

TECHNICAL SPECIFICATION FOR PHE SYSTEM

Date – 10.02.2025.

REV-R0

PROJECT

JSW ACADEMIC BLOCK- NLSIU

CLIENT

NATIONAL LAW SCHOOL OF INDIA UNIVERSITY

ARCHITECT



HUNDRED HANDS

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SECTION ONE - GENERAL**1. General Scope of Works**

National law school of India university, Bengaluru requested for a quote from reputed Plumbing Contractors to carryout plumbing works for their proposed JSW Academic block-NLSIU @ Bengaluru.

The work to be performed under this Contract consists of the supply, delivery, installation, testing, commissioning, maintenance and warranty of the installation comprising of plumbing systems and equipment which are further described in other sections of this specification.

2. Codes and Standards

2.1 The works and all plant, equipment and materials forming part of this Sub-Contract shall comply in all respect with any relevant codes and standards tabulated below:

IS 1172	Code of basic requirements for water supply, drainage & sanitation (revised).
IS 771 – (Part 3to 6)	Specific requirements for urinals
IS 1200 (Part 16)	Method of measurement of laying of water and sewer lines including appurtenant
IS 1200 (Part 19)	Method of measurement of Water supply, plumbing and drains.
IS 1742	Code of practice for building drainage. (Second revision)
Is 2064	Code of practice for selection, installation and maintenance of sanitary appliances
IS 2065	Code of practice for water supply to buildings.
IS 2527	Code of practice for fixing rainwater gutters and down pipes for roof drainage.
IS 2548 (Part 1&2)	Specification for plastic seats and covers for water closets.
IS 4111	Code of practice for Ancillary structures in sewerage system
BS 4515	Specification for un-plasticized UPVC pipe fittings.
IS 5329	Code of practice for sanitary pipe work above ground for buildings.
IS 12235 (Parts 1 to 11)	Methods of test for un-plasticized UPVC pipes for portable water supplies.
IS 13592	Specification for un-plasticized UPVC pipes for soil and waste discharge system inside building including ventilation and rainwater.

Note: All IS Codes Latest year of Publication/ Revision to be considered.

2.2 National building Code for Water Supply, drainage and Sanitation - Part IX Plumbing services - Section 1 and 2.

2.3 The installation shall also be in conformity with the bylaws and requirements of the local authority in so far as these become applicable to the installation. Wherever this specification calls for a higher standard of materials and/or workmanship than those required by any of the above regulations and standards, then this specification shall take precedence over the said regulations and standards. Wherever the specifications and drawings require something that may conflict with the regulations, the regulations shall

govern. This shall be confirmed from Client/ Consultants before execution.

- 2.4 The contractor shall obtain and complete all notices required by the authorities as necessary and shall obtain all consents necessary for the various works to be executed and shall pay all fees in connection therewith.
- 2.5 All Codes, acts, standards and regulations shall be the latest published edition unless otherwise stated.
- 2.6 The contractor shall bear the cost for all necessary arrangement to obtain approval for fittings, valves, expansion joints, equipment and materials from the relevant authority if required.

3. Noise Level and Sound Control

- 3.1 All installed plant is to be reasonably quiet in operation. Preference will be given to equipment operating at low noise level.
- 3.2 Vibration isolators shall be installed where necessary so as to eliminate the transmission of vibration.
- 3.3 During initial testing operation of the installation, the Contractor is to correct for any undue noise and to make any adjustment and modifications necessary for this purpose.
- 3.4 The noise/sound level in the various areas due to operation of equipment shall not exceed the recommended standard by local authority or IS codes whichever is the lowest.

4. Permits and Fees

The contractor shall procure all permits and pay all fees and charges incurred in connection with this contract. (If required)

5. Specification

- 5.1 This specification is intended to set out in general outline the minimum requirements and standards of installation for the various units of equipment and works it covers. Provision set out, or claim made in the successful tender which are in excess of, or improved upon the basic requirements of the specification shall unless otherwise determined by the client become part of the requirements of the specification whether or not they are subsequently incorporated in addenda to the specification.
- 5.2 The client shall be the sole judge of what constitute an improvement upon or exceeds the requirements of the specification.
- 5.3 The specification shall be read in conjunction with the tender drawings (as per schedule of drawings) and are intended to be mutually explanatory and complementary to one another. All works and specification called for by one, i.e. specification or drawings even if not by the other shall be fully executed and complied with in total.
- 5.4 The entire system shall be engineered by the contractor based on the guidelines furnished in the specification, various codes / standards, with good engineering practice.
- 5.5 Supplies and services to be covered under this tender specification and the conditions thereof are detailed in the subsequent sections of the specifications. In case of conflict

among various sections, subsections, documents, drawings the same shall be referred to purchaser whose decision shall be final and binding to the Bidder

6. Materials and Workmanship

- 6.1 Unless expressed to the contrary, all materials, and equipment supplied by the contractor shall comply with the applicable Indian standards (I.S) or various codes or specifications with good practice as approved by the Indian standards.
- 6.2 Where a standard is referred to, that standard shall be the latest published edition thereof, unless otherwise stated.
- 6.3 All materials and equipment supplied shall be new and of the best type for each particular purpose and of the first quality with regard to design, manufacture and performance.
- 6.4 The equipment and materials shall be suitably designed and constructed for safe, proper and continuous operation under all conditions described or implied in this specification without undue heat, strain, vibration, corrosion or other operating difficulties.
- 6.5 Unless otherwise specified, the equipment and material within the scope of this specification shall be of a standard proven design. Design incorporating components which may be considered prototype in nature will not be accepted.
- 6.6 Equipment and equipment components shall be designed and supported to permit free expansion and contraction without causing excessive strains, distortion or leakage.
- 6.7 Parts subject to wear, corrosion or other deterioration, or requiring adjustment, inspection or repair shall be accessible and capable of reasonably convenient removal, replacement and repair. All such parts shall be of suitable material for keeping maintenance to a minimum.
- 6.8 The equipment shall be designed to permit replacement of parts and ease of access during inspection, maintenance and repair.
- 6.9 Vibration, noise, mechanical and thermal stresses and susceptibility to corrosion and erosion shall not be greater than with similar plant of first class design and workmanship operating under similar conditions.
- 6.10 All works shall be carried out in accordance with the best engineering practice by experience tradesmen of appropriate grades to the approval of the Indian Standards.
- 6.11 Where disagreement occur between the drawings and the specification or within either document itself, the item or arrangement of better quality, greater quantities, or higher cost shall be deemed to be included in this contract.

7. Shop Drawings

- 7.1 The contractor shall immediately upon the award of the contract prepare and submit to the project managers/ consultants for approval all plant and equipment layout drawings showing full details within four weeks. Detailed calculations shall be submitted where applicable. All equipment and materials proposed shall be submitted for approval.
- 7.2 Shop drawings shall cover complete details for the following but not limited to:
 - a) Dimensions of all plant, equipment and accessories which include the details drawings of superstructure construction necessary to finalize the superstructure

requirements.

- b) Equipment room layout, showing all clearances for operating, servicing and sufficient details to ensure that the provision made in the working drawings shall be adequate and satisfactory.
 - c) Control equipment, system wiring and control diagrams and power requirements.
 - d) Vibration Isolation Equipment.
 - e) Hangers and supports
 - f) Foundations
 - g) Chases, drains, openings in walls, floors, roof slabs and beams.
 - h) Piping, ducting and electrical cable runs.
- 7.3 These layout drawings shall be based generally on the design engineering consultant GFC drawings, modified only as required to suit the specified materials and equipment to be provided, to fit in with the latest available information on building construction details and the requirements of other services and equipment and also to incorporate any improvements proposed by the contractor.
- 7.4 The drawings shall be drawn by fully qualified draughtsman with experience in relevant Installation Works. The drawings shall be neat and clearly legible.
- 7.5 The drawings shall be drawn in the same scale as the consultant drawings. Details shall be drawn in larger scales. Where applicable, symbols the same as those in the consultant drawings shall be used and all other symbols shall conform to the acceptable local drafting practice.
- 7.6 Legend for all symbols shall be shown on every drawing.
- 7.7 Six (6) copies of each drawing shall be submitted for approval. Drawings with inadequate details and not conforming to the requirements as stated above will not be considered.
- 7.8 Upon approval of the drawings, the contractor shall deliver six (6) copies of each approved drawing to the project engineer for the purpose of contract administration.
- 7.9 The drawings shall be submitted in ample time for review and approval by the project engineer and no work shall be carried out until such drawings are approved.
- 7.10 Inspection of shop and working drawings is not to be considered as a guarantee of measurements or building conditions. Where drawings are inspected and approved by the project engineer, such approval does not in any way relieve the contractor neither from his responsibility nor from the necessity of furnishing material or performing work required by the drawings and specification which shall in the event of a dispute, take precedence over shop drawings.
- 7.11 Schedule of submission of shop drawings shall be submitted for approval not later than 2 weeks after award of the Contract.

8. Program

- 8.1 The contractor shall immediately upon the award of the contract liaise with the client and prepare and submit to the project engineer for approval the detailed time schedule for the progress of the work.
- 8.2 The schedule shall be submitted with ample time for review and approval by the consultant. The contractor shall keep a buffer period of not less than 2 weeks for the consultant to study the schedule for approval.
- 8.3 The schedule shall be based generally on the clients program and shall end on the same contract dates.
- 8.4 The schedule shall also indicate the dates of:
- a) Submission of shop drawings and Technical data sheet of the equipment's.
 - b) Delivery of materials
 - c) Installation program and cleaning up, etc.
 - d) Testing and commissioning and completion.

9. Site Management and Supervision

- 9.1 The contractor shall keep upon the works on a full-time basis in adequate numbers the following English/Hindi speaking key site personnel:
- a) One project site engineer with a minimum tertiary educational qualifications and at least 5 years of project experience in similar installation in building.
 - b) Two site supervisors with a minimum qualification and have been involved in similar project and with at least three years' experience.
- 9.2 In addition, the contractor shall arrange for the services of a professional engineer/licensed plumber experienced in this class of contract, who will be required to devote sufficient time to ensure:
- a) That the whole of the work is satisfactorily designed to comply with the minimum requirements of the specification and is suitable for its purpose.
 - b) That the work of the contractor and his contractors are properly coordinated and integrated with that of the contractor.
- 9.3 The site management and supervision team shall be full time on site and not be replaced or absent for more than a week without the prior consent of the project manager. The team must be able to receive and carry out instruction by the project manager and must be able to make all decision pertaining to the Project.
- 9.4 The tendered shall provide an organization chart showing the full and detailed list of his site management and supervisory staff and their resume for the project for the approval of the project manager at the time of tender.
- 9.5 The site management/supervision team as specified here and the provision of such organization chart and the project manager's approval thereof shall not limit the contractor's responsibility and obligation in respect of adequate staffing on the site. In the event that additional staff is considered necessary to properly and effectively manage and supervise the execution of the works, the contractor shall provide them at no extra cost to the clients.

10. As Installed Drawings and Manuals

- 10.1 Prior to the completion of the works, and not later than the date of practical completion, the contractor shall submit to the satisfaction of the project manager six (6) hard cover bound sets of comprehensive/non-comprehensive operation and maintenance manuals and data sheets published by the equipment manufacturers, Six (6) hard cover bound sets of "As-Installed" drawings and one (1) set of "As-Installed" drawings in polyester film transparency (intermediates) and two (2) sets of "As-Installed" drawings in AutoCAD (latest release) compact discs subject to project managers approval.
- 10.2 These instruction manuals shall be typed in good quality paper and neatly bound into a manual having rigid covers. A draft shall be approved before final submission.
- 10.3 The operation manual and as-built drawings shall be bound with hard covers.
- 10.4 All "As-Installed" plumbing single line drawings and control diagram shall be endorsed and signed by the contractor's professional engineer.
- 10.5 The manuals shall contain and be set out as follows:

a) Description of System:

This section shall simply but clearly describe the operation of the system and the equipment.

b) Summary of Equipment List

This section shall include all major equipment complete with makes, models, serial number with technical catalogues (at least one set to be original and others in legible print).

c) Spare Parts, Special Tools and Equipment List

Include manufacturer's list of all recommended spare parts for replacement and special tools and equipment for maintenance used.

d) Operational Procedure

This section shall fully described start and stop sequence of operation; program for alternate running of plant to even out wear and testing procedures for all sections of the plant, including emergency procedures and breakdown trouble-shooting.

e) Manufacturer's Handbook

Include Manufacturer's technical literature on all components of the installation, particularly as applying to operation and maintenance. The technical literature shall include all major equipment, control instruments and equipment used and other related materials

f) Installation Instruction

g) Maintenance and Trouble Shooting Instruction

h) Include manufacturer's technical literature on all components of the installation, particularly as applying to operation and maintenance.

i) Equipment Operation Instruction

j) Hang-up Instructions

k) Equipment Suppliers

This section shall comprise a full list of names, addresses and telephone numbers (including after office hours numbers) of all contractors and suppliers of equipment (local and overseas) incorporated in the installation.

l) Maintenance & Breakdown Service

This section shall comprise a list of the names and telephone numbers of the company's maintenance and servicing section personnel for normal maintenance and breakdown request.

- 10.6 In the event of the contractor failing to fulfill the aforesaid requirements, the project manager shall reserve the right to obtain all of the required operating and maintenance manuals by other means and shall deduct all cost incurred thereof from monies due to the contractor. In addition the project manager shall forfeit the rights of the contractor in relation to further payment and the issue of the Certificate of Practical Completion will also be withheld until he has so complied accordingly.

11. Metrification

All gauges and indicators shall be provided with scales marked in SI units as well as in relevant Imperial units.

12. Samples

Samples to be submitted by the contractor shall be for the following but not limited to:

Pipes and pipe fittings

Pipe/Flange Joints

Hangers

Isolators

Adhesive/Sealant

Pipe Insulation

Sanitary items if supplied by contractor

Valves

- 12.1 In addition, the contractor shall also submit any other samples as may be required by the project manager.

13. Work by Other Contractors

The following works will be provided by the other Contractors:

13.1 Building Works (Main Contractor)

- a) Openings in floors, walls, beams, partitions for pipe work, ductwork or electrical cabling and making good around same with approved fire rated fillings. PHE contractor to share the details of openings in the slabs beams prior to slab casting.

- b) Concrete plinths, pads, supports or foundations as required for equipment.
- c) Masonry ducts and shafts for pipe work where indicated in the drawings.
- d) Plumbing contractor to provide necessary drawings for cut outs for retaining wall, slab and beams with sizes and levels, also to provide equipment pedestals details.

14. Provision of Works by Other Trades

- 14.1 It shall be the Contractor's responsibility to advice, check and confirm that the works listed above are provided to his requirements during the course of building construction. Failure on the part of the Contractor to ensure that any or all of these services are provided will result in the Contractor in having to carry out the respective works at his own expense.
- 14.2 The Contractor shall liaise closely with all the other trades for such provisions and communicate all his requirements well in advance and conform to the construction program.

15. Co-ordination of Work

- 15.1 The contractor to co-ordinate the details of civil work required with the civil contractor by furnishing relevant drawings for construction. Contractor shall validate the drawing and submit the shop drawings for approval with changes if any to suit design. Necessary coordination with civil contractor for hydraulic testing, water tightness / seepage as per relevant IS codes for all retaining wall structures and hydraulic levels of the units / works done.
- 15.2 The Contractor shall check and ensure that all equipment's provided are suitable for the space allowed. The contractor shall, if necessary, locate the equipment's before the erection of the walls and doors. All abortive work arising from failure to comply with the above shall be paid by the Contractor.
- 15.3 The Contractor shall be responsible for the proper and accurate setting out of his work. He shall furnish all necessary information on the installation to the project manager and the Main Contractor for work co-ordination purposes. The Contractor shall also obtain information on routes of other services from the main contractor before commencing any works to any floor of the building. He shall co-operate with the Main Contractor and all other Contractors on the job and his work shall be suitably preplanned to ensure proper co-ordination with other Contractors.
- 15.4 The Contractor shall inform and check with the Main Contractor on all building works (such as holes, openings, grooves required on floors, walls, beams etc) that are required to be done as early as possible in order that holes, openings, etc, may be formed as the building work proceeds. Should the Contractor neglect to give the Main Contractor reasonable notice and full particulars of any building works required to be done, and thereby cause delay or additional expense to be incurred by the Main Contractor, the Contractor shall be required to identify the Main Contractor against all charges or additional expense incurred in respect thereof. The Contractor shall be held solely responsible for making necessary arrangements and/or co-coordinating with all relevant authorities, specialists, other Contractors, etc, to ensure satisfactory completion of this Contract.

- 15.5 The Contractor shall inform the project manager of any discrepancies in construction details installed on site (eg pipe size, etc) as compared with "approved" drawings owing to unforeseen site conditions. The contractor shall bear the full cost of rectification if the failure to comply with the above clause leads to a malfunction of the system.

16. Testing

- 16.1 The Contractor shall allow in his Tender price for the cost of all acceptance tests required as hereinafter specified or as required by the authorities having jurisdiction over the installation.
- 16.2 Water and electricity used during the testing and commissioning of the system and at any time within the tenure of the contract shall be provided by the employer to the contractor at single point. Distribution system will be at the sole responsibility and expense of the contractor. The monthly consumption charges for the same shall be debited to the contractor and deducted from their Running Bills. Separate meters shall be installed by the Employer for this purpose.
- 16.3 All pipe works which are to be encased or concealed shall be tested and approved before they are finally enclosed.
- 16.4 The Contractor shall give the project manager seven (7) days' notice of his readiness to carry out acceptance test and shall submit for his approval a complete and detailed schedule of his tests to be carried out.
- 16.5 Before the commencement of acceptance tests, the Contractor shall have brought the installation to a state of practical completion and shall have completed all of his preliminary testing and adjusted the equipment to its proper running order.
- 16.6 During the testing period, no modifications, adjustment or other work on the installation shall be carried out without the permission of the project manager. Should there be any contravention of this requirement, the results of all tests completed may be rejected and a retest ordered.
- 16.7 No acceptance test shall be carried out except in the presence of the project manager or the representative appointed for the purpose.

SECTION TWO - SANITARY PLUMBING**1. General:**

This section of the specification covers the supply, delivery, installation, testing, commissioning of Sanitary Plumbing Installation of all soil, waste and vent pipe as well as the installation and connection of all sanitary fitments to the plumbing system.

2. Rules and Regulations:

- 2.1 The sanitary plumbing and drainage work shall be executed by a licensed plumber and in accordance with the latest edition of IS 5329 (Code of practice for sanitary pipe work above ground for buildings), IS 12251 (Code of practice for drainage of building basements) and other relevant codes as specified in codes and standards to be followed.

3. Materials for Piping:

- 3.1 Unless otherwise stated in the drawings or elsewhere in the specification, all sanitary piping shall comply with the following:

a) Soil and/or Waste Pipes inside toilets

i. UPVC pipes confirming to IS 13592- 2013 and IS 4985 or UPVC pipes (SWR Class) Type B confirming to IS 13592- 2013 and IS 4985.

ii. UPVC pipes conforming to IS 4985 and fittings confirming to IS 7634 (part 1) Shall be used for conveying waste from washbasin, pantry sinks to floor trap.

b) Vent Stacks, Piped Anti-Siphon Pipes

i. UPVC pipes (SWR class) Type A confirming to IS 13592- 2013 and IS 4985.

c) Soil Stacks, Drain stack lines and Rain water down takes

i. UPVC pipes (SWR class) Type B confirming to IS 13592- 2013 and IS 4985.

ii. UPVC pipes (SWR class) Type A confirming to IS 13592- 2013 for rain water down takes.

- 3.2 The contractor shall supply the test certificates or manufacturer's certificates showing that the piping complies in all respect with the provisions of the relevant Standards as stated above.

4. Handling:

Because of their lightweight, reasonable care should be taken in handling and storage to prevent damage to the pipes and others. The pipes shall be stored as per manufacturer's specification. The contractor will hold full responsibility in this case. On no account the pipes should be dragged on the ground. Pipes should be given adequate supports at all times.

5. Laying :

The UPVC pipes shall be laid under the floors below slab or on walls either buried or exposed as the case may be, as shown in the drawings. The fittings shall be of injection mould type suitable for solvent cement joint or rubber ring joint. The pipes and fittings shall be capable of withstanding

sun's rays. UPVC pipes laid below slab or suspended in ceiling shall be supported by angle brackets/ supports as detailed in the drawings. All external pipes shall be mounted on special sliding brackets of Galvanized MS grouted to the duct wall, with the pipes being held to it using GI "U" clamps. These brackets shall provide for a least 50mm clear working space behind the pipes.

6. Joints and fittings for uPVC Pipes:

The jointing of pipes to fittings shall be done as per the manufacturer's instructions / recommendations. The uPVC pipes and fittings shall be joined (pasted joint) with Solvent cement; this method of jointing shall be used for piping below slab or at sunken floor and jointing shall be carried out as follows:

- 6.1 Cut the spigot end of the pipe square.
- 6.2 All burrs from the internal and external surfaces should be removed.
- 6.3 The spigot should be marked with a pencil line and a distance equivalent to the Socket depth. Clean the surface within the marked area.
- 6.4 Apply uniform coat of solvent cement on the external surface to the pipe and a Lighter coat on the internal surface of the fitting.
- 6.5 Insert the pipe end into the socket of the fitting and push it in up to the mark.
- 6.6 Remove the excess solvent cement and hold the joint firmly in position as per Solvent manufacturer's recommendation.
- 6.7 Every joint shall be made air-tight and water-tight.

The method of jointing shall be by rubber rings and all the external pipe jointing and in stacks shall be by this method. The material of rubber ring should conform to IS 5382. The ring is housed in groove formed in a plastic housing. The rubber is compressed and makes a seal between the pipe and housing. Lubricating paste should be applied before compressing the rubber. Where natural rubber rings are used, mineral oil or petrol or grease should be used.

7. Internal toilet pipe work:

- 7.1 All waste pipes of 40mm-160mm diameter shall be of 6 Kg/cm² or 10kg/cm² classification.
- 7.2 All such pipes shall be supported and clamped as per the table below.

Maximum support distance in meters						
Size in mm	40	50	75	90	110	160
Horizontal	0.4	0.5	0.75	0.9	1.1	1.6
Vertical	1.2	1.5	2.0	2.0	2.0	2.0

- 7.3 All waste pipes being connected to a floor trap shall be connected only through an inlet receiving cap, with an inlet connection joint of appropriate diameter, capable of being pasted to the floor trap providing for a leak proof joint.
- 7.4 The inlet receiving pipes shall extend to the toilet finished floor where its joints with the floor shall be sealed with Silicone Sealant.

- 7.5 All pipes being used on exposed surface shall be UV protected with a UV inhibitor built in during Molding / extrusion.
 - 7.6 WC Pan Connectors shall be as to suit the requirement with 110mm dia, vent horn for connection to the anti-siphonage pipe with pan connector of PVC.
 - 7.7 Connection of the branch pipes to main or other branch pipes shall be so arranged as to prevent cross flow from one appliance to another.
 - 7.8 Connection to the sewage or storm water collection sumps to be perfectly water tight and as specified in the drawing.
 - 7.9 The floor traps for toilets shall be molded PVC or fabricated from UPVC 6kg/cm² pipes with or without an inlet receiving cap. The traps shall have a minimum water seals of 50mm.
 - 7.10 The pipes shall be laid to a slope of minimum 1 in 75 and connected to the stack.
 - 7.11 Sufficient access shall be provided to enable all pipe work to be cleared and tested. Access openings of adequate size shall generally be provided on the vertical stack directly opposite a branch line, at the junction of a subsidiary branch and at bends.
 - 7.12 All bends and junctions of the soil and waste fittings shall be provided with access doors, fitted with washers and gun metal set screws, provided on the heel or the front of the fitting.
 - 7.13 Bends shall be of a long radius of two 45° short radius bends and these shall be separated by a 300 mm straight length of pipe.
 - 7.14 Use reducers or increasers when changing pipe sizes.
 - 7.15 All soil, waste and vent pipes shall normally be placed in ducts or brick encasement with means of access at each floor level for branch connections.
 - 7.16 The main vent stacks shall be extended through the roof to the required height, with the open end protected by means of an uPVC vent cowl or to have air vent with diaphragm.
 - 7.17 Open ends of all piping shall be covered with wood or metal plugs or caps during construction, to prevent foreign matter falling in.
 - 7.18 The top of every discharge stack shall be at the same height as the parapet on the roof.
 - 7.19 The top of every discharge stack shall be provided with uPVC cowl for uPVC stack. The cowls shall be installed at the height above the parapet on the roof.
8. Floor Waste :
- 8.1 All floor traps, outlets gratings and gully traps shall be suitably protected from the ingress of cement grout and foreign objects during construction stage which will choke up the traps. All traps must be cleaned before fixing or grating covers.
 - 8.2 All wastes or floor trap shall have a minimum of 50 mm water-seal.

8.3 Grating covers shall be of stainless steel type (with perforated holes) as indicated in drawings.

8.4 All wastes, floor traps and gulley traps shall come complete with cockroach/insect trap.

9. Testing of pipes:

9.1 Water test:

Water test shall be applied before the appliances are connected and carried out in sections so as to limit the static head to 5 m. All openings affected by the test shall be sealed and the system filled with water. Sometime shall be allowed for absorption by the pipes and joints to take place after which the level shall be tapped up. The pipes and joints shall be inspected for leakage. If no appreciable fall in water level occurs during a period of 10 minutes the system shall be deemed to have passed the test.

9.2 Air Test: DO NOT TEST WITH AIR OR COMPRESSED GAS.

9.3 Hydraulic Performance test:

- a) Hydraulic performance discharge test shall be made from all appliances, single and collectively.
- b) Obstruction in any of the pipe lines shall be traced and the whole system examined for proper hydraulic performance, including the retention of an adequate water seal in trap.
- c) Any defect revealed by the test shall be made good and the tests repeated until a satisfactory result is obtained.

SECTION THREE - EXTERNAL DRAINAGE

1. General:

- 1.1 The work to be done under this section of the contract consists of the supply, delivery, installation and testing of drainage piping connecting the vertical and horizontal stacks to the external drainage lines and then to the sewage treatment or to external drainage. Provide all piping fittings, excavation and backfilling necessary to complete the works.
- 1.2 This section of the works shall be executed by a licensed plumber and carried out strictly in accordance with the standard drawings, specification and National building codes, Ministry of Environment and others specified hereunder or as shown in the drawings.

2. Material of Pipe and Fittings:

Unless otherwise stated in the drawings, all soil and waste stacks and drain lines, for connections to sump drain, manholes and the master plan sewer shall be carried out using uPVC pipes (6 kg/cm²) and fittings shall conforming to IS:13592-2013.

3. Joints for Piping:

Solvent cementing or solvent welding is a method of jointing pipes and fittings using solvent cement. The solvent constituents penetrate, soften and swell the mating plastic surfaces and cause the plastic pipe to soften and swell. Swelling continues until the gaps between the pipe and fitting walls are closed and consequently the pipe and fitting cure and fuse into a tight weld. As the solvents evaporate, the pipe and fitting cure into a single piece of plastic.

The contractor shall carry out pipe jointing as per instructions listed.

Cut the pipe as square as possible. Ensure that fitment of pipe with socket of fitting is correct.

- 3.1 Total length of insertion of socket shall be marked on pipe.
- 3.2 The pipe and the socket should be clean and dry and free from dust, oil, water; grease etc. should be wiped out with dry cloth or cleaner from the surfaces to be coated with solvent cement.
- 3.3 Roughen the outside of the pipe and the inside of the socket using sand paper or piece of hacksaw blade up to the entry mark. Stir adhesive i.e. solvent cement thoroughly.
- 3.4 Apply a thick coat of suitable grade of good quality solvent cement using a flat clean brush evenly on the inside of the socket mouth for full length of insertion and then on outside of the pipe end up to the marked line.

4. Excavation:

The contractor shall carry out all excavation for the works specified hereafter.

- 4.1 The trench should not be opened too far in advance of pipe laying and should be backfilled as soon as possible.
- 4.2 The contractor shall be required at all times to keep the trenches dry and free from water by pumping, bailing and temporary drainage.
- 4.3 The width of the trench at the crown of the pipe should be as narrow as practicable but not less than the outside diameter of the pipe plus 300mm to allow proper compaction of the side fills and at a height of 225 mm above the crown of the pipe, the trench may be of any convenient width
- 4.4 The minimum depth should be width plus outer diameter of pipe, or 0.75 m above the crown of pipe, whichever is more.
- 4.5 The excavated material should be deposited at a sufficient distance (at least 500 mm) away from the edge of the trench to avoid damage to the pipes through falling stones or debris.
- 4.6 The contractor is to include in his excavation rates for any necessary planking, strutting and shoring for safe and efficient completion of the work.
- 4.7 The contractor shall be completely responsible for the safety of all excavation, trenches, pits, etc. from collapse, and for the safety of any surrounding structures which may become endangered by the works and they shall ensure that all safety measures necessary shall be applied to any works before and during any excavation.
- 4.8 The contractor should liaise with all service departments, etc., for the location of all pipes, cables, mains, ducts, posts manholes, boxes, etc. beneath road reserves or in any other part of the work in order to ensure that all service requirements are met before commencement of the Work.

- 4.9 The contractor shall obtain up-to-date information or drawings from the respective authorities with regard to the existence of other services along or beneath the road.
- 4.10 The contractor shall be held responsible for any damage done during the progress of works and shall meet all costs and repairs and reinstatement due to such damage.
- 4.11 As with pipes of other materials, it is necessary to ensure with PVC pipes, that sharp edged objects such as large flints do not bear directly upon the pipes, and also that they are not placed in a way where they may come into contact with such tough objects with the passage of time.
- 4.12 Bedding and filling material shall be granular sand; max particle size shall not exceed 20 mm.
5. Alignment and Grade:
- 5.1 All pipes shall be laid and maintained in accordance with the sizes, locations, dimensions, grades and other particulars as indicated in the drawings.
- 5.2 The line of the trench shall be accurately set by means of suitable pegs.
- 5.3 The contractor shall provide suitable instruments and set up and maintain all sight rails, boning rods and bench marks, etc necessary for the purpose.
6. Pipe laying
- 6.1 Each pipe shall be carefully examined on arrival at site. Sound pipes shall be carefully stored. Defective pipes shall be marked and removed from site.
- 6.2 Drain line shall be laid as shown on the drawings.
- 6.3 Every drain line shall be bedded on concrete (1:3:6) at least 150 mm thick.
- 6.4 Piping shall be hunched with concrete, the concrete to be carried up to the full width of the bed to the level of the horizontal diameter of the pipe, and shall be splayed from this level and carried upwards to meet the pipe barrel tangentially.
- 6.5 The pipe laying in the finished trench shall start at the lowest point and laid up-grade.
- 6.6 All piping at the lowest basement shall be laid in the reinforced concrete slab at uniform grade to ensure proper gradient of the pipeline. Standard heavy duty fitting shall be provided at all joints. The contractor shall lay all piping before the casting of floor slab.
- 6.7 The alignment and level of each pipe laid shall be tested before covering.
7. Backfilling:
- 7.1 After the pipes have been tested and approved, the trench shall be backfilled with approved filling.
- 7.2 Special care shall be taken to place and compact the fill material under haunches of the pipe.
- 7.3 Backfill material shall preferable be granular to provide good structural performance. It shall be free of vegetable matter, lumps, cinders, boulders or rocks.

- 7.4 The backfill material shall be deposited evenly on both sides of the pipe in layers not exceeding 150 mm in depth (loose measure) and thoroughly compacted to a minimum of 90% of optimum dry density. Each layer shall be moisturized or dried, if necessary, to the optimum moisture content and thoroughly compacted. This method of fill placement shall be continued to at least 300 mm over the top of the pipe.
- 7.5 Compaction may be done by hand or with mechanical equipment tamping rollers or vibrating compactors depending upon field conditions and as specified by the project manager.
- 7.6 Material used to complete the fill over the pipe shall be essentially the same as that used for the backfill and shall be compacted to the same standard.
- 7.7 The contractor shall provide a compacted earth cover of at least 600 mm over the pipe before equipment is allowed to be driven over it.
8. Removal of Surplus Soil:
- 8.1 On completion of all the drainage work, all surplus soil shall be spread and leveled off, or removed from the site as directed by the project manager.
9. Inspection Chamber or Manholes:
- 9.1 After the pipes have been tested and approved, the trench shall be backfilled with approved filling.
- 9.2 Brick shall be with best quality table molded bricks in 1:3 cement mortar as per brick masonry. The thickness of masonry shall be as indicated on drawings and RCC walls as per structural design.
- a) Bed concrete shall be in 1:4:8 cement concrete 150 mm thick for inspection chambers, 230 mm for depths up to 2.1 m and 300 mm for higher depths in case of manholes.
- Workmanship and material shall generally be in accordance with the following:
- b) Inside wall of chamber/ manholes shall be plastered with 12 mm thick cement plaster 1:3 mixed with water proofing material and finished smooth with a floating coat of neat cement. External walls shall be plastered in CM 1:3 and sponge finished.
- c) Channels and benching shall be done in CM 1:2:4 rendered smooth with neat cement. The following sizes of channels for the bench shall be adopted.
- | Size Of drain pipe | Depth of Center | Depths at sides (@ walls) |
|--------------------|-----------------|---------------------------|
| 100 mm (4") | 150 mm (6") | 250 mm (10") |
| 150 mm (6") | 200 mm (10") | 300 mm (12") |
| 200 mm (8") | 250 mm (10") | 350 mm (14") |
- d) Covers shall be of heavy duty fiber rein forces cement concrete or ductile iron, hinge type with lifting handle. The covers shall be fixed on the frame. Covers

placed on the frame shall be airtight.

- e) PVC encapsulated rungs of size 25 mm thick x 175 mm wide and 265 mm length, reinforced with 10 mm steel rod, bent in U shape. Rungs shall be capable of withstanding 200 Kgs load.
- f) In case the difference in invert levels between the main drain and the branch line requires a drop more than 600 mm, a drop connection should be provided with a uPVC junction, fixed at right angles to the drop pipe at the level where branch pipe enters the manhole. Access for cleaning shall be provided at finished floor level/ ground level.

- 9.3 Backwater valve: Back water valves to be installed at inspection chambers with or without raw sewage. The backwater valve to prevent wastewater from backing up the drainage pipe during backwater / flooding.

The valve should be kept in good operating condition and should be accessible at all times. During normal conditions the backwater flap is in the vertical, free handing position. Wastewater draining out of the building pushes the flap open and is allowed to flow through the valve and out of the building. The valve is equipped with a manual flap locking valve which can be used to fully lock the flap shut – allowing no wastewater in either direction to pass through the valve. In the case that the drainage pipes connected to the valve will not be used over extended periods of time it is recommended that the flap is securely locked with the locking lever. Important is that when the wastewater pipes return to service that the flap is unlocked

10. Testing of Sewer Pipe and Manhole:

- 11.1 The contractor shall carry out tests to the sewer installation in accordance with the method and requirement as described hereinafter. The contractor shall give reasonable notice in writing to the project manager before such tests are carried out.

- 11.2 Every drain line and pipe work shall be water tight and subjected to a water test.

a) Mirror Test

- i) When a reasonable length of pipe has been laid, the accuracy of the pipe joints may be checked by means of drain mirror.
- ii) A mirror or stainless steel reflector is placed in the channel of each of the Chambers so that light is reflected along the drain. The mirror or stainless steel reflector to be adjusted or set up at any convenient angle by means of the metal stand attached, to enable the Inspector to view the inside of the pipes in the mirror or reflector. If the drain is sound and has been truly laid the effect will be similar to looking through a long tube, the joints appearing as a series of concentric circles.
- iv) Any defect should be readily discernible and the position arrived at by counting the number of the defective joint from either end of the length of drain.

b) Water Test

- i) Pipelines shall be hydrostatically tested by applying not more than 3.0 m head at the downstream end and not less than 1.2 m at the upstream end of the section of the line being tested for a period of at least 15 minutes. If the

difference in level between the extremities of the line under test exceeds 1.8 m. The maximum head may be increased to not more than 4.5 m.

- ii) The water test is applied by plugging the lower end of the drain by means of an expanding drain plug, or stopper, filling with water until say 0.6 m stands in the top manhole.
1. The water level should then be carefully recorded and watched for subsidence. At least half-an-hour should be allowed to elapse between observations, with fifteen minutes before the first observation to allow for absorption by cement rendering of manholes etc. Each branch drain or a reasonable length shall be tested separately and the main drain dealt with in sections from manhole to manhole starting at the top of the system and working downwards towards the sewer. After the drain has been almost completely filled, it shall be brought up to its final level from a graduated container, set at the required height above ground level, and connected to the drain plug by a length of rubber tubing.
2. All tests should be carried out after the drain is laid but before it is hunched or covered and after any hunching or covering with concrete and backfilling of trench.
3. Any leakage or defect in the drain line and manhole must be rectified to the satisfaction of the project manager.
4. The contractor shall provide all labor, drain testing equipment, etc. for conducting the tests.

SECTION FOUR – COLD WATER SUPPLY

1. General:

- 1.1 This section of the specification covers the supply, delivery, installation, testing, commissioning and maintenance of the cold water supply system and shall generally consist of the following:
 - a) Complete water reticulation system for the building inclusive of all pipe work, fittings, pumps and tank connections, final connections to all sanitary fitments, etc.
 - b) Connection from water main to UG sumps and OHT's with necessary pipes, fittings and valves.
 - c) Water supply distribution piping.
 - d) Cold Water Transfer Pumps to all other demands complete with control panel.
- 1.2 A licensed water service plumber shall be employed to carry out the installation.

2. Material for Piping:

Cold water supply piping shall be as per the details below.

- 2.1 All internal cold-water supply piping shall be of CPVC, CPVC pipes & fittings shall meet the requirement of ASTM D-2846, pipes shall be of pressure class SDR- 11. Pipe dimensions and pressure rating shall be as per table below.

Nominal bore (inch)	Outer diameter in mm		SDR-11			
			Wall thickness (t) (mm)		Working pressure @	
					23 ° C	82 ° C
	Avg.	Tolerance	Minimum	Tolerance	Kg/cm2	
½"	15.90	+/- 0.08	1.73	+0.51	28.10	7
¾ "	22.20	+/- 0.08	2.03	+0.51	28.10	7
1"	28.60	+/- 0.08	2.59	+0.51	28.10	7
1 ¼ "	34.90	+/- 0.08	3.18	+0.51	28.10	7
1½"	41.30	+/- 0.10	3.76	+0.51	28.10	7
2"	54.00	+/- 0.10	4.90	+0.58	28.10	7

- 2.2 Shaft piping more than 50 mm dia shall be of UPVC unthreaded pipes (Schedule-80) confirming to ASTM D- 1785 and fittings confirming to ASTM D- 2467. Pipe dimensions and pressure rating shall be as per table below.

Nominal bore (inch)	Outer diameter in mm		Sch-80			
			Wall thickness (t) (mm)		Working pressure @	
					23 ° C	
	Avg.	Tolerance	Minimum	Tolerance	Mpa	
½"	21.34	+/- 0.10	3.73	+0.51	5.86	
¾ "	26.67	+/- 0.10	3.91	+0.51	4.76	
1"	33.40	+/- 0.13	4.5	+0.53	4.34	
1 ¼ "	42.16	+/- 0.13	4.85	+0.58	3.59	
1½"	48.26	+/- 0.15	5.08	+0.61	3.24	
2"	60.32	+/- 0.15	5.54	+0.66	2.76	
2½"	73.02	+/- 0.18	7.01	+0.84	2.90	
3"	88.90	+/- 0.20	7.62	+0.91	2.55	
4 "	114.30	+/- 0.23	8.56	+1.02	2.21	
5"	141.30	+/- 0.25	9.52	+1.14	2.00	
6"	168.28	+/- 0.28	10.97	+1.32	1.93	
8"	219.08	+/- 0.38	12.70	+1.52	1.72	

3. Handling:

The contractor shall handle the pipes with reasonable care because pipes are much lighter in weight, than the metal pipe. There is sometimes a tendency to throw it around. This should be avoided. The pipe should never be dragged or pushed from a truck bed. Pallets for pipe should be removed with a fork lift. Loose pipe can be rolled down timbers, as long as the pieces do not fall on each other or on any hard or uneven surface. In all cases, severe contact with any sharp objects {rocks, angle irons, forks on forklifts, etc.) should be avoided.

4. Storing:

If possible, pipe should be stored inside. When this is not possible, the pipe should be stored on level ground, which is dry and free from sharp objects. If different schedules of pipe are stacked together, the pipe with the thickest walls should be at the bottom. The pipe should be protected from the sun and be in an area with proper ventilation. This will lessen the effects of ultraviolet rays and help prevent heat build-up. If the pipe is stored in racks, it should be continuously supported along its length. If this is not possible, the spacing of the supports should not exceed three feet (3'). When storage temperatures are below 32°F, extra care should be taken when handling the pipe. This will help prevent any problems, which could be caused by the slightly lower impact strength of PVC and CPVC pipe at temperatures below freezing.

5. Joints and Pipe laying:

5.1 CPVC pipe jointing shall be solvent cement leak proof joints. The contractor to carry out the jointing as per the instructions detailed below.

- a) Cut the pipe square with hand saw with suitable guide or by pipe cutter.
- b) Joints shall be chamfered approximately at an angle of 10-15°. Remove burrs from inside and outside with a knife or abrasive paper. Remove any dirt or grease from pipe and fitting if any.
- c) Apply solvent cement lightly but uniformly to inside of the socket and outside of the pipe end with natural bristle nylon brush. Apply second coat of solvent cement to pipe end. Ensure solvent cement to cover complete surface area of pipe and fitting and shall be applied quickly to avoid drying of solvent. CPVC solvent cement shall confirm to ASTM F-493. Consumption of solvent cement shall be as per the table below.

d)

Pipe Size (mm)	15	20	25	32	40	50
No of fittings per liter	1200	750	500	450	325	225

- e) Within 10-20 seconds after applying of solvent cement forcefully bottom the male end of pipe in the socket giving the pipe or fitting the quarter turn. Remove excess cement. Jointing shall confirm to ASTM- F 656.
- f) Allow joint to cure as per the table below before applying pressure on the joints.

Curing time for operating.		
Ambient temp.	Up to 32mm	32 mm and above
17° to 48 ° C	1 hr	2 hr
5° to 17 ° C	3 hr	4 hr
Up to 5 ° C	8 hr	16 hr

- g) Horizontal and vertical supports shall be by using clamps to protect building against excessive buckling. Spacing of such clamps on the temperature of conveyed medium and diameter of conduit are as follows.

Nominal pipe size (mm)	21 ° C b	49 ° C	71 ° C
	Spacing In CM		
15	167.70	137.16	91.44
20	167.70	152.40	91.44

25	182.88	167.70	106.68
32	198.12	182.88	106.88
40	213.36	182.88	106.88
50	213.36	198.12	121.92

5.2 UPVC- SCH-80 pipe jointing shall be solvent cement leak proof joints. The contractor to carry out the jointing as per the instructions detailed below.

- a) Cut the pipe square with hand saw with suitable guide or by pipe cutter.
- b) Joints shall be chamfered approximately at an angle of 10-15°. Remove burrs from inside and outside with a knife or abrasive paper. Remove any dirt or grease from pipe and fitting if any.
- c) Apply solvent cement lightly but uniformly to inside of the socket and outside of the pipe end with natural bristle nylon brush. Apply second coat of solvent cement to pipe end. Ensure solvent cement to cover complete surface area of pipe and fitting and shall be applied quickly to avoid drying of solvent. Solvent cement shall confirm to ASTM D-2564. Consumption of solvent cement shall be as per the table below.

Pipe Size (mm)	15	20	25	32	40	50	80	100	150	200
No of fittings per liter	274	169	148	106	74	42	32-40	21-30	5-10	3-5

- d) Within 20 seconds after applying of solvent cement forcefully bottom the male end of pipe in the socket giving the pipe or fitting the quarter turn. Remove excess cement. Jointing shall confirm to ASTM- F 656.
- e) Allow joint to cure as per the table below before applying pressure on the joints. Curing time for joints shall be 12hours.
- f) Horizontal and vertical supports shall be by using clamps to protect building against excessive buckling. Spacing (CM) of such clamps on the temperature of conveyed medium and diameter of conduit are as follows.

Nominal Pipe Size		Temperature				
(In)	mm	15.5	26.6	37.7	48.8	60
1/2"	15	152.4	137.16	137.16	91.44	76.2
3/4"	20	167.64	152.4	137.16	91.44	76.2
1	25	182.88	167.64	152.4	106.68	91.44
1 1/4	32	182.88	182.88	167.64	106.68	91.44
1 1/2	40	198.12	182.88	167.64	106.68	106.68
2	50	213.36	198.12	182.88	121.92	106.68
2 1/2	63	228.6	228.6	198.12	106.68	121.92
3	75	243.84	228.6	213.36	137.16	121.92
4	100	274.32	259.08	228.6	152.4	137.16
6	150	259.08	243.84	228.6	152.4	137.16

6. Testing :

6.1 Pressure testing.

The contractor shall carry out the pressure testing as per procedure listed below.

- a) Prior to testing, safety precautions should be instituted to protect personnel and property in case of test failure.
- b) Conduct pressure testing with water. DO NOT USE AIR OR OTHER GASES for pressure testing.
- c) The piping system should be adequately anchored to limit movement. The system may require thrust blocking at changes of direction.
- d) The piping system should be slowly filled with water, taking care to prevent surge and air entrapment. The flow velocity should not exceed 1 foot per second.
- e) All trapped air must be slowly released. Vents must be provided at all high points of the piping system. All valves and air relief mechanisms should be opened so that the air can be vented while the system is being filled. Trapped air is extremely dangerous and it must be slowly and completely vented prior to testing.
- f) The piping system can be pressurized to 125% of its designed working pressure. However, care must be taken to ensure the pressure does not exceed the working pressure of the lowest rated component in the system (valves, unions, flanges, threaded parts, etc.)
- g) The pressure test should not exceed one hour. Any leaking joints or pipe must be cut out and replaced and the line recharged and retested using the same procedure.

7. Valves

7.1 General:

This section deals with different type of valves like butterfly valves, gate valves, ball valves, check valves, balancing valves and Strainers and pressure gauges. The contractor shall refer to the approved make of materials specified herein and the drawings.

Valves shall be provided on branch pipe connections to mains and at connection to equipment's where indicated. Flanged or threaded valves are preferred. All valves are to be located for easy access. All valves shall be supported wherever necessary with MS brackets. Valves shall comply with IS 780 (Class I) for C.I sluice valves, IS 778 for G.M valves, ASTM D 2486 for CPVC, and ASTM D 2467 for UPVC.

7.2 Ball Valve

The ball valve shall be of high-pressure type and shall be of sizes as specified and/or shown in the drawings. The normal size of a ball valve shall be that, corresponding to the size of the pipe to which it is fixed. Ball valves shall have body of gun metal. The ball and the shaft shall be of bronze/stainless steel. These shall be of PTFE. The valve shall be

complete with socket weld ends and the floats. The body of the high pressure ball valve when assembled in working condition with the float immersed to not more than half of its diameter shall remain closed against a test pressure of 3.5kg/sqcm.

The ball valve shall generally conform to IS specification No.1703:1977. The weight of ball cock and the size of the ball cock shall be as per IS specification.

7.3 Butterfly Valves

Butterfly valves shall be slim seal, short wafer type with standard finish. The valves shall be suitable for mounting between flanges drilled to IS 6392/ANSI 125. The valve body shall be cast iron. The disc shall consist of disc pivot and driving stem shall be in one piece centrally located. The disc shall move in bearings on both ends with 'O' ring to prevent leakage. The seat shall be moulded with black nitrile rubber or nylon and shall line the whole body. The spindle shall be AISI 41 steel.

The valve shall be suitable for a working pressure of 16.5 kg/sq.cm and shall be complete with flow control lever and notches, factory machined companion flanges and bolts and nuts. These valves conform to BS 5155 with electro steel nickel coated SG Iron (N) and seat material EPDM3.

7.4 Non- Return Valves (Check Valves)

Check valves are designed to prevent reversal of flow. These are also called Non-return valves or reflux valves to avoid reversal of flow. Check valves shall be Dual Plate check valves with CI body, aluminum bronze plate, SS 316 hinge pins and springs and Buna-N seals to ANSI series 125. They can also conform to IS 778-1984, Specifications for Copper Alloy Gate, Globe and Check Valves for Water Works.

Sl. No	Type of Valve	Size	Construction	Ends
a.	Isolating Valve	15 mm to 50 mm 65 mm and above	Forged brass Forged brass	Screwed Flanged
b.	Sluice Valve & Butterfly Valve	65 mm and above	Cast Iron	Flanged
c.	Forged brass on return valve	15 mm to 50 mm 65 mm above	Forged brass Forged brass	Screwed Flanged
d.	Flap Type – Non return valve	65 mm and above	Cast Iron	Flanged

7.5 “Y” Strainers

“Y” strainers up to 50mm shall be of Forged brass and above 50mm shall be of cast iron body. Strainers shall incorporate a removable bronze screen or SS mesh perforations and a permanent magnet. Strainers shall be provided with flanges at both inlet and outlet. They shall be designed to enable blowing out of accumulated dirt and facilitate dirt and facilitate removal and replacement of the screen without disconnection of the main pipe.

All strainers shall be provided with equal size isolating “Slim Seal” butterfly valves of approved brands as shown in drawings so that the strainer may be cleaned without draining the system.

7.6 Installation of Valves

Valves should be installed in true tolerance of +/-5mm with respect to the center line of the pipe. Where threaded joints are encountered the threads should be initially sealed with UPVC tape to avoid leakage due to improper tightening and leakage from threading.

Proper care has to be taken in welded installation so that the centerline of valve should not deviate from the pipe causing uneven load on the pipe and further stress during its operation. The welding should be done only after proper inspection of the joint by the Employer/OE&PMC/Architects/Consultants in the tacked position of the joint.

Before putting the line in operative mode the valves should be checked for free and easy operation of the hand wheel. Any burrs or foreign materials should be removed by flushing before final operation so that no choking in the valves should occur which might damage the valve seat.

SECTION FIVE –PUMPS AND MOTORS

1. General:

The pump set offered shall be generally horizontal / vertical centrifugal pump, single stage or multistage or mono block pump to satisfy the duty conditions stipulated.

The pump set shall conform to IS 8034-1972, IS 5120-1968 for handling water, IS 8034-1976 for submersible pump sets and IS 5600-1970 for pumping storm water and sewage.

The pumps shall be selected having their maximum efficiency at average operating conditions. The maximum speed at which a pump shall run is determined by the net positive head available at the pump, the quantity of liquid being pumped and the total head.

2. Pumps

2.1 Material of construction for different parts of pump set shall be as per IS 5120.

2.2 Pumps shall be horizontal/vertical centrifugal mono block pumping sets.

2.3 Pumps shall be cast iron with dynamically balanced and consist of a gunmetal impeller and stainless steel shaft. The bearing shall be grease lubricated ball type.

2.4 The motor shall be squirrel cage, totally enclosed fan cooled induction type suitable for 400/440 volts, 3 phases, 50 cycles AC supply. The winding shall be specially insulated with class 'F' materials and impregnated to exclude moisture. The performance of the motor shall be conformed to IS 325.

2.5 The frame and base for the pumping set shall be cast iron, drip and splash proof and shall incorporate both the pump and motor.

2.6 Each pump shall be provided with

- a) Gate valves at suction and discharge.
- b) Check valve at discharge.

- c) Flexible connections at suction and discharge
 - d) Concentric tapered reducer at discharge
 - e) Strainer at suction.
 - f) 100 mm diameter pressure gauges complete with stop cock, at suction and discharge.
 - g) 100 mm diameter flow meters complete with stop valves, bypass pipe and valve for every two (2) pump sets at the common discharge pipe.
- 2.7 Pumps shall be installed true to level on suitable concrete foundations. Base plate shall be firmly fixed by foundation bolts properly grouted in the concrete instrument. Manufacturer's instructions shall be followed for installation and commissioning of the pump set and electrical panel.
- 2.8 Pumps shall have name plate giving all the necessary information about pumps.
- 2.9 Pump sets shall be measured by number and shall include all accessories mentioned in the above specification.
- 2.10 Sewage application pump shall be vertical submersible type with built in vortex motor. Pump shall be used to pump the sewage collection tank to sewage treatment plant. Material of construction shall be CI. Casing and impeller should be so designed to allow free passage of the specified max size of solid.
- 2.11 Pump Installation
- Certain precautions must be observed in planning a pump installation and during the erection period.
- a) Piping
 - i) Both the suction and discharge lines should be independently supported so as no strains will be thrown on the casing such strains may cause distortions and rubbing.
 - ii) The suction line should be as short and straight as possible. Any elbows should have large radii. For pumps operation with suction lifts no valves other than a foot –valve should be placed in it.
 - iii) Generally, the diameter is made one or two sizes larger than the pump flange size. All these precautions insure the maximum available suction head on the pump. When an oversize line is used an eccentric reducer, which is horizontal at top is placed between it and the pump flange size.
 - iv) It is very important to have the suction line airtight and to avoid high spots at which dissolved gases or air might separate out and destroy the vacuum.
 - v) After piping is installed and the pump is running all joints should be inspected with a flame, as air leakage will draw the flame to the opening.
 - vi) The same method can be used to determine leakage through the

packing box; the eccentric reducer is used at the suction flange to avoid high spot at which the air might collect. The inlet end of the suction line i.e., submergence should be 1 to 2m below the minimum water level of the pump (not less than 600mm) to prevent air from being drawn into the pipe with the water.

- vii) It is desirable to have as long a length of straight piping between the elbow and suction flange as possible to even out the flow of the water as it enters the pump. The pump should be placed to secure the greatest possible suction head and yet to be available for inspection and repair work.

b) Foundation

The foundation with anti-vibration pads should be heavy to reduce vibrations and should be rigid to avoid any twisting or misalignment. A space of suitable height is allowed between the base plate and top of the foundation to accommodate approved make anti vibration pads.

The base plate should be drawn down evenly to avoid springing it. After this has been done the shaft is finally aligned both radially and axially with the driver by means of shims or wedges so that it turns freely. If the shaft is not properly aligned there will be vibration and excessive wear on the bearings, packing and wearing rings.

2.12 Pump Operation

- a) **Trial Operation:** The operation of centrifugal pump is quite simple and safe. There are relatively few valves and the pump will not be damaged even if the discharge valve is closed for short periods of time.
- b) **Starting:** The pump must be primed before it will deliver any fluid. Failure to prime the pump may cause the wearing, rings, rub and seize or the shaft may be scored at the packing boxes. During starting it is wise to have the vent cock in the casing open slightly to remove any dissolved air in the water.

It is best to have the discharge valve set so that the least load is thrown on the driver when the pump is started. The valve should be opened gradually to avoid throwing a large sudden load on the driver and to prevent a sudden surge in the discharge line. The discharge valve should be fully open when starting mixed flow or propeller pumps because the brake horse power will then be a minimum.

- c) **Running:** When the unit is running it requires very little attention beyond occasionally checking to see that the journal and thrust bearings are running cool and has a sufficient supply of oil. The packing is adjusted to permit a slight leakage to cool and lubricate it, and the water is flowing to the water seal of the suction gland to prevent air from leaking in.
- d) **Shutting Down:** When shutting down, the discharge valve should be in the same position as when starting up by closing the discharge valve gradually so that less power is dropped from the line and any sudden pressure surges in the pipe system are avoided.

2.13 Inspection and Maintenance

Manufacturer's instruction book, which gives directions for the operations and maintenance of each pump, shall be shared.

The following information is general.

- a) The wearing ring clearance should be checked as they will increase with time and thus cause a decrease in efficiency. The frequency of the inspection will depend upon the liquid handled. If the liquid contains gritty materials or is corrosive, inspection may be made monthly, but if clear water is pumped it may be sufficient to check them annually.
- b) A general rule is to replace the rings when the clearance has increased 100 percent above the original.
- c) The packing should be replaced after it becomes hard and tends to score the shaft. When the packing is being replaced the finish of the shaft sleeves should be examined for smoothness.
- d) It is essential that the lantern ring be placed directly under the water inlet when putting in the new packing to insure a circulation of the water and a satisfactory seal. The packing should be gradually compressed with the pump running. It should not be compressed too much as local heating of the shaft and consequent misalignment will result. A slight leakage will insure proper lubrication and cooling.
- e) If the base is not too rigid the shaft alignment should be checked occasionally when the pump is at a temperature corresponding to running conditions. This must be done with the packing removed. At the same time the clearance of the journal bearings should be checked for wear.
- f) The oil should be changed as required and at that time inspected for the presence of water. If water appears in the oil the pump casing should be examined to find the leak.

2.14 Guarantee of Performance

- a) The pumps shall be guaranteed by the manufacturer/supplier against defects in material and workmanship under normal use and service for a period of at least one year from the date of issue of the Certificate of Substantial Completion.
- b) The supplier shall indicate the working range of the pump and the efficiency of the pump shall be guaranteed at a specified point of rating only and shall not be guaranteed to cover the performance of the pump under conditions varying there from nor for a sustained performance for any period of time. If the purchaser so desires, the manufacturer shall guarantee the non-overload of the prime mover for variations in the head in the working range.
- c) In the case of pumps where acceptance tests cannot be conducted on the liquid for which the pump is designed, the manufacturer shall indicate the liquid performance of the pump based on the results of the tests conducted by him on the pump with water as required. However, in these cases, the manufacturer shall guarantee for the performance of the pump with water for the specified range.

SECTION SIX: TANK FITMENTS**a) PUDDLE FLANGES FOR RESERVOIR (INSERTS)**

Inlets, outlets, interconnection sleeves and drain outlets for the reservoir shall be made through mild steel bath galvanised puddle flanges obtained from reputed manufacturers and to be inserted at suitable levels as indicated on the drawings. The Contractor shall be responsible for placing the inserts at required level well in advance and before making the final shuttering layout for casting the walls.

b) MANHOLE COVERS

The manhole covers shall be of medium duty type (FRP) with double seal, locking arrangement and lifting hooks. The shape of the cover to be as per the drawings.

c) PVC RUNGS STEP LADDER

For effective maintenance of the reservoir portable PVC Rungs step ladder to suit the depth of the tank shall be provided with necessary hooks.

d) LINK SEALS

Link seal is a seal which is used as a substitute for puddle flanges in underground sumps and overhead tanks and in places where positive hydrostatic sealing is mandatory. The link seals shall be suitable to withstand a pressure of 20 psig (40 feet of head). It should be capable of withstanding temperatures from as low as -600 F to as high as 4000F, it should provide three minimum three hours of protection against flames, smoke, gases and water even when exposed to temperatures up to 19000F. The seal should be of HDPE thermoplastic / heavy wall welded or seamless pipe to withstand angular and off- center pipe misalignment and has to seal effectively.

The following table indicates the materials for accessories of different models of link seals.

MODEL	TYPE	SEAL ELEMENT	PRESSURE PLATES	BOLTS & NUTS	TEMPERATURE RANGE (°F)
C	Standard	EPDM Black	COMPOSITE	STEEL zinc-dichromate	-40 to +250
S	Stainless	EPDM Black	COMPOSITE	316 STAINLESS STEEL	-40 to +250
O	Oil-resistant	NITRILE Green	COMPOSITE	STEEL zinc-dichromate	-40 to +210
OS	Oil-resistant	NITRILE Green	COMPOSITE	316 STAINLESS STEEL	-40 to +210
T	High/low temperature	SILICONE Grey	STEEL zinc-dichromate	STEEL zinc-dichromate	-67 to +400
FD/FS	Fire seals	SILICONE Grey	STEEL zinc-dichromate	STEEL zinc-dichromate	-67 to +400
M	Non-insulating	EPDM Black	STEEL	STEEL zinc-dichromate	-40 to +250

SECTION SEVEN –EXTERNAL RAIN AND STORM WATER DRAINS.**1. Scope of work**

Work under this section consists of furnishing all labor, materials, equipment and appliances necessary and required to completely install rain and storm water drainage system as required by the drawings, specified herein after and given in the schedule of quantities.

Without restricting to the generality of the foregoing, the drainage system shall include the following:

- DWC pipes.
- Connection of all pipes from terrace to rain water catch Basins as shown on the drawings.
- Testing of all pipe lines.

2. Catch basins

Catch Basin of Internal size 450 X 450 mm or 600 mm x 600 mm up to a depth of 0.75 to 1.2 m. Catch basin shall be provided with RCC pre-cast grating and frame of suitable size, and with hinge arrangement of easy lifting.

3. Material of Pipe and Fittings:

Class SN 8 Structured Double Wall (Non-Smooth External Annular Corrugated wall & Smooth Internal wall) Polyethylene Piping System for non-pressure suitable underground Drainage Applications.

4. HDPE DWC pipe (SN8)

Pipes shall be conforming to specifications as per IS 16098 (Part 1). These pipes shall connect the catch basins to external drain laid in slope.

5. Applicable Codes:

The manufacturing, testing at factory, supplying, transportation, handling, stacking, installation, jointing, and testing at sites shall comply with all currently applicable statutes, manuals, regulation, standards & codes. If requirements of these specifications are at variance with any other standards, this particular document shall govern the proceedings.

IS 16098-2	Structured Wall Plastics piping Systems for non-pressure drainage and sewerage- Specification Part 2: Pipes and fittings with non-smooth external surface, Type B
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Other Indian standards which are integral part of above standard as normative references form a significant portion of this specification document.

6. Manufacturing:

The Structured Double Wall Piping System of stiffness class designation SN 8 shall confirm to the Indian standards as mentioned above and shall be configured as per the indicative Cross-sectional & Profile Drawings by manufacturers. Each pipe shall be coupler (on-line or off-line) and spigot type along with rubber sealing ring (as designated under above international specifications).

7. Transportation

The arrangement of loading the pipes in a telescopic manner is advised, i.e. smaller diameters inserted into the next higher sizes of pipes. While loading the pipes onto the truck, care should be taken that the coupler- end should be arranged alternatively in the corresponding layers so as to avoid the damage to the coupling/ socket ends.

8. Handling

Following Recommendations shall be followed while handling the pipes:

- a) Adherence to National Safety requirements
- b) Pipes to be smoothly lowered to the ground
- c) Pipes should not be dragged against the ground to avoid the damages to the Coupler/pipes.
- d) 800mm and larger diameter pipes are carried with Slings at two points spaced approximately at 3 Meters apart
- e) For smaller diameters (400mm – 800mm) one lift point shall be sufficient & can be handled either manually or mechanically
- f) Do not use a loading Boom or Fork Lift directly on or inside pipe.

9. Pipe Storage at Site

- a) Stockpiling shall be done temporarily on a Flat Clear Area as per Fig. 1 & 2.
- b) For avoiding collapse of Stacks, use Wooden Posts or Blocks
- c) Stacking shall not be higher than 2.5 Meters
- d) While stacking, alternate the socket/coupler ends at each row of stacked pipes as per Fig. 2.

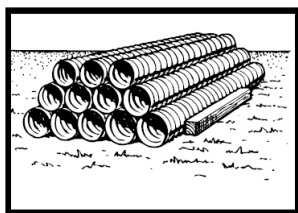


Fig 1

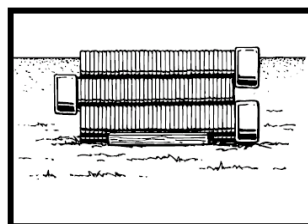


Fig 2

SECTION EIGHT: SANITARY INSTALLATION AND FIXTURES:**1. General**

- 1.1 The contractor shall supply, install and commission all sanitary fittings and accessories including but not necessarily limited to the following :
 - a) Assembling and jointing components parts, making all connections to services and waste inclusive of any electrical or control works.
 - b) Protect sanitary fittings and accessories after installation, clean and disinfect prior to handing over.
- 1.2 Any damaged or missing sanitary fittings and accessories shall be replaced by the contractor at his own expense. Documents or proofs for substantiating claim of replacement of damaged or defective sanitary fittings and accessories from the nominated supplier are to be submitted to the project manager.
- 1.3 All water flow fixtures provided in the project shall be strictly confirming to flow rates specified in the annexure list.
- 1.4 All fittings and accessories supplied and installed shall include all taps, flush valves, urinal, WC, wash basins, sinks, etc. The contractor shall supply all jointing and fitting materials and necessary supporting brackets to make the installation complete in all respects.
- 1.5 The contractor shall allow for building into walls, wall anchors for wall hung water closet and other fittings.
- 1.6 All items not specifically mentioned in this specification or shown in the drawings but which are necessary to make a complete working installation shall be included.
- 1.7 All fixtures shall be fixed in a neat workman like manner true to line and as recommended by the manufacturer or shown on the drawings. Care shall be taken to fix all fixtures, brackets and accessories by proper wooden cleats, plugs, bolts and nuts as each fixture will warrant with the correct size of screws, nuts or bolts.
- 1.8 Care shall be taken in fixing all approved chromium plated fixtures and accessories so as not to leave any tool marks or damages on the finish. All such fixtures shall be tightened with fixed spanners.
- 1.9 All fixtures shall be thoroughly tested after connecting up the drainage and water supply system. All fixtures shall be thoroughly finished and any leakage in piping, valves and waste fittings shall be corrected to the entire satisfaction of the Architects.
- 1.10 Upon completion, remove all labels, stickers, plasters etc, from the fixtures and clean fixtures with soap and water so as to present a neat and clean toilet.
- 1.11 Contractor to refer GFC drawings for location of sanitary fixtures.

2. Indian Water Closet (if any)

- 2.1 Indian Water Closet sets with 'P' or 'S' trap shall be the type as given in the schedule with 32 mm PVC flush pipes, high level cistern, PVC inlet connection and brass strip cock. Indian Water Closet and trap shall be set in lime surki concrete 1:4 and flush with the floor. Cistern shall have maximum flow rate of 1.28 GPF.

- 2.2 Indian Water Closet shall be measured per number and quoted rate shall include:
- The cost of W.C pan with 'P' or 'S' trap, cistern, PVC inlet pipe,
 - CP brass stop cock and pair of white glazed foot resets,
 - Setting the closets in lime surki concrete including the cost of surki concrete,
 - Painting the brackets and cistern.

2.3 Refer sanitary items list below for make, color and catalogue number of fixtures.

3. European Water Closet:

- 3.1 The closet shall be of vitreous China wall hung box rim pattern having back inlet and P trap.
- 3.2 Each closet and cistern shall be provided with the following accessories: Double flapped heavy plastic seat cover of approved quality and color with rubber buffers with C.P brass bar and screws and fixed to the pan, Concealed cistern or metro pole flush valve of 4.2/2.1 liters, CI chair with bolts / bidet bolts for mounting the closet.
- 3.3 Water closets shall be measured per number and the rate quoted shall be per number only. The quoted rate shall include: The cost of W.C pan, trap with brackets / bolts and concealed cistern or metro pole flush valve, plastic seat and cover, jointing and fixing material, painting of brackets.
- 3.4 Sanitary fixtures and fittings make, color and catalogue number is as per client's requirement.

4. Wash Basins:

- 4.1 These shall be of approved color of vitreous China of best quality manufactured by an approved firm of size as specified in the annex below. The basins shall be fixed by using steel bolts and the bolts are grouted into the wall before tiling as per approved design.
- 4.2 Wash basins shall have lavatory faucet or press-matic tap of recommended make and catalogue number as mentioned in the annexure.
- 4.3 Each wash basin shall be provided with 15 mm CP brass stopcock, 8 mm PVC/CP inlet pipe, 32 mm CP waste coupling, 32 mm CP bottle trap of recommended make and catalogue number as mentioned in the BOQ.

5. Sink:

- 5.1 These shall be of approved make stainless steel material and sizes as per the schedule of quantities. The sink shall be supported with stainless steel bolts of required size.
- 5.2 Each sink shall be provided with 40 mm CP waste coupling & 40 mm GI waste pipe with bottle trap and single lever sink mixer or sink cock.
- 5.3 Sink shall be measured by number including all items stated and shall include the cost of all fixing materials.
- 5.4 Refer sanitary items list below for make and catalogue number of fixtures.

6. Urinals:

- 6.1 These shall be of vitreous China of best quality manufactured by an approved firm of size

as specified in the schedule of quantities.

- 6.2 Each Urinal shall be provided with 1 No. CP dome coupling
- 6.3 Urinal flush system shall be sensor type (built in) connected to the urinal spreader or Aqua free/water free urinals with cartridge.
- 6.4 Large flat urinal should be supported with CI brackets of approved design.
- 6.5 Refer sanitary items list below for make and catalogue number of fixtures.
- 6.6 Urinals shall be measured per number and quoted rate shall include.
- 32mm CP brass bottle trap of casted type/ 32 mm PVC waste pipe.
 - 40 mm OD PVC waste pipe concealed in wall.
 - GI pipe concealed in wall with required specials for water supply.
 - Jointing and fixing material.
 - Painting the brackets.

7. SHOWER SET

- 7.1 Shower set shall comprise of two CP brass concealed stop cocks with shower mixer, adjustable type over-head shower with CP shower arm, all with CP wall flanges of approved quality all as specified in the Schedule of Quantities. Bath spout, hand showers and pop up wastes shall also be provided wherever, specified. Wall flanges shall be kept clear off the finished wall. Wall flanges embedded in the finishing shall not be accepted.

8. Mirror:

The mirror shall be of the best quality India makes 5.5 mm thick. The size shall be as specified and of approved design and make 8 mm thick commercial plywood shall be fixed to the back of the mirror and wall with C.P side clips and screws.

9. Towel rail:

Towel rail shall be of anodized aluminum C.P with reinforced bends and circular flanges. The size of the rail shall be as per Schedule of Quantities. The bracket shall be fixed by means of CP brass screws to wooden cleats firmly embedded in the wall. Refer sanitary items list below for make and catalogue number.

10. Toilet Paper Holder:

Toilet paper holder shall be of anodized aluminum C.P with reinforced bends and circular flanges. The size of the rail shall be as per Schedule of Quantities Refer sanitary items list below for make and catalogue number.

11. Floor Traps:

The trap shall be of CI/PVC, self-cleaning and deep water seal type with minimum of 50 to 65 mm water seal. It shall have a 100 mm diameter grating. These shall be fixed in concrete to the required level and position.

12. Towel Ring, Soap Tray, and Coat Hook:

These shall be of CP/anodized aluminum as described in the schedule of quantities and as per the displayed sample. These shall be fixed by means of C.P brass screws to wooden cleats, firmly embedded in the wall. Refer sanitary items list below for make and catalogue number.

13. Bottle Traps:

Bottle traps (for wash basins, sinks, urinals, etc.,) shall be deep seal (minimum 6 cm seal) cast brass bottle traps, heavy chromium plated. All bottle traps shall be provided with suitable cleaning eye, extension piece, flare nuts all chromium plated. Bottle traps shall be of approved make and design. Traps for wash basins shall be 32mm for urinal and wash basin and 40mm for sinks. Refer sanitary items list below for make and catalogue number.

14. Soap Dispenser and Grab Bars:

Soap Dispenser and Grab Bars shall be as per the sanitary items chart below and same shall be fixed at locations as per GFC drawings.

15. Hand Drier:

The hand drier shall be no touch operating type with solid state time delay to allow user to keep hand in any position. The hand drier shall be fully hygienic, rated for continuous repeat use (CRU). The hand drier shall be of wall mounting type suitable for 230 V, single phase, 50 Hz, AC power supply.

Hand drier specifications:

- ABS body suitable design
- Rated Power: 2000- 2500 Watt (max)
- Current : 9- 10 A
- Blowing Volume: 900M/ Minute.
- Blowing Rate: 15 m/s
- Dimensions: 240X240X230
- RPM : 3000 revolutions / min
- Noise : $\leq 40\text{Db}$
- Sensing Range: 12 ± 3 cm
- Hot Temperature: 30 - 50 $^{\circ}\text{C}$
- Continuous Work Time: $60 \pm 25\text{s}$
- Temperature of wind: 40-54 deg C.

SECTION NINE: SERVICE AND MAINTENANCE**1. General**

- 1.1 This section covers the work involved in the regular maintenance and/or breakdown service of the systems and equipment, etc., installed under other sections of this Specification.
- 1.2 The work shall be carried out in accordance with the schedule stated in this section or other section of the specification during the defects and liability period.

2. Scope :

- 2.1 The warranty period shall commence after the successful handover of the entire installation to the employer.
- 2.2 It is the responsibility of the contractor to maintain the systems in first class running condition.
- 2.3 During the warranty period the contractor shall carry out free servicing to the systems and equipment including cleaning etc at approximately monthly intervals in accordance with the maintenance responsibilities outlined hereinafter or as indicated within other sections of this specification. Allowance shall be made in the Tender price for any cost incurred by complying with this requirement.
- 2.4 The contractor shall replace all faulty or damaged parts with new ones during the warranty period at no expense to the employer. This clause shall override any standard warranty conditions of the contractor or his supplier of equipment. Allowance shall be made here for any cost incurred by complying with this requirement.
- 2.5 The contractor shall prepare a detailed inspection and service report form showing functions to be carried out and the intervals between each function to enable records of servicing to be maintained. The functions shall include all the maintenance responsibilities outlined hereinafter for each specific protection devices plus any other special maintenance requirements recommended by the manufacturers. The inspection and service report duly signed by the Employer shall be recorded within the first week of every month.
- 2.6 The contractor shall also inform the employer within the last week of every month, the date and time scheduled for the maintenance and servicing of the system in the next month.
- 2.7 Routine maintenance and servicing to the system is to be carried out during normal working hours unless it is otherwise specified elsewhere in this specification.
- 2.8 During the warranty period, the Contractor shall attend to any complaint promptly at no expense to the Employer.
- 2.9 After the attendance of complaint and completion of the repair work, a copy of the report or service chit duly signed by the Employer shall be recorded.
- 2.10 The Contractor shall be responsible for the conduct and behavior of his workmen. Upon arrival at the premises for servicing or repair works, the workmen are required to inform the officer-in-charge in the premises the purpose of their visit. The Contractor shall ensure that minimal inconvenience is caused to the Employer.

2.11 Final payment of retention monies to the contractor will be certified only after evidence of regular and satisfactory maintenance during the warranty period and had been shown.

2.12 All tests, observations, readings and rectification works shall be fully recorded in a log book provided in the Maintenance Office and signed and acknowledged by the Employer.

3. Workmanship and Materials

3.1 All work described herein shall be performed by workmen skilled in the service and maintenance and repair of and the installation and shall be executed in accordance with the best commercial practice.

3.2 All materials to be supplied in connection with works shall be new and unused and shall generally be of the best quality as regards manufacture and performance. Replacement of parts and accessories shall be of the original manufacture, make and model. Any deviation shall be approved by the project manager.

4. Schedule of Servicing and Maintenance:

Servicing and maintenance of equipment and pipe work shall be carried out as stated below on a periodic basis as specified. All works recommended and required by the manufacturers shall also be performed.

Inspect all pumping system equipment and test operation of controls monthly

4.1 Pumps sets:

- a) Check all seals, glands and pipe lines for leaks, and rectify as necessary.
- b) Check all pumps bearings and lubricate with oil or grease as necessary.
- c) Check the alignment and condition of all rubber couplings between pumps and drive motors and rectify as necessary.
- d) Check all bolts and nuts for tightness and tighten as necessary.

4.2 Electric installation:

- a) Check all motor bearings and lubricate with grease as necessary.
- b) Check safety devices fitted to all motors and clean, adjust and lubricate as necessary.
- c) Inspect and check the routine operation of all electrical starters, electrical control gears and ancillary electrical apparatus.
- d) Clean, adjust and lubricate all bearings, pivots and other moving parts as necessary.
- e) Renew electric fuses as necessary.
- f) Clean or renew electric contactors as necessary.
- g) Test all electrical wiring.

4.3 System Control:

- a) Check all sensors and clean, adjust and calibrate as necessary.
- b) Check and run program for system

4.4 Pipe work and Accessories:

- a) Check for leakages in the pipes and fittings.
- b) Check all bolts and nuts for tightness and tighten as necessary.
- c) Perform function test on all fittings and rectify as necessary.
- d) Check all pipe lines for leaks and rectify as necessary.
- e) Check all water levels and adjust all fill up as necessary.
- f) Check the operation of all safety devices - clean, adjust and lubricate as necessary.
- g) Check all bolts and nuts for tightness, and tighten as necessary.

4.5 "Check" shall include for all visual inspection, recording of all necessary site measurement and fixed instruments readings, testing to ensure and confirm that the whole system is in an efficient and serviceable condition and performance.

4.6 "Service" shall include for all adjustments, re-calibration, reading, cleaning, changing of lubricant or coolant, tightening of all hold down bolts and mountings, draining and purging of air or water, sequence testing and verification of alarm and fail-safe safety device and to ensure that the system is maintained in an efficient and serviceable condition and performance.

4.7 "Rectify" shall include for dismantling, replacement, re-installation, adjustment, testing, touching up all paintwork, etc. to ensure that the system is put back into efficient and serviceable condition and performance.

4.8 The service provided in this Contract shall include for attendance and provision of all labour, equipment and instruments as required during normal testing of the Piped Services Installation as called for by the Authorities.

4.9 All tests, observations, readings, rectification works shall be fully recorded. A log book shall be provided in the Building Maintenance Office and all reports and recordings shall be entered into the book and to be signed and acknowledged by the Building Maintenance Engineer. All consumable materials required for carrying out the works are part of contractor scope of work.

4.10 Should the installation fail to perform in accordance with the requirements of the Specification and/or authorities, the project manager may reject the whole or any part of it.

4.11 The testing period shall form part of the Contract period and no extension of the time will be granted by reasons of any extension of the testing period to permit rectification, modification, adjustment or retesting of the installation except where testing has been

delayed or retesting has been necessitated by circumstances beyond the control of the Contractor.

4.12 The Contractor shall make all arrangements and supply all labour, equipment, instruments and tools for necessary tests to be carried out as required by the relevant Authorities, in addition to all those tests as specifically called for in this Specification.

4.13 The Contractor shall also be required to conduct all tests as and when requested by the Authorities during the maintenance and guarantee period.

5. Tools and Equipment

A complete set of tools and equipment for maintenance shall be supplied to the approval of the project manager.

6. Certification by Contractor

6.1 On completion of all performance testing as required in the specification, the Contractor shall be required to submit all test reports to the project manager for approval prior to acceptance of the installation. The Contractor shall also be required to certify in writing to the project manager that the installation is in full compliance with the requirements of the Specification and the Codes.

6.2 The Contractor shall engage his own Professional Engineer to endorse and submit four (4) sets of the original 'Certificate of Supervision' and drawings for the respective installation works one month before system handing over date.

6.3 The Contractor is to note that his Tender price shall deem to include for all testing requirement.

6.4 The Certification of Practical Completion will not be issued unless the clauses as stated above are complied with to the satisfaction of the project manager.

7. Operation and Maintenance Training

The Contractor shall train the employer's operating personnel in the operation and maintenance of the plants.

8. Maintenance and Guarantee

8.1 The whole of the work to be performed under the contract shall be completed and left in running order to the satisfaction of the project manager.

8.2 The performance of the whole installation shall be guaranteed to conform to the requirements of this Specification. The contractor shall without additional charge replace any works which prove faulty from workmanship or materials and fully maintain the whole installation for a period of one year after the commencement of the Defects Liability Period.

8.3 The Defects Liability Period shall commence from the date of issuing the Certification of Practical Completion.

- 8.4 During the Defects Liability Period the Contractor shall be responsible for all costs involved in balancing, setting and adjustment of controls, and supplying all test equipment and instruments deemed necessary by the project manager.

9. Quality Assurance

- 9.1 The contractor shall establish, document and maintain a quality system to demonstrate his commitment to quality in construction.
- 9.2 Specifically, the Contractor shall plan, establish, implement and maintain a project quality plan setting out, as a minimum, the following:
- a) the quality objectives to be attained;
 - b) the specific allocation of responsibilities and authority during the different phases of the project;
 - c) the specific quality procedures, methods and work instructions to be applied, including detailed procedures for each of the major work activities;
 - d) suitable testing, inspection, examination and audit programs at the appropriate stages;
 - e) a method of changes and modifications in a quality plan as the project proceeds; and
 - f) Other measures necessary to meet the objectives.
- 9.3 The contractor's project quality plan shall be documented in the form of a project quality manual and project operating procedures which shall be submitted to the project manager within 30 days from the date of letter of acceptance of tender. The quality control procedures shall be submitted at least 14 days before the commencement of the activity.
- 9.4 Any comment, advice or acceptance of the project quality plan by the project manager, shall not, in any way, alter or diminish the Contractor's obligations under the Contract for the quality of the Work.
- 9.5 The Contractor shall adequately price for the above provision in the Preliminaries.

SECTION TEN: PREAMBLE TO SCHEDULE OF QUANTITIES

1. All items of work mentioned in the schedule of quantities shall be read and executed strictly in accordance with the description of the item in the schedule of quantities, Local Statutory Authority requirements, etc., read in conjunction with the appropriate IS and conditions of Contract.
2. The rate for each item of work included in the bill of quantities shall unless expressly stated otherwise included cost of: -
 - 2.1 All materials, fixing materials, accessories, hardware, operations, tools, equipment, consumables, civil works wherever involved and incidentals required in preparation for in the full and entire execution and completion of the work called for in the item as per specification and drawings completely.
 - 2.2 Wastage on materials and labour.
 - 2.3 All taxes, duties, octroi, including works contract tax, sales tax, transit insurance, packing and forwarding charges, loading, transportation, unloading, handling, hoisting, to all levels, setting and fixing in position, disposal of debris and all other labour necessary in accordance with contract documents, good practice and recognized principles.
 - 2.4 Liabilities, obligations and risks arising out of conditions of contract.
 - 2.5 Liaison service charges.
3. All requirements of system whether such of them are mentioned in the item or not the specifications and drawings are to be read as complimentary to and part of the schedule of quantities and any work called for in one shall be taken as required for all.
4. In the event of conflict between the bill of quantities and other documents, the most stringent shall apply and interpretation of the client/consultant shall be final and binding.
5. No change in unit rate shall be allowed for any change in quantity or for any other reason whatsoever.
6. Supply of materials shall mean supply of materials at site. The rate for supply shall include all taxes, octroi, and insurance, packing and forwarding charges, transportation, unloading at site.
7. The successful contractors shall submit the schematic diagrams, fabrication drawings with details of all equipments wirings diagrams etc., to Local Statutory Body/Consultants for approval prior to supply/commencement of such works. The approval of these drawings will be general and will not absolve to contractor of the responsibility of the correctness of these drawings. At-least four copies of the approved drawings shall be supplied to architects for their distribution to various agencies at site at no cost of Owner.
8. The contractors must see the site conditions such as type of soil, locations etc., and take all factors into consideration while quoting the rates as no extra cost will be allowed on any ground arising out of or relating to the site conditions.
9. Any error in description or in quantity or omission of items from the contract shall not vitiate this contract but shall be corrected and deemed to be a variation required by the client/consultant.
10. The contractor shall take into account the expenses of pre-commissioning tests to be conducted as per specification of the complete installation by licensed agencies.