

**PARTICULAR SPECIFICATION PS.PD-01**

**Plumbing and Drainage Installation**

## **1.0 Plumbing and Drainage**

### **1.1 Scope of Works**

The scope of works given below must not be read as a complete description of the works but only as an indication of extent of works. The tender drawings shall be regarded as for reference only showing the general design intent.

- (1) Supply and installation of complete fresh, irrigation and flushing water system teed-off from the fresh and flushing water Government supply mains outside site boundary. Water is then fed via the boosted pumps from the storage tank and then to all fittings and termination points as shown and specified.
- (2) Supply and lay in trenches or fix to walls of all supply, branch and other piping and fittings for the fresh, irrigation and flushing water supply system, including all distribution pipeworks, valves, fittings, hangers, pressure reducing valve sets, filters, irrigation water booster pumps, pneumatic pressure vessel and controls, electrical control wiring, etc. as shown and specified.
- (3) Supply and installation of complete soil, waste and anti-syphonage/vent piping systems, sump pumps system, floor drains, vertical grating, weep hole, traps, manhole, final connection and make good to the existing Government sewers at Government Land as shown and specified.
- (4) Supply and installation of complete rainwater piping system including rainwater outlet, vertical grating, weep hole, traps, manhole, final connection and make good to the existing drainage components at slope outside site boundary which is maintained by the adjoining school.
- (5) Supply and installation of repeated panel for signals as specified for monitoring pumps, water tank, sump pit etc. including all cables, contactors, indicating lamps, conduits, control wiring and the like at Store Room.
- (6) Supply and installation of all recessed type galvanized mild steel proprietary made covers and frames for manhole, valve pit as shown and specified.
- (7) Replacement of cover and frame with recessed type galvanized mild steel proprietary made cover and frame for the existing sand trap. Structural calculation for the design and construction of the cover and frame shall be submitted for Project Structural Engineer's comment.
- (8) The Contractor shall include the construction of all water tanks including the following piping and fittings:-
  - (a) Supply and set all the required pipe connections with puddle flanges;
  - (b) Supply and installation of make-up pipework to the tanks including the associated isolating valves and ball valves as required; and
  - (c) Supply and installation of all water level switches in the tanks including wirings and conduits.

**1.1 Scope of Works (Cont'd)**

- (9) Supply and installation of sanitary fixtures and accessories as shown on the drawings.
- (10) Provision of fire rated enclosures as shown and specified.
- (11) This Contractor is responsible for carrying out utilities condition survey to all existing and new drainage components including the existing sand traps, catchpits and surface channel within site and at the slope maintained by the adjoining school as shown on drawing.

The utilities survey shall be submitted by this Contractor both on 21 days after site possession and 7 days before formal inspection by Government Department(s) including but not limited to the following details:-

- Setting out, dimension and level of all existing drainage installations.
- CCTV survey for internal condition of all existing and newly installed drains / sewers including the final connections to government manhole.

This Contractor is responsible for making good of all retained drainage components such as sand traps catchpits, surface channels located at site and the slope maintained by the adjoining school as shown on drawing.

- (12) This Contractor shall be responsible to prepare as built drawings and as built final drainage connection record in hard copy and electronic file format to Government Department's satisfaction for the Architect's onward submission to ASD/Government Departments.
- (13) Painting of pipework and equipment. For pipework located at external area, colour of painting shall match with the surrounding to the satisfaction of the Architect/Consulting Engineer.
- (14) The Contractor shall be responsible for collecting from Water Supplies Department for the fixing of water meters, submitting the amendment plans to Water Supplies Department and relevant Government Department as may be required by the Architect for approval and ensuring that the final installation is in full accordance with the Water Authority and any other requirements and regulations.
- (15) Provision of as-fitted drawings in AutoCAD and CD Rom format, operating instruction and maintenance manual.
- (16) Provision of spare parts and samples.
- (17) Provision of twelve months free comprehensive maintenance and services including 24 hours breakdown services during Defects Liability Period.

## **1.2 Drainage Connections**

The Contractor is strongly advised to carry out site visit and inspection before pricing the tender for the part of drainage connections.

The Contractor is responsible for the following works in relation to the drainage connections:-

### **(1) Stormwater Connection**

The stormwater from the site will be connected to the existing sand trap via manholes. The stormwater inside the existing sand trap will then discharge to the existing catchpits and sand trap via surface channel which located at and maintained by the adjoining school. This Contractor is responsible for making good to all retained drainage component of sufficient flow capacity for the stormwater discharging from the site.

### **(2) Sewage Connection**

The foul water from the site will be connected to the existing government manhole at Chung Yee Street. Before carrying out connection work, this Contractor shall seek Drainage Services Department's permission to conduct CCTV survey on the existing government sewer at Cheung Yee Street as shown and specified. This Contractor shall submit CCTV survey report to the Architect upon completed of survey. This Contractor is drawn to particular attention that there is a covered walkway erected outside site boundary in front of the last foul water manhole which may hinder the evacuation and laying of drainage pipe to existing Government manhole.

## **1.3 Climatic Conditions**

The Contractor is deemed to be familiar with climatic conditions prevailing in Hong Kong and to be aware of the high temperature (up to 36°C) and the high relative humidity during the summer and the contrasting low temperatures and low relative humidity experienced in the winter. All equipment supplied and/or installed shall be suitable for the climatic condition and the special condition of the vicinity in which the equipment is situated. Except otherwise stated hereunder in this specification, no artificial means will be provided to improve the condition to suit special requirement.

#### **1.4 Statutory Obligations and Other Regulations**

**1.4.1** The Contract works shall fully comply with all statutory obligations and regulations together with any amendments made thereto as required by the following bodes:-

- (1) Fire Services Department (Hong Kong);
- (2) Water Supplies Department (Hong Kong);
- (3) Lands and Works Branch;
- (4) Building Authority, Buildings Department (Hong Kong);
- (5) Geotechnical Engineering Office of Civil Engineering Department;
- (6) Environmental Protection Department;
- (7) Labour Department;
- (8) Food and Environmental Hygiene Department;
- (9) Leisure and Cultural Services Department; and
- (10) Any other local authority having jurisdiction.

**1.4.2** All plumbing installations shall comply with the following obligations and regulations:

- (1) Buildings Ordinance Cap 123;
- (2) Building (Standards of Sanitary Fitments, Plumbing and Drainage Works and Latrines) Regulations;
- (3) Practice Notes for Authorized Persons and Registered Structural Engineers issued by the Buildings Department with respect to the obligations imposed on the Contractor for plumbing and drainage works;
- (4) Hong Kong Waterworks Standard Requirements (August 1995) issued by the Water Supplies Department;
- (5) A Guide to the Preparation of Plumbing Proposals (March 1995) issued by the Water Supplies Department;
- (6) WSD's Circular letters in force;
- (7) Current Practice Notes issued by the Environmental Protection Department with respect to drainage works; and
- (8) Hong Kong Government General Specification for Civil Engineering Works.

The complete set of the above documents could be available for sale at the Government Publication Sales Centre or for collection upon request from the relevant government departments.

## **1.5 Liaison with Utility**

It is the responsibility of the Contractor to liaise with the utilities and Government Departments to arrange for all necessary inspections as required by the Authority, and to make formal application on behalf of the Employer to expedite services connections and for approval of equipment installation.

## **1.6 Plumbing Materials**

### **1.6.1 Potable, Irrigation and Flush Water Pumps**

- (a) The pumps shall be with flanged suction and delivery connections.
- (b) Materials for construction of potable and irrigation water pumps shall be as follows:-
- |                        |   |
|------------------------|---|
| . Casing & Impellers - | Cast stainless steel to B.S. 3100 : 1991 - 316C16                               |
| . Diffuser -           | Demountable type, same material as casing                                       |
| . Shaft -              | Stainless steel Grade 316 to B.S. 970 : 1970<br>minimum 13% CR. with Ni content |
| . Seal -               | Mechanical seal   |
| . Couplings -          | Flexible type, complete with coupling guards                                    |
| . Guide Rings -        | Phosphor bronze   |
| . Bearings -           | Ball thrust type, grease lubricated   |
- (c) Materials for construction of flush water pumps shall be suitable for sea water duty and as follows:-
- |                 |   |
|-----------------|---|
| . Casing -      | Cast stainless steel Grade 316 to B.S. 3100 : 1991 - 316C16 |
| . Diffuser -    | Demountable type, same material as casing                   |
| . Shaft -       | Stainless steel Grade 316 to B.S. 970 : 1970                |
| . Seal -        | Gland packing (suitable for sea water duty)                 |
| . Couplings -   | Flexible type, complete with coupling guards                |
| . Guide Rings - | Phosphor bronze   |
| . Bearings -    | Ball thrust type, grease lubricated                         |
- (d) Submersible sewage pumps shall be installed in sump pits consisting of coupled flanged, ductfoot elbow coupling, stainless steel (SS 316) guide rail, stainless steel chain, stainless steel bolts and nuts upper fixation as per detail shown on the Drawings.

- (e) Construction Materials for submersible sewage pumps shall be non-clog, suitable for seawater and sewage water duty and comprise the following:
- . Casing - High grade cast iron to BS1452 grade 220 with external and internal sewage and sea water corrosion resistant coating such as epoxy.
  - . Impellers - Epoxy coated ductile iron with sea water corrosion resistant coating such as epoxy.  

Cutter type impeller with minimum 50mm Bore Pass.
  - . Shaft - Stainless steel to B.S. 970:1970 minimum 17% CR. with Ni content or stainless steel grade 316
  - . Seal - Double mechanical seal (suitable for sea water duty)
  - . Bearings - Ball thrust type, grease lubricated
  - . Maximum speed - As shown on the Equipment Schedule A.
- (f) Details shall be submitted by this Contractor to the Architect for checking and endorsement prior to ordering.
- (g) Level switches (high/low levels alarm and indications) shall be supplied and installed by this Contractor in the sump pits for the proper operation of the pumps as indicated on Drawings. The switches shall be of mercury float switch type. The lead-lag selection of pumps shall be changed automatically after each cycle.
- (h) Attention shall be paid to the internal dimensions of the sump pits when selecting pumps.
- (i) This Contractor shall supply and fix pump discharge pipework and vents. Three spare packings shall be provided for each pump.
- (j) Other accessories required to be provided by this Contractor shall be as follows:
- (i) Automatic control boxes.
  - (ii) Waterproof type cables of sufficient length and size for connection of the control box to the pump.
  - (iii) Alarm bells.
  - (iv) Cable holders.

### **1.6.2 Hydro-pneumatic Booster Sets**

- (a) The hydro-pneumatic booster set shall be of robust design. Booster pumps and pressure tanks shall be mounted on a vibration - absorbing baseplate. Each set shall comprise the following:-
- . One set approved pattern vertical multi centrifugal pumps (no. of pumps as shown on drawing).
  - . One set pressure tank with rubber bag (no. of pressure tanks as shown on drawing).
  - . Associate pipework including control valves, water hammer absorber, check valves, flexible connectors and the like.
  - . Vibration-absorbing baseplate.
  - . Pressure gauges, pressure switches, emergency stop button and safety valves, and the like.
- (b) Only one pump shall be in operation at a time, the other one shall be on standby. The pumps shall be changed over after each cycle by an automatic device. The standby pump shall be automatically switched on if the water pressure of the pressure tank drops down to the minimum set pressure and then the two pumps shall be in parallel operation. Dry running protection shall also be provided.
- (c) Construction of the pumps shall conform to the requirements stipulated in the preceding Clause for potable and flush water pumps.
- (d) Pressure tanks shall be of galvanized mild steel cylindrical pre-changed pressure vessels with epoxy or polypropylene anti-corrosion lining in the internal surface. A rubber bag shall be fitted for separation of the water nitrogen gas. The pressure tank shall be externally treated in synthetic enamel. An approved type valve shall be fitted for pre-pressure adjustment. Baseplates shall be manufactured in heavy gauge fabricated mild steel, zinc plate finish.
- (e) All piping, flexible connectors, control wedge gate valves and non-return vales shall be as described in the other section herein.
- (f) The following accessories shall be provided by this Contractor:-
- . One no. pressure gauge with siphon pipes and isolating valves for each pressure tank air chamber.
  - . Three nos. adjustable pressure switches for incoming and outgoing pressure adjustable individually and low water pressure (no flow) cut-out of booster pumps.
  - . One no. bronze drain cock at the bottom of each pressure tank with pipe extension to the nearest drain point.
  - . One no. 25mm diaphragm type safety valve at air chamber of each pressure tank.
- (g) A test certificate for the performance and test pressure of the tank issued by the manufacturer shall be submitted by the Sub-contractor to the Architect for approval.

### **1.6.3 Pump Fittings**

- (a) Each pump shall be fitted with valves to enable it to be isolated, and in addition, where shown on the Drawings, a silent check/non-return valve shall be fitted in each pump discharge.
- (b) All pumps shall be fitted with air-cocks and drain plugs. Each pump discharge and suction line shall have a pressure gauge with a dial diameter of 150mm complete with copper/brass siphon loop tube and isolating gate valves for potable water and stainless steel for flushing water. Flow meter shall be installed at the pump discharge side for measurement of the flow rate. Drains shall be piped to floor drain or channel.
- (c) This Contractor shall supply and install flexible pipe connectors at the pump suction and discharge sides for each pump as detailed in the other section herein.
- (d) All flexible connectors shall have flanged joints for the connecting pipework and must be suitable for the working conditions and test pressure of the particular system installed.
- (e) Automatic air valves shall be fitted in the pumps to purge any air likely to be trapped inside the pump casings. Suitable fittings to be approval of the Architect shall be used for such connection and the automatic air valves shall not discharge at a location directly over to near to the pump motor or any other electrical equipment.

#### **1.6.4 Pump Motor**

- (a) Motor in all cases shall be entirely suitable for the duty. A margin of not less than 15% shall be provided between the continuous rating of the motors (without overloading) and the maximum power absorbed by the item of equipment (as installed) under its most arduous operating condition, taking account of the characteristics of the driving machine. All motors up to 30kW shall have full load efficiency of not less than 85% and power factor of not less than 0.85. Motor of rating greater than 30kW shall have full load efficiency of not less than 90%, power factor of not less than 0.85 and comply with efficiency class EFF1 in accordance with the EU / CEMP agreement.
- (b) Winding insulation and general construction of the motor casing, terminal block, etc. shall be to Class F in accordance to EN60034.
- (c) All motors shall have an isolating switch adjacent to and within sight of the motor. The switch shall be such that all conductors to the motor are isolated in one operated. A push button interlocking with a contactor may be accepted as a means of isolation.
- (d) Motors up to an including 3.7kW shall be fitted with ball bearings at both ends. Larger motors shall be fitted with roller or deep groove ball bearings. Motor operating with vertical shafts shall be equipped with bearings designed to counter balance end thrust.
- (e) Terminal blocks enclosed in cast iron or aluminium boxes shall be provided for all wiring connections to motors. The blocks shall be arranged to enable easy access for maintenance.
- (f) On all motors over 25kg in weight, lifting eyes or lugs shall be supplied.
- (g) Water cooled squirrel cage induction motors shall be provided for potable and irrigation supply water pumps to reduce plant noise during pump operation.
- (h) A totally enclosed water jacket shall be provided to attenuate noise from motor operation for potable and cleansing water pump. The water cool jacket shall provide adequate cooling to the motor with insulation temperature not exceeding the maximum rated class.
- (i) The water jacket shall protect motors from extreme environmental factors such as ducts, fibre material, dirt and water. Direct emission of heat from motor to the atmosphere is not allowed.
- (j) The motor and pump shall be factory assembled with cooling pipe fitted on pump casing. Cooling water extracted from pump flow shall be of suitable quantity and pressure to allow satisfactory motor cooling.
- (k) Motors shall be manufactured in accordance with EN60034. Motors shall have IP55 protection and be S1 rated continuously.
- (l) Anti-condensation heaters shall be provided to motors.

### **1.6.5 Pump Bases**

- (a) All pump sets except submersible sewage pumps shall be mounted on anti-vibration pump bases. Details shall be submitted by this Contractor to the Architect for approval well before the manufacture of the structural base. All holding down bolts shall be provided and cast-in by this Contractor.
- (b) The structural base shall be formed by this Contractor to the details approved by the Architect.
- (c) Anti-vibration mountings shall be springs and neoprene pads or rubber-in-shear isolators with high density cork sandwich type plinth as specified in the Equipment Schedule in Technical Schedule A herein with specified static deflection and an isolating efficiency of not less than 95%.

### **1.6.6 Pump Certificates**

- (a) Each pump shall be provided with a certificate issued and signed by the manufacturer. The certificate shall clearly record the pump model, serial number and the materials of the casing, shaft and impeller.
- (b) Each pump or each batch of pumps shall also be provided with a certificate on their place of manufacture. The certificate shall be issued by a recognized Chamber of Commerce of the place of manufacture concerned.

Failing to present the abovementioned certificate may render to rejection on the installation of the concerned pump or batch of pumps and subsequential removal from site unless sufficient evidences/information were provided to prove the country of origin for the same.

All rectification works for the same shall be borne by this Contractor without both cost and time claims.

### **1.6.7 Vitriified Clay Pipe**

Vitriified clay pipe shall be complying with BSEN295 with flexible O-ring type push-in spigot and socket joints.

- 1.6.8** (a) Check valves on the discharge side of water pumps shall be:-

- . **Of double guided disc globe type.**

- . Constructed with cast iron body, bronze disc and seat, stainless steel spring with viton or P.T.F.E. sealing material for use in potable water supply system and rain water disposal pump and pump system only.

- . Constructed with Type 316 stainless steel body, disc seat and spring with viton or P.T.F.E. sealing material for use in flush water supply system and waste water disposal sump and pump system only.

- (b) Check valves on the discharge side of sewage pumps and drainage pumps shall be full open silent type as manufactured by 'Apco' or equivalent as approved by the Architect.

### **1.6.9 Galvanized Steel Pipe and Fitting**

Galvanized steel pipe to BS1387 medium duty and fittings to BS143 and BS1256.

Size : Below 40mm diameter  
Joint : Screwed joint to BS21

### **1.6.10 Copper Pipe and Fitting**

Copper pipes to BSEN 1057 Table 3 / (R250 for aboveground and R290 for underground) and copper capillary fittings to B.S. 864 Part 2.

### **1.6.11 uPVC Pipe and Fitting**

uPVC pipes and fittings to BS3505 Class E in grey colour.

uPVC pipes and fittings shall be as manufactured by Japan or equal as approved by the Architect.

### **1.6.12 Pipe Joints**

#### **(a) Copper**

- For sharp right angle bends in the pipework, elbows shall be provided.
- Pipes over 28mm dia. shall be fitted with elbows and bends and whenever possible, bends are preferred to elbows.
- Pipes shall be connected with gunmetal silver brazing fittings by welding as follows:
  - To the relevant welding code B.S. 1723:1963 (brazing).
  - All bracing fittings shall be casted one piece. Local welded lobster fittings shall not be accepted.
  - All welders shall be fully qualified. Appropriate Certificates shall be provided if, so required by the Architect.
  - Welding rods shall be of not less than 5% silver content and suitable for the piping materials and atmospheric conditions to B.S. 1845:1977.
- Pipes in nominal sizes over 219mm shall be flange jointed with gunmetal flanges to BSEN 1092, rated for the working pressure involved but in no case less than 16 bar.
- Pipes brackets or hangers shall be of a pattern to the approval of the Architect.
- End or end butt-welded joint shall not be permitted.

(b) Ductile Iron Pipes

- All ductile iron pipes for pressurized systems shall be assembled by means of cast on flanges to BSEN 1092 for aboveground pipework and 'Tyton' joint for underground pipework with pressure class suitable for the working pressure involved but in no case less than PN 16.
- Flanged joints shall be made by using proper full faced jointing gaskets coated on both sides by an approved jointing compound approved by the Architect. Joints between flange and plain end pipe shall be made in accordance with the manufacturer's instructions.
- Pipes shall coat with bitumen coating outside and internal high alumina cement lining to potable, flushing water and drainage system.
- All bolts and nuts shall be made of stainless steel grade 316. Bolts shall be of hexagon head and shall be of adequate length such that at least three complete threads protrude through the hexagonal nut when the flange joint is fully tightened.
- Tailor made cleaning eye for ductile iron fittings shall be provided for the drainage disposal system excluding the flanged joint system.

(c) Galvanised Steel Pipes

- Drainage
  - Screw joints shall be used throughout, with beaded fittings for connecting to cast iron socketless with gasket joints.
  - No yarn shall be permitted in any joint, PTFE plumber's tapes shall be used throughout the installation.
  - Flanged joints shall be used on pipework to enable ease in removal of equipment or valves for inspection or repair. Flanges shall be of forged steel, flat faced slip on type in accordance with BSEN 1092 'Flanges and bolting for pipes, valves and fittings' with pressure class suitable for the working pressure involved but in no case less than PN10. Jointing face of the flanges shall be truly parallel to each other and in alignment. A suitable approved gasket of at least 1.5m thick shall be used between each jointing flange. Bolts shall be of hexagon head and shall be of adequate length such that at least three complete threads protrude through the hexagonal nut when the flanged joint is fully tightened. All bolts and nuts shall be stainless steel made.
  - No welded joint shall be allowed.

(d) UPVC pipes

- All UPVC pipes shall be jointed with sockets and fittings and as recommended by the UPVC manufacturer.
- Solvent cement joints shall be used for all pipework, particular paid to preparation. All the surfaces shall be cleaned with abrasive paper and spirit cleaner. When applying solvent, heat shall be avoided as the cement may dry before chemical bonding between the two surfaces is completed. Mating surfaces shall be turned for even spread of the solvent. Excessive cement shall be wiped off quickly.
- Flange joints on water services shall be used where solvent welding is not practicable and for the connection of valves and at locations to facilitate dismantling. Factory cut neoprene ring gaskets with approved by the Architect Jointing paste shall be used between flanges. The jointing medium must be in accordance with manufacturers recommendation.

(f) Different material pipe connection

The Contractor shall provide special make fitting, coupling, adapter, viking joint or manufacturers recommendation on the joint for the different material pipes connection.

### **1.6.13 Pipe Sleeves**

Where pipes pass through walls, floors, beams, transfer plate and the like, the Contractor shall provide pipe sleeves to be cast-in by the Management Contractor. Sleeves for ductile iron, cast iron, galvanised steel and copper pipes shall be steel. Where sleeves are fitted through floors, they shall extend to at least 20mm clear above the level of the finished floor.

The space between pipe sleeves and the pipe or insulation shall be completely backfilled by the Contractor with materials having the same fire resistant rating as the walls and floors.

Sleeves shall be of sufficient size to allow free movement of pipes and furthermore where pipes are insulated the sleeves shall be oversized to allow the insulation to be carried through the sleeves.

Details of pipes through walls and floors shall be submitted to the Architect for approval before commencement of the installation.

The Contractor shall supply sleeves for setting in walls, floors, beams, and the like and in the shuttering before concrete is poured.

### **1.6.14 Pipe Movement and Expansion Joints**

Wherever possible, advantage shall be taken of changes in direction of pipes to take up expansion and contraction due to temperature changes of the pipe contents.

Expansion joints and movement joints shall be provided in pipes which cross the building expansion/contraction joints (150mm axial expansion) and elsewhere to absorb the effect of expansion/contraction on pipes whether shown on the Drawings or not. Movement joints with 100mm lateral movement shall be provided for building settlement at the building joints and ground settlement.

The estimated figure of ground settlement is of 50mm:-

- PS.PD-01/13 -

The figures stated above are indicative only. The Contractor shall however verify the exact figure on site prior to submission of relevant equipment.

Expansion joints where required on plumbing services shall be stainless steel bellows type with inner and outer telescopic sleeves. The joints shall be suitable for a test pressure as specified herein for the pipes. Expansion couplings shall be used on waste pipes and rainwater pipes in accordance with the manufacturer's recommendations. Filled arch for all bellows shall be provided for drainage services.

Where movement points occur, couplings similar to Viking Johnson or equivalent as approved by the Architect shall be used so that building movement does not cause fracture or stress in the pipework.

Upon sizing and fixing expansion joints on pipes crossing the building expansion joints, the Contractor shall take into account, in addition to the expansion/contraction of pipes due to temperature changes, the effect of relative horizontal movement between the two parts of the building structure. Pipe guides shall be fitted on each side of each joint to keep the joint and pipe in true alignment according to the manufacturer's instruction.

#### **1.6.15 Pressure Reducing Valves**

Pressure reducing valves for water supply system shall be:-

- (a) In bronze body with stainless steel 316 piston for use in potable water supply system.
- (b) In bronze body with zinc free bronze trim or stainless steel grade 316 trim and sea water corrosion resisting reinforced nylon or rubber diaphragm suitable for sea water duty for use in flush water supply system.
- (c) Of fixed pressure type with reduced pressure range appropriate to the duty required.
- (d) With screwed joints for nominal sizes up to and including 50mm.
- (e) With flanged joints for nominal sizes from 65mm and upwards to B.S. 4504 : Part 1, rated at working pressure involved but in no case less than PN16.
- (f) With manufacturer's guarantee of performance for minimum 5 years. The certificate of warranty shall be handed over to the management team upon project handover.
- (g) Test certificate for each pressure reducing valve shall be submitted upon delivery to site.

#### **1.6.16 Water Tanks**

Fresh water tanks shall be fitted with double seal covers for manhole opening with locking devices.

### **1.6.17 Glass Reinforced Polyester (GRP) Water Tanks**

- (a) Where Glass Reinforced Polyester (GRP) water tanks are specified on the tender drawings, or where they are proposed by the Contractor in his shop drawings, the Contractor shall be responsible for preparing all necessary structural plans and calculations, which shall be endorsed by a Registered Structural Engineer, for the Architect's onward submission to and obtaining approval and consent from the Buildings Department.
- (b) Except for small GRP water tanks where separate guidelines are given in clause 6.2.6 below, the following particulars shall be included in the structural plans:-
- . Reference to design standards;
  - . Material specifications (e.g. material types, relevant compliance standards and mechanical properties, etc.);
  - . General arrangement showing the maximum designed capacity, the principal dimensions and thicknesses;
  - . Fabrication details of the major structural components;
  - . Fixing arrangement and details of the tank supports.
- Design calculations are also required to be submitted to substantiate the structural adequacy and integrity of the water tank and the base support.
- (c) The following documents shall be submitted for vetting and agreement by the Engineer prior to consent application by the Architect for the commencement of GRP water tank installation works:
- . Test reports issued by a recognized laboratory/organization to substantiate the mechanical properties of the fibre glass panel and its ability to withstand 6 times the design hydrostatic pressure; and
  - . Manufacturer's quality control details of the production of fibre glass panels and fabrication of the GRP tank.
- (d) Performance tests shall be carried out upon completion of the GRP water tank to satisfy the following requirements. The water tank shall be filled with water up to the overflow level at ambient temperature of the testings:-
- . Leakage tests - The assembled water tank should be tested to demonstrate that there will be no visible sign of leakage after standing for at least 48 hours.
  - . Deflection tests - The assembled water tank should be tested to satisfy that the deflection of the sides and bottom of the tank shall not exceed 1.0% of the depth of the tank and 10mm respectively after maintaining the full water load for at least 2 hours.
- (e) Upon satisfactory completion of the tests, the test reports shall be submitted for onward submission to the Building Authority.

- (f) For GRP water tanks with a volume capacity and height dimension not exceeding 8m<sup>3</sup> and 2m respectively, requirements described in clauses a, b and c above would normally not be required. However, the following particulars should be included in the structural plans:-
- . Location, principal dimensions, capacity and weight of the water tank;
  - . Reference to design standards and material specification of the tank; and
  - . Fixing arrangements and details, with calculations substantiating the structural adequacy of the tank supports.
- (g) For indoor GRP water tanks with a volume capacity and water head not exceeding 4m<sup>3</sup> and 1.2m respectively, only the following need to be included in the structural plans together with calculations substantiating the structural adequacy of the floor structure supporting the water tank:-
- . Location, principal dimensions, capacity and weight of the water tank.

#### **1.6.18 Traps for Floor Drains**

- (a) This Contractor shall provide and fix 100mm dia. cast iron antisiphone traps for floor drains in mechanical rooms as indicated on the Drawings.
- (b) This Contractor shall provide and fix 100 / 150mm dia. cast iron antisiphone traps for floor drains in surface channel / trapped gully.

#### **1.6.19 Automatic Infra-red Sensor for Sanitary Fittings**

Automatic infra-red sensor shall be:-

- (a) Provided to all wash basins, urinal and water closet for sea water use.
- (b) Of a.c. electrical supply operation with IP 65 enclosure.
- (c) Integrated into body of faucet.
- (d) Infra-red actuated with anti-blocking security system, flow regulator and stop valve with filter.

#### **1.6.20 Flushing Valve**

Flushing valve shall be:-

- (a) Of operated by push button and automatic infra-red sensor.
- (b) Of automatic time delayed shut-off.
- (c) Of self cleaning mechanism and filter.
- (d) Suitable for recessed mounting behind wall.

- (e) Installed for all water closets and urinal for sea water use.
- (f) Test certificate for 100,000 cycles issued by a recognized laboratory shall be submitted to the Architect for approval.

#### **1.6.21 Sanitary Fixtures**

Water closet shall be:-

- (a) Of wall hung construction.
- (b) Wall carrier for the closet.
- (c) Chrome plate inlet spud of sea water use.
- (d) Flushing operation controlled by chrome plate concealed type flush valve with built-in automatic infra-red sensor and manual push button, for sea water use.
- (e) Plastic seat and cover.
- (f) Chrome plated gunmetal angle valve with S.S. wall flange, plastic flexible tube and extension piece, etc.
- (g) uPVC pan connector / adaptor for back outlet water closet and / or uPVC floor connector with butter gasket for bottom outlet water closet.
- (h) Flushing water supply pipe together with Y-strainer and filter from flushing main to water closet.
- (i) All bolts and nuts for fixing fixtures and the assembly of their components shall be of stainless steel grade 316 (the size and length of the bolts / screws shall be submitted for approval).
- (j) S.S. or chrome plate brass wall flange for exposed 100mm diameter drainage pipe of connection to back outlet water closet,

Water basin shall be:-

- (a) Under counter top wash basin and / or wall mounted wash basin.
- (b) Supporting bracket for fixing under counter top wash basin and wall mounted type wash basin.
- (c) Lift up / anti-theft waste outlet fitting.
- (d) Faucet with built-in type infra-red sensor.
- (e) White plastic resealing bottle trap c/w anti-siphonage functions, chrome plate extension piece, S.S. wall flange and chrome plate screwed end connection pipe from bottle trap to the concealed waste pipe.

- (f) Chrome plated angle valve with S.S. wall flange, chrome plate flexible tube and extension piece, etc.
- (g) All bolts and nuts for fixing fixtures shall be of stainless steel grade 316 (the size and length of the bolts / screws shall be submitted for approval).

Urinal shall be:-

- (a) Of urinal bowl construction.
- (b) Flushing operation controlled by chrome plate concealed type automatic flush valve with built-in automatic infra-red sensor for sea water use.
- (c) Concealed type wall bracket.
- (d) Sea water duty outlet fitting.
- (e) Stainless steel back inlet spreader for concealed pipework.
- (f) Plastic resealing bottle trap for without integral trap of urinal bowl c/w chrome plate extension pieces, S.S. wall flange and chrome plate screwed end connection pipe from bottle trap connected to concealed soil pipe in wall.
- (g) uPVC flushing water supply pipe from cistern to urinal.
- (h) uPVC or gunmetal wall flange connector for back outlet urinal.

Automatic sensor type soap dispenser (wall mounted) shall be:-

- (a) of wall mounted type.
- (b) integrate with infrared sensor for touch-free use.
- (c) controller supplied by DC power and complete with low battery indicator.
- (d) the capacity of battery shall be able to provide up to 10,000 cycles of dispenses.
- (e) all parts of the dispenser shall be detachable for quick and easy maintenance.

Automatic sensor type soap dispenser (deck mounted) shall be:

- (a) of deck mounted type to counter top.
- (b) integrate with infrared sensor for touch-free use.
- (c) controller supplied by AC power.
- (d) with three plugs and including the extension cords and all necessary accessories.

### **1.6.21 Perforated Sub-soil Strip Drain**

Perforated sub-soil strip drain shall be:-

- (a) Of high density polyethylene interconnected corrugated pipe including all necessary connectors, couplers and all accessories.
- (b) Material of geotextile and core shall be of polypropylene and polystyrene respectively.
- (c) Compressive strength of core shall be minimum 383KN/m<sup>2</sup>.
- (d) Wrapped with non-woven geotextile needle-punched polypropylene filter fabric.

### **1.6.22 Proprietary Made Recessed Type Cover and Frames for Manhole and Valve Pit shall be:-**

- (a) Construction of 6mm thick hot dip galvanized steel complying with BS 729.
- (b) Double-seal for drainage manhole.
- (c) Cover in various depth to accommodate floor finish depth.
- (d) Triangular lifting points.
- (e) Marking for stating service of cover.
- (f) Comply to BSEN 124 Class C250.

Test report and certificate on compliance to BSEN 124 issued by a recognized laboratory shall be submitted to the Architect for approval.

### **1.6.23 Cast Iron Manhole Cover and Frames**

- (a) Standard manhole cover and frames : cast iron to BSEN 124 Class D400 coated with 2 coats of bitumastic paint.

Size and weight:

560mm diameter for storm water manhole;  
510mm square for sewage and waste manhole;  
64kg standard weight.

- (b) Double-seal manhole cover and frames : cast iron to BSEN 124 Class D400 coated with 2 coats of bitumastic paint.

Size and weight:

660mm diameter for storm water manhole;  
610mm square for sewage and waste manhole;  
68kg standard weight;  
113kg for heavy-duty cover.

- (c) Heavy-duty manhole cover and frame : cast iron to BSEN 124 Class D400 coated with 2 coats of bitumastic paint.

Size and weight:

560mm diameter for storm water manhole;  
510mm square for sewage and waste manhole;  
102kg standard weight.

Heavy-duty, manhole cover and frame shall be used for all carpark levels and G/F external and internal area subject to vehicular loading.

- (d) Trapped gully: constructed with concrete of design mix grade 25D/20 with hinged cast iron grating and salt glazed ware or cast iron trap of appropriate size to match with the drain pipes and set in concrete surrounding as shown on the drawings. Provide 75mm x 75mm concrete curbs as receptor as required.
- (e) Back inlet trapped gully : similar to (i) but include a square stainless steel cover and a diameter galvanized steel vent pipe as shown on the detail drawings.
- (f) Channel cover : capable of withstanding 350KN test load (for EVA), or shown on the drawings.

**1.6.24** Construction of brackets and hanger exposing to weather shall be of stainless steel grade 316.

## **1.7 Material and Equipment**

### **1.7.1 Selection**

Selection of equipment and materials shall be based on the drawings and design criteria given in this specification and data given in the Equipment Schedule. Within this Contract all materials which are of a common nature shall be supplied from a single manufacturer.

### **1.7.2 Samples to be approved by the Architect**

A sample board containing samples of materials and accessories which shall be supplied by the Contractor shall be shown to the Architect, and shall receive his written approval before the commencement of the installation works. A label bearing the name of the Contractor, the title of the Contract, the name of the manufacturer and the specific service for which the material or accessory is to be used shall be attached to each item. Approved sample board shall be displayed in the Site Office during the whole of the Contract period. The Contractor shall supply sufficient samples of materials as required for testing purpose.

### **1.7.3 Equipment Catalogue and Manufacturer's Specification**

Equipment catalogue and manufacturer's specification related to proposed item of equipment shall be specific and shall include all information necessary for the Architect to ascertain the equipment comply with this specification and drawings. Data and sales catalogue of a general nature will not be accepted.

Equipment catalogue and manufacturer's specifications must be submitted for the examination and approval of the Architect before any equipment is to be ordered.

#### **1.7.4 Technical Information Required**

All equipment and materials shall be approved by the Architect in writing before installation. The Contractor shall be fully responsible for delays and problems arising from his late submission of required information and from his failure to provide adequate information or acceptable equipment.

The Contractor shall be required to demonstrate at site that the duties required of the equipment included in this Contract are obtainable.

Physical sizes of all equipment shall be suitable for the spaces allocated for the accommodation of such plant and equipment, taking into account the requirement on access for maintenance purposes.

#### **1.7.5 Operation and Service Manuals**

Six(6) sets of the Operation and Service Manuals for each item of equipment shall be provided by the Contractor within a period of two weeks after the certified date of completion of the works.

The manual shall include the following:-

- (1) Description of the systems and equipment installed;
- (2) Details and frequency of maintenance recommended;
- (3) List of spares and their local agent's names, addresses and telephone numbers;
- (4) Method of operation of all systems;
- (5) Equipment Schedule;
- (6) Catalogues and performance data of all items of equipment;
- (7) Correct settings of protection devices.

#### **1.7.6 Spare Parts List**

The Contractor shall provide within a period of 14 days after the practical completion, two copies of complete manufacturer's spare parts catalogue of the equipment offered together with a priced schedule for the supply of the manufacturer's recommended spare parts against a separate order. The price quoted shall remain valid for at least twelve months and must include for the clear labeling of each item.

#### **1.7.7 Special Tools**

The Contractor shall supply in this Contract any special tools required for the operation and maintenance of the plant.

## **1.8 Drawings**

### **1.8.1 Tender Drawings**

Tender drawings are diagrammatic and indicate the general arrangement of system and work included in the Contract. The architectural drawings and details shall be examined for exact location of fixtures and equipment. Where they are not definitely located, this information shall be obtained from the Architect.

### **1.8.2 Combined Services Drawing and Combined Builder's Work Drawing**

The Contractor shall coordinate with other Building Services Nominated Sub-Contractors for all services and equipment installations. Upon finalization of coordination, the Contractor shall submit the combined services drawing and combined builder's work drawing (both including Building Services Installations) for the Architect's approval.

Drawings shall be prepared on the following metric scales:-

Floor plans and sections	:	1:50
Plant room layouts and sections	:	1:20
Details	:	1:10

### **1.8.3 Shop Drawings to be Approved**

The Contractor shall submit to the Architect for approval six(6) sets of detailed shop drawings of all equipment and work for the installation. No equipment shall be delivered to site and no work shall be executed until such drawings are approved.

Drawings shall be prepared on the following metric scales:

Floor plans and sections	:	1:50
Plant room layouts and sections	:	1:20
Details	:	1:10

### **1.8.4 Responsibility of Main Contractor not Relieved by Approval**

Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. The approval of any shop drawings does not relieve the Contractor from his responsibility or necessity of furnishing material or performing work as required by this specification, the particular specification and drawings.

### **1.8.5 Failure to submit Shop Drawings in Time**

Failure of the Contractor to submit shop drawings in ample time shall not entitle him to an extension of Contract period, and no claim for extension by reason of such default will be allowed.

### **1.8.6 Number of Copies of Shop Drawings to be Provided**

The Contractor shall provide at least eight (8) copies of approved shop drawings for distribution by the Architect.

Drawings shall be prepared on the following metric scales:

Floor plans and sections	:	1:50
Plant room layouts and sections	:	1:20
Details	:	1:10

### **1.8.7 Checking Drawings of Other Trades**

The Contractor shall follow drawings in laying out work and check drawings of other trades to verify spaces in which work will be installed. Maximum headroom and space conditions shall be maintained at all points. Where headroom or space conditions appear inadequate, the Architect shall be notified before proceeding with installation.

If directed by the Architect, the Contractor shall without extra charge, make reasonable modifications in the layout as needed to prevent conflict with work of other trades of the proper execution of works.

### **1.8.8 Government Department's Submission Drawings**

This Contractor shall make submissions to the relevant Government Departments whenever directed by the Architect/Consulting Engineer.

Prior to formal submission to the Government Departments, this Contractor must put forward the submission drawings to the Architect/Consulting Engineer for vetting/endorsement in any circumstances.

For any changes made on the submission drawings which deviated from the original design as set out in this Contract, prior approval/confirmation shall be obtained from the Architect/Consulting Engineer before the formal Government submission.

Should this Contractor fails to comply with the above requirements, no claims for additional cost nor extension of time shall be entertained in which caused by this unauthorized amendment.

Moreover, all rectification works resulting from such unauthorized amendments shall be carried out by this Contractor at his own expense without reimbursement from the Employer.

### **1.8.9 As-fitted Drawings**

- (1) After completion and before the acceptance of the installation, the Contractor shall provide 'as-fitted' drawings of the whole installation one(1) set in black ink lines on transparent linen or other approved ground, one(1) set in CD-Rom copy and six(6) sets prints. Drawings shall show all ductwork, piping, equipment, electrical wiring, maintenance accesses, maintenance facilities and all necessary details for the proper maintenance and operation of the system.

- (2) Each drawing shall also bear the name of the installation, name of Contractor and title of the work or equipment arranged in a similar manner to the contract drawings.

Drawings shall be prepared on the following metric scales:-

Floor plans and sections	:	1:50
Plant room layouts and sections	:	1:20
Details	:	1:10

- (3) For the drainage installation. The Contractor shall submit the as-fitted record drawings at least two months before completion for submission to the relevant Government Department.

### **1.9 Supervision**

The Contractor is to employ on the supervision of all work on site, one or more qualified supervising engineers.

The Contractor shall also employ full time on site a competent foreman for each trade.

The Contractor shall replace any supervising engineer or trade foreman whose experience, skill or competency is in the opinion of the Architect inadequate for the particular work.

### **1.10 Programme of Works**

The Contractor shall commence the works immediately he is awarded the Contract and he shall proceed with the same with all speed and in such order as to conform strictly to the Building Programme.

The Contractor shall submit to the Architect a detailed programme showing his intended method, stages and order of proceeding with the works, together with the period of time he has estimated for each and every stage of progress within two weeks after award of Contract.

### **1.11 Protection**

The Contractor shall protect all works and materials from damage by his work and workmen, and shall be liable for all damage thus caused.

The Contractor shall be responsible for work and equipment until finally inspected, tested and accepted; he shall protect work against theft, injury or damage, or inclement weather; and shall carefully store material and equipment received on site which are not immediately installed and provide covering for the protection of work installed. He shall close open ends of work with temporary covers or plugs during storage and construction to prevent entry of foreign material.

## **1.12 Builder's Works**

### **1.12.1 Foundations, Footings, Trenches, Holes Openings shall be provided by the Contractor**

All concrete foundations, footings, pits chases, ducts, trenches, holes, drains and other facilities required for the installation shall be provided by the Contractor. The Contractor shall supply, in good time, full particulars of these together with the weights of the various pieces of equipment when installed and working. Builder's works drawings shall be submitted to the Architect for their onward submission to the Structural Engineer for approval.

### **1.12.2 Cutting Away and Making Good**

All cutting away and making good of concrete works necessary or required for the works shall be carried out by the Contractor.

The Contractor is to minimize the amount of cutting away and making good by giving timely instructions for the leaving of holes and ways and shall from time to time supply drawings and mark out on the site and give the necessary details for all cutting away and preparing of ways. The Contractor shall see that the work is carried out in accordance with his requirements and he will be charged the cost of all work and material for any unnecessary cutting away and making good.

### **1.12.3 Sleeves and Plates**

The Contractor shall locate all sleeves and inserts required before the floors and walls are built.

Positioning through all structural elements shall be approved by the Architect. The Contractor shall submit sleeve and opening drawings (6 copies) to the Architect for approval immediately after the award of Contract.

Sleeves shall be provided for all mechanical piping passing through concrete floor slabs and concrete, masonry, tiles and gypsum wall constructions. Sleeves shall not be provided for piping running embedded in concrete.

Where sleeves are placed in exterior walls below grade, the space between the pipe or conduit and the sleeve shall be packed with caulking and lead and made completely watertight.

Where pipe motion due to expansion and contraction will occur, make sleeves of sufficient diameter to permit free movement of pipe. Where sleeves pass insulated pipes, the sleeves shall be large enough to pass the pipe and insulation.

Floor and wall construction finishes shall be checked to determine proper length of sleeves for various locations: actual lengths to suit the following are required:

- (1) Sleeves flush with walls, partitions and ceilings;
- (2) All sleeves shall be extended 25mm above finished floor.

Sleeves shall be of steel construction.

Sleeves shall be fastened securely in floors, walls so that they will not become displaced when concrete is poured or when other construction is built around them. Precaution shall be taken to prevent concrete, plaster, or other materials being forced into the space between pipe and sleeve during construction.

The Contractor's attention is drawn to the vertical pipe ducts. At all floor levels in the building, the ducts are to have floor slabs and where pipes pass through these, sleeves are to be provided.

The gap between pipe and its sleeve shall be firmly packed with fiberglass blanket material. However, for pipe/sleeves through fire barriers, the gaps must be firmly sealed with soft packings having a period of fire resistance equal to the fire barriers. The ends of sleeves shall be caulked with non-hardening mastic to the Architect's approval.

Details of pipes through walls and floors shall be approved by the Fire Services Department and the Architect before installation.

#### **1.12.4 Waterproofing**

Where any work pierces waterproofing including waterproof concrete, the method of installation shall be as approved by the Engineer. The Contractor shall provide all necessary sleeves, caulking and flashing required to make openings absolutely watertight.

#### **1.12.5 Equipotential Bonding**

Provide screw holes or other suitable connection points to all service pipes, ducts, metal fittings, etc. for the purpose of connecting equipotential bonding conductors by the Electrical Contractor.

#### **1.13 Guards or Railings**

The Contractor shall provide readily removable guards or railings for moving or rotating parts. Guards shall consist of heavy angle iron frames, hinged and latched, with heavy galvanized iron wire crimped mesh securely fastened to frames. Railings shall be 1.5 inch (40mm bore) G.I. pipe matching railing fitting of similar metal.

#### **1.14 Labels**

The Contractor shall provide labels for all equipment, fuses, terminals, lamps, switches, handles, keys, instruments, gauges, valves, circuit, wiring and piping diagrams, indicators and wherever their provision will facilitate the attainment of the objects of the Operation and Maintenance design clause.

Each label shall be made from sandwich type plastic material, with black outer layers and white inner layer. Lettering shall be engraved by cutting away one of the outer layers to the outline of the required letter, exposing the white layer underneath. All lettering will be in English with a translation into Chinese adjacent to it.

### **1.15 Workmanship**

All work shall be installed in a first-class, neat and workmanlike manner by tradesmen experienced in the trade involved and acceptable to the Architect.

All plumbing works shall be carried out by an approved licensed plumber and registered contractor to the requirements of the Water Authority and Building Authority.

### **1.16 Services Co-ordination**

The Contractor shall obtain the latest technical information, details and layouts of other services and latest architectural and structural drawings from the Architect and shall complete co-ordination of his works with other trades for a neat, workmanlike installation. The co-ordination shall be reflected in this shop drawings and actual installation.

The Contractor shall be responsible for costs of taking down installed works, re-fixing etc., as a result of his lack of and/or improper co-ordination and co-operation among his contractors.

### **1.17 Training and Maintenance**

**1.17.1** The Contractor shall provide adequate training of the Employer's staff, until they are fully familiar with the operation and maintenance of the complete installation.

**1.17.2** The Contractor shall carry out servicing and maintenance of all the works included in the Contract for a period of twelve(12) months from the date of practical completion of works certified by the Architect. The Contractor shall provide competent technicians to take responsibility for the maintenance of the works.

The service and maintenance shall include systematic checking, adjustment and testing of all equipment. The Contractor shall also repair or replace parts of equipment whenever this is required and shall only use genuine standard parts provided by the manufacturer of the equipment concerned.

**1.17.3** The maintenance work shall include, but not necessarily be limited to, the following to satisfy requirements of the Contract:

- (1) Repair or replace all malfunctioning contactors, starters, fuses indicating lamps, motors, pumps, etc.;
- (2) Clean and lubricate all pump shafts and bearings;
- (3) Inspect conditions of equipment operating in site as directed but not less than once per month;
- (4) Maintain pumps and valves packings, clean and grease spindles of valves as necessary;
- (5) Upon instruction by the Employer, whether face to face, or over telecommunication devices, etc., in case of emergency or when there is operation defects discovered in the supplied installation, the Contractor shall provide qualified engineers and technicians on 24-hour-on-call basis to take responsibility for the maintenance/rectification and operation of the supplied installation works.

- (6) At the completion of the twelve months maintenance period, a functional test shall be carried out to demonstrate that the entire system is in good working condition. Any defect found during such functional test shall be remedied by the Contractor with no additional charge to the Employer.

**1.17.4** The Contractor shall submit six(6) months before the date for completion the proposed staffing levels and grades for the maintenance works. Should the Employer/Architect feel that the staff on the site are too few, then the Contractor shall dispatch to the site immediately the staff so instructed by the Employer.

**1.17.5** The Contractor shall also provide all equipment and materials including consumables necessary to maintain, operate, repair and overhaul the installation on a routine basis during the Free Maintenance Period.

## **1.18 Painting**

**1.18.1** In addition to special painting and finishing specified elsewhere, the Contractor shall allow for painting after erection all plant and equipment including (but not by way of limitation) motors, pumps, piping hangers brackets and supports insulation etc., provided under this Contract and requiring to be painted.

**1.18.2** All metallic surfaces shall be wire-brushed and cleaned from rust, scale, dirt, and grease and shall then be painted one coat approved priming paint, not less than two approved undercoat and approved high gloss finishing coat.

Galvanized steel pipework in service ducts and false ceiling spaces need not be painted.

**1.18.3** The primer shall be genuine red lead paint, the remainder genuine oil paint.

**1.18.4** All paints to be heat resisting where required. Colours for painting to be selected by the Architect and different colours will be selected for different items and locations. The type of paint to be used shall be approved by the Architect before use.

## **1.19 Labelling**

**1.19.1** All plant and equipment provided under this Contract shall be labeled in both English and Chinese as to duty or services, all such labeling to correspond to schedules, diagrams, etc. to be provided as part of the Record Drawings. Labels generally to be 'Perspex' reverse engraved with red lettering, or as otherwise required by the Architect.

**1.19.2** The following refers to specific items (but not by way of limitation) requiring labeling:

- (1) All valves, motor starters, distribution boards, wirings, isolators, and pumps, etc.
- (2) Labels shall be attached to valves (or pipe adjacent thereto) with a light gauge metal band. Distribution boards, starters, etc. are to be labeled to indicate the circuit number, phase, and item controlled.

## **1.20 Identification of Systems**

**1.20.1** The Contractor shall submit colour banding of pipework for the Architect's comment before application.

**1.20.2** The colour bands shall be approximately 50mm wide and paint stenciled to pipes or insulation at intervals not exceeding 3000mm. Additional bands shall be provided adjacent to valves, crossovers and elsewhere, where required for identification.

**1.20.3** At reasonable intervals on straight pipes and adjacent to valves, coloured arrows shall be stenciled to the insulation or pipework to indicate direction of flow, where the finish is unpainted, metal bands and discs shall be fitted for colour identification specified above.

## **1.21 Operating Tests**

**1.21.1** The Contractor shall ensure to the satisfaction of the Architect that the installation or portion thereof which has been set to work complies with all requirements including the following:-

- (1) That the plant and apparatus is of robust construction and of capacity for the duty specified;
- (2) That all valves, switches, controls, etc. are regulated and capable of proper operation and in the case of valves that they are capable of tight shut-off;
- (3) That all apparatus is silent;
- (4) That all instruments are correctly calibrated and read accurately;
- (5) That all services are tested in accordance with the details of the relevant clauses of this specification.

**1.21.2** Prior to start-up and after satisfactory hydraulic testing, all piping systems shall be flushed and drained at least once through to get rid of contaminating materials.

All strainers shall be inspected and cleaned out or replaced.

When the entire plumbing systems are reasonably cleaned, a pretreatment chemical shall be introduced and circulated for at least 8 hours. Warning signs shall be provided at all outlets during pretreatment. The pretreatment chemical shall:

- (1) Remove oil, grease and foreign residue from the pipework and fittings;
- (2) Pre-condition the metal surfaces to resist reaction with water or air;
- (3) After pre-treatment, the system shall be drained and refilled with fresh water and left until the system is put into operation;
- (4) Details and procedures of the pretreatment shall be submitted for approval.

## 1.22 Closed Circuit Television Surveys

**Closed circuit television (CCTV) surveys shall be used to investigate the condition, in particular the structural integrity, of all existing and newly installed underground drains.**

The following equipment is required:-

- (a) A CCTV colour camera with integral lighting unit. The camera shall be a type designed and constructed for the specified purpose and shall be capable of operating in 100% relative humidity. The camera shall be fitted with a rotating mirror for completely circumferential viewing. The system shall be capable of producing a clear and high quality picture of the entire periphery of the pipelines on the monitor screen and recording tape. The camera and lighting unit shall be mounted on a self-propelled crawler or on skids linkage to a manual or power operated winch.
- (b) A monitor screen which displays the camera view during the inspection. The monitor screen shall be housed in covered accommodation with facilities for inspection by the Consulting Engineer and others.
- (c) A screen writer which displays on the monitor screen details of the inspection including date, location, pipe material, diameter of pipe direction of view and comments on the condition of the pipe.
- (d) A measuring device which displays the camera location automatically on the monitor screen. The device shall be capable of measuring the location to within an accuracy of 0.1% of the length of the pipeline or  $\pm 0.3\text{m}$  whichever is the greater.
- (e) A control unit which controls camera movement, lighting intensity focusing and recording.
- (f) A VHS video recording system to record the inspection and information displayed on the monitor screen.
- (g) A 35mm single lens reflex (SLR) camera capable of producing photographs with the date.

The procedure shall be as follows:-

- (a) The camera shall be moved through the pipeline in the direction instructed by the Consulting Engineer at a speed not exceeding 0.15m/s. If the camera cannot pass through the complete pipeline in one operation, the inspection may be carried out from both ends of the pipeline.
- (b) The camera shall be stopped whenever instructed by the Consulting Engineer to allow inspection by the Consulting Engineer.
- (c) The video system shall be operated during the complete inspection to provide a continuous record of the inspection and information on the monitor screen.

- (g) (cont'd)
- (d) Photographs of the monitor screen shall be taken whenever instructed by the Consulting Engineer.
- (1) Records of the inspections shall be kept by this Sub-Contractor on the Site and a report shall be submitted to the Consulting Engineer within 14 days of completion of the inspection. The report shall contain the following details:-
- (a) key map showing pipelines inspected and associated manholes, chambers and structures,
  - (b) tables listing details of inspection, including date, location, pipe materials, diameter of pipe, chainage, manholes, junctions and other features and the condition of pipes and joints; the condition of pipes and joints shall be illustrated by a coding systems in accordance with the annual of 'Sewer Condition Classification' (1980) published by the U.K. National Water Council, and
  - (c) a summary showing the number and type of defects in each pipeline inspected.
- (2) The following items shall be submitted at the same time as the report:-
- (a) video film providing a continuous record of the inspection and information on the monitor screen, and
  - (b) photographs of the monitor screen including date and chainage; the photographs shall be 3R size and shall be mounted in photograph albums.

CCTV surveys shall be conducted during low flow conditions. If the flow quantity is large, the drain system shall be temporarily blocked and the flow diverted. An adequate lighting system shall also be adopted so as to produce a clear picture of the drain. Pipes which are silted and the surfaces coated with grease shall be cleared prior to the survey.

The scoring system on the CCTV result in accordance with the Sewerage Rehabilitation Manual by the Water Research Centre (WRC, 1986) shall be adopted to determine the priority of remedial works and the future inspection programme.