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PLUMBING SYSTEMS

1.0 GENERAL REQUIREMENTS

1.1 General

a) Scope:

The work included in this section consists of providing and installing a complete system of Potable Water Distribution System, Sanitary Sewerage System, Storm Water Drainage System, Plumbing Fixtures, Drainage Lift Pump, Pumping equipment, Sewer Appurtenances, Miscellaneous Items, Make-up Water filling System as per drawings and specifications including all labor, materials, equipments, tools and tackles and implements necessary for the execution and completion of the entire system.

b) General:

The work will be carried out to the strict requirements and directions of the Consultant and complete to his entire satisfaction and conform to the good sanitary practices.

The Contractor shall appoint and keep for all times during the currency of this contract qualified plumber holding – license from local bodies and fully competent technicians of the required trades.

The Contractor shall be deemed to have visited and/or inspected the site prior to tendering to apprise himself of the condition under which the work will be executed.

The Contractor will have to coordinate this work with other civil works in such a manner that all works are completed within the accepted time of completion of the civil works.

The Contractor shall be deemed to have thoroughly studied the specifications and drawings.

The Contractor shall allow in his price for all cutting charges and holes and subsequently repairing these in a workmanlike manner. No claim will be allowed on this account.

The Contractor shall include in his price for painting all pipes with one primer and two finishing coats of approved make and shade enamel paint.

The Contractor shall at his own expense, get the entire system tested or retested to the satisfaction of the Consultant.

c) Method of Testing:

Water system shall be tested in the following manner and cost of testing including all damaged pipes shall be deemed to be included in the price of water supply works:

Initial testing (individual testing).

Progressive testing.

Final testing.

d) Individual Testing:

In initial testing pipes shall be tested individually over a test bed consisting saddles, thrust plate and force pump with a pressure gauge. The thrust plate shall be strong enough to resist a pressure equivalent to double the test pressure i.e. 150 psi pipe

shall be placed over test bed with one end inserted into thrust plate groove and the other plugged water-tight and to pump forcing water with pressure.

Pump shall be operated to buildup to required pressure in pipe i.e. 150 psi. After the test pressure is reached the pump shall be stopped and pipe shall be watched for 6 hours for any drop in pressure and any visible leaks. Any pipe showing leaks or pressure drop beyond 5 psi shall be rejected and removed from site.

e) Progressive Testing:

Test shall be made after roughing in and before walls ceiling and floors are finished. Water under pressure shall be used, all the openings in the installation shall closed and pressure of 15 psi shall be developed in the system with the help of a bond force pump. After the required pressure has been obtained and pumps have stopped, the pipes shall be inspected by eye or ear for any leak and also for any pressure drops in the gauge. The test shall be performed in convenient segments during the course of work and provision of sufficient plugging tees and valves in the pipe line shall be made available for the purpose at the cost of the Contractor. The Contractor shall submit a time schedule for such tests.

f) Final Test:

The test shall be made with the same pressure as given above after the fixture has been installed and the system is completed.

g) Sewerage:

Method of Testing

(i) Initial Testing

After the completion of lying and jointing of the plumbing system it shall be tested to locate leakage connections or faulty installation the following procedure:

(ii) Water Test

For this test all the openings in the drainage pipe shall be closed. The openings shall be closed by – test plug which shall be inserted in the open end of pipe or fitting so that the heavy rubber gasket fits tightly all around. When all openings have been closed water shall be run into the pipes and the test pressure at the lowered end shall be built up by operating force pump. The drop in pressure the water after pumping is stopped, indicates the leakage that shall be subjected to pressure of 4.2 meter of water in pipes. This test shall be performed in convenient segments and provision for plugging etc. shall be done by the Contractor for this purpose.

1.2 SPECIAL REQUIREMENTS

a) General:

It is the intent of the drawings and specifications that all works, machinery equipment and piping fixtures be provided complete, tested adjusted and made ready for operation. The drawings and specifications shall be taken as a whole and not separately since they are intended to explain and illustrate each other.

Any apparatus, appliances, materials or work not shown on drawings but mentioned in the specifications or vice versa and any incidental accessories necessary to make the work complete in all respects and ready for operation, even if not particularly specified, or shown in the drawings shall be provided without additional expenses.

Minor details not usually shown or specified, but necessary for the proper installation and operation, shall be included in the work and in the Contractor offer, the same as if herein specified or shown.

b) Coordination:

The contract documents have been carefully coordinated to avoid overlapping or conflict, however, should any discrepancies by old between contract documents within a trade or between trades, they shall be immediately reported to the Consultant so that the required revision, or work directive may be issued to all parties concerned, at the earliest possible date.

c) Coordination With Other Traders:

The Contractor shall cooperate with other trades and furnish and/or exchange the information necessary to permit the work of all trades to be installed satisfactory and with the least possible interference or delay.

Contractor shall be responsible for all setting plans, templates, shop drawings, and layout diagrams to assure installation of equipment in proper space relationship to other equipment and Contractor so that the equipment shall be operate-able in accordance with completion schedule as set forth.

d) Standard Specification:

In all cases where standard specifications, such as BSS, ASTM and the like are referred to in these specifications, the latest revision in effect at the time of bidding, shall govern.

e) Materials & Equipment:

Unless otherwise specified, all materials and equipment provided shall be new and shall conform to the grade, quality and standards specified herein.

Materials and equipment provided under these Specifications shall be limited to products regularly produced and recommended by the manufacturer for the service intended. This material and equipment shall have capacities and ratings sufficient to amply meet the requirements of the project. The capacities and ratings shall not be in excess of those published by the manufacturers but must be in accordance with the engineering data or other comprehensive literature made available to the public by the manufacturer and in effect at the time of opening bids.

Sanitary fixtures shall be installed in strict accordance with manufacturer's instructions for type and functioning of each piece if fixture used.

These instructions from the manufacturer shall be considered part of these specifications. Type, capacity and functioning shall be guaranteed suitable and shall operate satisfactory in the system, for the purpose intended.

f) Drawings:

The drawings have been made to scale with the best knowledge of conditions, dimensions and space requirements available at the time of drafting. Any error, or discrepancies detected in the drawings shall be reported to the Consultant immediately upon discovery for the attention and instruction and as to further procedure.

The contractor shall follow drawings in laying out work and check drawings of other trade to verify space, in which the plant will be installed, Maintain maximum headroom and space condition at all points. Where headroom or space condition appear inadequate the drawings shall be modified and approved by the Consultant before proceeding with the installation and if directed by the Consultant before proceeding with the installation and if directed by the Consultant reasonable modifications made in the layout as needed without extra charges; to prevent conflict with the work of other trades or for prior execution of the work. Where variations occur between the drawings and the specifications or either documents itself the item or arrangement of better quality and/or greater quality, shall be included into the contract price. The Consultant will decide on the items and manner in which the work shall be installed.

g) Approval of Materials & Equipment:

The materials, workmanship, design and arrangement of all work installed under the contract shall be subject to the approval of the Consultant. Reference to model, type

or figure number of particular manufacturer is done solely for the purpose of indicating the standard of quality, type character and finish desired. Equipment manufactured by other companies of comparable design and configuration, meeting all the specific requirements of the item number may be acceptable when approved by the Consultant.

The Contractor shall submit to the Consultant for approval within fifteen (15) days after the acceptance of the bid, a complete list of manufacturers of sanitary fixtures and materials, along with detailed catalogues. All other items shall be provided in accordance with the detailed specifications. The Contractor's intent to use the exact marks specified does not relieve him of the responsibility of submitting such a list. Where any equipment, materials process or method of construction of manufactured article is specified by name or by reference to the catalogue number of manufacturer, use the specifications as a guide and not to take precedence over the basic duty and performance specified, as noted on the drawings. In all cases verify the duty specified with the specific characteristics of the materials offered for approval, if materials is installed before it is approved, the Contractor shall be liable for its removal and replacement at no extra charges to the Client if in opinion of the Engineer the material or equipment does not comply with the drawings and specifications.

h) Samples:

The Contractor shall submit samples of any and all materials for approval at the instructions of the Consultant.

i) Accessibility:

The Contractor shall locate all equipment which must service operated or maintained in fully accessible positions, include, but do not limit access to valves, traps, clean out, drain points and controllers, if required for better accessibility, furnish access doors for the purpose.

j) Open Ends:

Plug or cap shall be provided at all open ends in the piping, conduit and duct work system as the work is erected, in the order to keep out all foreign objects and water.

Contractor shall be responsible for removing from the system any foreign materials which could adversely affect the operation of the system.

k) Record Drawings:

The contractor shall during the progress of work keep a careful record of all changes where actual installation differs from that shown on the drawings. Upon completion of work the contractor shall furnish at this cost a completion set of tracings on which the contractor shall in neat and accurate manner make a complete record of all changes and revisions of the original design and as installed in the completed work.

The completion drawings shall be scrutinized and finalized by the Consultant and two sets of prints handed over to Consultant.

l) Other Works:

Builder's Works

Builder's work including foundations, cutting, patching and redecorating of construction is included in this contract. This work will be carried by the contractor at his own cost and arrangement. All cutting in the construction shall subject to the approval of the Consultant and shall subject to the approval of the Consultant and shall make good after completion on work to the entire satisfaction of the Consultant.

2.0 POTABLE WATER DISTRIBUTION SYSTEM

2.1 GENERAL

a) Scope

The extent of the potable water distribution system is shown on the drawings and includes pipe work, valves, fittings and miscellaneous appurtenances, chambers, related structures and testing and disinfecting the entire system.

b) Quality Assurance

i. Quality Control

Establish and maintain quality control to assure compliance with the specified requirements for all work to the satisfaction of the Engineer.

ii. Codes and Standards

Comply with the applicable requirements of the following Codes and Standards:

- IPC – International Plumbing Codes.
- AWWA – American Water Works Association
- ASTM – American Society for Testing and Materials

c) Submittals

Manufacturer's Data: Submit manufacturer's data, test certificates, specification and installation instructions for pipe, pipe fittings, valves and other accessories.

d) Material Delivery, Storage and Materials

i. General

At every point of loading or unloading, provide suitable means for lifting and loading. Do not unload by means of rolling down plank or other form of inclined ramp. Ensure that pipes, fittings and other items are kept dry, clean and adequately stored. Perform work in accordance with manufacturer's instructions and to approval of the Engineer.

ii. Handling of PPR Pipes

- Store PPR pipes in covered areas and protect from direct sunlight.
- During storage, ensure that PPR pipes are not distorted. Stack pipes on a level surface off the ground or in suitable racks. Ensure that sockets are situated at alternate ends. Install bearing timber at appropriate spacing and to sufficient width to prevent denting of pipes. Stack pipes only to the extent recommend by manufacturer. Provide adequate protective measures for pipes and other items in transit.

- Distorted, buckled or defective pipes shall not be used in the work.

2.2 MATERIALS

a) Polypropylene Random (PPR) Pipes and Fittings

- i. **Pipes and Fittings**
Provide PPR pipes and fittings that comply with DIN 8077-8078 PS45339-98 & 4534-99 Standard. Provide pipes that are suitable for installation depths, bedding and loading conditions and working pressure to which they will be subjected.
- ii. **Joints**
For pipe jointing, comply with DIN 8077-78.
- iii. **Testing**
Provide manufacturers certificate that testing of pipes and fittings complied with the specified requirements.

b) Gate Valves

Provide gate valves, conforming to BSS-1952 flanged or threaded ends and suitable for a working pressure of not less than 7 bar.

Provide valves designed to turn counter clockwise to open with indication arrows. Valves in chambers with hand-wheel or with operating nut and key as indicated and buried valves with operating nut and key. Provide not less than one (1) tee bar for every five (5) valves.

Carryout protection of surfaces of valves in chambers by the application of two (2) coats of approved oil paint to a total dry film thickness of not less than 0.15 mm.

c) Concrete Works

Concrete and all related works shall conform to Specification of Concrete. Provide anchor blocks, valve chambers, encasement concrete, etc. where required and indicated on drawings.

d) Pipe Embedment

Provide fine aggregate complying with ASTM C33 consisting of natural sand, manufactured sand or a combination thereof.

e) Equipment

All equipment necessary and required for the proper construction of water supply lines shall be on the project in first class working condition and shall have been approved by the Engineer before construction is permitted to start.

2.3 EXECUTION

a) Inspection

The Contractor shall examine the substrates and the conditions under which the potable water system shall be carried out and correct any unsatisfactory conditions.

Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

b) Excavation

- i. The width of the pit or trench for the structure shall be sufficient to permit satisfactory jointing of the pipe and / or pouring of concrete and thorough tamping of the bedding material under and around the structure, but it shall not be less than the external diameter of the pipe.
- ii. Where a firm foundation is not encountered at the design grade, due to unsuitable material, this soil shall be removed and replaced with approved fill material for the full trench width. The Engineer shall determine the depth of removal. The fill material shall be compacted to provide adequate support for the pipe.
- iii. Excavate trenches to the depth indicated or required and carry the excavation to a depth below the bottom of pipes for pipe embedment, or concrete encasement as indicated or directed.
- iv. Employ hand excavation methods when machine digging will cause damage to buildings or other structures, above or below ground. Wherever necessary to prevent caving, trench excavations in soils such as but not limited to sand, gravel and sandy soil shall be adequately sheeted and braced. Withdraw sheeting in increments of not more than 300 mm and fill and compact resulting void by the withdrawn sheeting. Pile all excavated material in a manner that will not endanger the work or obstruct walkways and roads.
- v. Provide and maintain adequate barricades, construction signs, warning lights, and guards to protect persons from injury and to avoid property damage during the progress of the work until the site is safe for traffic use. Rules and regulations of the Government regarding safety provisions shall be observed.

c) Pipe Laying

i. General

Install the potable water system generally in compliance with the lines and grades indicated on drawings and as herein specified.

- *PPR Pipes*

Install in accordance with the manufacturer's instructions.

- *Valves*

Install in accordance with manufacturer's written instructions unless otherwise specified or directed.

ii. Alignment and Grade

Lay and maintain pipes to the required lines and grades. Provide fittings, valves, hydrants, etc. at the required locations with joints centered and all valve and hydrant stems plumb. No deviations shall be made from the required lines for grade except with written consent of the Engineer.

d) Maintenance

Restoration and Cleanup: Restore and replace any removed or damaged paving, curbs, etc. or other disturbed surfaces and structures, to the satisfaction of the Engineer.

Removal all surplus pipe material, tools, temporary structures etc. Dispose of all dirt, rubbish, excess excavated material to approved dumping area, and leave construction site clean to the satisfaction of the Engineer.

e) Disinfection

Before the Engineer places in service and before certification of completion the pipeline, flush and disinfect the potable water system in accordance with AWWA C601, "Disinfection Water Mains".

2.4 CONNECTION FROM THE EXISTING SWEET WATER MAINS

The Contractor is required to conduct the survey of the proposed route from the point indicated on the drawing up to the existing mains from where water connection will be permissible. This item of bill of quantities includes survey, design and connection with water mains for sweet water from the water mains. The Contractor will submit his proposal for this work to the Engineer for approval, which shall include taking connection from the mains, providing and laying PE Schedule-80 water pipelines of appropriate diameters including all valves and specials, as required and connect with project pipelines.

3.0 SANITARY SEWERAGE SYSTEM

3.1 GENERAL

a) Scope

The sanitary sewerage system shall consist of all piping, manholes, sewage lift pumps and all ancillaries including connecting to the existing system as shown on the drawings.

b) Quality Assurance

- i. Establish and maintain quality control to assure compliance with contract requirements and local codes for all construction operations required under this Section.
- ii. Prior to shipment from factory, test all types of pipes and fittings at the place of manufacture. Submit to the Engineer for each consignment or shipment authenticated certificates to indicate that the manufacturer satisfactorily tests the pipes and fittings and found to comply with these specifications.

iii. Codes and Standards

Comply with the applicable requirements of the following codes and standards:

- IPC – International Plumbing Codes:
- Pipes for Potable Water of Un plasticized Plastic (Polyvinyl Chloride).

Methods of Testing of Pipes for Potable Water of Un plasticized Plastic (Polyvinyl Chloride).

- ASTM - American Society for Testing and Materials
- A 48 Specification for Gray Iron Castings
- A 126 Specification for Gray Iron Castings for Valves, Flanges and Pipe Fittings
- C 33 Specification for Concrete Aggregates
- C 270 Specifications for Mortar for Unit Masonry

c) General Requirements

- i. Connections to manholes shall be watertight after installation.
- ii. All piping shall conform accurately to the lines and grades shown on the Drawings.
- iii. Any connections for existing systems shall be made with a minimum amount of disturbance to the existing lines.

- iv. Any existing pipelines or structures which are damaged while making connections shall be replaced or reconstructed to the satisfaction of the Engineer without cost to the Employer.
- v. All piping shall be examined for defects. Any defective piece discovered after installation and test shall be removed and replaced by the Contractor at no expense to the Employer.
- vi. System shall be inspected and joints approved before any backfilling is placed over pipes.
- vii. All pipe and fittings shall be kept clean until final acceptance of work. The exposed ends of all uncompleted lines shall be closed with wooden plugs adequately secured at all times when pipe laying is not actually in progress.
- viii. All piping shall be installed on a good foundation and adequate means taken to prevent settlement.
- ix. The Contractor shall trim the bottom of trenches to receive the pipes and shall round out bottoms so that the pipe will rest firmly on 200 mm undisturbed sand at proper line and grade.
- x. All piping laid in trenches shall be provided with a solid uniform bearing throughout the entire length.
- xi. Trenches shall be kept free from water by pumping; use of well points, under drains or other approved means during pipe laying operations so that all pipe joints are made in dry areas.
- xii. Precautions shall be taken to protect incomplete work from flooding due to storms or other causes. All pipe lines or structures not stable against uplift during construction shall be thoroughly braced or otherwise protected.
- xiii. All work under this section shall conform to the requirements of the National Plumbing Code Handbook, International Plumbing Codes and Uniform Plumbing Code, unless otherwise specified hereinafter.

d) Submittals

- i. If an inspection of the completed sewer or any part thereof shows any structures, pipes or joints which are defective, the defective work shall be replaced or repaired immediately and to the satisfaction of the Engineer.
- ii. The Contractor shall perform, at his own expense, any tests or inspections required by local authorities. The Engineer shall witness the tests.
- iii. All joints shall be inspected and an inspection of the line as a whole shall show pipes to be true to line and grade with full circles visible at all manholes.

e) Material Delivery, Storage and Handling

- i. **General**

At every point of loading or unloading, provide suitable means for lifting and loading. Do not unload by means of rolling down planks or other form of inclined ramp. Ensure that pipes, fittings and other items are kept dry, clean and adequately stored. Perform work in accordance with manufacturer's instructions and to the approval of the Engineer.

ii. **Handling of UPVC Pipes**

- Store UPVC pipes in covered areas and protect from direct sunlight.
- During storage, ensure that UPVC pipes are not distorted. Stack pipes on a level surface off the ground or in suitable racks. Ensure that sockets are situated at alternate ends. Install bearing timber at appropriate spacing and of sufficient width to prevent denting of pipes. Stack pipes only to the extent recommended by manufacturer. Provide adequate protective measures for pipes and other items in transit.
- Distorted, buckled or defective pipes shall not be used in the work.

3.2 MATERIAL

a) **Un plasticized Polyvinyl Chloride (UPVC), Pipes and Fittings**

i. **Pipes and Fittings**

Unless otherwise indicated provide UPVC pipes and fittings that comply with British Standard. Provide pipes that are suitable for installation depths, bedding and loading conditions and working pressures to which they will be subjected.

ii. **Joints**

For pipe jointing provides rubber rings that comply with ASTM D 1869. Provide 2 rubber rings for each pipe joint.

iii. **Testing**

Provide manufacturer's certificates that testing of pipes and fittings complied with the specified requirements of BSC 15.

b) **Pipe Embedment**

Provide fine aggregate complying with ASTM C33 and consisting of natural sand, manufactured sand or a combination thereof.

c) **Concrete Works**

Concrete and all related works are to conform to Specifications of "Concrete".

d) **Thermal and Structure Protection**

Bituminous damp-proofing and joint fillers and sealants and all related works shall conform to British Standards.

e) **Manholes**

- Manholes shall have the minimum inside dimensions shown on the Drawings.
- Manhole walls shall be of poured-in-place reinforced concrete. Top section must be cast such as to suit elevation and accommodate size of manhole frame and cover.

- Manhole floor shall be of reinforced concrete and inverts stream lined with cement and mortar into a semi-circular path with sanitary turns and have their corners filled and sloped towards the water path to prevent any settlements of solids as detailed on the Drawings.
- Concrete foundation and benching for manholes shall be constructed in accordance with details as shown on the Drawings.
- All pipes or castings to be embedded in the manhole walls shall be accurately set, and if so required, headers shall be laid round the casting so embedded.
- All work must be carried out in a manner to ensure watertight work, and any leaks shall be caulked, repaired, or the entire work shall be removed and rebuilt. Attention is particularly called to the necessity of keeping the water level below all parts of the foundation and walls until the concrete has obtained adequate setting.

f) Frames, Covers and Gratings

- The Contractor shall furnish and set level and to the proper grade, a cast iron frame and cover or frame and grating of the form and dimensions shown on the Drawings. The concrete shall be neatly and accurately brought to the dimensions of the base of the frame. The frames shall be thoroughly embedded in mortar. All covers and frames shall be heavy-duty quality.
- All castings for frames, covers, and gratings shall be of gray iron unless specified in the BOQ/drawings. All castings shall be made accurately to dimensions and shall be machined to provide even bearing surfaces. Covers and gratings must fit the frames in any position and if found to rattle under traffic, shall be replaced. Filling to obtain tight covers will not be permitted. No plugging, burning-in or filling will be allowed. All castings shall be carefully coated inside and out with coal tar pitch varnish of approved quality.

3.3 EXECUTION

a) Inspection

The Contractor shall examine the substrates and the conditions under which the sanitary sewerage system shall be carried out and correct any unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

b) Excavation and Preparation of Trench

- i. Unless otherwise specified herein or directed on drawings, comply with the requirements of Specification of "Site Work", and "Concrete".
- ii. Open trenches only as far in advance of pipe laying in order to maintain continuity of operations. Keep trench and other excavations dry at all times, and lead drainage to natural drainage channels.
- iii. Trench width varies in respect to depth, nature of soil and pipe diameter. Maintain widths indicated on the drawings for at least 300 mm above crown of pipes. Where the trench crosses under a pavement or floor slab, hold width of

the trench to the absolute minimum. Trench width shall be minimum of O.D. + 600.

- iv. Excavate trenches to the depth indicated or required and carry the excavations to a depth below the bottom of pipes for pipe embedment, for the replacement of unsatisfactory soil materials, or for concrete encasement as indicated and specified.
- v. Provide and maintain adequate barricades, construction signs, warning lights, and guards to protect persons from injury and to avoid property damage during, the progress of the work until the site is safe for traffic use. Rules and regulations regarding safety provisions shall be observed.
- vi. Conduct excavations for pipe laying operations to cause the least interruptions to the traffic. Ensure that hydrants under pressure, valve pit cover, valve chambers and other utility controls are unobstructed and accessible during the construction period. Provide adequate provisions for the flow of sewers, drains and watercourses encountered during construction. Restore satisfactorily all structures and any property that has been disturbed to their original conditions.

c) Pipe Lying

i. General

The entire work of pipe laying and manhole construction shall be carried out in a manner to ensure watertight construction and any leaks shall be repaired as directed by the Engineer. Pipe laying shall proceed upgrade with the spigot ends' of bell and spigot pipes pointing in the direction of the flow.

ii. Standards

UPVC Pipes

Unless otherwise directed, install UPVC pipes and fittings in compliance with the manufacturer's instructions. Take adequate care and schedule operations to ensure protection of pipes and fittings against undue deflection and over stressing.

iii. Alignment and Grade

Lay and maintain pipes to the required lines and grades. Provide fittings, at the required locations with joints centred and watertight. No deviation shall be made from the required line or grade except with the written consent of the Engineer. Furnish temporary support, adequate protection and maintenance of all underground and surface utility structures, and other structures encountered during the progress of the work. Where the grade or alignment of the pipe is obstructed by existing utility structures, relocate, remove or reconstruct such obstruction as directed by the Engineer. Whenever necessary to determine the location of existing underground utility structures, after examining the available records, make all explorations and the Engineer may direct excavations for such purpose as. Lay pipes to the depth shown or as directed. Coordinate the levels, and routings of all utilities and services in order to avoid any interference prior to installation of the utilities and services.

iv. **Pipe Laying**

Unless otherwise indicated, lay pipes on a minimum 150 mm pipe embedment material shaped to provide continuous support for the pipe barrel between coupling holes. Before the pipe is lowered into the trench, provide the following:

- Level bottom of trench to the lines and grades indicated and fill in and compact a layer of pipe embedment material to a minimum of 150 mm compacted thickness.
- Excavate and form coupling holes with sufficient length, width and depth to permit assembly as required.

v. **Lowering of Pipe and Fittings into Trench**

Provide implements, tools and facilities satisfactory to the Engineer for the safe and efficient execution of the work. Carefully lower into the trench with suitable and adequate equipment all pipes and fittings and in a suitable manner that will prevent damage to pipes and fittings. Under no circumstances permit pipes and fittings to be dumped into the trench. Inspect pipes and fittings prior to their being lowered into the trench. Repair or replaced as directed all defective, damaged or unsound materials, remove all foreign matter or dirt from the interior of pipes and fittings before jointing. Keep pipe clean by approved means during and after laying.

vi. **Pipe Joints**

- *Jointing with Rubber Rings*

Immediately before assembly, clean ends of pipes to be jointed and the coupling grooves and rubber rings. Assembly shall be made as specified and as recommended by the manufacturer. Ensure by suitable gage that rubber rings are in the required position and pipes are well centred.

- Pipes shall not be deflected either vertically or horizontally more than the limits recommended by the manufacturer. When pipe laying is not progress, close the ends of installed pipes by an approved means, to prevent the entrance of foreign bodies, water, soil etc. into the line. No line shall be laid in wet soil conditions that preclude proper bedding or in the opinion of the Engineer, the trench conditions or the weather are unsuitable for proper installation. Seal socketed ends with approved flexible material to prevent entry bedding material.

vii. Pipes built into structure shall have two (2) flexible joints adjacent to the structure, obtained by the use of two short pieces as indicated.

viii. Stub out and stopper shall be installed in manhole walls where indicated or required for future connections. Ensure that the stub out is completely sealed by the stopper.

d) Pipe Embedment and Backfilling

i. Pipe Embedment Procedure

Unless otherwise indicated, provide pipe embedment material as specified. Deposit and compact material in the trench uniformly in layers of 150 mm maximum thickness at both sides of the pipeline for the full width of the trench and up to 300 mm above the top of pipeline. Well compact material below and all around the pipe to provide firm and continuous support. Ensure that the pipeline and protective systems are not displaced or damaged by the embedment operations.

- ii.** Provide concrete encasement to pipeline where indicated to dimensions and lengths specified on the drawings. Concrete for encasement shall have compressive strength of not less than 21.0 MPa. Protect pipeline from damage or displacement by the encasement operations. Provide appropriate concrete saddles to support pipes prior to encasement. Concrete encasement shall be discontinued for a length of 150 mm each side of the centreline of each pipe joint, to maintain flexibility of the pipeline.

iii. Backfill Remainder of Trenches and Around Structures

Backfill and compact trenches above embedment or encasement and around structures in layers of 200 mm compacted thickness and to a density as per area classification specified.

e) Leakage, Tests for Gravity Sewers

i. General

Except as otherwise directed, all pipelines shall be given leakage tests in sections of approved length. The Contractor shall carry out such tests after the partial trench backfilling has been carried out over the pipe barrel, excluding pipe joints, in order that pipes are not displaced during testing and that joints are apparent for inspection.

The Contractor may at his option carry out any preliminary tests he considers necessary before trench backfilling in addition to the leakage tests specified herein.

The Contractor shall furnish and install suitable and approved temporary plugs, supports and caps, all necessary pressure pumps, pipe connections, meters, gauges and other necessary equipment and labour required.

- ii.** Air or smoke shall be used for testing gravity sewer pipelines and the Contractor shall provide and, use equipment specifically designed and manufactured for the purpose of testing sewer pipelines using low pressure air or smoke.

iii. Tests by Air or Smoke

- Pipes shall be tested in accordance with ASTM C 828. The testing equipment shall be provided with an air regulator valve or air safety

valve so set that the internal air pressure in the pipeline cannot exceed a predetermined value approved by the Engineer.

- Pneumatic plugs shall have a sealing length equal to or greater than the diameter of the pipe to be tested. Pneumatic plugs shall resist internal test pressures without requiring external bracing or blocking.
- If the section fails to pass the requirements, the Contractor shall at his own cost do all work of locating and repairing leaks, removal and replacement of defective pipes, joints, couplings or fittings, making good and retesting as the Engineer may require and to his satisfaction. The Contractor shall be responsible for the ultimate tightness of the pipeline within the test requirements stipulated hereinabove.

f) Pressure and Leakage Tests for Pressure Lines

a) General

Unless otherwise, directed, comply with the applicable requirements of the general provisions of leakage tests for gravity sewers above.

b) Test

- The section of the pipe to be tested shall be filled with potable water and all air shall be expelled from the pipe. If blow offs are not available at high points for releasing air, the Contractor shall carry out the necessary excavation, backfilling, tapping at such high points and plug and make good any damage after completion of the test.
- The section of the pipe under test shall be maintained full of water for a period of 24 hours prior to the start of the pressure and leakage test.
- The pressure and leakage test shall consist of first raising the water pressure (based on the lowest point of the section under test and corrected to the gauge location), to a pressure equal to 0.8 Map. While maintaining this pressure, the Contractor shall make a leakage test by metering the flow of water into the pipe. If the average leakage during two (2) hours period exceeds a rate of 25 litres per 25 mm diameter per 24 hours per kilometre of pipeline, the section shall be considered as having failed the test. Furthermore, the pipeline shall have no visible leakage.
- If the section shall fail to pass the pressure test, or the leakage, test, or both, the Contractor shall at his own cost do all work of locating and repairing the leaks, removal and replacement of defective pipes, joints, couplings, or fittings, making good and retesting as the Engineer may require and to his satisfaction. The Contractor shall be responsible for the ultimate tightness of the pipeline within the test requirements stipulated hereinabove.

g) Maintenance

Restoration and Cleanup: Restore and replace any removed or damaged paving, curbs, etc., or other disturbed surfaces and structures, to the satisfaction of the Engineer.

Remove all surplus pipeline material, tools, temporary structures. Dispose of all dirt, rubbish, excess excavated material to approved dumping areas, and leave construction site clean to the satisfaction of the Engineer.

3.4 CONNECTING TO THE EXISTING SYSTEM

The Contractor is required to submit his proposal how he intends to connect the sewage generated from the end marked on the drawing to the designated manhole of the existing city sewerage system. The works include survey and pumping machinery with all structures and laying of pipeline to connect with the city existing system, complete. The Contractor is required to submit his proposed design to the Engineer for approval.

3.5 EXCAVATIONS

a) Trenching out Ground for Pipes and Tunneling:

Excavation for the drains in open trench shall be to the line and depth as directed. Great care shall be taken to excavate only to such depths as are correctly required for regular gradient.

Gap for joint as required shall have sufficient width to allow adequate working space for the pipe jointer and should in no case be less than 375 mm or the external diameter of the pipe plus 300 mm. Trenches are to be kept clear of water including any necessary pumping. Perform all tunneling for pipe when required. In the event of the excavation being made deeper than necessary they shall be filled up to proper level with cement concrete 1:4:8 at the contractor's expense. Cement concrete 1:4:8 is to be laid before the pipes are placed in position.

b) Planking, Strutting and Staging:

Excavation materials shall not be deposited within 45 cm of the edge of the trench and sides of the excavation shall be supported by planking and strutting if necessary to ensure proper and speedy excavation works.

c) Blasting

No blasting shall be allowed near new works. The rocks shall be excavated by chiseling except where otherwise allowed in writing by the Engineer.

d) Buried Services:

All pipes, ducts, cables, main and other services exposed by all excavation shall be effectively supported by timber or other means and protected from all kinds of damage. In case of any damage to the services, these shall be adequately repaired and restored to original condition by the Contractor at his own cost.

e) Backfilling:

No trench shall be backfilled until after the sewer pipes therein has been tested and approved by the Engineer. Earth filling to the bottom of the trenches and to a height of 150 mm above the top of the pipes shall be of selected materials, hand packed, watered, if necessary, and well rammed on either sides of the pipe. Special care shall be exercised where pipes are laid direct on the earth or no beds without benching or covers. The remainder of the earth filling shall be in 150 mm layers, each layer wetted, if necessary and well rammed with mechanical rammers or other efficient means for effective of consolidation. Where vegetable soil has been removed it shall be replaced at top of the trench and similarly consolidated. Headings shall be filled with the excavated materials, packed tightly in layers and rammed by hand on concrete of mix 1:3:6 or broken or hard core kept to a stepped face as the work proceeds. Surplus earth shall be disposed off as directed to the Contractor's expense. The trenches under paving shall be backfilled with local sand will compact to 97% density.

f) Holes & Chases:

Perform all holes, chases, sinking, cutting, under piping, sealing courses and labor, no extra will be paid for such work.

g) Sewer Pipe Lying:

Each pipe shall be carefully examined on arrival. Any defective pipes shall not be used and shall be segregated and marked in a conspicuous manner. Minor damage to the protective coating on iron drain pipes shall be made good by painting with cut bitumen or tar, if major defects in the coating exist, the pipes shall be returned to the works for recreating. Drains shall be laid in straight lines and to even gradients as shown on the drawings or as directed. Great care shall be exercised in setting out and determining the levels of the pipes and the Contractor shall provide suitable instrument to set up and maintain all sight rails, bending and bench marks etc., necessary for the purpose. All drains shall be kept free from earth in a clean condition. Pipes shall be laid with the sockets leading up hill and shall rest on solid and even foundations for the full length of the barrel. Socket holes shall be formed in the foundation, as short as practicable but sufficiently deep to allow the pipe jointer room to work right round the pipes.

h) Jointing:

i. Joining Concrete Hume Pipe

All joints or RCC Hume pipes shall, unless otherwise described, be made by wrapping one lap of tarred gas-kitting round the spigot of the pipe and placing it into the collar of previous pipe. It shall then be adjusted, fixed in its correct position and gas-kitting caulked home not so as to occupy more than one quarter of the collar depth, the collar shall then be completely filled with cement sand mortar (1:1) and fillet shall be formed round the joints with a trowel, forming an angle of 45 degree with the barrel of the Pipe. All joints of pipes with bitumen rings shall, unless otherwise described, be made by first smearing them with cement motor and forming fill round it as described above for standard cement joints. Pipes designed for water logged trenches shall be constructed with push-on rubber ring joints.

ii. Jointing of API Drain Pipes:

All joints of MS pipes shall be by electric arc welding. All welding shall be cleaned free from under cut, porosity and slag welding should be done in a manner to produce well penetrated weld.

iii. Jointing Feet of Vertical Pipes in Concrete:

The rest beds in the ground at the set of all soil, rain water ventilating and other vertical pipes, to be bedded on solid concrete 150 mm thick.

3.6 MANHOLE AND CHAMBERS:

The specified sizes of the manholes and chambers, refer to inside dimension in the table below. Execute the manholes and chambers of 250 mm thick C.C. brick masonry laid in 1:6 cement mortar on 150 mm 1:3:6 C.C. bed with 13 mm thick 1:4 cement plaster on inside of walls and finished smooth with cement.

The specified sizes of manholes and chambers refer to the inside dimensions, the following sizes should be regarded as the minimum for rectangular square manholes unless otherwise given:

TYPE	INTERNAL DIMENSION OF CHAMBERS		
	DEPTH	LENGTH	WIDTH
"A"	up to 1 M	0.75 M	0.75 M
"B"	up to 2 M	0.75 M	0.75M
"C"	beyond 2 M	1.00 M	1.00 M

The manhole shall be provided with iron rings as per drawings or as directed by the Engineer.

i. Manhole Covers and Gratings:

Heavy duty C.I. covers with frame shall be provided. The weight of the cover with frame shall not be less than 1 Cwt. The dimensions shall be as indicated on the drawings. If no dimension are provided in drawing and BOQ a minimum if 450mm x 450mm cover shall be installed.

ii. Testing:

Immediately after the drains are laid and joined but before launching with concrete (where required) and the fitting in done, they shall be inspected. tested and passed by the Engineer, as satisfactory. All length of sewer and drains shall be tested for water tightness by water pressure.

3.7 CLEAN OUTS:

Clean out shall be of uPVC as shown on drawing. Clean out turning up through floors shall be made by long sweep 'ells' bends with plugs, at face or deck plates to conform to architectural finish in the room.

3.8 GULLY TRAPS:

Gully traps of China clay duly glazed with 150 mm x 150 mm cast iron/PVC gratings shall be supplied and installed. Masonry plastered with 1:3 cement, sand mortar on both sides and outside shall be constructed over the gulley traps and fitted with C.I. cover and frame of required size.

4.0 STORM WATER DRAINAGE SYSTEM

4.1 GENERAL

a) Scope

Storm water drainage system is shown on the drawings and consists of the construction of the storm water drainage network complete. Storm water be drained by means of roof drains and leaders will be freely discharged to the surface as indicated on the drawings.

b) Quality Assurance

Establish and maintain quality control to assure compliance with contract requirements and local codes for all construction operations required under this Section.

c)

Prior to shipment from factory, test all types of pipes and fittings at the place of manufacture. Submit to the Engineer for each consignment or shipment authenticated certificates to indicate that the manufacturer satisfactorily tests the pipes and fittings and found to comply with these specifications.

d) Codes and Standards

Comply with the applicable requirements of the following codes and standards:

- i. IPC – International Plumbing Codes:
- ii. Pipes for Potable Water of Un plasticized Plastic (Polyvinyl Chloride).

Methods of Testing of Pipes for Potable Water of Un plasticized Plastic (Polyvinyl Chloride).

- i. ASTM – American Society for Testing and Materials
- ii. A 48 Specification for Gray Iron Castings
- iii. C 33 Specification for Concrete Aggregates
- iv. C 270 Specification for Mortar for Unit Masonry

e) Submittals

Submit shop drawings, details and descriptive literature showing pipe dimensions, joint and fitting details, recommended methods of installation, testing equipment, bedding details and calculations, recommended methods of cutting pipes and other relevant details.

f) Material Delivery, Storage and Handling

i. General

At every point of loading or unloading, provide suitable means for lifting and loading. Do not unload by means of rolling down planks or other form of inclined ramp. Ensure that pipes, fittings and other items are kept dry, clean and adequately stored. Perform work in accordance with manufacturer's instructions and to the approval of the Engineer.

ii. Handling of uPVC Pipes

- Store uPVC pipes in covered areas and protect from direct sunlight.
- During storage, ensure that uPVC pipes are not distorted. Stack pipes on a level surface off the ground or in suitable racks. Ensure that sockets are situated at alternate ends. Install bearing timber at appropriate spacing and of sufficient width to prevent denting of pipes. Stack pipes only to the extent recommended by manufacturer. Provide adequate protective measures for pipes and other items in transit.
- Distorted, buckled or defective pipes shall not be used in the work.

4.2 MATERIAL

a) Un plasticized Polyvinyl Chloride (uPVC), Pipes and Fittings

i. Pipes and Fittings

Unless otherwise indicated provide uPVC pipes and fittings that comply with BSC 14, Class D. Provide pipes that are suitable for installation depths, bedding and loading conditions and working pressures to which they will be subjected.

ii. Joints

For pipe jointing provides rubber rings that comply with ASTM D 1869. Provide 2 rubber rings for each pipe joint.

iii. Testing

Provide manufacturer's certificates that testing of pipes and fittings complied with the specified requirements of BSC 15 3505.

b) Equipment

- i. All equipment necessary and required for the proper construction of the structures shall be brought on the project site in first class working condition and shall have been approved by the Engineer before construction is permitted to start.
- ii. The Contractor shall provide hand tampers and pneumatic tampers to obtain the required compaction of the pipe bed and the backfill as specified.

4.3 EXCAVATION

- a) The width of the pit or trench for the structure shall be sufficient to permit satisfactory jointing of the pipe and/or pouring of concrete and thorough tamping of the bedding material under and around the structure, but it shall not be less than the external diameter of the pipe or structure plus 0.30m on each side. Trench or pit walls shall be approximately vertical.
- b) Where rock, hardpan, or other unyielding material is encountered, the Contractor shall remove it from below the foundation grade for a depth of at least 0.15 m. The excavation below grade shall be backfilled with selected fine compressive material.

- c) Where a firm foundation is not encountered at the design grade, due to unsuitable material, this soil shall be removed and replaced with approved fill material for the full trench width. The Engineer shall determine the depth of removal. The fill material shall be compacted to provide adequate support for the pipe.
- d) The Contractor shall do such trench or pit bracing, sheeting, or shoring necessary to perform and protect the excavation and structure as required for safety and conforming governing laws, and perform and protect the excavation and the structure as required for safety and conforming governing laws, and perform all grading and pumping, if necessary, to prevent water running into the trench and to keep the trench dry. The Contractor shall remove the bracing, sheeting, or shoring after placing at the structure. Removal shall be done in such a way that it will not disturb the structure.

4.4 PLACING PIPE

a) General

Proper facilities shall be provided for lowering the pipe when it is to be placed in a trench. The pipe shall be laid carefully and true to lines and grades on a bed, which is uniformly firm throughout its entire length. Any pipe which is not in true alignment, or which shows any undue settlement after being laid, or is damaged, shall be taken up and re-laid or replaced without extra compensation. The laying of the pipe in the finished trench shall be started at the lowest point and laid upgrade. The bed of the trench shall be such that at least the lower quarter of the pipe shall be in continuous contact with the bed.

b) Pipe Laying

The Engineer shall inspect all pipes before they are laid, and reject any section that is damaged by handling or is defective to a degree, which will materially affect the function and service of the pipe.

When bell and spigot pipe is used, the bell shall be laid upgrade.

If tongue and groove pipe is used, the grooved end shall be laid upgrade.

The pipe shall be firmly and accurately set to line and grade so that the invert will be smooth and uniform. The pipe shall be protected from water during placing and until the mortar in the joints has thoroughly set.

4.5 MORTAR

Mortar shall be mixed in a ratio of 1 part by volume of Portland cement and 2 parts by volume of sand. The mortar shall be of the desired consistency for caulking and filling between the pipe and the drainage structures. Mortar, which is not used within 45 minutes after water has been added, shall be discarded.

4.6 PIPE JOINTS

- a) Before any joint is made, the previously installed unit shall be checked to assure that a close joint with the adjoining unit has been maintained and that the inverts are matched and conform to the required grade. The pipe shall not be driven down to the required grade by striking it with a shovel handle, timber or other unyielding object.
- b) All joint surfaces shall be cleaned.

- c) Where any two-pipe units do not fit each other closely enough to enable them to be properly jointed, they shall be removed and replaced with suitable units and new gaskets.
- d) Open ends of pipe and branches shall be closed with stoppers and secured in place in an acceptable manner.
- e) The Contractor shall take all necessary precautions to prevent flotation of the pipe in the trench.
- f) All times when pipe installation is not in progress, the open ends of the pipe shall be closed with temporary watertight plugs or by other approved means. If water is in the trench when work is to be resumed, the plug shall not be removed until suitable provisions have been made to prevent water, earth, or other substances from entering the pipe.
- g) Pipelines shall not be used as conductors for trench drainage during construction.
- h) Care shall be taken to prevent earth, water, and other materials from entering the pipeline. As soon as possible after the pipe and manholes are completed, the Contractor shall clean out the pipe and manholes, being careful to prevent soil, water, and debris from entering any existing pipe.

4.7 WORKMANSHIP

Bedding of Pipelines

- a) The minimum thickness of bedding material beneath the pipe shall be 150 mm (minimum 100mm under sockets) for pipes not exceeding 200 mm internal diameter except when bedded on rock.
- b) The time interval between placing bedding material on the trench formation and commencing pipe-laying shall be as short as is practicable.
- c) The bedding material shall be compacted in layers not exceeding 200mm with one pass of a plate vibrator for gravels and two passes for sands or other approved equivalent mechanical method. Hand tamping or punning will only be permitted where insufficient space is available to allow the use of mechanical plant.
- d) Recesses shall be formed in the bedding to accommodate pipe joints while ensuring continuous even support along the pipe length. Bedding material shall be prevented from entering pipe joints. After the joint has been made bedding material shall be carefully placed and hand compacted beneath the joint barrel to close any void left by the recess. Where the formation of the trench is of silt or soft clay and is below the natural water table a 75mm blinding layer of sand shall be substituted for the specified bedding material directly above formation and carefully compacted if directed on site.
- e) Granular material for pipe bedding shall be free-draining, hard, clean, chemically stable gravel, crushed stir crushed slag, graded in accordance with the following table:

Percentage by Weight Passing Sieve

<u>Test Sieve</u>	<u>For Pipes of Diameter</u>
<u>mm</u>	<u>500mm and below</u>
63	---
37.5	---
20	---

14	100
10	85 - 100
5	0 - 25
2.36	0 - 5

- f) The material shall have a Compaction Fraction value not exceeding 0.2 when determined in accordance with the following test:

A representative sample of about 40kg shall be heaped onto a clean surface and quartered to obtain approximately 10kg. The moisture content of the sample should not differ materially from that of the main body of material, at the time of use in the trench.

4.8 LEAKAGE TESTS FOR GRAVITY PIPES

- a. The pipelines shall be as nearly watertight as practical and leakage tests and measurements shall be made. Tests shall be carried out between each two manholes in the presence and to the satisfaction of the Engineer's Representatives.
- b. Before commencing with the tests, all pipelines and concrete works shall be clean.
- c. The Contractor shall furnish suitable test plugs, water pumps and appurtenances, and all labor required to properly conduct the leakage tests on the pipelines.
- d. Upon completion of a section of the storm water bulkheads shall be installed, as required, to permit the test of the storm water pipe.
- e. The storm water pipe shall be subjected to an internal pressure by plugging the pipe at the lower end and then filling the pipelines and manholes with clean water to a height of 60 cm above the top of the pipe at its upper end. Where conditions between manholes may result in test pressures, which would cause leakage at the stoppers in branches, provisions shall be made by suitable ties, braces, and wedges to secure the stoppers against leakage resulting from the pressure. The rate of leakage from the storm water shall be determined by measuring the amount of water required to maintain the level 60cm above the top of the pipe.
- f. Leakage from the storm water pipe under test shall not exceed the requirements 1890 liters per 100mm diameter per km of the storm pipe per 24 hrs.
- g. The Contractor shall construct weirs or other means of measurement as may be required, furnish water and do all necessary pumping to enable the tests to be properly made.
- h. Should the sections under test fail to meet the requirements, the Contractor shall do all work of locating, repairing leaks, and retesting as the Engineer may require without additional compensation.
- j. If the Engineer is in doubt that any damage had occurred in the pipelines in the process of pouring the concrete or backfilling, he shall have the right to order retesting of the doubted part. If the second test proves that the pipeline is not serviceable then the Contractor shall have to locate the damage, make it good, and carry out retesting until he secures satisfactory results. The cost of all such works shall be at the Contractor's expense.

- k. All manholes shall be constructed so as to prevent leakage of water . Normally no testing for the Contractor conducts leakage of water from manholes unless it is in the opinion of the Engineer that the method of construction carried out does not fulfill the requirements.
- l. In such a case, the Engineer shall have the right to ask the Contractor to carry out the testing to the manholes (in connection with water leakage) prior to backfilling and any damage revealed as a result of such testing shall be made good. All these works shall be carried out at the Contractor's expense and in accordance with the direction of the Engineer.
- m. The Contractor shall prepare on site, and at his own expense, all work requirements, i.e. plugs for all diameters of pipes, pumps, etc., which should be acceptable to the Engineer.
- n. The Contractor shall only use acceptable water for the purpose of testing. The Contractor shall bear all the costs regarding serviceable water used in testing, flushing and satisfactory disposal thereof.
- o. The Contractor shall have to fix the plugs in ends of pipes to be tested and shall have to take necessary precautions to prevent plugs or fixings tools from getting inside the pipes as a result of water flushing.
- p. Should the selections under test fail to meet the requirements, the Contractor shall do all work of locating and repairing the leaks and retesting as the Engineer may require without additional compensation.

4.9 BACKFILLING OF PIPELINES

- a. After completion of placement and Compaction of the surrounds to the pipelines and leakage test backfilling shall proceed using selected excavated materials in accordance with the specifications for earthworks.
- b. The use of power rammers will not be permitted over any pipe until the depth of fill above the crown of the pipe is at least 300 mm.
- c. Movement of construction machinery over a pipe drain shall be at the Contractor's risk. Any pipe damaged thereby shall be replaced at the expense of the Contractor.

4.10 CONNECTIONS

Where the drawings call for connections to proposed structures, these connections shall be watertight and so made that a smooth uniform flow line will be obtained throughout the system.

4.11 CLEANING AND RESTORATION OF SITE

After the backfill is completed the Contractor shall remove all tools, surplus material, dirt, and rubbish from the site. For paved areas the Contractor shall restore all disturbed areas to their original condition.

4.12 INSPECTION

Prior to final approval of the drainage system, the Engineer accompanied by the Contractor, shall make a thorough inspection. Any indication of defects in material or workmanship, or obstruction to flow, or poorly constructed joints in the system, shall be

further investigated and corrected. Defects due to the Contractor's negligence shall be corrected by the Contractor without additional compensation and as directed by the Engineer.

4.13 GENERAL EQUIPMENT

- All horizontal piping shall be pitched not less than one percent.
- Changes in direction of piping shall be made with long radius fittings.
- PVC non-pressure pipes and fittings for storm drainage should be capable to hold sufficient pressure and to the satisfaction of the Consultant.
- All roof drains shall be set 1 / 8" below normal finished floor, with a gradual pitch extending away from the drain.
- All pipe and fittings shall be kept clean, with the exposed ends of incomplete or unconnected work to be plugged.
- Cleanouts shall be placed at all changes in directions.

4.14 TESTS

When the roughing in work is complete, the entire system shall be subjected to flushing and then to a water test by plugging- up all openings and fillings all of the lines to the roof level. Any apparent defect shall be corrected or removed. The Consultant shall witness the test and inspect the workmanship.

4.15 DRAINS

Shall be PVC with large sump and flange, threaded or caulked bottom outlet, removable non-clogging low silhouette dome strainer, flashing clamping device and integral gravel stop. Each roof drain shall be provided with its own lead flashing.

4.16 MEASUREMENT AND PAYMENT

Measurement for PVC-non pressure pipe shall be in running length and the work to be done shall include earthwork, providing and fixing of pipe, pipe fittings, jointing, cutting, breaking concrete and then making it good applying protective painting, cleaning, testing and the measurement will be made for the full work specified herein.

Payment will be made at the unit rate quoted in the BOQ per running foot length of PVC pipe. The amount bid shall be full payment for the work specified herein.

5.0 PLUMBING FIXTURES

5.1 General

a) Scope of Work

The work included in this section of Contract consist of providing and installing complete system of plumbing fixtures, fittings and accessories as per Drawings, Specification and Bill of Quantities, including all labor, equipment and materials required for the satisfactory operation and installation of plumbing fixtures Complete in all respect.

All model numbers not indicated or approved equal implies that the contractor shall submit for the approval of Engineer a summary of the plumbing fixtures proposed indicating type, manufacturer name, model number. If samples are required by the Engineers then they shall be provided at no additional cost. No materials shall be purchased, before such approval is obtained in writing from the consultant.

b) General Requirements

All fixtures shall be free from imperfections, true as to line, angles, curves and colors, smooth, water tight and complete in every respect.

All fixtures specified to be of vitreous ware, shall be fired vitreous China ware of the best quality nonabsorbent and burned so that the whole mass is thoroughly fused and vitrified producing a material white or colored, which when manufactured will show a homogeneous mass, close grained and free from pores. The glazing and vitreous China fixture shall be of color approved by the Consultant thoroughly fused, and united to the body, without discoloration, chips, or flaws and shall be free from craze. Warped or other imperfect fixtures will not be accepted.

All plumbing fixtures and fittings shall be supplied by Contractor, all fixtures should be approved by the Consultant prior to installation.

All fittings, cast brass set screws, escutcheons, faucets, traps, exposed piping etc., shall be brass chrome plated over nickel plate with polish finished. Any hanger nuts visible shall likewise be chrome plate over nickel plate.

After installation of plumbing accessories, the Contractor shall ensure their protection against damage, misuse and general deterioration. Fixture outlets shall be plugged with suitable material to prevent external debris. All chrome plated and other metallic fittings shall be provided with a coat of grease to prevent their deterioration. All items prior to handing over must be in perfect condition in the visual and operational sense.

c) Materials Required

i. Lavatory

White vitreous china lavatory with pedestal / counter top shall be "PORTA/ICL BOSH MODEL" or equivalent with approved fittings.

Lavatory shall be completed with the following accessories

- Exquisite Line PORTA/ICL BOSH MODEL".
- Fix 11, concealed 1 / 2 inch diameter basin mixer with hot and cold brilliant handles, cast spout with mousseure, pop-up waste set.
- Handles trecorn deluxe.
- 1 / 2" diameter stop cocks with flexible / chrome plated pipe.
- 1-1 / 2" diameter C.P Bottle Trap with removable sump, outlet with

compression nut.

- C.P Towel rail of required length.
- 1-1 / 2" inch diameter stainless steel waste pipe with chain waste and plug.
- Soap tray of ICL BOSH MODEL".

ii. **Water Closet WWC-1 (WESTREN WATER CLOSET)**

White vitreous china siphon jet water closet with P or S trap shall be "PORTA MODEL" or equivalent with approved fittings.

Water closet shall be complete with the followings accessories.

- 4" diameter flush pipe of required length
- Vacuum breaker
- Solid plastic closed front seat with cover and screws.
- 1 / 2" diameter C.P. Inlet spout.
- C.P Toilet paper holder.
- Floor Flange gasket rubber bumper.
- 1 inch diameter Flush valve.

iii. **Water Closet AWC-1 (EASTREN WATER SLOSET)**

White vitreous china siphon jet water closet Orissa type, with P or S traps shall be "PORTA MODEL" or equivalent with approval fittings.

Water closet shall be complete with the following accessories.

- 4" diameter flush pipe of required length.
- Vacuum breaker.
- 1 / 2" diameter C.P. Inlet spout.
- Floor Flange gasket rubber bumper.
- 1 inch diameter Flush valve.

iv. **Shower**

Shower accessories will consist of the following approved fittings.

- 1 / 2" diameter concealed valves threaded pipe connection with brilliant handles blue and red.
- 1 / 2" inch diameter 4 way diverter.
- Bath combination 1 / 2" inch.
- Adjustable ball joint shower head 3 inch diameter with 1 / 2 inch shower arm.
- 3 / 4 inch diameter bath spout with mousseur.

v. **Kitchen Sink**

Kitchen sink shall be "PORTA/ICL BOSH/REGINOX MODEL" or equivalent approved with "MASTER" approved fittings.

Kitchen sink shall consist of the following accessories.

- Double bowl 20 gauge nickel stainless steel sink with double drain board.
- PVC waste coupling, and 1-1 / 2" P.V.C bottle trap.
- C.P 1 / 2 inch. Combination mixer (hot & cold) with pipe.
- Cabinet fitted, size 550"x900x150" deep and 1100"x 900" x 150 deep.
- Stain finish, self rim, Back Ledge with holes.
- 1 / 2 inch single hole mixer.
- Brilliant handles.
- Extractable rising spray with diverter.
- Set / spray metal tube.
- Chain support.

- 1-1 / 2" diameter PVC flush pipe of required length.

vi. Shower Jet

- Shower Jet shall be "PORTA" or equivalent approved.
- Shower Jet will consist of the following accessories.
- Double hole mixer.
- Hand spray with trigger control.
- Pressure proof flexible hose of SFS of required length.
- Jet / spray, tube socket.
- 3 / 4 inch diameter extractable spout.

d) Fixture Supports / Settings

Provide all hangers, supports, brackets, etc, for the proper installation of water closet, urinals, lavatories, suits etc, requiring supports shall be in accordance with the manufacturers recommendation, as approved and where necessary built into partitions or walls, and shall be set with the Construction progress.

e) Fixture Settings

Fixture shall be set in a neat, finished and uniform manner making the connections to all fixtures at right angle to the wall unless otherwise directed by the Consultant. Roughing for this work must be accurately laid out so as to conform with finished wall materials. Fixtures are not being set until as directed by the Consultant.

Each fixture and piece of equipment including floor drain, requiring connections to drainage system shall be equipped with a trap. Traps are to be supplied with the fixtures. Each trap shall be placed as near to the fixtures as possible and no fixture shall be double trapped, except as otherwise indicated. Trap installed on bell and spigot pipe shall be cast iron.

All fixtures and trimmings in so far as practicable shall be of one manufacturer.

All exposed chromium plated fittings such as pipes; valve etc. shall be protected immediately after installation. During installation s-trap or p-trap added wrenches shall be used on chrome plated pipe and fittings etc.

All fixtures shall be set straight and true. The setting shall be level and flush with finished floors and partitions.

Plumbing fixtures shall be supplied complete with all required trimming; vitreous china fixtures shall be first class quality with smooth glazed surfaces, free from warp, cracks, discolorations or other imperfections.

Fixture mounting heights and spacing shall be as detailed on the Architectural and Engineer's drawings.

Protect fixtures from damage before and after installation.

Fasten fixture carriers securely to slab construction with power driven expansion shields and bolts.

f) Cleaning

Clean and adjust all fixtures and trim before acceptance.

g) Measurement and Payment

Measurement for payment of mirrors shall be made as net actual area in square feet of the mirror acceptably provided and installed in position as per drawings and instructions of the Consultant.

Payment for wash basins, kitchen sinks, water closets, urinals, showers, mirrors, and foot rest pairs shall be made at the applicable unit price as bid in the Bill of Quantities. The amount bid shall be full payment for the work specified herein.

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6.0 DRAINAGE LIFT PUMP (not used)

6.1 GENERAL

a) Scope of Work:

Install and provide: complete assembled Drainage Duplex Lift Pump submersible type with controls as per drawings, specification and bill of quantities, complete in all respect to the satisfaction of CONSULTANT.

b) Material Required

Complete assemble including motor-driven submersible pump and all necessary auxiliary component, level controller, controls, wiring and interconnecting flexible aero flex rubber piping.

c) Pumps:

Pumps shall be Submersible type by Grundfos /KSB/ AMSTRONG. Entirely of stainless steel, wholly submerged in the liquid. The pump shall be capable of handling clean or slightly dirty waste water.

All external bolts and nuts shall be stainless steel. The impeller shall be capable of passing clean or slightly dirty waste water.

d) Controls:

Automatic sequence of pump with level controller as indicated in drawings.

The pump manufacturer shall warrant the pump being supplied to the consultant against defects in workmanship and materials for a period of one year after the system is handed over to the consultant by the contractor.

All sections of specification in section "Pumping Equipment" shall also apply in this section.

The sequence of control shall be such as stated on the drawings. The relevant electrical specification shall be as per electrical specification and to approval.

e) Sequence of Drainage Pump

Furnish and install cellar drainage pump with sufficient electrical cable to control pump operation. The built in switch shall automatically the pump operation to start/stop between two liquid levels. In case of pump failure a water alarm consisting of light and horn shall be suitably mounted on the control panel.

7.0 PUMPING EQUIPMENT [Pumps to fill Overhead tank]

7.1 GENERAL

a) Scope of Work:

Furnish and install pumps for the water filling/drainage & sewerage system as per drawings, specifications, and Bill of Quantities and as approved by the CONSULTANT.

b) Materials Required:

Install best quality Grundfos/KSB pumps complete with Siemens electric motors to CONSULTANT satisfaction.

c) Approval:

Before purchase of any pumping equipment, the Contractor shall submit all relevant data about the equipment to the Engineer for his approval. No equipment to be purchased before such approval is obtained in writing from the consultant. Also approval given by the consultant does not relieve the Contractor for his responsibility of providing the pumping system complete in all respect, as per drawings, bill of quantities, and specification to the satisfaction of the CONSULTANT.

d) Installation:

Pumps and motors shall aligned in vertical/horizontal and leveled throughout the length and width and wherever necessary suitable support shall be provided to facilitates pipe connections and leveling.

Pumps shall be secured to bases with proper size anchor bolts.

Drains for packing glands etc. shall be piped to the nearest drain.

Pumps shall be located in accessible location for repairing and maintenance.

Grout base plates completely to provide a rigid non deflection support.

e) Testing:

Pumping equipment shall be tested for operating characteristics and duration of test shall be set by the CONSULTANT. Apparent defective equipment shall be repaired or replaced and such adjustments made to the equipment as may be necessary, all to the satisfaction of the CONSULTANT.

Also provide to the CONSULTANT the following information.

- i. Pump data Make, Model, number, serial Number Design and Actual GPM, BHP, maximum shut off and design head, rpm suction and discharge pressures.
- ii. Motor data; Make model and serial number, hp, rpm, locked rotor amps, Voltage, phase, frequency and actual volts and amps.
- iii. Starter data: Make, size, model number, heater sizes, ampere reading, live voltage, control voltage frequency.
- iv. The contractor shall also provide equipment catalog/certified performance curves, showing impeller diameter, BHP, and design conditions.

f) Controls:

All electrical equipment shall be operated at either 3 phase 380 volts or single phase 220/240 volts, 50 hertz or otherwise approved.

All electrical works, i.e. wiring, pumps starters & controls, etc., shall confirm with the approval of the CONSULTANT.

g) Sequence of Water in U/G:

Furnish & install a mechanical float valve in the U.G and Overhead Water Tanks. This shall cut off incoming water supply once the tank is full.

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8.0 SEWER APPURTENANCES

8.1 GENERAL

a) Scope of Work

The work to be done under this section of the Specifications consists of providing all material, labor, equipment and appliances and in performing all operations including earthwork, concrete, block masonry, plaster, fixing manhole cover and frame, making holes etc. in connection with proper installation of miscellaneous sewer appurtenances i.e. manholes, grease traps, gulley traps etc. complete in strict accordance with this section of the Specifications and the drawings, and subject to the terms and conditions of the Contract. All sewer appurtenances shall be placed at locations to lines and levels as shown in the drawings and as directed by the CONSULTANT.

b) Material and Installation

i. Manholes / Inspection Chambers

Manholes and inspection chambers shall be built on sewers of the size, form, thickness and positions shown on the drawings or as directed by the CONSULTANT. The foundations and bed shall be made of concrete and the walls shall be of block masonry plastered with 1/2" thick 1:4 cement sand plaster. The inverts and benching shall be properly shaped to the forms and dimensions shown and shall be rendered with two coats of granolithic concrete and brought up to a smooth face to the forms and gradients indicated on the drawings. Unless otherwise indicated on the drawings, every manhole shall be provided with a cast iron frame and cover of dimensions shown on the drawings. The frame and cover shall be cast iron from good quality.

All manhole covers shall be true to pattern in form and dimensions, free from faults, cracks and other defects affecting their strength. The cover shall have a continuous and even bearing on the frame, and shall be properly set to avoid knocking. All inequalities, projections or roughness on abutting surfaces of the cover and the frame shall be removed, and the cover fitted into the frame as neatly as possible without jamming.

ii. Grease Trap

Grease traps shall be installed on waste line in the kitchen. The size, thickness and position shall be as shown on the drawings or as directed by the CONSULTANT. The grease trap shall be PDI Certified. The inlet and outlet pipes in the grease trap shall have Roding eyes.

Grease trap shall be provided with a G.I. sheet frame and cover of dimensions shown on the drawings.

iii. Gully Trap

Cement concrete gulley trap with chamber having cast iron frame and cover, shall be used on the downstream side of a manhole for isolating the drainage system from the sewer as shown in the drawings or as directed by the CONSULTANT. It shall have a water seal and a Roding arm to permit the outgoing pipeline to be rodded. The Roding eye shall have a remarkable air-tight plug which shall be provided with a chain.

c) Measurement and Payment:

Measurement for payment of sewer appurtenances shall be made on the basis of actual number of such fixtures acceptably provided and installed; of complete units as specified herein, inclusive of earthwork, concrete work, block masonry, plaster, iron steps, making holes etc. complete as per Contract Documents and/or as directed by the CONSULTANT.

Payment for sewer appurtenances shall be made at the applicable unit price per number bid in the Bill of Quantities. The amount bid shall be full payment for the work specified herein.

9.0 MISCELLANEOUS ITEMS

9.1 GENERAL

a) Scope of Work:

The work to be done under this section of the Specifications consists of providing all material and labor, equipment, appliances etc. for proper installation of miscellaneous plumbing items of valves, cocks, floor traps, rain water pipes, cleanouts, towel rails, service connections, water heaters, as specified herein or as shown on the drawings and/or as directed by the CONSULTANT.

b) Material and Installation:

i. Bronze/Malleable/Ductile Valves

All valves of 4" diameter and below shall be of bronze/Malleable iron/Ductile iron conforming to BSS 1952 and shall be of appropriate class for the working pressure on which they are installed. Open and shut indicators shall be marked on the handle. The ends may be threaded or flanged. The valves are to be installed inclusive of all fittings and accessories.

ii. Float Valves

Float valves shall be made of cast iron body, gunmetal leather faced valve and seating, forged Bronze spindle, gunmetal links and pins and gunmetal lined cylinder, wrought iron lever and copper ball, and capable for working pressure 300 psig.

iii. Foot Valves

Foot valves shall be made of brass as per PN16 with strainer, and renewable disc ring.

iv. Taps

All the fittings shall be of approved model and appropriate class for 125 psig working pressure on which they are installed.

v. Floor Traps

Floor traps shall be of PVC. They shall have minimum water seal of 3" and shall be provided with removable stainless steel grating.

The traps shall be of self-cleaning type. The open area of the grating shall be at least two thirds of the cross-section area of the drain line to which it connects. Floor traps shall be well set in position so that there is no leakage at the joint between traps and the floor.

vi. Cleanouts

Cleanouts shall be of the same nominal size as that of the pipe on which it is installed. Cleanout shall consist of the same material as pipe i.e. PVC. Cleanouts shall be turned up through floor by long sweep fittings, wherever the space so permits. Top finish of cleanout shall be flush with the floor when located in open area. They may not be flush with the floor when installed near wall levels and not deep enough to make them flush.

Cleanouts shall be so installed that there is a clearance of at least 1'-6". Cleanouts near walls shall be embedded in concrete. All other work of ferrule, plug, concrete work, frame and cover etc, shall be paid under cleanout item.

vii. Service Connection

Service connection of water to building shall consist of cast iron saddle clip, gasket, bolts, polyethylene pipe up to plug stop-cock with access pipe and

cover etc. All material and equipment shall be suitable for pressure of potable water system.

Complete work including excavations, backfilling, supply and installations of all material as shown in the Contract Documents shall be covered under this item.

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10.0 BOOSTER PUMPS

PACKAGED BOOSTER PUMPS

10.1 SUMMARY

Variable -speed, [Triplex], packaged booster pumps for domestic water piping systems.

10.2 QUALITY ASSURANCE

Quality Standard: UL 778 and ASME B31.9.

Packaged Booster Pumps: Listed and labeled by an NRTL as pumping systems.

10.3 PRODUCTS

Variable-Speed, Duplex Booster Pumps:

Pump: Overhung impeller, close coupled, multistage stage, end suction, centrifugal.

Casing: Radically split, cast iron.

Impeller: Stainless Steel/Cast bronze.

Shaft and Shaft Sleeve: Steel shaft, with copper-alloy shaft sleeve.

Seal: Mechanical.

Pump Data:-

Capacities and Characteristics:

Capacity: As per Schedule

Discharge Head: As per schedule

Discharge Size: As per schedule

Motor Horsepower: As per Schedule

Volts: <400>

Phases: <3>

Refer schedules for further details.

Motor: Variable speed, with oil-lubricated bearings.

Piping: PPR PN-20.

Valves: Control, relief, shutoff, and check valves.

Sensors: Pressure and flow switches.

Dielectric fittings.

Control Panel:

High-suction pressure cutout.

High-discharge pressure cutout.

Remote signal contacts.

Hydro pneumatic tank. [As per drawings]

11.0 NATURAL GAS PIPING

11.1 PIPING MATERIALS

Steel Pipe: ASTM A 53/A 53M, Type E or S, Grade B, black. Wall thickness of wrought-iron and steel pipe shall comply with ASME B36.10M. Retain one of first two subparagraphs below.

Malleable-Iron Threaded Fittings: ASME B16.3, Class 150, standard pattern, with threaded ends according to ASME B1.20.1.

Steel Threaded Fittings: ASME B16.11, forged steel with threaded ends according to ASME B1.20.1.

Unions: ASME B16.39, Class 150, malleable iron with brass-to-iron seat, ground joint, and threaded ends according to ASME B1.20.1.

11.2 SPECIALTY VALVES

Gate and Check Valves, NPS 2 (DN 50) and Smaller: Class 125, bronze body, valves suitable for fuel oil service, with "WOG" indicated on body.

Gate valves shall have solid wedge.

Swing check valves shall have bronze disc.

Lift check valves shall be vertical pattern; two-piece construction with bronze disc.

Ball Valves: UL 842; metal-body ball valve with threaded ends according to ASME B1.20.1 for pipe threads.

Pressure-Reducing Valves: UL listed for fuel oil service. Include bronze body with 150-psig (1035-kPa) minimum pressure rating.

11.3 PIPING INSTALLATION

General piping installation requirements are specified for water supply.

Use eccentric reducer fittings to make reductions in pipe sizes. Install fittings with level side down.

Install strainer on inlet side of control valves, pressure-reducing valves, fuel oil pumps, and oil burner connections.

11.4 VALVE INSTALLATION

General valves installation requirements are specified for Water Supply.

Install valves in accessible locations, protected from damage.

Install ball valves at branch connections to supply mains and at equipment.

Install drain valves at piping low points.

11.5 CONNECTIONS

Install piping adjacent to equipment to allow service and maintenance.

Connect piping to equipment with ball valve and union. Install union between valve and equipment.

Install flexible piping connectors at final connection to burners or oil-fired appliances that must be moved for maintenance access.

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SECTION - 2 FIRE FIGHTING SYSTEMS

1.0 FIRE EXTINGUISHING SYSTEM

1.1 DESCRIPTION OF WORK

Extent of Work: The extent of fire fighting equipment including is indicated on the drawings and as defined in these specifications. The type of fire protection is by portable fire extinguishers (CO₂ and Dry Powder chemical).

1.2 QUALITY ASSURANCE

- a. Comply with governing regulations and use products produced by a sound firm with not less than 5 years experience in manufacturing similar products, and installed in similar service.
- b. Comply with local fire department regulations for sizes, threading and arrangement of connections, and with NFPA-10 / Local Fire Code portable fire extinguishers.
- c. Comply with Factory Mutual Approval Guide and with governing regulations.

1.3 SUBMITTALS

Submit manufacturer's data for Fire Extinguishing equipment.

1.4 MATERIALS

- a. **Dry Chemical Powder Fire Extinguisher**
6 Kg capacity, enamelled steel container with pressure indicating gage. Provide manufacturer's standard mounting brackets for above extinguishers.
- b. **CO₂ Fire Extinguisher**
6 Kg capacity, enamelled steel container with pressure indicating gage. Provide manufacturer's standard mounting brackets for above extinguishers.
- c. **Mounting Brackets**
Provide manufacturer's standard bracket designed to prevent accidental dislodgement of extinguisher, or proper size for type and capacity of extinguisher indicated, in manufacturer's standard plated finish.

1.5 INSPECTION

The Contractor shall examine the condition of the substrate to receive work, and the conditions under which the work will be performed, and shall correct unsatisfactory conditions. Do not proceed with the work until unsatisfactory conditions have been corrected in a manner acceptable to the Engineer.

1.6 INSTALLATION

Install fire protection accessories where shown and in accordance with manufacturer's written instructions. Install in locations and at mounting height to comply with governing

regulations. Securely fasten to Structure Square and plumb, in accordance with recognised industry practices.

1.7 IDENTIFICATION

After installation and finishing is completed, apply red-letter indicating contents by appropriate wording "FIRE EXTINGUISHER" and similar words' Provide 38mm high lettering of style approved by the Engineer. Extinguisher identification shall be in Arabic and English languages.

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2.0 FIRE HOSE CABINETS AND STAND PIPES

2.1 DESCRIPTION OF WORK

Extent of Work: The extent of fire fighting equipment including is indicated on the drawings and as defined in these specifications. The type of fire protection is by Fire Hose Cabinets which are fed by piping system connected to Fire Pumps set located in a pump room located at basement floor.

2.2 QUALITY ASSURANCE

- a. Comply with governing regulations and use products produced by a sound firm with not less than 5 years experience in manufacturing similar products, and installed in similar service.
- b. Comply with local fire department regulations for sizes, threading and arrangement of connections, and with NFPA-14 / Local Fire Code for "Standard for the Installation of Standpipe and Hose Systems".

2.3 SUBMITTALS

Submit manufacturer's data for Fire Hose Cabinets with its contents & accessories complete.

2.4 FIRE HOSE CABINETS & ACCESSORIES

Dual Compartment Fire hose Cabinets be wall recess type, made of 1.5 mm thick epoxy painted steel sheet, complete with hinged door 180° open wind-poor lock.

Fire Hose Cabinet shall comprise of the following:-

Upper Compartment:-

- One roll of 30 Meter long, 1¼" woven synthetic filament hose, one end with adjustable spray to straight spray to straight stream nozzle,

Lower Compartment:-

- 2 ½" Diameter Landing Valve with Spanner.
- One CO2 Fire extinguisher not less than 4.5 Kg Capacity.
- One Dry Powder Chemical Fire Extinguisher not less than 4.5 kg Capacity.
- Spare Hose and Nozzle.

2.5 MATERIALS

- a. **Piping**
The Material and dimension of the piping material shall be black and hot-dipped zinc coated (Galvanised) welded and seamless steel pipes.
- b. **Fittings**
Fittings shall be designed to withstand the system working pressures, but not less than 175 psi (12.1 bars) cold water.

Material and dimensions of fittings are:

Steel Factory made wrought steel Butt welded fittings ANSI-16.9.

Butt welding Ending pipe, valves, Flanges & fittings ANSI16.25

Steel pipe flanges and flanged fittings ANSI 16.5

Forged Steel Fittings, Socket welded and threaded ANSI 16.11

a. **Dry Chemical Powder Fire Extinguisher**

At least 4.5 Kg capacity, enamelled steel container with pressure indicating gage.
Provide manufacturer's standard mounting brackets for above extinguishers.

b. **CO₂ Fire Extinguisher**

At least 4.5 Kg capacity, enamelled steel container with pressure indicating gage.
Provide manufacturer's standard mounting brackets for above extinguishers.

3.0 FIRE PUMPS AND ACCESSORIES

3.1 DESCRIPTION OF WORK

a) Section Includes

- i. Fire pumps.
- ii. Pressure maintenance (Jockey) pumps.
- iii. Pump control panels.
- iv. Fire pump accessories.
- v. Electrical works in connection with fire pumps.

b) Related Works

References

- i. NFPA-20 Automatic fire pumps and controllers.
- ii. National electrical code.
- iii. IEE Regulations

c) Quality Assurance

- i. Conform to the requirements of the following:
 - National Fire Protection Association of U.S.A./ Local Fire Code.
- ii. Refer specifications of the Electrical works of the project for system power supply ratings, fault levels of breakers and other similar general criteria. These shall be binding and mandatory for works covered by this Section.
- iii. Conform to NFPA-20 / Local Fire Codes in respect of fire pump controllers. Comply with additional requirements, if stated.

d) Submittals

- i. Submit product data and manufacturer's assembly drawings.
- ii. Submit certified pump performance characteristics, with selection plotted.
- iii. Submit data on equipment dimensions, service connections, operating weights etc.
- iv. Submit characteristics such as full load starting KVA, power factor and current, full load running current and power factor etc. for all motors connected to standby diesel generator.
- v. Submit wiring diagrams, details of components and panel construction and mounting details in respect of control panels.
- vi. Furnish all relevant information, in a form as prescribed by the Ministry of Electricity and Water for obtaining approvals.
- vii. Submit certificates, that the pump assembly, construction and performance equals or exceeds NFPA / Local Fire Code requirements.

e) Delivery, Storage And Handling

- i. Deliver products to site, store and protect under provisions.
- ii. Retain weatherproof covering on pumps and control panels until commissioning.

f) System Interfaces

All electrical works starting from the outgoing terminals of switch fuses / sub-main switchboards onwards, for fire protection equipment are included in this Section.

3.2 PRODUCTS

a) GENERAL

- i. Equipment like fire pumps, control panels and fire pump accessories must be approved by NFPA/ Local Fire Code.
- ii. Components such as fuses, contactors, indicators, timers, etc. which may require replacement in future, shall be products of the same standard / manufacture as that of the electrical works of the project.
- iii. Equipment like fire pumps and the control panels shall have local dealers / representatives certified to check, test, adjust and commission this equipment.

b) Horizontal Split Case Fire Pumps

- i. Description: factory-assembled and -tested, electric-drive, Horizontal Split case fire pumps capable of furnishing not less than 150 percent of rated capacity at not less than 65 percent of total rated head and with shutoff head limited to 140 percent of total rated head.
 - Refer to Approved Manufacturer List
 - Fabricate base and attachment to fire pumps and controllers with reinforcement to resist movement of pumps and controllers during a seismic event when their bases are anchored to building structure.
 - Finish: Manufacturer's standard red paint applied to factory-assembled and -tested unit before shipping.
 - Nameplate: Complete with capacities, characteristics, and other pertinent data.
 - Pump: Horizontal Split Case pump
 - Construction:
 1. Pump Head: Cast iron, for aboveground discharge, with discharge flange machined to ASME B16.1, Class 300 dimensions, unless otherwise indicated.
 2. Shaft: Stainless steel.
 3. Pump Line Shaft Bearings: Rubber sleeve, water lubricated.
 5. Pump Line Shaft Bearings: Corrosion resistant, oil lubricated.
 6. Pump Bowl Assemblies: Cast iron with closed-type bronze impellers.
 - Driver: open-drip proof, squirrel-cage, induction motor complying with NFPA / Local Code. Include wiring compatible with controller used.
- ii. Horizontal Split Case Fire Pump :

Type Fire Pump Plan No.: FP-01 & 02

 1. Rated Capacity: As per schedule
 2. Total Rated Head: As per schedule
 3. Discharge Flange Size: 150 mm (6")
 4. Discharge Flange Class: 300
 5. Speed: Same as driver.
 - Electric-Motor Driver: __ KW, 2900 rpm, 400V, 3 phase, 50 Hz.

c) Fire Pump Control Panels

The controller shall be of the combined manual and automatic type suitable for star (Wye) - delta starting at 415 v / 3 ph / 50 Hz supply. Refer to schedules on drawings for power ratings. The panel components / functions shall be as listed below:

- i. Mains isolator switch (4 pole) and circuit breaker combination, mechanically interlocked to operate with a single, flange mounted, external handle. The interlocking shall be such that the circuit breaker (with minimum 22 Kamps rupturing capacity) will engage or break the load current. Both of the above shall be suitable for padlocking in ON or OFF position and shall be interlocked with the panel door; restricting access to the controller with the switch in 'ON' position, except by a hidden tool operator defeater. Provide external emergency release for the circuit breaker.
- ii. Audio visual earth leakage alarm.
- iii. Power on (supply healthy) indicator wired through normally closed contacts of the power available relays to give true indication. Loss of power in any one phase shall cause the light to go off.
- iv. Control circuit healthy indicator.
- v. Pump on demand indicator.
- vi. Pump run indicator.
- vii. Manual, pump start and stop push buttons.
- viii. Emergency start lever with latch.
- ix. Adjustable star to delta change over timer (consult motor manufacturer for change over timing.)
- x. Adjustable, 10-300 psi, combination pressure gauge switch, mounted on the enclosure flange. Extend piping to outside of the panel with union. Pressure switch shall be wired for automatic start only.
- xi. Starter contactor with auxiliary relays.
- xii. Fused control power circuit, with voltage not exceeding 240 v / 1 ph / 50 Hz. Use transformers where appropriate.
- xiii. Terminal block for interlocking wiring.
- xiv. Earthing bar for equipotential bonding.
- xv. Set of terminals / relays with volt free contacts for connecting to building automation system and remote alarm panel.

d) Remote Alarm Panels

Remote alarm panels shall be complete with 24-hour standby battery pack, battery charger, alarm bell with mute push button etc. to indicate the following.

- i. Supervisory voltage normal.
- ii. Pump 1 phase failure.
- iii. Pump 2 phase failure.
- iv. Pump 1 on demand.
- v. Pump 2 on demand.
- vi. Pump 1 running.
- vii. Pump 2 running.

e) Jockey Pump Starters. (Not Applicable)

This starter shall be of the combined manual and automatic type, suitable for direct on line (DOL) starting at 415 v / 3 ph / 50 Hz supply. Refer to schedules on drawings for power ratings. The panel components / functions shall be as listed below.

- i. Mains isolator switch (4 pole) with 'power on' indicator.
- ii. DOL starter contactor with overload trip and set of fuses.
- iii. Hand / off / automatic selector switch.
- iv. Pump run and trip indicators with audible alarm for trip.
- v. Adjustable, 10 to 300 psi, combination pressure gauge-switch, mounted on the enclosure flange. Extend piping to outside of the panel with union. Pressure switch shall be wired for automatic start and stop of the pump.
- vi. Start / stop push buttons.

- vii. Adjustable minimum run timer with 0 to 6 minutes range.
- viii. Fused control power circuit, with voltage not exceeding 240v/1ph/50 Hz.
- ix. Earthing bar for equipotential bonding.

f) Reassure Relief Valves For Fire Pumps

Cast iron body with bronze trim, angle pattern, pilot operated diaphragm valve. The valve shall be rated class 125, factory preset at 7.5 Bars (110 psig) and shall be bypass (to pump suction) type. Provide pressure gauge with unit.

g) Low Meters

Stainless steel, shunt orifice type flow meter complete with mating flanges; fixed, direct reading type meter with safety housing; copper capillary connections; strainer; shutoff cocks etc. all as approved by FOC.

3.3 FIRE PUMPS INSTALLATION

Install pumps in such a manner that avoids horizontal elbows at pump suction, excludes air entrapment in suction

Line and allows unrestrained movement of the pump assembly (for vibration isolation purposes).

Make required adjustments to pipe sizes, immediately after the pump flanges. Use flanged eccentric reducing spool with level crown at pump suction and concentric type at discharge.

Install pump flexible connections at suction and discharge to prevent carryover of pump vibrations to system piping. Anchor piping immediately after the flexible connections.

Install the suction header horizontally. Make foundations for different models of pumps to suit the suction header, so that all the suction lines are horizontal.

3.4 CONTROL PANELS

Panels shall be fabricated from minimum 1.5mm thick sheet steel and shall have continuously welded butt joints. Apply two coats of red oxide primer and two coats of baked on fire red enamel. All required holes and cut outs shall be done at the factory.

All internal wiring shall be done in a neat and professional manner, using cable ties, slip-on spiral plastic bundle sheaths etc. Provide ample free lengths to allow full swing of doors.

Provide suitable legs, drilled for bolting down to housekeeping pads.

Wall mounted panels shall be stiffened with profiled sections welded to the back plate, as required. Top of wall mounted panels shall be at 180 cms above FFL.

All panels shall have enclosures to IP-44 as minimum requirement and ant condensation heaters within.

3.5 CONDUITS, TRUNKING AND CABLE TRAYS

Fix conduits to walls / ceilings with two piece clamps, spaced at not more than 120cm.

Trunking shall be attached to walls by brass screws in plastic expansion plugs.

Cable tray hangers shall be attached to ceilings with expansion anchors and studs. Support vertical cable trays by bolting to steel angles extending from floor to ceiling.

The general arrangement of power distribution in the Fire protection plant room shall be as follows:

Rise from ESMSB to a horizontal network of cable trays. Drop to free standing panels in cable trays.

Rise from panels to another layer of horizontal network of cable trays. Drop to motors in cable trays.

Flow Meters

Install flow meters with minimum five (5) diameters upstream and two (2) diameter downstream, of straight piping. Install the pressure tap offs in horizontal position (vertical position prohibited) as far as possible.

3.6 INSPECTION, TESTS AND ADJUSTMENTS OF FIRE PUMPS

Prior To Start Up:

Check the pump motor assembly alignment. Adjust if necessary. Weld steel cleats on pump and motor bases to lock them in aligned position.

Tighten and lock foundation and coupling bolts.

Check pump shaft for free rotation.

Check electrical continuity and insulation of motor and the control panel.

Ensure that the relief valve is correctly calibrated and installed.

Shut off the system isolating valve/s and open the test line.

Ensure that the circuit breaker trip rate is correctly selected and the elements properly installed. Adjust the star delta change over timer to the period recommended by the motor manufacturer.

Check system power supply voltage. Perform all other checks outlined in the controller operation manual, before energizing the controller.

Ensure that the suction lines and the pump casing are full of water.

3.7 START UP

Check and correct, if necessary, the direction of rotation of the pump, by momentary operation of the emergency start lever.

Close the valve on the test line partially to avoid the operation of the pump at high discharge rates.

Start the pump on manual mode.

Check the motor full load current by manipulating the flow.

Check the pressure relief valve for proper operation by gradually closing the test valve.

Check the pump and motor bearings for signs of overheating.

Check the suction line for signs for entry of air and proper suction intake flow.

3.8 VERIFICATION OF PERFORMANCE

Check the pump head at nominal flow and at 150 % of nominal flow and ensure conformity with design requirements.

Close the test line and stop the pump. Release the system pressure gradually

with the test valve. Check and adjust the pressure switch setting for automatic cut-in. Check and adjust the pressure switch setting for automatic cut-in and cut-out of jockey pump.

Put System into Service

Isolate the fire pump controllers.

Close the test line and open the system isolating valve. Ensure that the system outlets are closed.

Fill the system with the jockey pump. Maintain pressure for 24 hours and ensure that there are no leaks.

Energize fire pump controllers and ensure that the system is in automatic mode.

3.9 GUARANTEES AND WARRANTIES

Furnish the client with manufacturer's guarantee and warranty certificates, duly registered with the manufacturer.

LIST OF APPROVED MANUFACTURERS AND MAKE

1. **PLUMBING WORKS**

- CERAMICS FIXTURES (LOCAL) ICL / KARAM CERAMIC /PORTA (Prime Quality)
- FAUCETS & TRIMS (LOCAL) MASTER / SONEX /PORTA
- TOILET ACCESSORIES (LOCAL) MASTER / SONEX/ NATIONAL
- uPVC SEWERAGE PIPES AND FITTINGS JEDDAH POLYMER, DADEX, FIRAT,PAK ARAB, Prince
- PP-R POLEY DEX, RETA,FIRAT, DADEX
- VALVES FIRAT, PAKLITE, DIZAYN, LIANSU
- GEYSERS VENUS PAKISTAN/ SINGER/ UNIGAS
- KITCHEN SINKS ASIA MAKE LOCAL
- WATER DISPENSER LG, WAVES OR LOCAL MAKE
- G.I. PIPES & FITTINGS IIL, PAKISTAN (Medium Quality)
- PAINTS ICI, BERGER
- FHC WITH HOSE REEL NAFFCO, ANGUS UK, CHUBB UK KIDDE UK FIGGIE FIRE PROTECTION
- M.S. PIPES UPTO 3", IIL MAKE ABOVE 3" STELLEX MAKE
- G.I. FITTING CHINA MAKE
- FIRE EXTINGUISHERS FIKE, TYCO, NOHA

Note: Contractor should provide a complete list of all materials with make, model & Country of origin.