a proven source with minimum 5 years of installation of Trace Tube Systems in India.

e) Cylinder shall be located so that they are not subjected to mechanical, chemical or other damage.

f) All system components shall be capable of withstanding heat of fire and severe weather conditions.

g) Detection Tube to be properly secured inside the panel by Clips/Tie etc.

h) The Detection Tube outside the panel should be protected in flexible conduit. Inspection certificate should be pasted on cylinder clearly marking next due date of inspection.

#### **4. Public Address System (PA System):-**

PA system shall be provided in the campus as required.

Speakers in the Ceiling/Wall shall be provided in corridors, lift lobbies and other common areas as per **NBC2016**/relevant IS codes.

- a) Box type speaker shall be provided in the entrance lobby.
- b) Horn type speaker are suggested in the basement (If any).
- c) Recessed speakers in the false ceiling areas.
- d) Proper zoning are to be done considering the user requirement, critical areas & floor etc.
- e) Control console shall be located in the fire control room with pre amplifiers, amplifiers, CD,
- f) DVD/Pen-drive, FM Player & gooseneck microphone.
- g) System shall have the facility to make announcement on all floors simultaneously or on individual floors.
- h) floors.
- i) Wiring shall be done with twin twisted tinned copper wire in the conduit.
- j) The system shall be integral with Fire alarm panel and with the BMS also.

## **e. COMMISSIONING & GUARANTEE**

### **1. SCOPE OF WORK**

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

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

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

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

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

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

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

### **2. PRECOMMISSIONING**

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

- a. Prior to start-up and hydraulic testing, the Contractor shall clean the entire installation including all fittings and pipe work and the like after installation and keep them in a new condition. All pumping systems shall be flushed and drained at least once through to get rid of contaminating materials. All pipes shall be rodded to ensure clearance of debris, cleaning and flushing shall be carried out in sections as the installation becomes completed.
- b. All strainers shall be inspected and cleaned out or replaced.

c. When the entire systems are reasonably clean, a pre-treatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pre-treatment. The pre-treatment chemical shall:

- ✓ Remove oil, grease and foreign residue from the pipe work and fittings;
- ✓ Pre-condition the metal surfaces to resist reaction with water or air.
- ✓ Establish an initial protective film;
- ✓ After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation.
- ✓ Details and procedures of the pre-treatment shall be submitted to the Architect for approval.

d. Check all clamps, supports and hangers provided for the pipes.

e. Fill up pipes with water and apply hydrostatic pressure to the system as given in the relevant section of the specification. If any leakage is found, rectify the same and retest the pipes.

### **Fire Protection System**

- a. Check all hydrant valves by opening and closing : any valve found to be open shall be closed.
- b. Check all the piping under hydro test.
- c. Check that all suction and delivery connections are properly made for all pump sets.
- d. Check rotation of each motor after decoupling and correct the same if required.
- e. Test run each pump set.
- f. All pump sets shall be run continuously for 8 hours (if required with temporary piping back to the tank).

### **Commissioning and Testing**

- a. Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump , then
- b. Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.
- c. Open hydrant valve and allow the water to below into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts,
- d. Switch off the main fire pump and test check the diesel engine driven pump in the same manner as the electrically driven pump,
- e. When the fire pumps have been checked for satisfactory working on automatic controls, open fire hydrant valves simultaneously and allow the hose pipes to discharge water into the fire tank to avoid wastage.
- f. Check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replace by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

g. Check all annunciations by simulating the alarm conditions at site.

### **Sprinkler System**

- a. Start the sprinkler pump and develop the required pressure in the sprinkler pipes.
- b. Open the test valve to test the automatic starting of the pump. If necessary , make necessary adjustments in the setting of pressure switch. The sprinkler water gong alarm shall also operate when the test valve is open. This operation is to be done for each and every section of the sprinkler system and the alarm for each section (via flow switch) shall be checked for operation.
- c. After satisfactory operation of the pump the Contractor shall set up mock fire and test the system.
- d. Check all annunciations by simulating the alarm conditions at site.

### **3. STATUTORY AUTHORITIES' TESTS AND INSPECTIONS**

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

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

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

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

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

### **4. FINAL ACCEPTANCE TESTS**

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

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

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

## **5. REJECTION OF INSTALLATION / PLANT**

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

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

## **6. WARRANTY AND HANDOVER**

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

## **7. HANDING OVER OF DOCUMENTS**

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

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

## **8. PIPE COLOUR CODE:**

| <b>S.No.</b> | <b>Pipe Lines</b> | <b>Ground / Base Colour</b> | <b>First Colour Band</b> | <b>Second Colour Band</b> |
|--------------|-------------------|-----------------------------|--------------------------|---------------------------|
|--------------|-------------------|-----------------------------|--------------------------|---------------------------|

|   |  |           |             |            |
|---|--|-----------|-------------|------------|
| 1 | Cooling Water                                      | Sea Green | French Blue |            |
| 2 | Boiler feed  | Sea Green | Gulf Red    |            |
| 3 | Condensate   | Sea Green | Light Brown |            |
| 4 | Drinking Water (All cold water lines after filter) | Sea Green | French Blue | Single Red |

|    |                                |                 |              |
|----|--------------------------------|-----------------|--------------|
| 5  | Treated Water (Soft Water)     | Sea Green       | Light Orange |
| 6  | Domestic Hot Water             | Sea Green       | Light Grey   |
| 7  | Compressed air upto 15/Kg/Sqcm | Sky Blue        |              |
| 8  | Steam                          | Silver Grey     |              |
| 9  | Drainage (Storm Water)         | Black           |              |
| 10 | Drainage (Sewage Water)        | Brown           |              |
| 11 | Gas                            | Canary Yellow   |              |
| 12 | Fire System                    | Post Office Red |              |

## 9. **CHECK LIST FOR COMMISSIONING**

### A) **Fire Protection System**

- 1) Check all hydrant & other valves by opening and closing. Any valve found to be open shall be closed.
- 2) Check all clamps, supports and hangers provided for the pipes.
- 3) All the pump sets shall be run continuously for 30 minutes (with temporary piping back to tank from the nearest hydrant, using canvas hose pipes).
- 4) Fire Hydrant System - Pressurise the fire hydrant system by running the jockey pump and after it attains the shutoff pressure of the pump, then

Open bypass valve and allow the pressure to drop in the system. Check that the jockey pump cuts-in and cuts-out at the preset pressure. If necessary adjust the pressure switch for the jockey pump. Close by-pass valve.

Open hydrant valve and allow the water to flow into the fire water tank in order to avoid wastage of water. The main fire pump shall cut-in at the preset pressure and shall not cutout automatically on reaching the normal line pressure. The main fire pump shall stop only by manual push button. However the jockey pump shall cut-out as soon as the main pump starts.,



Operate booster pump continuously for 30 minutes with piping back to underground tanks from the hydrant nearest to plant room.

Check each landing valve, male and female couplings and branch pipes, for compatibility with each other. Any fitting which is found to be incompatible and do not fit into the other properly shall be replaced by the Contractor. Each landing valve shall also be checked by opening and closing under pressure.

Check air cushion tanks on the terrace for proper functioning.

**f. HAZARD CLASSIFICATION:**

As per NBC-2016- this premises is classified as under:

**Table-F-4**

Table 7 — (Continued)

| Sl No.   | Type of Building Occupancy   | Type of Installation |                     |           |            |              |                            |  |   | Water Supply (litre)   |  | Pump Capacity (litre/min)  |   |
|--|--|----------------------|---------------------|-----------|------------|--------------|----------------------------|--|---|--|--|--|---|
|  |  | Fire Exting-uisher   | First Aid Hose Reel | Wet Riser | Down Comer | Yard Hydrant | Automatic Sprinkler System | Manually Operated Electronic Fire Alarm Systems (see Note 1) | Automatic Detection and Alarm System (see Note 2) | Under-ground Static Water Storage Tank Combined Capacity for Wet Riser, Yard Hydrant and Sprinklers per Set of Pumps | Terrace Tank over Respective Tower Terrace | Pump Near Underground Static Water Storage Tank (Fire Pump) with Minimum Pressure of 3.5 kg/cm <sup>2</sup> at Remotest Location | At the Terrace Tank Level with Minimum Pressure of 3.5 kg/cm <sup>2</sup> |
| (1)  | (2)  | (3)                  | (4)                 | (5)       | (6)        | (7)          | (8)                        | (9)  | (10)  | (11)   | (12)                                       | (13)   | (14)  |
| 2)   | 15 m and above but not exceeding 30 m                              | R                    | R                   | R         | NR         | R            | R                          | R  | R   | 150 000  | 20 000                                     | (see Note 11)  | NR  |
| 3)   | Above 30 m in height   | R                    | R                   | R         | NR         | R            | R                          | R  | R   | 200 000  | 20 000                                     | (see Note 11)  | NR  |
| e)   | Hotels (A-6)   | R                    | R                   | R         | NR         | R            | R                          | R  | R   | 250 000  | 20 000                                     | (see Note 12)  | NR  |
| <b>EDUCATIONAL BUILDINGS (B) (see Note 16)</b>   |  |                      |                     |           |            |              |                            |  |   |  |  |  |   |
| 1)   | Less than 15 m in height   |                      |                     |           |            |              |                            |  |   |  |  |  |   |
|  | i) Ground plus one or more storeys                                 | R                    | R                   | NR        | NR         | NR           | R (see Note 4)             | NR   | NR  | NR   | 10 000 (5 000) (see Note 6)                | NR   | 450 (450) (see Note 6)  |
| 2)   | 15 m and above but not exceeding 24 m in height                    | R                    | R                   | NR        | R          | NR           | R (see Note 4)             | R  | NR  | NR   | 25 000                                     | NR   | 900   |
| 3)   | Above 24 m but not exceeding 30 m in height                        | R                    | R                   | R         | NR         | R            | R (see Note 4)             | R  | NR  | 50 000   | (5 000) (see Note 6)                       | (see Note 14)  | NR  |
| <b>INSTITUTIONAL BUILDINGS (C) (see Note 16)</b> |  |                      |                     |           |            |              |                            |  |   |  |  |  |   |
| a)   | Hospitals, Sanatoria and Nursing Homes (C-1)                       |                      |                     |           |            |              |                            |  |   |  |  |  |   |
| 1)   | Less than 15 m in height with plot area up to 1 000 m <sup>2</sup> |                      |                     |           |            |              |                            |  |   |  |  |  |   |
|  | i) Up to ground plus one storey, with no beds                      | R                    | NR                  | NR        | NR         | NR           | R (see Note 4)             | R  | NR  | NR   | (5 000) (see Note 6)                       | NR   | (450) (see Note 6)  |

Table 7 — (Continued)

| Sl No. | Type of Building Occupancy                         | Type of Installation |                     |           |            |              |                            |  |   | Water Supply (litre)   |  | Pump Capacity (litre/min)  |   |
|--------|--|----------------------|---------------------|-----------|------------|--------------|----------------------------|--|---|--|--|--|---|
|        |  | Fire Exting-uisher   | First Aid Hose Reel | Wet Riser | Down Comer | Yard Hydrant | Automatic Sprinkler System | Manually Operated Electronic Fire Alarm Systems (see Note 1) | Automatic Detection and Alarm System (see Note 2) | Under-ground Static Water Storage Tank Combined Capacity for Wet Riser, Yard Hydrant and Sprinklers per Set of Pumps | Terrace Tank over Respective Tower Terrace | Pump Near Underground Static Water Storage Tank (Fire Pump) with Minimum Pressure of 3.5 kg/cm <sup>2</sup> at Remotest Location | At the Terrace Tank Level with Minimum Pressure of 3.5 kg/cm <sup>2</sup> |
| (1)    | (2)  | (3)                  | (4)                 | (5)       | (6)        | (7)          | (8)                        | (9)  | (10)  | (11)   | (12)                                       | (13)   | (14)  |
|        | ii) Up to ground plus one storey with beds         | R                    | R                   | NR        | NR         | NR           | R<br>(see Note 4)          | R  | NR  | NR   | 5 000<br>(5 000)<br>(see Note 6)           | NR   | 450<br>(450)<br>(see Note 6)  |
|        | iii) Ground plus two or more storeys, with no beds | R                    | R                   | NR        | R          | NR           | R<br>(see Note 4)          | R  | R   | NR   | 10 000<br>(5 000)<br>(see Note 6)          | NR   | 900<br>(450)<br>(see Note 6)  |
|        | iv) Ground plus two or more storeys, with          | R                    | R                   | R         | NR         | NR           | R                          | R<br>(see Note 1)  | R   | 75 000   | 10 000                                     | (see Note 14)  | NR  |

Table 7 — (Continued)

| Sl No.                                      | Type of Building Occupancy                      | Type of Installation  |                     |           |            |              |                            |  |   | Water Supply (litre)   |  | Pump Capacity (litre/min)  |   |
|---|---|-----------------------|---------------------|-----------|------------|--------------|----------------------------|--|---|--|--|--|---|
|   |   | Fire Exting-uisher    | First Aid Hose Reel | Wet Riser | Down Comer | Yard Hydrant | Automatic Sprinkler System | Manually Operated Electronic Fire Alarm Systems (see Note 1) | Automatic Detection and Alarm System (see Note 2) | Under-ground Static Water Storage Tank Combined Capacity for Wet Riser, Yard Hydrant and Sprinklers per Set of Pumps | Terrace Tank over Respective Tower Terrace | Pump Near Underground Static Water Storage Tank (Fire Pump) with Minimum Pressure of 3.5 kg/cm <sup>2</sup> at Remotest Location | At the Terrace Tank Level with Minimum Pressure of 3.5 kg/cm <sup>2</sup> |
| (1)   | (2)   | (3)                   | (4)                 | (5)       | (6)        | (7)          | (8)                        | (9)  | (10)  | (11)   | (12)                                       | (13)   | (14)  |
| 2)  | 10 m and above but not exceeding 15 m in height | R                     | R                   | R         | NR         | R            | R<br>(see Note 4)          | R  | R   | 100 000  | 5 000<br>(5 000)<br>(see Note 6)           | (see Note 10)  | NR  |
| 3)  | 15 m and above but not exceeding 24 m in height | R                     | R                   | R         | NR         | R            | R                          | R  | R   | 150 000  | 10 000                                     | (see Note 11)  | NR  |
| 4)  | 24 m and above but not exceeding 30 m in height | R                     | R                   | R         | NR         | R            | R                          | R  | R   | 200 000  | 20 000                                     | (see Note 11)  | NR  |
| <b>ASSEMBLY BUILDINGS (D) (see Note 16)</b> |   |                       |                     |           |            |              |                            |  |   |  |  |  |   |
| a)  | <b>Buildings (D-1 to D-5)</b>                   |                       |                     |           |            |              |                            |  |   |  |  |  |   |
| 1)  | Less than 10 m in height                        |                       |                     |           |            |              |                            |  |   |  |  |  |   |
|   | i) Up to 300 persons                            | R                     | R                   | NR        | R          | NR           | R<br>(see Note 4)          | R  | NR  | NR   | 20 000<br>(5 000)<br>(see Note 6)          | NR   | 450<br>(450)<br>(see Note 6)  |
|   | ii) More than 300 persons                       | R                     | R                   | NR        | R          | NR           | R<br>(see Note 4)          | R  | NR  | NR   | 25 000<br>(5 000)<br>(see Note 6)          | NR   | 900<br>(450)<br>(see Note 6)  |
| 2)  | Above 10 m but not exceeding 15 m in height     | R                     | R                   | R         | NR         | NR           | R<br>(see Note 4)          | R<br>(see Note 1)  | R   | 100 000  | 5 000<br>(5 000)<br>(see Note 6)           | (see Note 10)  | 450<br>(450)<br>(see Note 6)  |
| 3)  | Above 15 m but not exceeding 24 m in height     | R                     | R                   | R         | NR         | R            | R                          | R  | R   | 150 000  | 10 000                                     | (see Note 10)  | NR  |
| 4)  | Above 24 m but not exceeding 30 m in height     | R                     | R                   | R         | NR         | R            | R                          | R  | R   | 200 000  | 20 000                                     | (see Note 11)  | NR  |
| b)  | <b>D-6</b>                                      | R                     | R                   | R         | NR         | R            | R                          | R  | R   | 200 000  | 20 000                                     | (see Note 12)  | NR  |
| c)  | <b>D-7</b>                                      | For details see 6.4.4 |                     |           |            |              |                            |  |   |  |  |  |   |

**LIST OF APPROVED MAKES FOR FIRE**

| <b>S. No.</b> | <b>Material</b>   | <b>Brand Name</b>                 |
|---------------|---|-----------------------------------|
| 1             | Firefighting Pump   | Kirloskar/Grundfos/Wilo/Franklin  |
| 2             | Firefighting Equipment i.e. Landing valve, branch pipe, First aid hose reel, Nozzle, etc. | Minimax / Kalpex / Newage         |
| 3             | RRL type A  | Minimax / Kalpex / Newage         |
| 4             | Pressure Gauge  | Flebig / H Guru                   |
| 5             | GI & MS Pipes   | Surya Pipes/ Jindal Hissar/Tata   |
| 6             | Forge fitting   | Jainson / Drp / True Forge        |
| 7             | MS Pipe support   | Chilly / Buildtech/Intellotech    |
| 8             | Ball Valve  | Sant/ Jainson / Aip / Nvr/Zoloto  |
| 9             | Butter fly valve  | Sant/ Jainson / Aip / Nvr/Zoloto  |
| 12            | GI Fittings   | Unik / Zoloto / Nvr               |
| 13            | Annunciator Panel   | Agni / Safe Way                   |
| 14            | Control Cable   | Finolex/Havells/Universal/Polycab |
| 15            | Fire extinguisher   | Minimax / Kalpex / Kanex          |
| 16            | Enamel paint  | Asian/Nerolac/Berger              |
| 17            | MS Conduit  | Bec/Akg/Steel Craft               |
| 18            | Dash fastener   | Hilti / Fisher                    |
| 19            | Paint primer  | Asian / Jonsion                   |
| 20            | Weld Electrodes   | Advani / Esab / Victor            |

|    |   |  |
|----|---|--|
| 46 | Fire suppression system                             | Ansul/Tyco/Kalpataru/Engg System Incorporation |
| 47 | Addressable Fire alarm system, Detector and devices | Honeywell-ESSER,Notifier, Bosch,Siemens,GST    |
| 48 | Addressable Fire Alarm main control Panel           | Honeywell-ESSER,Notifier, Bosch, Siemens, GST  |
| 49 | Addressable Fire Alarm repeater Panel               | Honeywell-ESSER, Notifier, Bosch, Siemens, GST |
| 50 | Public address system.                              | Honeywell/Bosch, AV solution                   |