

## 1. Additional Installation Requirements

Pull all conductors splice free. Make all conductor connections under screw terminals. Provide insulated barrier type terminal strips at junction points. Use of wire nuts, crimped connectors, or twisting of conductors is prohibited. All control panels shall be dressed out in a professional manner with all wires running in the vertical or horizontal plane, cut to exact length, making all turns at 90 degree angles, and tightly bundled and wire wrapped. Conduit may not enter the top of control panel cabinet.

## FIELD QUALITY CONTROL

### 1. Preliminary Testing

Notify Engineer prior to performing preliminary testing. Contractor shall conduct the following tests during installation of wiring and system components. Any deficiency pertaining to these requirements shall be corrected by the Contractor prior to final acceptance testing of the system. Record results of testing. Submit all test results to the Engineer.

- a. Operation of Entire System. Operate all initiating and indicating devices.
- b. Operation of Supervisory Systems: Operate all portions to demonstrate correctness of installation.
- c. Smoke Detector Test: Clean the smoke detectors in accordance with the manufacturer's recommended procedures. Test smoke detectors using magnet-activated test switch, manufacturer provided test card, or smoke. Use of aerosol sprays to test smoke detectors is prohibited.

### 2. Final Acceptance Testing

The Contractor shall notify the Engineer when the system is ready for final acceptance testing. Request scheduling for final acceptance testing only after all necessary preliminary tests have been made and all deficiencies found have been corrected to the satisfaction of the equipment manufacturer's technical representative and the Engineer and written certification to this effect has been received by the Fire Protection Engineer. The system shall be in service at least 15 calendar days prior to final acceptance testing. The Contractor shall allow at least 15 calendar days between the dates final testing is requested and the date the final acceptance testing takes place. The Contractor shall furnish all equipment, instruments, devices and personnel for this test. The system shall be tested for approval in the presence of representatives of the manufacturer, the Engineer, and the Fire Protection Engineer. All necessary tests shall be made including the following, and any deficiency found shall be corrected and the system retested.

#### a. Entire System

Test the entire system by operating all fire alarm initiating, notification, and signalling devices. Perform tests with the system operating on primary power and repeat the test with the system operating on battery power only. Provide necessary equipment to test smoke detectors and heat detectors.

#### b. Supervisory Systems

All aspects of the supervisory functions of the systems shall be operated. Introduce faults in each circuit at random locations as directed by the Fire Protection Engineer. Verify proper trouble annunciation at the control panel.

### 3. Additional Tests

When deficiencies, defects or malfunctions develop during the tests required, all further testing of the system shall be suspended until proper adjustments, corrections or revisions have been made to assure proper performance of the system. If these revisions require more than a nominal delay, the Engineer shall be notified when the additional work has been completed, to arrange a new inspection and test of the fire alarm system. All tests required shall be repeated prior to final acceptance, unless directed otherwise.

**ITEM 23 : PLUMBING AND SANITARY WORKS****SCOPE OF WORK**

The work covered for this section shall consist of furnishing all labor, tools, equipment, materials and incidentals necessary for the complete installation, testing and operation of the plumbing and sanitary system within the buildings and premises in accordance with these Specifications and as shown on the drawings or as directed by the Engineer. The septic tank and their effluent and discharge pipelines shall be part of other section of these specifications.

**MATERIAL REQUIREMENTS****SUBMITTAL**

1. The Contractor shall submit his work method statement with necessary shop drawings to the Engineer for approval twenty eight (28) days before the start of the works.

Shop drawings shall be dated and shall contain the name of the project and location of the subject item in the shop drawing which is to be installed.

The Engineer will review and approve or return for correction all shop drawings with reasonable promptness. The Contractor shall make any corrections required and file with the Engineer three (3) corrected copies of the shop drawings.

2. The drawings shall indicate the general arrangement of all pipings, however, where actual conditions necessitate re-arrangement in opinion of the Contractor and/or the Engineer, the Contractor shall prepare and submit to the Engineer for approval, twenty eight (28) days before placing the order for materials, shop drawings of the proposed re-arrangement. Because of the small scale of the drawings, shop drawings to indicate all offsets, fittings and accessories shall be prepared. The Contractor shall carefully examine the drawings and shall carefully investigate actual structural and finish conditions affecting all his work.
3. The Contractor shall be responsible for the proper fitting of materials, equipment and accessories without substantial alteration and at no cost to the Employer.
4. The Contractor shall be responsible for the proper coordination of the work and shall provide all necessary clearance where necessary.

**STANDARDS**

Use of materials shall further be governed by other requirement imposed on other sections of these Specifications. Materials shall be subject to tests necessary to ascertain their fitness if the Engineer so requires. All works shall comply with the pertinent provisions of the Plumbing Code of the concerned city or town, the Code on Sanitation of the Philippines, and/or the National Plumbing Code of the Philippines.

**MATERIALS**

1. Identification of Materials

Each length of pipe, fittings, traps, fixtures and devices used in the plumbing work shall have cast, stamped or indelibly marked on it, the approved manufacturer's trademark or name, the weight, type and class of product when so required by the standards mentioned above.

## 2. Alternative Materials

Use of any material not specified in this Specification may be allowed provided such alternate has been approved by the Engineer and provided further that a test, if required, shall be done by an approved agency in accordance with generally accepted standards.

## 3. Soil, Waste, Drain, Vent Pipes and Fittings

Soil, waste and vent pipes shall be unplasticized Polyvinyl Chloride (uPVC) pipes. Diameter shall be as indicated on the Drawings. It shall conform to ASTM D 1784 or ASTM D 2729.

Drainage pipes shall be reinforced concrete pipes (RCP), diameter shall be as indicated on the Drawings.

## 4. Jointing Material

The joint material for uPVC pipes shall be PVC solvent cement as recommended by the approved pipe manufacturer.

## 5. Water Supply Pipes

Water supply pipes shall be polypropylene random-80 (PPR-80) pipes PN 20 conforming to DIN Standards DIN 1988/DIN 8078, German made. Jointing shall be fusion welded.

## 6. Cleanouts, Plugs and Tee

Cleanouts shall be of the same material as the pipe to be fitted. Cleanouts installed in connection with uPVC hubs and spigot pipes shall consist of a long sweep quarter bend of  $\frac{1}{4}$  as shown on the drawings.

## 7. Pipe Sleeves

Pipe sleeves shall be installed and properly secured in place at all points where pipes passes through masonry or concrete. Pipe sleeves shall be uPVC pipe, Schedule 40.

## 8. Downspout

All downspout shall be unplasticized polyvinyl chloride (uPVC) pipe class DWV conforming to ASTM D2729 or ASTM D1784 for sanitary pipes, Series 1000.

## 9. Splash Block

Provide splash blocks at the outlet of downspout emptying at grade which shall be made of pre-cast concrete, with smooth finished counter sunk dishes sloped to drain away from the building. Dimensions as shown on the Drawings.

## 10. Roof Strainers

The Contractor shall provide fittings and install 100mm G.I. mesh wire strainers where shown or indicated on the drawings and/or where the Engineer directs. Each strainer shall fit the size of the corresponding downspout which is to be installed.

## 11. Shower, Floor and Urinal Drain

Shower and floor drains shall be made of stainless steel non-tilting grate, perforated or slotted. Urinal drains shall be cast iron dome type drain.

**12. Pipe hangers, Inserts and Support**

- a. Pipe hangers shall be wrought iron, malleable iron pipe hangers spaced not over 1.5meters apart for uPVC pipes and 3.0meters apart for iron pipes. Chain straps, perforated bars or wire hangers will not be permitted.

Hangers shall have short turnbuckles or other approved means of adjustment. Turnbuckles may be omitted on hangers where space does not permit their use. Trapeze hangers may be used in lieu of separate hangers for pipes running parallel to each other and close together.

- b. Inserts shall be of cast iron or cast steel and shall be of a type to receive a machine bolt head or nut after installation.

- c. Wrought iron clamps or collars shall be used to support vertical runs of pipes.

**13. Unions**

Union pipe 50mmØ and smaller shall be malleable iron. Union on water piping 63mmØ and larger shall be flanged pattern and shall be of galvanized (zinc coated) cast iron. Gaskets for flange unions shall be of best quality fiber plastic or leather.

**14. Valves**

Valves shall be cast bronze or brass body. Chrome plated finish for all fixture taps and faucets and natural finish for all others, like hose bibbs, gate valves and which are not tapped directly to a plumbing fixture. Concrete valve boxes shall be installed where required and will be of sufficient size for operating the valve.

**15. Fixtures**

- a. Water Closets

All water closets for toilets as shown on the drawings shall be TANK TYPE, white with complete fittings and mounting accessories.

- b. Lavatories

- b. 1. Lavatory (Wall Hung)

Shall be vitreous china, wall hung lavatory with rear overflow holes, fitting ledge suitable for single faucet holes on centers complete with faucet, standard fittings, trap and lavatory brackets and other accessories.

- b. 2. Lavatory (Countertop Lavatory)

Shall be vitreous china, oval or round shaped countertop lavatory with front overflow hole, complete with faucet, supply valve and fittings with P-trap. Fitting ledge suitable for single hole on center.

## c. Urinals

- c. 1. Urinals for all comfort buildings shall be built-in urinal trough as shown on the drawings.
- c. 2. Urinals shall be vitreous china, wall-hung washout urinal, flushing rim, integral trap, 19mm top and shall be provided with water saving flush system.

## d. Service Sinks

Service sinks where indicated or shown on the Drawings shall be stainless steel, with single bowl and with complete U.S. or Japan imported fittings.

## e. Slope Sinks

Slop sink shall be 24"x20" acid resisting enamel on Cast-Iron with concealed hanger and faucet.

Hose bibb shall be of brass finish.

## f. Soap Holder

Soap holder and toilet paper holder shall be vitreous china, wall mounted. All toilet/bath rooms will be provided with soap holder, toilet paper holder and chrome plated towel racks.

## g. Faucet for lavatory

Faucet for lavatory shall be in chrome-finish.

## h. Bath and shower fitting

Bath and shower fitting shall be chrome-finish.

## i. Towel Rail

Towel rail shall be tubular stainless steel, 2.7mmØ, and 0.54m long or as specified in the drawings.

## j. Curtain rod

Curtain rod shall be tubular stainless steel, 19mmØ or as specified in the drawings.

## k. Grab Bar

Grab bar shall be tubular stainless steel, 25mmØ or as specified in the drawings.

## l. Bidet Spray Combination

Installed in every cubicle near on the water closet, colored white or its equivalent

## 16. Concrete, Reinforcing Steel, Pipe and Steel Plate

Materials for wash pits, catch basins and manholes shall conform to the requirements as follows:

- a. Concrete materials shall conform with the requirements in "Concrete Works" and shall be Class C concrete with a 28-day minimum compressive strength of 21 MPa (3,000 psi).
- b. Reinforcing steel shall be as shown on the drawings and shall conform with the requirements of reinforcing steel bars in "Concrete Works."
- c. Pipes shall be as shown on the drawings and shall comply with the relevant item of the particular pipe.
- d. Steel plates shall be as shown on the Drawings and shall comply with Section "Steel and Metal Works".

#### 17. Non-reinforced Concrete Pipe

Non-reinforced concrete pipe shall be as shown on the Drawings and shall conform with the requirements of non-reinforced concrete pipes AIC latest edition. Concrete shall be with a 28-day minimum compressive strength of 20.7 MPa.

#### 18. Valve for Drinking Fountain

Valve where drinking fountain will be connected shall be polished brass pipe and shall have red enameled handle.

### EXECUTION

All installation works shall be in conformity with the National Plumbing Code of the Philippines (NPCP).

#### EXCAVATION, TRENCHES AND BACKFILLING

1. Trenches for all underground pipelines shall be excavated to the required depth. The bottom of trenches shall be tamped hard and graded to secure the required fill. Bell holes shall be excavated so that pipes will rest on solid ground for their entire length.

Rocks where encountered, shall be excavated to a depth of 150mm below the bottom of the pipe and before the pipe is laid, the space between the bottom of the pipe and the rock shall be filled with sand. Sewer and water pipes shall be laid in separate trenches.

2. After pipelines have been tested, inspected and approved by the Engineer and prior to backfilling, all forms shall be removed and the excavation shall be cleaned of all trash and debris.

Materials for backfilling shall consist of acceptable excavated soil, borrow of sand, gravel or other materials approved by the Engineer and shall be free from trash, lumber or other debris. Backfilling shall be placed in horizontal layers not exceeding 150 mm in thickness and properly moistened to approximate optimum requirements. Each layer shall be compacted by hand or machine tamper or by other suitable equipment to a density that will prevent excessive settlement or shrinkage.

Backfilling shall be brought to a suitable elevation above grade to provide for anticipated settlement and shrinkage thereof.

Water pipes shall have a sand cushion 150mm below and above the pipes.

#### INSTALLATION OF SOIL, WASTE DRAINS OR VENT PIPES

## 1. Horizontal Drainage Pipe and Vent Piping

Horizontal waste pipes 75mmØ and smaller shall have a minimum grade of 6.5mm per 0.30m and for 100mmØ and larger, 3.2mm per 0.30m. All main vertical soil and waste stacks shall be extended full size above the roof line as vents, except where otherwise specifically shown.

Where practicable, two (2) or more vent pipes shall be connected together and extended as one pipe through the roof. Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched to stacks using fittings as required without forming traps in pipes.

Vertical pipe vents may be connected to a vent line carrying other fixtures. The connection shall be at least 1.20m above the floor on which the fixtures are located to prevent the use of vent lines as waste. Horizontal waste lines receiving the discharge from two (2) or more fixtures shall be provided with vents, unless separate venting of fixtures is noted.

## 2. Fittings

All changes in pipe sizes on soil waste lines shall be made with reducing fittings or recessed reducers. All changes in direction shall be made by the appropriate use of forty five (45) degree wyes. Long sweep quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical and on the discharge from water closets.

Where it becomes necessary to use short radius fittings in any location, the approval of the Engineer shall be obtained before they are installed.

## 3. Joints

### a. PVC Soil Pipe

All joints in uPVC soils, waste and vent pipe shall be accomplished by the use of PVC solvent cement.

### b. All joints for uPVC shall be accomplished by applying the manufacturer's recommended solvent before connection to the pipe.

## 4. Cleanouts

Cleanouts at the bottom of each soil stack, waste stack and where else indicated shall be the same size as the pipe.

Cleanouts on floors shall be by uPVC plug adapter fit into the hub and fitted with uPVC screw plugged flush with the floor.

Cleanout shall be provided at every change in direction greater than 45 degrees.

## 5. Flashings

All pipes passing through the roof shall be provided with lead flashings. All flashings shall be built to 40 lbs. bituminous felts and shall extend up to the pipe and down-over to top of pipe at least 150mm and along the roof not less than 300mm and shall lap over flashing to make a weatherproof joint.



## 6. Traps

Each fixture and piece of equipment requiring connections to the drainage system, except fixtures with continuous waste shall be equipped with a trap. Traps shall be specified to be supplied with the fixtures. Each trap shall be placed as near to the fixtures as possible. Traps installed on threaded pipes shall be recessed drainage pattern.

## 7. Pipe Sleeves, Hangers and Supports

Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete except unframed floors on earth.

Pipes shall not be permitted to pass through footings or beams unless noted on the drawings.

Pipe sleeves in floors shall extend not less than 25mm and not more than 50mm above the finished floor. After installation of the pipe, the space around the pipe shall be packed with plastic material and made watertight. Flashing shields for sleeves passing through waterproofing membrane shall be thoroughly mopped into the membrane. The space between the pipe and sleeves shall be made watertight by inserting approved sealing and caulking materials.

## INSTALLATION OF WATER PIPES, FITTINGS AND CONNECTIONS

### 1. Gate Valves and Outlets

Gate valves shall be installed close to the point of connection to the existing service line outside the building. The piping shall be extended to all fixture outlets and equipment from the gate valves. Outlets where indicated shall be capped or plugged and left ready for future connections.

### 2. Mains, Branches and Runouts

All runs of piping shall be installed as shown on the drawings. The piping shall be cut accurately to measurements, and installed at the building site by the Contractor and shall be worked into place without springing or forcing. Care shall be taken not to weaken the structural portions of the buildings.

All pipes above ground shall be run parallel with the lines of the building unless otherwise shown on the drawings. Branch pipes from service lines may be taken off on top of mains, bottom of mains or side of mains, using such cross over fittings as may be required by structural or installation conditions.

All service pipes, valves and fittings shall be kept at sufficient distance from the other work to permit finished covering not less than 6.5mm from such other work and not less than 13mm between finished covering on different services. No water piping shall be buried in floors unless specifically indicated on the drawings or approved. Changes in pipe sizes shall be made with reducing fittings.

The use of long screws and bushings is prohibited.

### 3. Joints

Joints and connections in the plumbing system shall be gas-tight and watertight for the pressures required by test.

After cutting and before threading all pipes shall be reamed and shall have burrs removed.

All screwed joints shall be applied with an approved graphite compound or TEFLON tape to facilitate connections. Threads shall be full cut and not more than three threads on the pipe shall remain exposed.

Caulking of threaded joints or top to prevent leaks shall not be permitted.

Unions shall be provided where required for disconnection. Threaded swing bolts shall be used for branch connections to risers and mains.

#### 4. Unions

Where required unions shall not be concealed in walls, ceilings or partitions.

#### 5. Tests

The following tests shall be conducted by the Contractor at his expense under the supervision of the Engineer.

##### a. Tests for Drainage and Venting System

The entire drainage and venting system shall have necessary openings plugged to permit the entire system to be filled with water to the level of the highest vent stack above the roof. The system shall hold the water for 30 minutes with a drop not greater than 100mm.

##### b. Sterilization

The entire water supply piping system shall be sterilized with a solution containing not less than fifty (50) parts per million of available chlorine, either liquid chlorine or a solution of sodium hypochlorite. The sterilizing solution shall remain in the system for a period of not less than 8 hours during which time all valves and faucets shall be opened and closed several times. After sterilization, the solution shall be flushed from the system with clean water until the residual chloride content is not more than 0.2 parts per million.

##### c. Pressure Test for Water Lines

1. After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section, thereof, shall be subjected to hydrostatic pressure one and one half (1½) the designed working pressure of the system or as specified by the Engineer.
2. The duration of each pressure test shall be at least 20 minutes unless otherwise specified by the Engineer.
3. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the pipeline. To accomplish this, tap shall be made if necessary, at the highest point of the pipe under test and after completion of the test, the taps shall be tightly plugged unless otherwise specified. During the test, all exposed pipes, fittings, valves, joint and couplings will be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials

at his expense. The test shall then be repeated until satisfactory results are obtained.

**d. Leakage Test for Water Lines**

1. Leakage test shall be conducted after satisfactory completion of the pressure test and shall consist of an examination of all exposed joints for leakage as well as an overall leakage test of the completed pipeline.
2. The pressure to be maintained during the test shall be the designed working pressure of the system.
3. Leakage test shall be made only after a minimum of 24 hours after the pipe to be tested has been filled with water.
4. The duration of each leakage test shall be two hours unless otherwise specified by the Engineer.
5. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation shall be applied by means of a positive displacement type pump and reservoir connected to the pipe in a manner satisfactory to the Engineer.
6. Before starting the leakage test, all air shall be expelled from the pipe. All exposed pipes, fittings, valves and joints shall be examined for leakage during the test.
7. Allowable leakage rate per 100 joints per inch of Pipe Diameter at Pressure Stipulated.

PRESSURE		LEAKAGE RATE	
psi	kg/cm <sup>2</sup>	liters/hr.	liters/2 hrs.
50	3.50	1.45	2.90
75	5.30	1.75	3.50
100	7.00	2.05	4.10
125	8.80	2.30	4.60
150	10.50	2.50	5.00
200	14.00	2.90	5.80

**e. Defective Work**

1. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Engineer.
2. All repairs to piping shall be made with new materials at the expense of the Contractor.
3. No caulking of screwed joints or holes will be accepted.

**ASSEMBLY, INSTALLATION AND CONNECTION OF FIXTURES**

Fixtures shall be supported and fastened in a satisfactory manner. Where secured to concrete or masonry work walls, fixtures and equipment shall be fastened with brass bolts or machine screws in lead-sleeve type anchorage units or with brass expansion bolts. Expansion bolts shall enter 7.5 cm into solid concrete or masonry works and shall be fitted with loose tubing or sleeves of proper

length to bring expansion sleeves into the solid concrete masonry walls.

Where wood screws are used, screws shall go into solid pieces set between studs. Where through-bolts are used, bolts shall be provided with plates or washers at back set, so that they will be concealed by plaster. Bolts and nuts shall be hexagonal and exposed nuts, cap nuts, and screw heads shall be provided with chromium plated brass washers.

## PROTECTION OF FIXTURES

Pipe openings shall be closed with caps or plugs during installation. Fixtures shall be tightly covered and protected against dirt, water and chemical injury. At the completion of all works, all fixtures shall be thoroughly cleaned and delivered in a condition satisfactory to the Engineer.

## FIXTURES AND FASTENING

All fixtures shall be supported and fastened in a satisfactory manner as follows:

1. Where secured to concrete or concrete hollow block walls, they shall be fastened with one quarter inch brass bolts with twenty threads to the inch and of sufficient length to extend at least 7.5 cm into solid concrete or hollow block work, fitted with loose tubing or sleeve insert and shall be securely anchored and installed flush with the finished wall and shall be completely concealed when the fixtures are installed.
2. Where through-bolts are used, they shall be provided with plates or washers back set so that heads, nuts and washers will be concealed by plaster. Bolts and nuts shall be hexagonal. Exposed bolts, nuts, capnuts and screw heads shall be provided with chromium plated brass washers.

## GUARANTEE

Upon completion and before final acceptance of the equipment installation, the Contractor shall furnish the Engineer a written guarantee stating that all equipment installed under this Section free from defects. The guarantee shall be for a period of one (1) year from the date of final acceptance of the work. Any part of the equipment that becomes defective during the term of the guarantee shall be replaced, renewed and/or made good by the Contractor, at his own expense and in a manner satisfactory to the Engineer.

Guarantees made by the approved manufacturers or suppliers beyond one year, shall be transferred to PPA without any expense on his part.

## CLEANING UP

Upon completion of the work, all parts of the installation shall be thoroughly cleaned of grease, metal cuttings and sludge which may have accumulated during the testing operation.

## PLUMBING, FIXTURES AND TOILET ACCESSORIES INSTALLATION

All installation works shall be as shown on the drawings and shall conform to the applicable standards set forth by the National Plumbing Code of the Philippines. All fixtures shall be fastened and/or supported in accordance with the given requirements.

**ITEM 24: SEWAGE WASTEWATER TREATMENT FACILITY****GENERAL**

Supply and installation of full sewage treatment facility (STP) including pipings, pumps, and equipment applies to this section with all parts and scope of work specified herein.

**SCOPE OF WORK**

The Contractor shall furnish, install and place in operating condition a sewage wastewater treatment facility capable of treating up to 10 cubic meters per day. Scope of work includes the installation of all components of the system including all pipings, lift pumps, blowers, built-in regulating tanks, and a fully enclosed carbon steel container compact sewage treatment equipment and electrical works for the pumps tapped to the existing facility or to the designated tapping point.

Contractor shall place the STP equipment underground of at least 100mm compacted gravel and soil below.

Aside from equipment supply and commissioning, Contractor shall also provide a monthly maintenance service plan to clean, maintain. And offer full warranties (parts and effluent quality) to the service equipment for a minimum of one (1) year and renewable yearly thereafter.

Total surface area space to be used below ground (STP only) shall be no more than 5m x 1.5m (L x W).

**TYPE OF SYSTEM**

The STP shall be utilizing biological conventional activated sludge (CAS) plus Membrane Bio-Reactor (MBR) technology in order to fully treat all the sewage water from toilets and kitchen of the Benoni Port facilities. The STP shall treat the sewage water as to meet the new DENR DAO 2016-08 and new DAO 2021-19 effluent standards.

No.	Parameters	unit	Effluent Limits (Class SB Levels)
1	Ammonia as NH <sub>3</sub> -N	mg/L	3.0
2	BOD	mg/L	30
3	COD	mg/L	60
4	Color	TCU	100
5	Nitrate as NO <sub>3</sub> -N	mg/L	20
6	pH (Range)	-	6.0-9.0
7	Phosphate	mg/L	2
8	Surfactants (MBAS)	mg/L	3
9	Temperature	°C change	3
10	Total Suspended Solids	mg/L	70
11	Oil & Grease	mg/L	5
12	Fecal Coliforms	MPN/100mL	200

## SYSTEM OPERATION

Sewage treatment facility shall be modular and made from compact carbon steel containers package modules with separate steel regulating tanks. The system shall be a complete sewage treatment plant which includes built-in regulating tank, anaerobic, aerobic, membrane bioreactor (MBR) ultrafiltration, sludge, and clean water tanks, as well as circulation pipings and a control room.

Wastewater shall convey by gravity from the septic tanks to the sewage treatment facility. Sanitary PVC pipe shall be use in the sewerage network.

The sewage water will then enter the STP built-in regulating tank. Float switches will indicate when the regulating tank is full and lifting pumps will then pump the sewage water from the regulating tank into initially the anoxic then aerobic tank to start nitrification/denitrification process via the biological treatment components (CAS) using air blowers and an air distribution system. It will then be treated using the membrane bio-reactor tanks (MBR) in the ultra-filtration range to filter out suspended solids, colloidal material, sewage microbes, and bacteria. Circulating reflux pumps within the system will ensure the MLSS levels are in check. MBR shall have automatic backwashing function using oxalic acid or hydrochloric acid.

The sewage water shall be treated at twenty (20) operating hours in day and then be discharged to the designated nearest drainage point approx. fifteen (15) meters away from the unit.

The Contractors scope of work shall include the excavation for the laying of the pipe lines and installation of underground tank. Pipe lines excavations shall be deep enough for a six (6) inches UPVC pipes according to local standards (please see detail at the construction plans).

## MATERIAL REQUIREMENTS

### CONTAINER STEEL HOUSING

The main STP equipment shall be housed in a Q235 Carbon Steel material coated with 3 layers of epoxy paint for anti-corrosion protection. The container shall have accessible hatch covers on top of each of the STP tanks for maintenance purposes. It shall also provide valves for drainage of each tanks when necessary for maintenance.

### REGULATING TANKS

The regulating tanks shall be built-in with the STP in one compact tank. This tank shall be no less than eight (8) cubic meters in volume.

### LIFTING PUMPS

Four submersible lifting pumps shall be placed in each septic tanks powerful enough to transport sewage water from the passenger facility to the STP. The minimum power of each pump shall be no less than 0.75kw. Float switches shall also be provided to allow for automatic switching of the lift pumps.

A submersible lifting pump shall be placed also inside the clean water tank of the STP to provide clean water transportation to the discharge point. This pump shall have a minimum of 0.75kW power.

### PIPES

Contractor shall supply and install the pipings for the STP system made from UPVC material three (3) inches in diameter with the minimum thickness of 2.3mm. The pipe lines shall be rated at

minimum Mpa 1.0 of pressure. Total length of pipelines from the three (3) septic tanks to the STP and to the discharge point is approximately 105 meters.

## **SEWAGE TREATMENT FACILITY REQUIREMENTS AND MATERIALS**

A fully enclosed, compact, and modular sewage treatment facility shall be provided housed in carbon steel. This facility shall utilize CAS and MBR technologies to effectively treat the wastewater and meet the DENR DAO 20160-08 effluent standards. This facility shall, at the *minimum*, include the following components and specifications.

### **AIR BLOWERS**

Two steel housed air blowers with at least 1.3kW of power each. One blower shall be operational while the other on standby at any given time. Each air blower shall automatically alternate in operations as to balance the usage.

### **AIR DISTRIBUTION SYSTEM**

The air distribution system shall be made from ABS pipelines to distribute air to the aerobic and membrane tanks.

### **MEMBRANE CARTRIDGES**

The membranes shall be Polyvinylidene Fluoride (PVDF) hollow fiber material in the ultrafiltration range. Cartridges shall be housed in stainless frame with easy access for inspection. Minimum lifetime of membranes shall be four (4) years included in the warranty.

The membrane shall utilize a permeate pump with a minimum of 0.37kW power to transfer the pre-filter water into the clean water tank. There shall also be a 0.55kW backwash pump to provide automatic back wash cleaning of the membranes using oxalic acid.

### **CIRCULATION PUMPS**

Mixed liquor and sludge reflux submersible pumps shall be in place to recirculate the sewage water within the system. Each pump shall be at the minimum 0.75kW in power.

### **BIO MEDIA**

Bio-media to house biological flocs and facilitate microbe digestion shall be included made from elastic Polypropylene (PP) material. This material shall be placed in both the anoxic and aerobic tanks.

### **CONTROL ROOM**

The STP facility shall include a control room with access door to house the electrical control panel, pumps, and acid container for membrane backwashing use. A door lock shall be provided for security purposes to the designated Pollution Control Officer (PCO) or maintenance personnel.

## **EXECUTION**

### **PRODUCTION**

All STP components shall be manufactured and delivered within 90 days.

## **INSTALLATION**

### **1. General**

Installation of all system components and pipes shall be in accordance with the manufacturer's instructions and as specified and shown.

### **2. Electrical**

Electrical supply shall be provided by the end user using 220v, 1-phase, 60hz. Electrical connection from the equipment and pumps shall be performed by Contractor and connected through the control box.

### **3. Plumbing**

All the water inlet pipes, outlet pipes, sludge return pipes should be connected according to the drawings submitted by Contractor. There should be a fresh water tap water source nearby for filling up and washing the unit when necessary.

### **4. Mechanical Installation**

The STP container shall be placed underground. A crane with minimum of 10 tons lifting capacity shall be provided by Contractor.

## **FIELD TEST**

### **1. Conduct testing specified herein in the presence of the Project Engineer.**

### **2. Acceptance Test**

After installation has been completed, Contractor shall conduct an acceptance test, to demonstrate that the equipment operates in accordance with specification requirements. The Contractor shall notify the Project Engineer, 2 weeks prior to performance of tests.

### **3. Sludge Seeding**

Contractor shall provide sludge from local wastewater treatment plant is introduced to speed up the biological breakdown of wastewater and grow bacteria.

### **4. Normal Operations**

The Contractor shall conduct effluent testing at the minimum of 30 days after installation to check if the equipment is treating the wastewater normally. A maximum of 90 days after installation shall be provided by end user for the equipment to be able to meet the effluent standards. During this period the Contractor shall be responsible for the operations and training of the sewage treatment facility to PCO and relevant personnel.

## **WARRANTY**

- 1) All equipment and installation shall have a one-year warranty from the delivery date for the mechanical parts based on correct installation and maintenance.



2) Within one-year guarantee period, if there is any default of the mechanical parts, Contractor shall deliver the parts for free. If due to incorrect operation caused the mechanical damage, Contractor will replace the parts based on the parts price list.

3) Warranty repairs or replacements does not include travel and accommodation of technician or engineer and shall be charged to the client.

## **MONTHLY AFTER SALES SERVICE PLAN**

Contractor shall provide a minimum of 1 year after sales service after installation of STP. The contract is for the full operation and warranty of the sewage wastewater treatment facility.

At the minimum the following scope of work shall be provided.

### **High Effluent Standards**

Contractor shall ensure that the equipment can meet regulatory standards while under the service contract.

### **Unlimited Warranty While Under Service**

The service plan shall provide unlimited warranty of parts and accessories. This means any damage caused by normal wear and tear or manufacture defect shall be repaired at no additional cost (excluding technician travel and/or accommodation if needed).

This includes membrane inspection only and does not include membrane cartridges replacement if needed after inspection.

### **Bi-monthly Technician Visit and Routine Maintenance**

The service plan includes a bi-monthly technician visit to inspect all the parts are in good working order and perform routine maintenance and effluent wastewater analysis.

### **Monthly Effluent Parameters Report**

Contractor shall provide at the end of each month within the contract year an effluent parameters report to make sure the unit is meeting the required standards or if it is needing modification. This report shall be provided via paper or electronic copy.

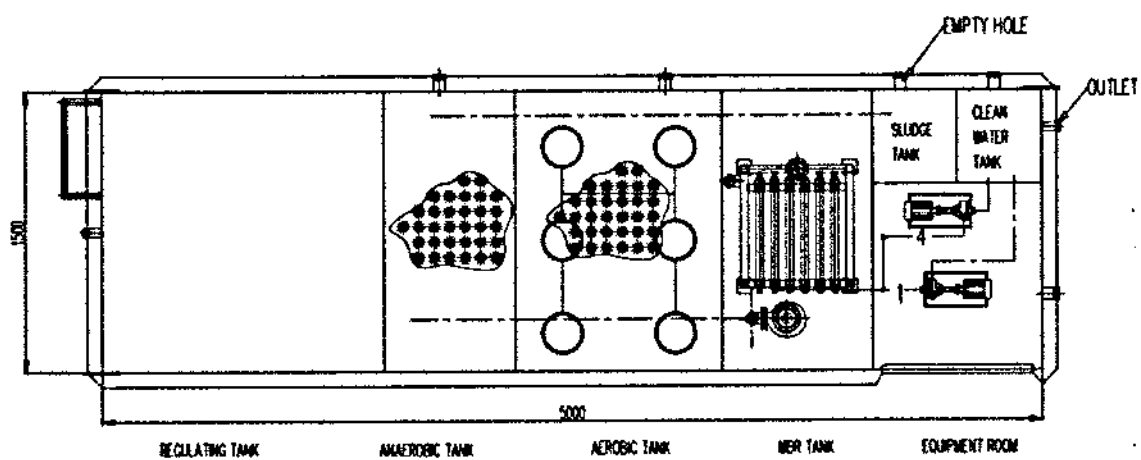
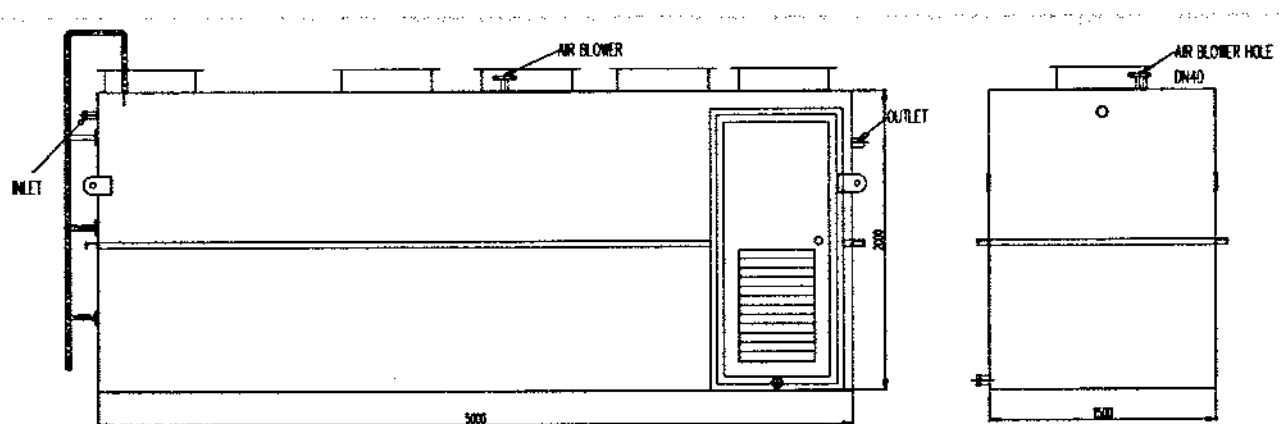
### **Accumulated Solids Removal and Disposal**

Under the service plan the Contractor shall also provide accumulated solids (sludge) removal from the STP whenever needed (excluding septic tank) at no extra charge to end user.

## **EFFLUENT STANDARDS**

The entire sewage treatment facility shall pass the DENR DAO 2016-08 and new DAO 2021-19 Class SB level effluent standards in accordance with the Clean Water Act 2004.

See attached drawings for details of the wastewater treatment plant.



**ITEM 25 : WATER PUMPS AND PRESSURE TANK****GENERAL**

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

**SCOPE OF WORK**

The work covered by this section consist of furnishing all labor, materials, equipment, tools and incidentals necessary to undertake, complete supply of water pump and pressured tank for the building as indicated on the drawings and as specified herein.

**Pressure Tank/ Water Pump****PRESSURE TANK**

1. Tank Volume and Dimensions : Varies per building

Connectors: 1 ¼ inches

Pressure: 125 psi

**WATER PUMP**

1. Location: Varies per building  
Description: Constant pressure booster pump  
Function: Booster pump  
Power: Varies per building  
Flowrate: Varies per building  
Specs: Varies per building

See plans for individual building requirements and specifications.

**EXECUTION**

All materials will be delivered and installed on site.

## **ITEM 26: FIRE PROTECTION WORKS**

### **GENERAL**

The General Condition and Provision of the Civil works contract not in conflict with these Specification and the Drawings form part of and/or included in this section of these Specification.

The work to be done. under this Division of the specifications consists of the fabrication, complete in all details, of the Fire Protection Works, at the subject premises, and all works and materials incidental to the proper completion of the installation, except where same shall be in conflict with such Codes, etc. which, later shall then govern. The requirements with regard to materials and workmanship specify the required standards for the furnishing of all labor, materials and appliances necessary for the complete installation of the work specified herein and indicated on the drawings.

The work covered in this contract is to be installed according to the specs. Codes, ordinances and requirements of the followings:

1. Revised Fire Code of the Philippines
2. National Fire Protection Association (NFPA) 10, 13, 14 and 20
3. Ordinances of concerned city or municipality

### **DRAWINGS AND SPECIFICATIONS**

The contract drawing and specifications are complementary to each other and any labor or materials called for by either, whether or not called for by both, if necessary, for the successful operation of any of the particular type of equipment will be furnished and installed without additional cost to the Owner.

All dimensional locations of equipment, fixtures, conduits, and chases shall be verified on site, on the architectural drawings and manufacturer's catalogue.

**INTENT** - It is not intended that the drawings shall show every wires, pipes, fitting, and equipment. All such items whether specifically mentioned or not, or indicated on the drawings, shall be furnished and installed if necessary, to complete the system in accordance with the best practice of the Fire Protection trade and to the satisfaction of the Owner through their Construction Manager and the Consultant.

**SITE INVESTIGATION** - The Contractor is required to visit the site and to ascertain for himself the local conditions and facilities that may affect his work. He will be deemed to have done this before preparing his proposal and any subsequent claims on the ground of inadequate or inaccurate information will not be entertained.

## **SHOP DRAWINGS**

The Contractor shall submit to the Architect and the Engineer, for approval, four (4) copies of all shop drawings of details and connections not shown on the drawings or deviations thereof but required for the work. The Contractor shall certify that the drawings have been checked for dimensions, materials, erection details and that they conform to the intent of the drawings and specifications.

The Shop Drawings shall be bound neatly in three (3) sets and submitted to the Architect with a letter of transmittal. The letter of transmittal shall contain a list of items indicated above to be submitted along with manufacturer's name.

The Contractor shall also be able to submit sample products when required by the Owner or Architect.

All materials and equipment installed without prior approval of the Architect shall be at the risk of subsequent rejection.

Approval rendered on shop drawings shall not be considered as a guarantee of measurements or building conditions. Where drawings are approved, said approval does not mean that drawings have been checked in detail. Said approval does not in any way relieve the contractor from his responsibility or necessity of furnishing materials or performing work as required by the contract drawing and specifications.

## **AS-BUILT DRAWINGS**

The contractor, shall during the progress of work, maintain accurate records of all deviations in work as actually installed from work indicated on the Drawings.

Upon completion of work, the Contractor shall submit four (4) copies in Autocad format, one (1) copy shall be reproducible, of the as-built drawings indicating the work as actually and finally installed.

## **CUTTING AND PATCHING**

Contractor shall provide all cutting and patching necessary to install the work specified in this section. The Contractor shall do all drilling required for the installation of his hangers.

No structural members shall be cut without the approval of the Owner or the Architect, and all such cutting shall be done in a manner directed by the Owner or the Architect.

All patching shall be performed in a neat and workmanlike manner acceptable to the Architect. Patching shall match adjacent surfaces.

## **SUB-CONTRACTOR**

Unless otherwise recommended on these Specifications, the Contractor shall not subcontract the whole or any part of the work without the written consent of the Owner. The Contractor shall be responsible for any work carried out by any subcontractor as if he himself were undertaking the work.

## **STANDARD OF WORKMANSHIP**

The Contractor shall execute all work in a neat and workmanlike manner and shall do all necessary work whether it is clearly specified in these Specifications or shown on the Drawings or not. All work shall be done in accordance with the best practices employed in modern sprinkler installations.

The Contractor shall employ only competent and efficient workmen and shall, upon written request of the Architect, discharge or otherwise remove from work any employee who is, in the opinion of the Architect, careless or incompetent, or who obstruct the progress of the work or acts contrary to instructions or conduct himself improperly.

## **STANDARD OF MATERIALS**

All materials shall be new and shall conform to the technical Specifications. All materials shall be standard products of reputable manufacturer's and shall bear the name of the manufacturer.

All materials shall be subject to the approval of the Architect and Consultant. This approval shall not relieve the Contractor of the responsibility of inspecting such materials for defect of non-conformance with the specifications.

Where the technical specifications or the Drawings give the name of the manufacturer and/or catalogue number of materials, it is given as a guide to the size, strength, quality or class of the materials desired and shall be interpreted to mean that item or another fully equal for the service intended. Substitution shall be subject to prior written approval of the Architect and Consultant.

The apparent silence of the Specification and Drawing as to any detail, or apparent omission from them of a detailed description concerning any material shall be regarded to mean that only material of first-class quality shall be used.

## **REMOVAL OF DEFECTIVE OR UNAUTHORIZED WORK**

Any defective work, whether the result of poor workmanship, defective materials, damage through carelessness or any other cause, found to exist prior to acceptance of, or final payment for the work shall be removed immediately and replaced by work and material which shall conform to these Specifications, or shall be otherwise remedied in an acceptable manner. This clause shall have full effect regardless of the fact that the work may have been done within the full knowledge of the Architect and Consultant.

All materials not conforming to the requirement of the technical Specifications shall be considered as defective.

No defective materials, the defect of which has been subsequently corrected shall be used unless approval has been given by the Architect and Consultant.

## **CONFORMITY WITH PLANS AND ALLOWABLE DEVIATIONS**

These Specification and Drawing indicate the general layout of the system and the Contractor shall be responsible for the installation of the system without substantial alteration or modifications. Wherever field conditions or exigencies of construction make departures from these Specifications and the Drawings necessary, detail of such departure and reason thereof shall be submitted without delay to the Architect and Consultant and no departure shall be made without written approval of the Architect and Consultant.

## **COOPERATION WITH OTHER TRADES**

The Contractor shall examine and shall familiarize with the Specifications and Drawings of the Civil Works, the Air Conditioning Works, Plumbing/Sanitary Work, and the Electrical Works. He shall arrange his work and dispose his materials so as not to interfere with the work or storage of materials of the other Contractor. Should the Contractor cause damage to any other Contractor on the work, the Contractor shall upon due notice settle with such Contractor by agreement or arbitration. The Contractor shall be liable for any claim by the other contractor against the Owner on account of such damage.

Where the work of the contractor will be installed in close proximity to, or will interfere with work of other trades, he shall assist in working out space conditions to make a satisfactory adjustment. If so, directed by the Owner, the mechanical contractor shall prepare composite working drawings and sections at a suitable scale not less than 1:50 - M., clearly indicating how his work is to be installed in relation to the work of other trades. If the contractor installs his work before coordinating with other trades, or so as to cause any interference with work of other trades, he shall make the necessary changes in his work to correct the condition without extra charge.

The mechanical contractor shall furnish to other trades, as required, all necessary templates, patterns, setting plans, and shop details for the proper installation of work and for the purpose of coordinating adjacent work.

## **INSPECTION AND TESTS**

The Architect and Consultant or his representative shall be allowed access to all part of the work at all times and shall be furnished such information and assistance by the Contractor as may be required to make a complete detailed inspection. Materials and installation shall be subject to such tests as are deemed necessary by the Architect to properly ascertain their fitness both during installation and after installation is completed. All expenses to conduct special test shall be by the contractor.

## **INJURY TO PERSONS OR DAMAGE TO PROPERTY**

The Contractor shall be responsible for all injury to persons and damage to property caused by the work or by workmen and shall be liable for any claim against the Owner on account of such injury and/or damage. The Contractor shall likewise take necessary precautions to protect the property of the Owner against rain or other inclemency of the weather and against theft, where exposure to such inclement weather or theft is due to the performance of his work. The Contractor shall be liable for any such damage or loss.

## **TEMPORARY FACILITIES**

The Contractor shall make all necessary arrangement and pay for the provisions of the necessary electrical supply required for the work and shall clear away all temporary installation before or upon completion of the work.

## **LEAVING THE SITE**

The Contractor shall not withdraw from the site until the whole Fire Protection system is completed and in operational condition and ready for use by the Owner.

## **SUSPENSION OR DELAY**

The Contractor shall not suspend or fail to make proper progress with the work without justifiable cause. The Owner, in the event of delay or suspension of the work still persisting after written complaint, shall have the right to take over the work and all materials on the site and make arrangements as are necessary to have the work completed by others.



## **CLEANING UP**

During the process of the work on the completion of the project, the Contractor shall remove from the premises all dirt, rubbish and waste materials caused by him in the performance of his work, he shall remove all tools, scaffolding and surplus materials after completion and acceptance of the work.

## **GUARANTEE**

The Contractor shall guarantee that the Fire Protection system is free from all defective workmanship and materials and will remain so for a period of one (1) year from date of acceptance of the work by the Owner or the Architect. Any defect, appearing within the aforesaid period shall be remedied or replaced by the Contractor at his own expense.

## **PERMITS AND DUES**

The contractor shall give all necessary notices, obtain all permits and pay all government taxes, fees, and other costs, including utility connections or extension, in connection with his work; file all necessary plans, prepare all documents, and obtain all necessary approvals of all governmental departments having jurisdiction; obtain all required certificates of inspection for his work and deliver same to the Construction Manager before request for acceptance and final payment for the work.

The contractor shall include in the work, without extra cost to the Owner, any labor, materials, services: apparatus, drawings, in order to comply with all applicable laws, ordinances, rules and regulations, whether or not shown on drawings and/or specified.

The Contractor shall include in his work, without extra cost to the Owner or Architect, Drawing (in addition to Contract/ Drawing and Documents and associated paperwork as required by the approving Authorities.

## **INSPECTIONS AND CERTIFICATES**

Upon completion of the entire installation, the approval of the Architect and Owner shall be secured, covering the installation throughout. The Contractor shall obtain and pay for certificate of inspection and approval from the Public Authorities having jurisdiction. A final inspection certificate shall be submitted to the Architect prior to the final payment. The Contractor shall pay any/ all cost incurred for fees.

## **EQUIVALENTS**

When materials or equipment are mentioned by name, they shall form the basis of the Contract, if not the Contractor may recommend, provided that they are equivalent. When approved by the Architect in writing, other materials and equipment may be used in place of those specified, but written application for such substitutions shall be made to the Architect as described in the Bid Documents. The difference cost of substitute materials or equipment and reason for substitution shall be given when making such request. Approval of substitute is contingent on same, meeting specified requirements and being of such design and dimensions as to comply with space requirements.

In case of a difference in price, the Owner shall receive all benefits of the difference in cost involved in any substitution and the Contract may be altered by Change Order to credit the Owner with any savings so obtained.

## **DETAILED BREAKDOWN OF ESTIMATES**

The Contractor shall submit detailed breakdown of estimate on each listed fire protection system herein along with the provided bid proposal. Detailed breakdown shall consist of the quantity, brand name and costing per item of a system.

## **SCOPE OF WORK OF THE CONTRACTOR**

The work of the Contractor consists of supervision, labor, equipment and materials, and perform all operations in connection with the Fire Protection System shown on the plan, their tests and inspections complete and in accordance with these Specifications and Plans and subject to terms and conditions of the Contract. Any equipment, materials, or works not shown on the Plans but mentioned in the Specifications, or vice-versa, shall be furnished and installed by the Contractor.

Specifically, the work shall involve the following:

- a. To secure, at his own expense, for all Fire Protection permits certificates and other related permits.
- b. Furnish and install an Automatic Wet Sprinkler System for the entire building, as indicated on the drawing.
- c. Furnish and install of Fire Pump assembly including the jockey pump.
- d. Furnishing of portable fire extinguishers.
- e. Testing of the automatic sprinkler and standpipe system within the facility as required by the laws, ordinances, rules, regulations and orders of governmental authorities having jurisdiction over this work.

## TECHNICAL SPECIFICATIONS

1. **Quality Assurance** - All materials to be used shall be new and shall conform with the referenced codes and standards. Use of materials shall further be governed by other requirements, imposed on other sections of these specifications. Materials shall be subject to the necessary tests to assure their fitness if so required.
2. **Alternate Materials** - Use of any material, not specified in these specifications may be allowed provided further that a test, if required, shall be done by an approved agency in accordance with generally accepted standards.
3. **Fire Pump**
  - a. The system shall consist of One (1) unit of UL Listed, FM approved Vertical Turbine Fire Pump. The necessary attachments specified herein shall be capable of delivering 150% of rated capacity at no less than 65% of total head. The fire pump shall deliver a capacity as shown on the plans. The motor drive shall be an induction motor of ODP type with an electrical characteristic as shown on the drawings
  - b. Accessories:
    1. Check valve in discharge pipe and suction strainer.
    2. OS&Y gate or butterfly valves on system discharge side of check valve and on supply side of pump.
    3. Piping for test and drain to water tank.
    4. Flow measuring device.
    5. Circulation relief valve and discharge cone.
    6. Automatic air release, valve and fittings.
    7. Primary Connect
    8. Capacity Plate.
    9. Pressure Switches.
    10. Water level testing device and piping.
    11. Eccentric Reducer and Concentric Increaser.
    12. Pressure gauges.

**c. Drive:**

**Motor:** Motor horsepower rating shall be in accordance with the manufacturer's requirements. The motor shall be of capacity that 1 15% of the full load ampere rating shall not exceed at any condition of pump load.

**Controller** UL listed, FM Approved Combined Manual and Automatic, reduced voltage, type open transition circuit breaker with interrupting capacity of 100,000 Amps, RMS Symmetrical at 460 volts. Standard features include air unit breaker, running period, timer motor starter, molation switch, pilot lights, pressure switch, manual start, start-push buttons, control relay and other standard accessories in drip-proof enclosure.

Provide Alarm circuit for power failure.

Fire Pump Controller shall be METRON or Approved Equal

**d. Controls:**

1. **Controller:** Hand-off automatic switch, fire water pressure switch to operate pump drive, fire water pressure switches for alarms.
2. Local alarm with indicating lights for low fire water pressure and high fire water pressure.
3. Alarm for low water level and no water at u/G Fire Water Tank.
4. Contacts for remote circuits to indicate pump operational status and alarm status.

- e. **Acceptable Manufacturers:** Peerless, Fairbanks-Morse, ITT-AC or approved equal.

**JOCKEY PUMP**

- f. Jockey Pump shall consist of 1 unit. Electrically driven Submersible type pump. The jockey pump shall deliver a capacity as shown on the plans, complete controller and accessories.
- g. Provide shut-off valves, check valve, and relief valves and Jockey Pump controller, with across the line controller with fusible disconnect switch, motor starter, timer, fuses, pressure switch, selector switch, overload relays, enclosure to be in NEMA 4 enclosure. Additional feature to have pressure recorder, power on pilot light.
- h. **Acceptable Manufacturers:**
  1. Grundfos
  2. Approved Equal.

## **WATER PIPING**

Sprinkler piping shall be Sch.40 seamless black steel or Iron pipe, ASTM A795 or ASTM A53; Fittings in accordance with ANSI B16 .3 rated for 200 lbs. (1380 kPa) working pressure, in accordance with NFPA.

## **FITTINGS**

Screw joint steel piping up to and including 2inch diameter. Weld piping 2.5inch diameter and larger, including branch connections.

Factory fabricated carbon steel weld fittings shall be 150 lb. or 300 lb., as required, and shall be produced in strict accordance with ANSI Specifications B-1 6.0 and shall conform to details, tolerances and dimensions contained therein.

Malleable iron screwed fittings, 150 lb. or 300 lb., as required, shall be provided in strict accordance with ANSI Specifications B-1 6.9 and shall conform to details, tolerances and dimensions c o n t a i n e d therein.

Should there be a grooved piping inside the building and above the floor, the piping shall be installed in a cut grooved method using ductile iron mechanical pipe couplings of a bolted type with pressure-responsive gasket along with bolted type mechanical pipe ductile iron fittings and flange adapters and shall conform to the details , tolerances and dimensions as required by the system manufacturer.

Fittings shall be designed to withstand the working pressures involved, but not less than 175 psi cold water pressure

## **ACCESSORIES**

- a. Alarm Check Valve: U.L. listed, divided seat ring type alarm check valve with external bypass and retarding chamber. Basic trimmings shall include nipples, fittings, devices for external bypass, alarm test bypass gauge and drain connections, and mounting supports for retarding chamber and drip funnel. Standard alarm trimmings shall be provided for use with, and including water motor alarm and a pressure switch. Alarm check valve shall be "Star", "Viking" or approved equal.

- b. Flush Fire Department Connection: For sprinkler system double clapper flush wall connection type, straight body connections, 6" x 2-1/2" x 2-1/2" x 2-1/2" (150 x 65 x 65 x 65) with pinlug plugs and chains, double female snoots, exposed parts with polished brass finish, threads to conform to those used by local fire department with "11 Auto-Sprk" Lettering.
- c. Check Valve: Shall be of the swing check type, with iron body, bronze mounted, renewable seat and disc, bolted cap, asbestos gaskets. Steel bolts, 175 lbs. (1225 KPa) water working pressure, flanged ends with drip connections.
- d. Gate Valves: Shall be iron body with bronze trim, solid wedge, outside screw and yoke, rising stem, flanged ends, 175 lbs. (1225 KPa) water working pressure. Valves at the discharge side of pumps shall be Class 200.
- e. Monitor Switch: U.L. listed, single pole double throw switch with a roller type switch actuator and a spring-loaded plunger mounted in a housing, design to make an electrical contact when O.S.&Y. Control gate valve at sprinkler main riser is closed, "Star", "Viking" or approved equal.
- f. Hose Valves: 65 dia. (2.5"), (65mm) polished brass finished, female & male hose threads to match local fire department equipment.
- g. Roof Manifolds: Cast brass with female N.P.T, inlet and male N.P.T. outlet, two-way, 150 x 65mm, back inlet.
- h. Pressure gauges and ball drip valves 2.5" NPT, bronze and cocks shall be as provided.
- i. Inspector's test and drain valve shall conform to the minimum requirements of the latest edition of NFPA No.13

## SPRINKLER HEADS

Sprinkler heads shall conform to the minimum requirements of the latest edition of NFPA No. 13, shall be UL and FM listed and shall be as specified hereinafter:

- i. For areas with exposed ceiling, use Quick Response upright, brass, 74 deg. C (165 deg. F) temperature rating and Y2 in. (13mm) standard orifice. (Glass bulb type). "Viking", "Star" or "Reliable" brand
- ii. For all areas with ceiling, use Quick Response pendent type chrome finish. with matching escutcheon, actuating temperature of 165 °F (74°C), listed by UL/FM. Preferably glass bulb type. "Viking", "Star" or "Reliable" brand.
- iii. For high heat areas such as kitchens, use Quick Response pendent type chrome finish. with matching escutcheon, actuating temperature of 212 °F (100 °C), listed by UL/FM. Preferably glass bulb type. "Viking", "Star" or "Reliable" brand.
- iv. Quick Response sidewall type sprinkler heads shall be chrome finish. with matching escutcheon, actuating temperature of 165 °F (74°C), listed by UL/FM. Preferably glass bulb type. "Viking", "Star" or "Reliable" brand.
- v. Sprinkler Cabinet: Shall be fabricated from sheet steel and finished painted with red enamel, to be provided complete with 12 spare sprinkler heads (6 plain brass and 6 chrome plated) and two sprinklers.

## **FIRE HOSE CABINETS**

Cabinet shall be recessed 16-gauge steel body, annulux finished aluminum door trim with pull handle and friction catch with lock key. Cabinet shall be designed for 100 ft. hose pin rack and fire extinguisher. Door shall be full panel glass. Cabinet finish shall be powder coated white inside with prime coat outside. Cabinet maybe made locally of approved quality. Provide "Break glass in case of Fire" sign.

### **Accessories:**

1. Pin rack for fire house cabinet shall be semi-automatic type, baked enamel finish designed for 100 ft. of 1.5 " hose and furnished with 1.5" chrome plated brass rack nipple.
2. Fire hose for fire hose station shall be 100 ft. of 1.5" cotton double jacket flexible fire hose. Hose coupling shall be 1.5" chrome plated male-female National Standard hose threads. Nozzle shall be approved by UL/FM.
3. Provide one (1) unit 10 lbs. ABC multi-purpose dry powder chemical portable fire extinguisher labeled with UL/FM.

### **Hangers**

Hangers shall conform to the minimum requirements of the latest edition of NFPA No. 13.

- a. All changes in direction of sprinkler heads shall be provided with hanger.

**PORTABLE FIRE EXTINGUISHERS** - Shall be tri-class dry chemical or multi-purpose (primarily monoammonium phosphate) or equivalent which is non-toxic agent which extinguishes flames in seconds and inhibits reflash. It shall be effective against Class A, B and C fires. Contents shall be 10 lbs. (4.5 kg), the unit shall be mounted inside the fire hose cabinet or thru the fire extinguisher cabinet. Shall be manufactured by UL/FM approved or Approved equal.

**Carbon Dioxide Fire Extinguishing System** - Carbon Dioxide fire extinguishing system will be provided for fire suppression for transformer and electrical rooms, lift motor room, electrical room using portable or wheeled type fire extinguishers. Shall be UL/FM approved or Approved equal.



## **EXECUTION**

### **Workmanship**

The work throughout shall be executed in the best and most thorough manner to the satisfaction of the Architect and the Engineer, who will jointly interpret the meaning of the drawings and specifications and shall have the power to reject any work and materials, which in their judgement, are not in full accordance therewith.

The Contractor shall assume unit responsibility and shall provide the services of a qualified Engineer to supervise the complete installation of equipment and systems and who shall be available for conducting the final acceptance tests.

### **Preparation**

Examine all surfaces which are to support or receive parts place and subsequent construction. Notify General Contractor if any condition exists which will prevent the completion of the Work in this Section in a satisfactory manner. Application or installation of materials constitutes acceptance of the supporting and adjoining construction.

### **Piping**

- a. Ream pipe and tube ends to full inside diameter.
- b. Remove burrs and bevel plain end ferrous pipe.
- c. Remove scale and foreign materials, inside and outside, before assembly.

### **Coordination**

Installation of the wet automatic sprinkler system shall be coordinated, by the Fire Protection Contractor, with the immediate and related mechanical and electrical installations and all other trades involved in other parts of the Work for the proper location and installation of sprinkler heads, piping, outlets and equipment before installation of same.

## **Installation**

Install the wet automatic sprinkler system in strict accordance with the approved drawings and each manufacturer's requirements where required, and as applicable an automatic fire alarm system.

All sprinkler pipe and fittings shall be so installed that the system may be trained. Sprinkler pipes may be installed level and trapped piping shall be drained.

Pipe, tube or fittings shall be joined by the following means:

### **Threaded Pipe and Fittings:**

- a. All threaded pipe and fittings shall have threads cut to ANSI Standards B2.1. Care shall be taken that the pipe does not extend into the fitting sufficiently to reduce the waterway.
- b. Pipe shall be reamed after cutting to remove all burrs and fins.
- c. Joint compound or tape shall be applied to the threads of the pipe and not in the fitting.

**Welding Pipe:**

- a. Sections of branch lines, cross mains, feed mains or risers may be shop welded.
- b. Sections of welded piping shall be joined by means of screwed bolt and nut flange or flexible gasketed joints or other approved fittings.
- c. Torch cutting shall not be permitted as a means of modifying or repairing sprinkler systems.
- d. Welding shall be done in accordance with the methods set forth hereinbefore.
- e. Welders shall be certified as specified hereinbefore.
- f. When welded fittings are used to form outlets:
  1. Holes in piping shall be cut to the full diameter of the fitting.
  2. Discs shall be retrieved.
  3. Openings in piping shall be made smooth.
  4. All slag and other welding residue shall be removed.

Sprinkler piping shall be substantially supported from the building structure which must support the added load of the water-filled pipe plus a minimum of 250 lbs. (114 kg) applied at the point of hanging.

Types of hangers and installation methods shall be in accordance with and conform to the latest edition of NFPA No.13, unless they are certified by a professional registered engineer for the following:

- a. Designed to support five (5) times the weight of the water-filled pipe plus 250 lbs. (114 kg) at each point of piping support.
- b. These points of support are enough to support the sprinkler system.
- c. Ferrous materials are used for hanger components.

Sprinkler piping shall be supported independently of the ceiling sheathing, except as follows:

- a. Toggle hangers may be used only for the support of branch lines under ceilings of hollow tile or metal lath and plaster.

When sprinkler piping is installed below ductwork, piping shall be substantially supported from the building structure or from steel angles supporting the ductwork provided the angles conform to the requirements of the latest edition of NFPA No.13.

For trapeze hangers, the minimum size of steel angle or pipe span between purlins or joints shall be as specified in the latest edition of NFPA No.13.

- a. All angles shall be used with longer leg vertical.
- b. Any other sizes or shapes giving equal or greater section modulus will be acceptable.
- c. The trapeze bar shall be secured to prevent slip page.

The size of hanger rods and fasteners required to support the steel angle iron or pipe shall be as specified in the latest edition of NFPA No.13.

Screwed unions shall not be used on pipe larger than 2 inches. Couplings and unions of other than screwed type shall be of the types approved specifically for use in wet automatic sprinkler systems. Unions, for fire protection screwed or flexible gasketed couplings or flanges may be used to facilitate installations.

Use one-piece reducing fittings wherever a change is made in the size of the pipe, except hexagonal or face bushings may be used in reducing the size of openings of fittings when standard fittings of the required size are not available.

## **Painting**

Paint sprinkler piping as shown on the Drawings and as specified.

1. Care shall be exercised whenever the sprinkler piping is given any kind of coating to ensure that no automatic sprinkler surfaces are coated.
2. Automatic sprinklers shall not be painted and any sprinklers which have been coated, except for factory applied coatings, shall be replaced with new listed sprinklers.

## **Cleaning**

Swab-out lines and/or flush out system with fresh water until they are clean and water runs clear at all outlets.

## **Acceptance Test**

All tests required shall be performed by the installing contractor and witnessed by the Owner or his representative.

The following minimum tests shall be performed. Any additional tests required by the local regulating authority having jurisdiction shall also be performed.

1. Flushing Test.
2. Hydrostatic Test @ a Test Pressure of 250 psi minimum.
3. Leakage Test.
4. Drainage Test.

## ITEM 27 : ROCKWORKS

### SCOPE OF WORK

The work includes the furnishing of all labor, materials and equipment required for the rock works including armour rocks, underlayer and rock fill in accordance with the Specifications and as indicated in the drawings or as directed by the Engineer.

### SETTING OUT OF WORKS

#### 1. Topographic/Hydrographic Survey

Prior to commencement of Works, the Contractor together with the Engineer shall conduct topographic and hydrographic surveys in order to establish the actual field condition or bathymetry of the project site. The said survey shall be used as the basis of quantity measurement.

#### 2. The Contractor shall set out the Works and shall solely be responsible for the accuracy of such undertaking. Visible construction markers shall be used to clearly define horizontal limits prior to placing of any material.

### MATERIAL REQUIREMENTS

1. All rocks to be used shall be angular, hard, durable and not likely to disintegrate in seawater. Rock layers to be installed should more or less be "global in shape", "angular in surface" and should avoid "river run rocks". Rocks that are sub-angular may be subject to the approval of the Engineer. Rounded or well rounded pieces will not be accepted.
2. All rocks shall have a minimum unit weight of 2,650 kg per cubic meter (specific gravity 2.65) of solid materials when measured dry.
3. Rocks with specific gravity higher than the above specified is preferable and will readily be accepted. But no adjustment (increase) in the contract price will be made on this account.
4. Rocks of the primary cover layer shall be sound, durable and hard. It shall be free from laminations, weak cleavages, and undesirable weathering, and shall be of such character that it will not disintegrate from the action of the air, seawater, or in handling and placing. All stone shall be angular quarry stone.
5. All rocks shall conform to the following test designations:

Apparent specific gravity	ASTM C 127
Abrasion	ASTM C 535

### EXECUTION

#### QUARRY SITE AND ROCK QUANTITY

1. It is the Contractor's responsibility to make necessary surveys / investigations on quarry sites applicable to the Works, taking into consideration the nature of the rock works required under the Contract such as required quality, total quantity and daily required quantity, transportation method and route etc.,

2. The Contractor shall submit data on characteristics of proposed quarry sites together with the location of sites, test results of their products and samples for the approval of the Engineer.
3. When the Contractor intends to operate a quarry for the Works, the Contractor shall take all the responsibilities in connection with its operation including, but not limited to, obtaining all necessary permits and approvals, payment of safety measures or like (if any), provisions and maintenance of safety measures and temporary access roads, all of private and public roads and temporary jetties to be used to transport quarried materials and the compliance with all regulations etc. required by the authorities having jurisdiction over any part of the operation.

Should any explosive be used in the quarry operations, the Contractor shall be responsible to meet laws and regulations, wherever applicable, established by the Local Government and Central Government Department concerned.

4. Despite the Engineer's previous approval of the natural rock and borrow pits, the Engineer reserves the right to suspend any operation in connection with the rock, if, in its opinion, such rock is not suitable for the work. In such case, the Contractor shall comply with the Engineer's instructions.
5. The finish bulkhead shall be true to grade and section. The spaces/voids between rocks shall be filled/sealed with 2 kg. to 16 kg. rocks and shall be approved by the Engineer before placing geotextile filter thereon to prevent the filling materials (soil and sand) from escaping to cause scouring and settlement of finished surface.

#### STORAGE OF MATERIALS

Quarried rock materials shall be stored by weight/class or in a manner approved by the Engineer and in a yard kept clean, free from undesirable materials.

#### SAMPLING TEST

1. Thirty (30) days prior to commencement of rock works, samples and test results of rock material which conforms to the Specifications called for in the Contract shall be submitted to the Engineer for evaluation and approval.
2. Rock samples from different sources and of different classes shall also be submitted, together with test results and its corresponding certificates, for the Engineer's approval.
3. Rocks accepted at the quarries before shipments or at the site before placement shall not be used as a waiver. The Engineer has the right to reject any inferior rock quality.
4. Samples for each class of approved materials are to be kept in the field for comparison/checking of delivered rock materials. A test shall be required for every 1,500 cu.m.

#### CROSS-SECTIONS OF COMPLETED ROCKWORK

Cross-sections showing the elevations of the completed rock works and the terrain of the existing seabed prior to construction shall go together with every progress report and request for progress or final payment.

Rock works which was previously paid should be easily identified from sections being requested for payment.

**ITEM 28 : GEOTEXTILE FABRIC****SCOPE OF WORK**

This work covers all the following requirements regarding the installation of geotextile (filter fabric) in accordance with the lines, grades, and dimensions shown in the drawings.

**MATERIAL REQUIREMENTS**

The geotextile fabric shall meet the following requirements in full. If required, a sample of 1.0 sq.m. shall be supplied to the Engineer for approval and retention for purposes of comparative testing against materials randomly sampled from the site.

**1. PHYSICAL PROPERTIES**

- a. The geotextile material shall be a nonwoven needle punched type comprising of needle punched polypropylene fibers or its equivalent.
- b. The geotextile material shall be UV stabilized to ensure retention of minimum 70% original tensile strength after 90 days exposure to sunlight. The manufacturer shall submit test results to the Engineer for approval.
- c. The geotextile must be highly resistant to long term contact with damp cementitious substances or acid or alkali solutions in the pH range 2-13. The manufacturer shall submit test data to ensure resistance of the polymer.

**2. MECHANICAL AND HYDRAULIC PROPERTIES**

The geotextile supplier is required to certify that the materials delivered to site will be proven to meet or exceed the following properties:

TECHNICAL PROPERTIES	UNIT	MINIMUM	TEST STANDARD
<b>A. Physical Characteristics:</b>			
Minimum Mass (per unit area)	(g/m <sup>2</sup> )	540	ASTM D5261
Thickness (F=2 kpa)	mm	4.5	ASTM D5199
<b>B. Mechanical Properties:</b>			
Tensile Strength (md/cd)	kN/m	13/22	ASTM D4595
Tensile elongation (md/cd)	%	90/40	ASTM D4595
CBR Puncture Resistance	N	3000	ASTM D6241
<b>C. Hydraulic Properties:</b>			
Effective Opening Size (O <sub>90</sub> Wet Sieving)	(mm)	0.08	ASTM D4751
Water Permeability: Permittivity	(s <sup>-1</sup> )	0.5	ASTM D4491



**EXECUTION**

1. The geotextile shall be delivered to site with an outer wrapper to protect it from exposure to the elements.
2. Prior to laying of geotextile filter, stone filler shall be placed between gaps or voids of armour / core rocks as likewise mentioned in the requirements of Item "Rock Works".
3. The non-wooven geotextile filter shall be installed and lay manually at site as per design drawings. The filter shall be laid lengthwise down slopes and appropriately anchored along the top edge.
4. The Engineer reserves the right to sample geotextile delivered to site for individual quality control testing at the contractor's expense. A material not meeting the manufacturer's certified values will be rejected from the site.
5. The geotextile shall be proven to resist dynamic puncture damage when subject to impact stress from stone armour (200-400 kg.) dropped from a minimum height of 2.0 m. and should be laid on at least 1-foot sand and gravel bedding. Geotextile failing to resist puncture shall not be accepted.
6. To facilitate site Quality Assurance, each roll of geotextile delivered to site shall be clearly labeled with brand name, grade, and production batch number.
7. Geotextile overlaps shall be at least 1.0 m unless otherwise stated on the drawings. Alternatively, geotextile overlaps are to be heat-welded or sewn using appropriate polypropylene or other synthetic thread and portable hand sewing equipment.

**ITEM 29 : RECLAMATION AND FILL**

**SCOPE OF WORK**

This item shall consist of the construction of back-up area in accordance with the Specifications and in conformity with the lines, grades, and dimensions shown on the Plans or established by the Engineer.

The area to be upgraded shall be as indicated on the Drawings.

The works includes furnishing of all labor, materials and equipment required to complete/finish the upgrading of the area in accordance with the Drawings and the Specifications.

The following major items of works are included:

1. Supply and fill of suitable materials to places required to upgrade elevation of areas as shown in the drawings.
  - a. Compaction of fill materials
  - b. Supply and placing of filter fabric
2. The work may also include the construction of temporary dike or structure to enclose the reclamation material before the completion of a permanent waterfront containment structure.

**MATERIAL REQUIREMENTS**

1. Filling Materials

a. General

All sources of filling materials shall be approved by the Engineer.

Appropriate quantities of sample of all materials to be used in the Works shall be submitted for acceptance and approval by the Engineer thirty (30) days before the commencement of work.

General filling shall consist of approved material from approved sources of suitable grading obtained from excavation, quarries or borrow pits, without excess fines, clay or silt, free from vegetation and organic matter.

Sample of approved materials shall be kept/stored in the field for ready reference/comparison of the delivered materials.

The Contractor shall ensure that adequate quantities of required materials that comply with the specifications and quality approved by the engineer are available at all times.

b. Fill Materials other than Dredged/Excavated Materials

Fill materials for reclamation purposes other than dredged materials shall be pit sand, quarry run, gravel or mine tailings. The fill material shall be of the same quality or better as approved by the Engineer.

**c. Type of Fill Materials**

**c.1 Sand and Gravel Fill (Offshore/Reclamation)**

The materials shall be composed of at least 50% sand and 50% gravel in terms of volume and shall be free from rock boulders, wood, scrap, vegetables, and refuse. The materials shall not have organic content and the maximum particle size shall not exceed 100mm diameter. Source of materials shall be river or mountain quarry or manufactured.

**c.2 Excavated Materials from Seabed (Offshore/Reclamation)**

The excavated materials shall be used for backfilling as directed by the Engineer.

**c.3 Select Materials (General Embankment)**

All materials used for fill shall be free of rock boulders, wood, scrap materials, organic matters and refuse.

The material shall not have high organic content and shall meet the following requirements:

- i. Not more than 10 percent by weight shall pass the No. 200 sieve (75 microns).
- ii. Maximum particles size shall not exceed 75 mm.
- iii. The fill materials shall be capable of being compacted in the manner and to the density of not less than 95%.
- iv. The material shall have a plasticity index of not more than 6 as determined by AASHTO T 90.
- v. The material shall have a soaked CBR value of not less than 25% as determined by AASHTO T 193.

**2. Unsuitable Material – Material other than suitable materials such as:**

- (a) Materials containing detrimental quantities of organic materials, such as grass, roots and sewerage.
- (b) Organic soils such as peat and muck.
- (c) Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.
- (d) Soils with a natural water content exceeding 100%.
- (e) Soils with very low natural density, 800 kg/m<sup>3</sup> or lower.
- (f) Soils that cannot be properly compacted as determined by the Engineer.

will not be accepted by the Engineer.

## **EXECUTION**

### **Reclamation and Fill**

#### **a. General**

The Contractor shall be responsible for all ancillary earthworks that are necessary for the reception of the fill material and including, all spout handling, temporary dike or shoring construction where necessary, temporary protection to dikes in the sea and drainage of excess water.

The arrangements of these ancillary earthworks shall be laid out in consultation with the Engineer and to the Engineer's satisfaction and care shall be taken to minimize the loss of fill.

- b.** Replacement, backfilling and reclamation may be done by any method acceptable to the Engineer. Prior to start of Work, the Contractor shall submit his method and sequence of performing the works to the Engineer for approval. However, the Engineer's approval of the method and sequence of construction shall not release the Contractor from the responsibility for the adequacy of labor and equipment.
- c.** The Engineer shall approve the type of material to be used as fill prior to its placement. If the material is rejected, such material shall be deposited into areas designated or as directed by the Engineer.
- d.** Reclamation of fill material shall be placed in horizontal layers not exceeding 200mm (8 inches), loose measurement, and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, blading, dicing, or other methods satisfactory to the Engineer.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until the necessary compaction is obtained.

Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

### **TRIAL SECTION**

Before finish grade construction is started, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m<sup>2</sup> shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for sub-base, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

## CROSS-SECTIONS OF COMPLETED RECLAMATION

Cross-sections showing the elevations of the completed reclamation and the terrain of the existing seabed prior to construction shall go together with every progress report and request for progress or final payment.

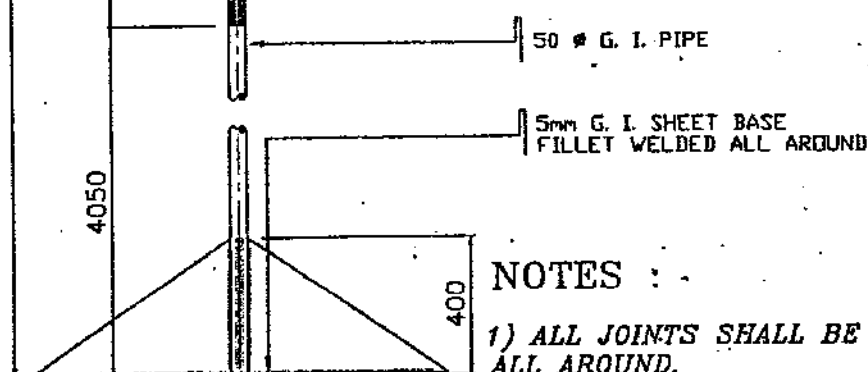
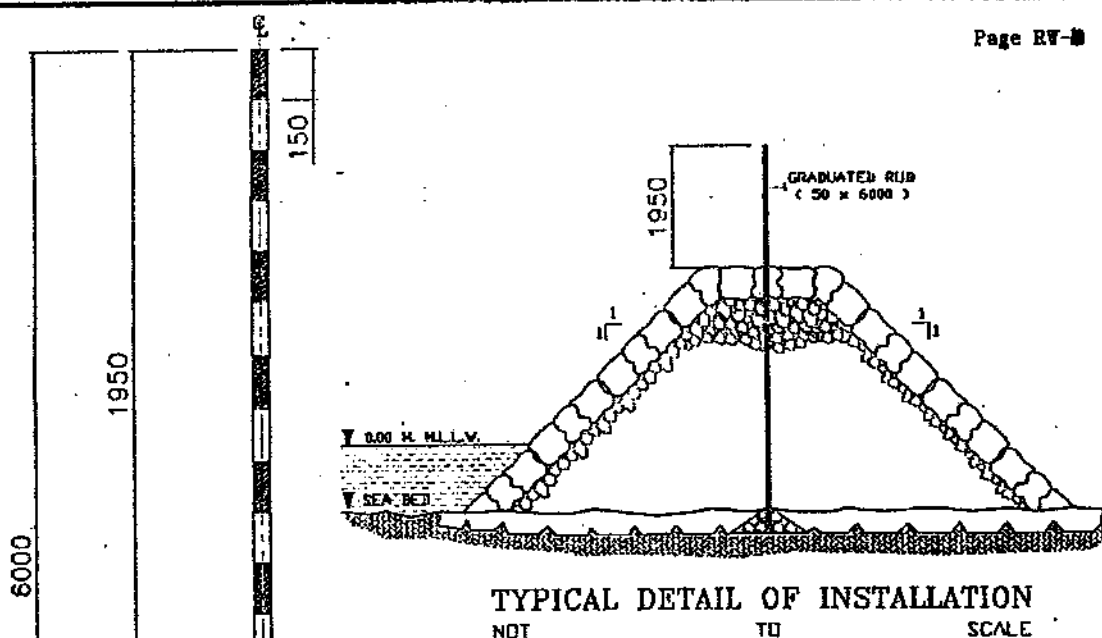
## FIELD COMPACTION TEST

Field Density tests to determine the percent of compaction of the compactable material shall be conducted. Compaction of each layer thereafter shall continue until the required field density in accordance with AASHTO T/180 Method D has been achieved. In place density determination shall be made in accordance with AASHTO T191/ ASTM D 1556.

## TOLERANCE

Elevation : plus 5 cm.

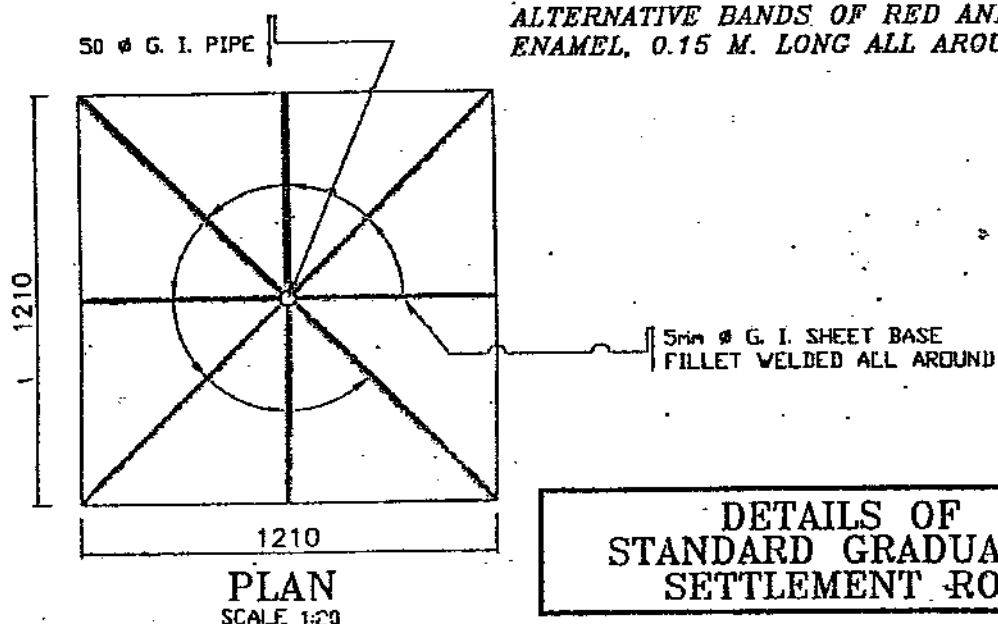
Page RV-8



ELEVATION  
SCALE 1:20

### NOTES :

- 1) ALL JOINTS SHALL BE FILLET WELDED ALL AROUND.
- 2) THE GRADUATED SETTLEMENT ROD INCLUDING THE BASE SHALL BE PAINTED WITH TWO (2) COATS OF ANTI-RUST PAINT AND THE 1.95 M. PAINTED WITH ALTERNATIVE BANDS OF RED AND WHITE ENAMEL, 0.15 M. LONG ALL AROUND.



DETAILS OF  
STANDARD GRADUATED  
SETTLEMENT ROD

**ITEM 30 : CEMENT TREATED BASE COURSE**

**1.0 SCOPE OF WORK**

- 1.1. The work under this Section to be carried out by the Contractor, consists of the construction of Cement Treated Base Course for the pavement composed of aggregate, Portland cement and water in proper proportions, plant-mixed and constructed on prepared subbase in accordance with the specifications herein and in conformity with the lines, levels, grades, thickness and typical cross-sections indicated on the Drawings, and as specified herein.
- 1.2. The Contractor shall, before any work on the cement treated base course is started, design the material proportions in accordance with the requirements of this Section and the Drawings, and secure the Engineer's approval of the materials to be used, and the method of work execution.
- 1.3. Before commencement of the work under this Section, the Contractor shall submit Method Statement stating work plan, materials, design the material proportions, schedule, quality control plan, safety control plan and personnel to be engaged in this work for approval of the Engineer.
- 1.4. The Contractor shall also prepare the finishing elevation drawing of the area for this work in accordance with the design drawings for approval of the Engineer.

**2.0 MATERIALS REQUIREMENTS**

**2.1. Cement**

- (1) The cement shall conform to the requirements in Reinforced Concrete Specification.
- (2) All bags showing initial setting or lumps of caked cement, as well as half used bags, shall be rejected.

**2.2. Aggregates**

- (1) Aggregates shall consist of natural sand, crushed stone or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles approved by the Engineer.
- (2) The Aggregate shall not contain more than 3 percent of material passing the 0.075 mm (no. 200 sieve) by washing nor more than 1 percent each of clay lumps or shale. The use of beach sand will not be allowed.
- (3) If the fine aggregate is subjected to 5 cycles of the sodium sulfate soundness test, the weighed loss shall not exceed 10 percent.

**2.3. Portland Cement**

- (1) Only Type I Portland Cement conforming to ASTM C 150 shall be used unless otherwise provided for. Different brands or the same brand from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the Engineer.
- (2) Cement which for any reason has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used.

- (3) Samples of cement shall be obtained in accordance with AASHTO T127.

#### 2.4. Water

- (1) Water used in mixing, curing or other designated applications shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water will be tested in accordance with Reinforced Concrete Specifications.
- (2) Water which is drinkable may be used without test. Where the source of water is shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.

#### 2.5. Proportioning of Mixture

- (1) The amount of cement to be added to the soil-aggregate shall be from 6 to 10 mass percent of the dry soil. The exact percentage to be added shall be fixed by the Engineer on the basis of preliminary laboratory tests and trial mixes of the materials furnished by the Contractor.
- (2) The mixture shall have the following grading characteristics:

**Table 1 – Mixture Gradation (CTBC)**

Sieve Designation	Percent passing cement/aggregate mix	
	Minimum	Maximum
2" (19 mm)	85	100
3/8" (9.50 mm)	55	80
1/4" (6.35 mm)	42	66
No. 4 (4.75 mm)	32	56
No. 10 (2 mm)	23	43
No. 40 (0.50 mm)	11	26
No. 80 (0.20 mm)	7	17
No. 200 (0.075 mm)	4	10

#### 2.6. Strength Requirements

- (1) The cement content for construction shall be that at which the mix develops a 7-day compressive strength of at least 5.20 MPa (53 kgs/cm<sup>2</sup>, 750 psi).
- (2) The testing procedure shall be as follows: mold and cure specimens in accordance with ASTM D 560; soak specimens in water for 4 hours; cap and break specimens in compression in accordance with ASTM D 1633.
- (3) CBR Test for Gravelly Soils. The mixture passing the 19 mm (3/4 inch) sieve shall have a minimum soaked CBR-value of 100% tested according to AASHTO T 193. The CBR-value shall be obtained at the maximum dry density determined according to AASHTO T 180, Method D.
- (4) Unconfined Compression Test for Finer Textured Soils. The 7-day compressive strength of laboratory specimen molded and compacted in accordance with ASTM D 1632 to a density of 100% of maximum dry density



determined according to AASHTO T 134, Method B, shall not be less than 2.1 MPa (300 psi) when tested in accordance with ASTM D 1633.

## **2.7. Mix Design**

- (1) The mix design shall be submitted to the Engineer for approval and shall be accompanied by test data. A change in the source of materials during the progress of work may necessitate a new design mix.
- (2) The mix design shall determine with accuracy the aggregate grading, the cement content and the required water content.

## **3.0 STORAGE OF MATERIALS**

### **3.1. Storage of Portland Cement**

- (1) Cement shall be stored in a cement silo or damp proof warehouses, and used on first in/ first out basis.
- (2) The Contractor shall, when storing cement in a cement silo, exercise care not to cause lump of cement sticking to the bottom of silo. Bagged cement shall be stacked on the warehouse floor which has been raised by not less than 30 cm above the surrounding ground in such a way to afford easy inspection and handling. Bags of cement shall not be stacked more than 13 bags in height.
- (3) Cement which has been stored for a long period and has not passed a pertinent quality test carried out before use or which contains caked lumps, shall not be used.
- (4) The Contractor shall cool cement before use if it has been warmed, having been stored in a hot place. Prior to construction, laboratory tests of the approved soil material shall be made to determine the quantity of cement required in the mix.

### **3.2. Storage of Aggregate**

- (1) The Contractor shall stockpile coarse and fine aggregate according to their sizes with proper partitions in between.
- (2) The Contractor shall take measures to maintain skin moisture content of stockpiled aggregate uniform in the entire mass by providing shade over the aggregate, water sprinkling or other means.
- (3) Care shall be exercised when receiving, storing and handling the aggregate not to cause segregation of sizes or allow mixture of dirt, mud or other foreign materials into the aggregate.
- (4) The Contractor when stockpiling aggregate under hot climate shall take measure to prevent direct exposure to the sunlight such as a shade not to excessively heat or dry the aggregate.

## **4.0 CONTRACTOR'S EQUIPMENT AND PLANT**

- 4.1. Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity and mechanical condition.

- 4.2. The equipment shall be at the site sufficiently ahead of the start of construction operations to be examined thoroughly and approved.

## **5.0 CONSTRUCTION METHOD**

### **5.1. Central Batching Plant Method**

- (1) The aggregate shall be proportioned and mixed with cement and water in a central mixing plant. The plant shall be equipped with feeding and metering devices which will introduce the cement, aggregate and water into the mixer in the quantities specified. Mixing shall continue until a uniform mixture has been obtained.

### **5.2. Spreading, Compacting and Finishing**

- (1) The material shall be spread by a mechanical spreader of approved type or asphalt paver. In spreading from the wind row, care shall be taken to avoid cutting into the underlying course.
- (2) Initial rolling shall be performed with pneumatic tire roller and final rolling with a 3 wheel or tandem-type steel wheel roller. Rolling shall be discontinued whenever it begins to produce excessive pulverizing of the aggregate or displacement of the mixture.
- (3) When the compacted thickness of the cement treated base course is to be more than 150 mm, the mixture shall be spread from the wind row and compacted in 2 approximately equal layers, the first layer to be bladed and rolled before the second layer is spread.
- (4) Compaction shall continue until field density of not less than 98% of the compacted maximum dry density determined in accordance with AASHTO T 180 Method D has been attained. Field Density test shall be in accordance with AASHTO T 191.
- (5) Where cement treated base is required under asphalt concrete pavement, the compacted cement treated base surface shall be scarified to produce corrugation and allow good bonding between layer of asphalt pavement and the cement treated base course.

### **5.3. Weather Limitations**

- (1) The cement treated base shall not be applied during windy, rainy or impending bad weather. In the event rain occurs, work shall be promptly stopped and the entire section if damaged shall be reconstructed in accordance with the Specification.

### **5.4. Protection, Curing and Maintenance**

After the cement treated base course has been finished as specified herein, the surface shall be protected against rapid drying for a period of at least five (5) days by either of the following curing methods:

- (1) Maintain in a thorough and continuously moist condition by sprinkling with water.
- (2) Cover the completed surface with a 50 mm layer of sand and maintain in moist condition.
- (3) Apply on the surface an asphalt membrane of the type and quantity approved by the Engineer.
- (4) Apply on the surface a liquid membrane curing compound of the type and quantity approved by the Engineer.

The Contractor shall be required to maintain at his own expense the entire work within the limits of his Contract in good condition satisfactory to the Engineer from the time he first started work until all work shall have been completed. Maintenance shall include immediate repairs of any defects that may occur before and after the lime-stabilized base course has been compacted and finished, which work shall be done by the Contractor at his own expense and repeated as may be necessary to keep the base continuously intact.

#### 5.5. Trial Sections

- (1) Before construction is started, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor.
- (2) Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m<sup>2</sup> shall be made for every type of material and/or construction equipment/procedure proposed for use.
- (3) After final compaction of each trial section the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.
- (4) If a trial shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable, the materials shall be removed at the Contractor's expense and a new trial section shall be constructed.
- (5) If the basic conditions regarding the type of material or procedures change during the execution of the work, new trial section shall be constructed.

## 6.0 QUALITY CONTROL

6.1. The quality shall satisfy the standard values shown in Table 6.1

Table 6.1 – MATERIALS (CTBC)

WORK ITEM	TEST FORM	TEST METHOD	FREQUENCY	STANDARD VALUE
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<b>Cement Treated Base Course</b>	Portland cement	As approved by the Engineer	Once for every 500 tons at receiving materials	To meet the requirements of Type I Portland Cement conforming to ASTM C 150 Manufacturer test data may be substituted as directed by the Engineer
	Gradation of aggregate	AASHTO T 11 and T 27 or equivalent	Once for every quarry	To meet the requirements of Table 20370.1
	Abrasion of aggregate	AASHTO T 96 or equivalent	- ditto -	Not more than 30%
	Soundness of aggregate	AASHTO T 104 or equivalent	- ditto -	Not more than 5%
	Water Absorption of aggregate	AASHTO T 84 and T 85 or equivalent	- ditto -	Not more than 3% (Dry specific gravity)
	Plasticity index	AASHTO T 90 or equivalent	- ditto -	Not more than 6 Aggregate passing No.40 sieve including mineral filler
	Moisture-density Relation	AASHTO T 180	Once for every 500 m <sup>2</sup> at Point designated by the Engineer	-
	Density of Soil in Place by the Sand Cone Method	AASHTO T 191	Once for every 2,000 m <sup>2</sup>	98 % or more
	Compressive Strength	ASTM D 560 and ASTM D 1633	Once for every 500 tons	More than 5.20 MPa (53 kgs/cm <sup>2</sup> : 754 psi )

Table 6.2 – WORKMANSHIP (CTBC)

WORK ITEM	TEST FORM	TEST METHOD	FREQUENCY	TOLERANCE
<b>Cement Treated Base Course</b>	Finish elevation	As approved by the Engineer	Once for every 400 m <sup>2</sup> at points designated by the Engineer	+ 5 mm/-10 mm
	Thickness	As approved by the Engineer	- ditto -	+0/- 5 mm
	Width	- ditto -	At point designated by the Engineer	+ Not specified - 15 mm
	Evenness of surface	By 3 meters straight edge	- ditto -	Within 5 mm of variation on 2 contacts

6.2. The workmanship shall be controlled in the manner shown in Table 6.2

6.3. Tolerances

- (1) The cement treated base course shall be laid to the designed level and transverse slopes shown on the Drawings. The allowable tolerances shall be in accordance with the following:

- (a) Permitted variation from design: Thickness of Layer : + 0/-10 mm
- (b) Permitted variation from design: Level of Surface : + 5/-10 mm
- (c) Permitted Surface Irregularity: measured by 3 m straight edge: 5 mm
- (d) Permitted variation from design: Cross-fall of Camber :  $\pm 0.2\%$
- (e) Permitted variation from design: Longitudinal Grade over 25 m length:  $\pm 0.1\%$

#### 6.4. Traffic

- (1) The Contractor shall not be permitted to drive heavy equipment over completed portions prior to the end of 5 days curing period except pneumatic tired equipment required for constructing adjoining sections.

**ITEM 31 : INTERLOCKING CONCRETE BLOCK PAVEMENT**

**SCOPE OF WORK**

This specification covers the construction of interlocking concrete block pavement on a prepared base courses and the laying of leveling course sand bedding all in accordance with the Specifications and Drawings.

**MATERIAL REQUIREMENTS**

**CONCRETE**

Concrete for the interlocking concrete block shall be 41.4 MPa (6,000 psi). Mixing and casting shall be in accordance with the Section "Reinforced Concrete" and the form and dimensions shall be as shown on the Drawings.

Additional requirements shall be as follows:

Minimum 28 day compressive strength	-	41.4 MPa
Minimum aggregate	-	19 mm
Minimum water-cement ratio	-	0.47
Minimum cement content	-	470 kg/m <sup>3</sup>

**SAND LEVELLING COURSE (Sand Cushion)**

Materials for sand cushion shall consist of sand with uncoated grains, free from injurious amount of dust, lumps of clay, soft or flaky particles, shale, alkali, organic matter, loam or other deleterious substances. Beach sand shall not be allowed for use.

**EXECUTION**

**LAYING OF INTERLOCKING CONCRETE BLOCKS**

Concrete blocks shall be laid dry and shall have attained the minimum 28 day compressive strength of 41.4 MPa (6,000 psi). No block with chipped surface, cracks or fabricated not to the dimension and truly square as shown on the drawings shall be used in the block work.

Block work shall be done in uniform manner such that the lines along the length or across the length formed by the edges of the blocks shall remain parallel all throughout the length and width of the pavement and the corners of the pavement forced by the lines of the edge between blocks for all sides shall be 4mm. The top of blocks forming the surface of the pavement shall be kept to the line, grade, slope and elevation as shown on the drawings.

The placing pattern of Interlocking concrete blocks shall be 45 degrees herringbone.

**JOINTING AND COMPACTION**

After laying the edges, the Interlocking concrete blocks shall be initially compacted into the sand bedding by means of a five (5) Horse Power (HP) vibratory plate compactor for at least two (2) passes.

Spread jointing sand over the block surface and swept into the joints using a soft brush. A second compaction with the vibrating plate compactor shall be performed for at least two (2) passes. The Interlocking concrete block surface shall be proof rolled or compacted with an approved roller not less than 10 tons for at least two (2) passes to further seat the units in to the sand bedding. Lastly, excess jointing sand shall be swept off the surface.

## **SAND LEVELLING CUSHION**

The sand shall be laid in thickness shown in the drawings spread out uniformly over the cement treated base (CTB) and in accordance with the lines and grades as directed by the Engineer.

## **SURVEYS AND SETTING OUT WORKS**

Before the commencement of the pavement works, the Contractor together with the Engineer shall conduct topographic survey which will form the basis of quantity measurement.

The Contractor shall set out the works and shall be solely responsible for the accuracy of such setting-out.

Prior to placement of any material, the Contractor shall establish visible construction markers to clearly define horizontal limits of the Work.

**ITEM 32 : ARCHITECTURAL ITEMS****A1 : FINISHES (PTB ANNEX)****GENERAL**

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

**SCOPE OF WORK**

The work covered by this section consist of furnishing all labor, materials, equipment, tools and incidentals necessary to undertake, complete all finishing works as indicated on the drawings and as specified herein.

Wall, floor, ceiling and other finishing works shall include but are not limited to the following:

**WALLS****Exterior**

- a. Plain cement finished painted with elastomeric paint.

Location as shown in the plans and elevations.

**Interior**

- a. Plain cement finished painted with elastomeric paint.
- b. 300mm x 600mm Glazed Ceramic Wall Tiles
- c. 12mm thick Fiber cement board on light steel frame. (For drywall works)

Locations are shown in the plans and elevations.

Stud: 75 mm (3 inches)  
3.00 meter length

Track: 75 mm (3 inches)  
3.00 meter length

Board: 1.20 x 2.40 x 12mm fiber cement

**Fiber Cement Surfaces****SUBMITTALS**

- a. Manufacturer's product data for each type of product specified.



**b. Samples**

- (1) 300 mm x 300 mm 2 sets of required mock up.
- (2) Miscellaneous product samples such as joint tapes and compounds.

**Application and Finishing**

- 1. Apply and finish fiber cement panels as per specifications by manufacturer for flush-jointed.
- b. Install fiber cement panels in manner which minimizes the number of end-butt joints or to avoid where possible.
- c. Install exposed fiber cement panel with face side out. Do not install imperfect, damages or damp boards. Bat boards together for slight contact at edges and ends with not more than 1.5 mm open space between boards. Do not force into place.
- d. Locate either edge or end joints over supports, except in horizontal applications where intermediate support is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
- e. Attach fiber cement panel for supplementary framing and blocking provided for additional support at openings and cutouts.
- f. Space fasteners in fiber cement boards in accordance with referenced application and finishing standard and manufacturer specifications

**Methods Panel Application**

- a. Follow specifications by manufacturer.
- b. Install fiber cement panel as follows, and as indicated on the drawings.
- c. Apply fiber cement panels to supports as follows:
  - Fasten to steel framing with adhesive and supplementary screws as per recommendation by manufacturer.

**Finishing of Fiber Cement Boards**

- a. Apply to joint treatment at fiber cement panels joints (both directions); penetrations; fasteners head, surface defects and

elsewhere as required to prepare works for decoration.

- b. Finish fiber cement panels as per recommendation by manufacturer.

### Protection

- a. Provide final protection and maintain conditions, in a manner suitable to installer that ensures, fiber cement panel construction being without damage or deterioration at time of substantial completion.

### Plain Cement Finish

- a. Surface Preparation

All surfaces shall be cleaned and projections, dust, loose particles and other materials, which would prevent good bond, shall be removed.

Plaster shall not be applied directly to concrete and masonry surfaces coated with bituminous compounds and surfaces previously painted or plastered.

All surfaces shall be thoroughly wetted before plastering.

- b. Trial Mix

A trial mix of at least three (3) different water-cement ratios for a proposed mix shall be prepared under full scale conditions and adequate workability. The proportions by weight of cement to the weight of sand shall not be less than one part of Portland cement to two parts of sand.

The proportion of cement-sand and water necessary to produce the cement plaster of the required consistency shall be subject to the approval of the Engineer. Such approval may be withdrawn at any time and a change in proportions may be required. Based on the approved mix proportions, the Contractor shall prepare a list showing the number of kilograms of the various materials to be used in the cement plaster finish mix.

No cement plaster finish shall be started without an approved trial mix by the Engineer.

- c. Cement Finish Application

A brown coat with sufficient pressure shall be applied to fill the gaps, and to secure a good bond. Moistened for 48 hours, each coat of cement plaster shall be kept after application and allow to dry.

A finish coat shall be applied after the brown coat has set. The brown coat shall be moistened before application of the finish coat. Finish coat shall be floated to plumb, even planes and surfaces.

Final plaster finishes shall be rubber sponged.

d. Tolerance

The Contractor shall finish plaster work plumb, level, square and true within tolerance of 3mm in 3 meters, without cracks and other imperfections.

e. Patching and Cleaning

Upon completion of the building, and when directed, all loose, cracked, damaged or defective plastering shall be cut out and re-plastered in a satisfactory and approved manner.

### Painting Works

a. Surface Preparation

Allow new masonry to dry for 14 days (for exterior surfaces) to 28 days (for interior surfaces) under normal conditions before painting. Surface to be painted should be clean and dry, free from oil, grease, dirt, dust, contaminants, and all loose grit and mortar.

Without mesh:

1st Coat: Elastomeric Wall Covering Sealer

2nd and 3rd Coat: Elastomeric Wall Covering Basecoat

4th Coat: Elastomeric Wall Covering Topcoat

With mesh:

1st Coat: Elastomeric Wall Covering Sealer

2nd Coat: Elastomeric Wall Covering Basecoat  
Reinforcing Membrane: Fiberglass Matting

3rd and 4th Coat: Elastomeric Wall Covering Basecoat

5th Coat: Elastomeric Wall Covering Topcoat

**Wall Ceramic Tiles**

- a. Wall tiles shall be glazed ceramic tiles color as per Architect's approval.
- b. Trimmers and moulding shall be lustrous, glazed with size and color corresponding to wall tiles.
- c. Portland cement, sand, bonding compound, lime and water shall conform with the requirements.

**FLOORS****F1 600mm x 600mm Unglazed Ceramic Floor Tile**

- a. Security Inspection Area
- b. Pre-Departure Areas
- c. Ballistic Room
- d. Security Room
- e. Information Area
- f. Terminal Fee Room
- g. Female Ecumenical Rooms
- h. Male Ecumenical Rooms
- i. Clinic
- j. Nursing Mother/ Diaper Changing Room
- k. Concessionaries
- l. Electrical/ Control Rooms
- m. Male/Female PWD Toilets
- n. All Gender Toilets
- o. Male Toilets
- p. Female Toilets

Locations are shown in the plan.

**F2 600mm x 600mm Non-Slip Tile Finish**

- a. Typical Stairs 1 & 2
- b. Exterior Stairs
- c. Entry Porch

Locations are shown in the plan.

**F3 Non-Skid Rough Cement Floor Finish**

- a. Ramps

Locations are shown in the plan.

**F4 Water Proof Finish**

- a. Toilets
- b. Roof Deck
- c. Concrete Canopy

Locations are shown in the plan.

**F5 300mm x 300mm Button Type Tiles**

- a. Ramps Entrance/ Exit

Locations are shown in the plan.

Waterproof finish for all toilets.

- a. Floor tiles shall be color varies and as shown on the drawings or to be designated by the Architect.
- b. Portland Cement, sand, water and adhesive shall conform with the requirements.
- c. Floor tiles shall be delivered in the manufacturer's original unbroken packages or containers that are labeled plainly with the manufacturer's name and brand. Containers shall be grade scaled. Materials shall be stored in dry weathertight enclosures, and shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness.

## **EXECUTION**

### **Floor Tiles**

- a. Mortar Preparation

Mortar mix proportion and preparation shall be in accordance with the requirements.

- b. Surface Preparation

Surfaces to receive the tiles shall be clean, free of dust, dirt, oil, grease, and other deleterious substances. Floor tile operations in spaces receiving wall tile shall not be started until wall tile installation has been completed. Before tile is applied with a dryset mortar bed, the structural floor shall be tested for levelness or uniformity of slope by flooding it with water. Areas where the water ponds shall be filled and leveled with mortar and shall be retested before the setting bed is applied.

c. Placing of Setting Beds and Floor Tile

Mortar setting beds shall have a minimum thickness of 20mm for floors. The structural concrete slab shall be soaked thoroughly with clean fresh water on the day before the setting bed is to be applied. Immediately preceding the application of the setting bed, the structural slab shall again be wetted thoroughly, but no free water shall be permitted to remain on the surface.

A skim coat of neat Portland cement mortar shall then be applied not more than 4mm thick. The mortar shall be spread until its surface is true and even and thoroughly compacted, either level or sloped uniformly for drainage, as the case requires. A setting bed, as large as can be covered with tile before the mortar has reached its initial set, shall be placed on one operation; but in the event that more setting mortar has been placed than can be covered, the unfinished portion shall be removed and cut back to a clean beveled edge.

All mounted tiles shall be soaked in clean water a minimum of one hour before they are set. Absorptive mounted tile shall be dampened by placing sheets on a wetted cloth in a shallow pan before setting. No free water shall remain on the tiles at the time of setting. Before the initial set has taken place in the setting bed, a skim coat of neat Portland cement mortar, 0.7mm to 1.6mm thick, shall be trowelled or brushed over the setting bed and/or the back of the tile, or a thin layer of Portland cement, 0.79mm to 2mm thick, may be hand-dusted uniformly over the setting bed and worked lightly with a trowel or brush until thoroughly damp.

The tiles shall then be pressed firmly upon the setting bed, and beaten into the mortar until true and even with the plane of the finished floor line. Beating and leveling shall be completed within one hour after placing tiles or sheets. Borders and defined lines shall be laid before the field or body of the floor. Where floor drains are provided, the floors shall be sloped to drain properly to the drains. Intersections and returns shall be formed accurately.

Cutting of tile, where necessary, shall be done along the outer edges of the floor. As far as practicable, no tiles of less than half size shall be used. Cutting and drilling of tiles shall be done neatly without marring the tile surfaces. The cut edges of tile against trim, bases, thresholds, pipes, built-in fixtures, and similar surfaces shall be ground and jointed carefully. Tile shall fit closely and neatly at all plumbing fixtures and around electrical outlets, pipes and fittings so that cover plates or escutcheons will overlap the tiles properly. Tiles shall be secured firmly in place and loose tiles or tiles sounding hollow shall be removed and replaced. All lines shall be kept straight, parallel, and true, and all finished surfaces brought to true and even planes. The inner edges of borders shall be kept straight and, where practicable, shall form right angles at all returns. The paper and glue shall be removed from mounted tile, without using excess water, within one hour after installing the tiles.

Joints shall be parallel and uniform in width, plumb, level and in alignment. End joints in broken-joint work shall be made as far as practicable, on the center lines of adjoining tiles. Except in special arrangement and design, as indicated or specified, square tiles shall be set with straight joints, and oblong tiles shall be set with broken joints.

Joint widths shall be uniform and spaced to accommodate the tile in the given spaces with a minimum of cutting. Tiles shall be wetted, if they have become dry, before applying grout. Joints 3.2 mm or less in width shall be grouted with a neat Portland cement grout of the consistency of thick cream. Other joints shall be pointed with mortar consisting of one part Portland cement and two parts pointing sand.

The grout or mortar for joints on floors shall be white Portland cement or as specified by the Engineer. Grout pointing mortar shall be forced into joints by using trowel, brush or finger application. Before the grout or mortar sets, the joints of cushion edge tile shall be struck or tooled to the depth of the cushion, filling all skips or gaps, and the joints of square edged tiles shall be filled completely flush with their surface. Dark cement shall not be seen through grouted white joints.

All surplus mortar or grout shall be removed before it has set or hardened.

d. **Cleaning and Curing**

Floors shall be covered with waterproofed paper with all joints lapped at least 96 mm and allowed to damp cure for at least 72 hours before foot traffic is permitted thereon.

All completed tile work shall be thoroughly sponged and washed diagonally across joints, and finally polished with clean, dry cloth. Acid cleaning of unglazed tile, when necessary, shall not be done within ten days after setting the tile. All metal shall be covered with approved grease and the tile shall be wetted with clean water, before tile is cleaned with 10% muriatic acid solution. After acid cleaning, the tile shall be flushed with clean water, and the grease coating on metal shall be removed.

Finished tile floors shall be covered with clean building paper before foot traffic is permitted on them. Board walkways shall be placed on floors that are to be continuously used as passage ways by workmen. Thresholds shall be covered with boards. Tiles vertical outside corners (external angles) shall be protected with board corners strips in areas used as passage by workmen.

## **Ceiling**

1. **Interior**

1. C1 - 1200mm x 600mm x 0.70mm Aluminum Clipped-in Perforated

Panels, Bone White or of Equivalent

- a. Pre-departure Areas
- b. Security Inspection Area

Locations are shown in the plan.

2. C2 - 600mm x 600mm x 0.70mm Aluminum Clipped-In Perforated Panel, Bone White or Approved Equivalent

- a. Ballistic Room
- b. Security Room
- c. Information Area
- d. Terminal Fee Room
- e. Female Ecumenical Rooms
- f. Male Ecumenical Rooms
- g. Clinic
- h. Male/ Female PWD Toilets
- i. Nursing Mother/ Diaper Changing Room
- j. Concessionaries
- k. Electrical/ Control Rooms

Locations are shown in the plan.

3. C3 - 12mm thk. Gypsum Board Painted on 0.40 mm thk. Galvanized Steel Ceiling Suspension System

- a. All Gender Toilets
- b. Female Toilets
- c. Male Toilets
- d. Boarding Gates

Locations are shown in the plan.

## SUBMITTAL

1. Shop drawings for all finishing and painting works for the building shall be submitted in advance to allow twenty-eight days for review and approval. Shop drawings shall indicate materials and details of finishing works. The Contractor shall be responsible for all errors of detailing and fabrication, and for the correct finishing work items shown on the shop drawings.
2. The Contractor, before placing order for the finishing materials shall submit to the Engineer for approval representative samples of finishing materials. No placing of orders for material for finishing works shall be made without his approval.
3. Samples of all walls finishes, measuring not less than 1000mm x 1000mm shall be submitted to the Engineer for approval as to its finish texture and workmanship.



**GRANITE TILES**

- a. Black granite slabs for toilet countertops, fascia and splashboard. Dimensions as shown on the drawings.
- b. Shall be sound material with uniform and favorable working qualities and with very limited natural faults.
- c. Color, veining and quality shall be approved by Engineer.
- d. Veining shall run vertically on all vertical surfaces and direction of veining shall continue in same directions over horizontal surfaces except as directed by the Engineer.
- e. Sealer
  - e. 1. Shall be a commercial penetrating type free from harmful alkali or acid content specially prepared for marble work
  - e. 2. Shall have a Ph factor between 7 and 9
  - e. 3. Shall not discolor
  - e. 4. Shall produce a slip resistant surface
  - e. 5. Shall have a flash point not less than 35 °C
- f. Cleaning fluid
  - f. 1. Shall be commercial neutral liquid type especially prepared for marble work
  - f. 2. Shall have a Ph factor between 7 and 9
  - f. 3. Shall be free from crystallizing salts or water-soluble alkaline salts
  - f. 4. Shall be biodegradable and phosphate free

**INSTALLATION OF DOORS / GLASS PANELS****1. Surface Preparation**

Ensure surfaces to receive panels are structurally sound, even, smooth, clean, dry, and free from defects detrimental to work.

**DOORS**

- D-1 - 1.5mm thk. Aluminum Automatic Door 2 Leaves, Bi-Parting Sliding Doors Clear Anodized Brushed Aluminum Finish with Fixed Type Transom Window (1.90m x 2.75m)
- D-2 - 1.5mm thk. Aluminum Framed Powder Coated Finish with 10mm Tempered Glass Double Swing Door with Stainless Steel Handle and

- Fixed Type Transom Window (1.90m x 2.80m)
- D-3 - 1.5mm thk. Aluminum Framed Powder Coated Finish w/ 10mm Tempered Glass Double Swing Door w/ Fixed Type Transom Window (1.90m x 2.80m)
  - D-4 - 1.5mm thk. Aluminum Automatic Sliding Door, Clear Ionized Brushed Aluminum Finish w/ Fixed Type Windows (2.40m x 3.00m)
  - D-5 - Marine Plywood Finish Flush Door in Quick Drying Enamel w/ 8mm Thk. Clear Glass (0.90m x 2.15m)
  - D-6 - Marine Plywood Finish Flush Door in Quick Drying Enamel Finish w/ Louver at the Bottom Portion (1.10m x 2.15m)
  - D-7 - Cold Rolled Steel Emergency Exit Door in Quick Drying Enamel Finish w/ Panic Push Bar Lock (1.00m x 2.15m)
  - D-8 - Marine Plywood Finish Flush Door in Quick Drying Enamel Finish w/ Louver at the Bottom Portion (0.90m x 2.15m)
  - D-9 - Marine Plywood Finish Flush Door in Quick Drying Enamel Finish (0.90m x 2.15m)
  - D-10 - Marine Plywood Finish Flush Door in Quick Drying Enamel Finish w/ Louver (0.70m x 2.15m)
  - D-11 - Marine Plywood Finish Flush Door in Quick Drying Enamel Finish with Louver (0.725m x 2.10m)

## INSTALLATION OF WINDOWS

### 1. Surface Preparation

Ensure surfaces to receive panels are structurally sound, even, smooth, clean, dry, and free from defects detrimental to work.

W-1 - 12mm thk. Low-E Glass Curtain Wall Framed at the back in Wood Grain on Finish on Aluminum (11.55m x 2.80m)

W-2 - 12mm thk. Low-E Glass Curtain Wall Framed at the back in Wood Grain on Finish on Aluminum (6.20m x 2.80m)

W-3 - 12mm thk Frameless Tempered Glass Partition in Powder Coated Aluminum Channel (4.475m x 3.00m)

W-4 - 12mm thk Frameless Tempered Glass Partition in Powder Coated Aluminum Channel (2.075m x 3.00m)

W-5 - 1.5mm thk. Aluminum Framed Powder Coated Finish Fixed Type Window w/ 10mm Reflective, Tempered Glass (1.60m x 2.80m)

W-6 - 1.5mm thk. Aluminum Framed Powder Coated Finish Fixed Type and Awning Type Window w/ 10mm Reflective, Tempered Glass (3.60m x 1.80m)

W-7 - 1.5mm thk. Aluminum Framed Powder Coated Finish Fixed Type and Awning Type Window w/ 10mm Reflective, Tempered Glass (1.80m x 1.80m)

W-8 - 1.5mm thk. Aluminum Framed Powder Coated Finish Awning Type Window w/ 10mm Reflective, Tempered Glass (1.80m x 0.60m)

W-9 - 1.5mm thk. Aluminum Framed Powder Coated Finish Awning Type Window w/ 10mm Reflective, Tempered Glass (1.20m x 1.20m)

W-10 - 1.5mm thk. Aluminum Framed Powder Coated Finish Awning Type Window w/ 10mm Reflective, Tempered Glass (1.20m x 0.60m)

## **GLAZING MATERIAL**

All glazing materials shall be delivered at jobsite with labels affixed indicating quality, make, type and thickness.

## **MATERIAL**

Use 6.3mm plate glass mirror on 6mm marine plywood backing with aluminum frame.

Refer to plans for the required dimension of various glass mirror and location.

## **INSTALLATION**

1. All comfort rooms whether shown or not, the Contractor shall provide and fit securely in place at the most convenient height above each lavatory.
2. Setting and edge blocks shall be made of neoprene, chemically compatible with sealant.
3. All glass mirror shall be bedded, back puttied, secured in place and face puttied. Secure glass in aluminum frame with non-corrosive clips.

**ITEM 32 : ARCHITECTURAL ITEMS**

**A2 : FINISHES ( POB EXTENSION)**

**GENERAL**

General Requirements contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

**SCOPE OF WORK**

The work covered by this section consist of furnishing all labor, materials, equipment, tools and incidentals necessary to undertake, complete all finishing works as indicated on the drawings and as specified herein.

Wall, floor, ceiling and other finishing works shall include but are not limited to the following:

**WALLS**

**Exterior**

- a. Plain cement finished painted with elastomeric paint.

Location as shown in the plans and elevations.

**Interior**

- a. Plain cement finished painted with elastomeric paint.
- b. 300mm x 600mm Glazed Ceramic Wall Tiles
- c. 12mm thick Fiber cement board on at least Ga. 25 thick uncoated metal galvanized C- shaped studs framing.

Locations are shown in the plans and elevations.

Stud: 75 mm (3 inches)

3.00, 2.70, 2.40 meter length

Track: 75 mm (3 inches)

3.00 meter length

Board: 1.20 x 2.40 x 12mm fiber cement

## **Fiber Cement Surfaces**

### **SUBMITTALS**

- a. Manufacturer's product data for each type of product specified.
- b. Samples
  - (1) 300 mm x 300 mm 2 sets of required mock up.
  - (2) Miscellaneous product samples such as joint tapes and compounds.

### **Application and Finishing**

1. Apply and finish fiber cement panels as per specifications by manufacturer for flush-jointed.
- b. Install fiber cement panels in manner which minimizes the number of end-butt joints or to avoid where possible.
- c. Install exposed fiber cement panel with face side out. Do not install imperfect, damages or damp boards. Bat boards together for slight contact at edges and ends with not more than 1.5 mm open space between boards. Do not force into place.
- d. Locate either edge or end joints over supports, except in horizontal applications where intermediate support is provided behind end joints. Position boards so that like edges abut, tapered edges against tapered ends. Do not place tapered edges against cut edges or ends. Stagger vertical joints over different studs on opposite sides of partitions.
- e. Attach fiber cement panel for supplementary framing and blocking provided for additional support at openings and cutouts.
- f. Space fasteners in fiber cement boards in accordance with referenced application and finishing standard and manufacturer specifications

### **Methods Panel Application**

- a. Follow specifications by manufacturer.
- b. Install fiber cement panel as follows, and as indicated on the drawings.
- c. Apply fiber cement panels to supports as follows:

Fasten to steel framing with adhesive and supplementary screws as per recommendation by manufacturer.

### **Finishing of Fiber Cement Boards**

- a. Apply to joint treatment at fiber cement panels joints (both directions); penetrations; fasteners head, surface defects and elsewhere as required to prepare works for decoration.
- b. Finish fiber cement panels as per recommendation by manufacturer.

#### Protection

- a. Provide final protection and maintain conditions, in a manner suitable to installer that ensures, fiber cement panel construction being without damage or deterioration at time of substantial completion.

### Plain Cement Finish

#### a. Surface Preparation

All surfaces shall be cleaned and projections, dust, loose particles and other materials, which would prevent good bond, shall be removed.

Plaster shall not be applied directly to concrete and masonry surfaces coated with bituminous compounds and surfaces previously painted or plastered.

All surfaces shall be thoroughly wetted before plastering.

#### b. Trial Mix

A trial mix of at least three (3) different water-cement ratios for a proposed mix shall be prepared under full scale conditions and adequate workability. The proportions by weight of cement to the weight of sand shall not be less than one part of Portland cement to two parts of sand.

The proportion of cement-sand and water necessary to produce the cement plaster of the required consistency shall be subject to the approval of the Engineer. Such approval may be withdrawn at any time and a change in proportions may be required. Based on the approved mix proportions, the Contractor shall prepare a list showing the number of kilograms of the various materials to be used in the cement plaster finish mix.

No cement plaster finish shall be started without an approved trial mix by the Engineer.

#### c. Cement Finish Application

A brown coat with sufficient pressure shall be applied to fill the gaps, and to secure a good bond. Moistened for 48 hours, each coat of cement plaster shall be kept after application and allow to dry.

A finish coat shall be applied after the brown coat has set. The brown coat shall be moistened before application of the finish coat. Finish coat shall be floated to plumb, even planes and surfaces.

Final plaster finishes shall be rubber sponged.

d. **Tolerance**

The Contractor shall finish plaster work plumb, level, square and true within tolerance of 3mm in 3 meters, without cracks and other imperfections.

e. **Patching and Cleaning**

Upon completion of the building, and when directed, all loose, cracked, damaged or defective plastering shall be cut out and re-plastered in a satisfactory and approved manner.

## **Painting Works**

a. **Surface Preparation**

Allow new masonry to dry for 14 days (for exterior surfaces) to 28 days (for interior surfaces) under normal conditions before painting. Surface to be painted should be clean and dry, free from oil, grease, dirt, dust, contaminants, and all loose grit and mortar.

**Without mesh:**

1st Coat: Elastomeric Wall Covering Sealer

2nd and 3rd Coat: Elastomeric Wall Covering Basecoat

4th Coat: Elastomeric Wall Covering Topcoat

**With mesh:**

1st Coat: Elastomeric Wall Covering Sealer

2nd Coat: Elastomeric Wall Covering Basecoat

Reinforcing Membrane: Fiberglass Matting

3rd and 4th Coat: Elastomeric Wall Covering Basecoat

5th Coat: Elastomeric Wall Covering Topcoat

### Wall Ceramic Tiles

- a. Wall tiles shall be glazed ceramic tiles color as per Architect's approval.
- b. Trimmers and moulding shall be lustrous, glazed with size and color corresponding to wall tiles.
- c. Portland cement, sand, bonding compound, lime and water shall conform with the requirements.

## FLOORS

F1 600mm x 600mm Floor Tiles, Rustic finish

- a. Lobby
- b. Fire Pump House

Locations are shown in the plan.

F2 600mm x 600mm Floor Tiles, Kolorstone White Finish

- a. Hallway

Locations are shown in the plan.

F3 600mm x 600mm Floor Tiles, Rustic White Matte Finish

- a. Pump Room
- b. Elec / Mech Room
- c. BAC Storage
- d. PSDM Office/Lounge
- e. Port Services Division
- f. Business Dev;t Service/Storage
- g. COA / Storage
- h. Activity Area
- i. Hallway
- j. GAD Storage
- k. COMM Room
- l. Record Library/Storage
- m. FDM Office/Lounge
- n. Finance Storage
- o. Finance Division/Pantry
- p. Cashier Booth/Safety Vault Room



- q. Audio Visual Room
- r. Conference Room Pantry
- s. Engineering Services Division/Pantry/Storage
- t. ESDM Office/Lounge
- u. Admin Unit Supply Storage
- v. Admin Division
- w. ASDM Office/Lounge
- x. Office of the Port Manager/Pantry
- y. Port Manager's Office/Lounge
- z. Multi-purpose Hall
- aa. Audio Visual Room
- ab. Storage
- ac. Port Manager's Quarter/Bedroom
- ad. PSD Pantry
- ae. Storage
- af. Pantry/Kitchen
- ag. Conference Room
- ah. Assessor/HOO/TOO/Cashier
- ai. Existing Electrical Room
- aj. GSU Storage
- ak. Personnel Unit Storage

Locations are shown in the plan.

**F4 600mm X 600mm Floor Tiles, Rustic Light Gray Matte Finish**

- a. PSDM Office Toilet
- b. FDM Office Toilet
- c. Conference Room Toilet
- d. ESDM Office Toilet
- e. ASDM Office Toilet
- f. Port Manager's Office Toilet
- g. Port Manager's Quarter T&B
- h. Port Manager's Quarter Toilet

**Renovation**

- a. Male & Female Toilet
- b. Janitor's Closet/PWD Toilet

Locations are shown in the plan.

**F5 600mm X 600mm Floor Tiles, Gray Carpet Tiles**

- a. Access to Pump Room
- b. Fire Exit
- c. Exit Ramp Stair
- d. Conference Room
- e. OPM Conference Room

Locations are shown in the plan.

**F6     600mm X 600mm Floor Tiles, Beige Finish**

- a. Entrance Canopy
- b. Stairs (Tread)
- c. Stairs (Riser)

Locations are shown in the plan.

**F7     Non-Skid / Rough Cement Floor Finish**

- a. Ramps
- b. Garden Area
- c. Roof Deck

Locations are shown in the plan.

**F8     300mm x 300mm Button Type Tiles**

- a. Ramp (Front)
- b. Ramp (Side)

Locations are shown in the plan.

Waterproof finish for all toilets.

- a. Floor tiles shall be color varies and as shown on the drawings or to be designated by the Architect.
- b. Portland Cement, sand, water and adhesive shall conform with

the requirements.

- c. Floor tiles shall be delivered in the manufacturer's original unbroken packages or containers that are labeled plainly with the manufacturer's name and brand. Containers shall be grade scaled. Materials shall be stored in dry weathertight enclosures, and shall be handled in a manner that will prevent the inclusion of foreign materials and damage by water or dampness.

## EXECUTION

### Floor Tiles

- a. Mortar Preparation

Mortar mix proportion and preparation shall be in accordance with the requirements.

- b. Surface Preparation

Surfaces to receive the tiles shall be clean, free of dust, dirt, oil, grease, and other deleterious substances. Floor tile operations in spaces receiving wall tile shall not be started until wall tile installation has been completed. Before tile is applied with a dryset mortar bed, the structural floor shall be tested for levelness or uniformity of slope by flooding it with water. Areas where the water ponds shall be filled and leveled with mortar and shall be retested before the setting bed is applied.

- c. Placing of Setting Beds and Floor Tile

Mortar setting beds shall have a minimum thickness of 20mm for floors. The structural concrete slab shall be soaked thoroughly with clean fresh water on the day before the setting bed is to be applied. Immediately preceding the application of the setting bed, the structural slab shall again be wetted thoroughly, but no free water shall be permitted to remain on the surface.

A skim coat of neat Portland cement mortar shall then be applied not more than 4mm thick. The mortar shall be spread until its surface is true and even and thoroughly compacted, either level or sloped uniformly for drainage, as the case requires. A setting bed, as large as can be covered with tile before the mortar has reached its initial set, shall be placed on one operation; but in the event that more setting mortar has been placed than can be covered, the unfinished portion shall be removed and cut back to a clean beveled edge.

All mounted tiles shall be soaked in clean water a minimum of one hour before they are set. Absorptive mounted tile shall be dampened by placing sheets on a wetted cloth in a shallow pan before setting. No free water shall remain on the tiles at the time of setting. Before the initial set has taken place in the setting bed, a skim coat of neat Portland cement mortar, 0.7mm to 1.6mm thick, shall be trowelled or brushed over the setting bed and/or the back of the tile, or a thin layer of Portland cement, 0.79mm to 2mm thick, may be hand-dusted uniformly over the setting bed and worked lightly with a trowel or brush until thoroughly damp.

The tiles shall then be pressed firmly upon the setting bed, and beaten into the mortar until true and even with the plane of the finished floor line. Beating and leveling shall be completed within one hour after placing tiles or sheets. Borders and defined lines shall be laid before the field or body of the floor. Where floor drains are provided, the floors shall be sloped to drain properly to the drains. Intersections and returns shall be formed accurately.

Cutting of tile, where necessary, shall be done along the outer edges of the floor. As far as practicable, no tiles of less than half size shall be used. Cutting and drilling of tiles shall be done neatly without marring the tile surfaces. The cut edges of tile against trim, bases, thresholds, pipes, built-in fixtures, and similar surfaces shall be ground and jointed carefully. Tile shall fit closely and neatly at all plumbing fixtures and around electrical outlets, pipes and fittings so that cover plates or escutcheons will overlap the tiles properly. Tiles shall be secured firmly in place and loose tiles or tiles sounding hollow shall be removed and replaced. All lines shall be kept straight, parallel, and true, and all finished surfaces brought to true and even planes. The inner edges of borders shall be kept straight and, where practicable, shall form right angles at all returns. The paper and glue shall be removed from mounted tile, without using excess water, within one hour after installing the tiles.

Joints shall be parallel and uniform in width, plumb, level and in alignment. End joints in broken-joint work shall be made as far as practicable, on the center lines of adjoining tiles. Except in special arrangement and design, as indicated or specified, square tiles shall be set with straight joints, and oblong tiles shall be set with broken joints.

Joint widths shall be uniform and spaced to accommodate the tile in the given spaces with a minimum of cutting. Tiles shall be wetted, if they have become dry, before applying grout. Joints 3.2 mm or less in width shall be grouted with a neat Portland cement grout of the consistency of thick cream. Other joints shall be pointed with mortar consisting of one part Portland cement and two parts

pointing sand.

The grout or mortar for joints on floors shall be white Portland cement or as specified by the Engineer. Grout painting mortar shall be forced into joints by using trowel, brush or finger application. Before the grout or mortar sets, the joints of cushion edge tile shall be struck or tooled to the depth of the cushion, filling all skips or gaps, and the joints of square edged tiles shall be filled completely flush with their surface. Dark cement shall not be seen through grouted white joints.

All surplus mortar or grout shall be removed before it has set or hardened.

d. **Cleaning and Curing**

Floors shall be covered with waterproofed paper with all joints lapped at least 96 mm and allowed to damp cure for at least 72 hours before foot traffic is permitted thereon.

All completed tile work shall be thoroughly sponged and washed diagonally across joints, and finally polished with clean, dry cloth. Acid cleaning of unglazed tile, when necessary, shall not be done within ten days after setting the tile. All metal shall be covered with approved grease and the tile shall be wetted with clean water, before tile is cleaned with 10% muriatic acid solution. After acid cleaning, the tile shall be flushed with clean water, and the grease coating on metal shall be removed.

Finished tile floors shall be covered with clean building paper before foot traffic is permitted on them. Board walkways shall be placed on floors that are to be continuously used as passage ways by workmen. Thresholds shall be covered with boards. Tiles vertical outside corners (external angles) shall be protected with board corners strips in areas used as passage by workmen.

## **Ceiling**

1. **Interior**

1. C1 - 1200mm x 600mm x 19mm Mineral Fiber Acoustical Lay-in Panel on Galvanized Exposed Grid and Framing Finish with Low Sheen White Enamel Paint
  - a. Port Services Division
  - b. Business Dev't Services