

Section VI. Specifications

GENERAL REQUIREMENTS

I. LICENSE AND PERMITS

The Contractor shall secure from the government agencies all necessary licenses and permits needed to proceed with the implementation of the Project.

II. TEMPORARY STRUCTURES AND SERVICES

a) Temporary facilities

Temporary facilities shall be of a design and materials acceptable to the PSHS-MC.

b) Field Office

b.1. The Contractor shall provide separate temporary office (if necessary) for use of the Contractor at an approved location.

b.2. The Contractor shall make available Protective Gears for the workers.

c) Temporary Electric Power

The PSHS-MC shall provide for Temporary Power Facility required for the entire construction phase. The Contractor shall provide conduits, wires, connections and accessories and labor.

d) Temporary Water Supply

The PSHS-MC shall provide temporary water facility that will be used during the entire construction stage.

e) Temporary Scaffolding, Hoist, etc.

The Contractor shall, operate and maintain adequate number of temporary hoist, scaffolds, runways, ladders, and the like as required for the proper execution of the work. Safety precautions shall at all times be observed.

f) Removal of Temporary Services and Facilities

All temporary services and facilities installed by the Contractor shall be removed by the Contractor on completion of this Contract or as directed by the PSHS-MC. The Contractor shall restore any damage, alteration, caused by such removal and during the project implementation.

III. PROTECTION OF WORK, PROPERTY AND PERSONS

The Contractor shall protect the work of employees, equipment at the PSHS-MC's property and adjacent property from damage for any cause whatsoever, and shall be responsible for any damage or injury (including death) due to his act or neglect. These provisions are solely for the benefit of third persons.

The Contractor shall provide watchmen and erect all planking bridges, bracings, shorings, sheet piling, lights and warning signs necessary for the public. The Contractor shall provide scaffolds, tarpaulins, and similar items as directed by the PSHS-MC to protect Owners, equipment and employees and shall if necessary seal off his work so as not to interfere with PSHS-MC's business operation.

a) Watchmen Service

a.1 The Contractor shall provide reputable watchmen service or in lieu thereof, any approved protective service to guard the construction area against vandalism, theft, and mischief. Such service should be in operation at all hours that the Contractor's supervisory staff is not in attendance at the site, 24 hours per day and 7 days per week from the date of Contractor starts work until the date of final acceptance of the work under this Contract.

a.2 Watchmen or approved protective service shall continue uninterrupted during delays in the work such as inclement weather, delays in delivery, and the like. In the event of any official work stoppage of the project, make immediate arrangements with the PSHS-MC regarding watchmen service continuation and cost thereof during the time the work will be stopped. If such official stoppage is found to be due to fault, neglect or improper work performance of the Contractor, the extra cost for watchmen service shall be borne by the Contractor.

The Contractor shall be responsible for any injury loss or damage to any presently existing improvements on the premises caused by him or his employees, agents or any sub-contractors, and in the event of such injury, loss or damage shall promptly make such repairs or replacement as required by the PSHS-MC without additional cost to the PSHS-MC.

During the progress of the work, the Contractor shall protect all finished work as soon as it is erected and shall maintain such protection until such time they are no longer required.

IV. INSPECTION AND TEST

The Contractor shall permit and facilitate inspection of the work by the PSHS-MC or his authorized representative, and the public authorities having jurisdiction at all times during the progress of the work.

The Contractor will be responsible for all test and engineering services required by the Specifications. The cost for inspection or tests not required by the specification but which the PSHS-MC requires, will be borne by the PSHS-MC.

All tests shall be performed by the testing agency approved by the PSHS-MC and shall be in accordance with the current standards of the American Society for Testing and Materials unless otherwise specified by the PSHS-MC. The Contractor shall furnish the PSHS-MC with 2 copies of the test procedures used.

V. CLEANING

The Contractor shall at all times keep the premises from accumulation of waste materials or rubbish caused by his employees, sub-contractors, or the work by providing trash receptacles. At completion of the work he shall remove from the building and site all rubbish, scaffolding and surplus materials and shall leave the work broom clean, unless otherwise specified. If the Contractor fails to keep the premises clean, the PSHS-MC may remove the waste materials and rubbish; charge the expense of such removal to the Contractor.

The Contractor shall thoroughly wash and clean all glass and hardware, remove stains, spots, smears, marks and dirt from all surfaces; clean fixtures, wash terrazzo, tile floors and all exposed concrete so as to present clean work to the PSHS-MC for acceptance.

VI. FINAL COMPLETION

The term final completion, means the completion of all work called for under the Contract to include but not limited to satisfactory operation of all equipment, by means of acceptance tests, correction of all punch list items to the satisfaction of the PSHS-MC, settlement of all claims, if any payment and release of all record of all mechanics materials, men and like lines, delivery of all guarantees, Equipment Operation and Maintenance Manuals; as built drawings, Building certificates prior to occupancy; Electrical permits; all other required approvals and acceptance by the City or other authority having jurisdiction and removal of all rubbish, tolls scaffoldings and surplus materials and equipment from the job site.

VII. PUNCHLIST

The list prepared by the PSHS-MC of the Contractor's uncompleted defective or uncorrected work. This shall be reflected in the Punchlist Form and is marked as Annex "A" of the Certificate of Completion, upon the satisfactory completion of the corrective works.

VIII. SAFETY AND ACCIDENT REPORTS

The Contractor shall take necessary precautions for the safety of all employees; PSHS-MC's Representatives. The Contractor shall comply with all instructions and Government Safety laws and Building Codes to prevent accident or injury to persons on about or adjacent to the premises as well as for the protection of adjacent property where work is performed.

GENERAL SCOPE

I. DESCRIPTION OF THE PROJECT

The project calls for the **Rehabilitation of the Academic Buildings** of the Philippine Science high School Main Campus (PSHS-MC).

II. CONTRACT IMPLEMENTATION

The work includes furnishing of materials, labor, tools, equipment, consumables, technical supervision and other services necessary for the completion of the proposed project at the PSHS-MC Building, all in accordance with the specifications and subject to the terms and conditions of the contract.

a) Workmanship

All operations/undertakings required in any and all parts of the plans and technical specifications shall be undertaken in an orderly, workmanlike manner. Only qualified and skilled personnel with sufficient experience in similar operations nominated by the Contractor/Supplier shall be allowed to undertake the same.

b) Inspection of site

The Bid is deemed to have been based on current data, including physical conditions at the site. The Contractor acknowledges and warrants that it has inspected and examined the site and their surroundings, and has satisfied itself by submitting its Bid as to the requirements of the work and materials necessary for the completion of the works, and the means of access to the site, the accommodation it may require, and that it has obtained for itself, all necessary information as to risks, contingencies and other circumstances which may have influenced or affected its Bid. No increase in cost or extension of time will be considered for failure to familiarize, inspect and examine the site condition.

c) Changes

The PSHS-MC reserves the right to make minor changes in details of works and materials as may be deemed necessary to fully implement the requirements of the plans and specifications. These changes may include revision or modifications of shapes and dimensions of elements due to actual site conditions and thereby will not entail the deletion or addition of items of work, including materials to be used, specified in the contract.

d) Conflicts between plans and specifications

Should there be any conflict between indications on drawings and provisions in specifications same shall be referred to the PSHS-MC decision on the matter and whose opinion shall be final. Any omission in the specification of work or works to be undertaken but is/are necessary for the completion of work, shall be undertaken by the Contractor as if indicated on drawings, without extra

compensation. Such works shall be done in the usual manner as required to ensure quality of both materials and workmanship.

e) Rejections

Materials or completed work not in conformance with the provisions of these Specifications shall be rejected outright at anytime during the progress of the work. The Contractor shall receive copies of reports of rejections of materials and workmanship made by PSHS-MC. Any part of the work that has been done and is not of quality required by reasonable interpretation of the plans and specifications shall be torn down or removed immediately and rebuilt or otherwise remedy such work in accordance with the requirements of the plans and specifications.

III. CONTRACTOR'S RESPONSIBILITIES

- a) The principal features of the work do not in any way limit the responsibilities of the Contractor to the general description of his scope of work. He shall perform all the work fully and make operational to the intent of the project.
- b) The Contractor shall be responsible for the proper execution and coordination of his work with the Authorized representative of PSHS-MC. He shall schedule and program all necessary work activities according to the specified completion period. He shall submit inspection requests and have it approved before proceeding to the next stage of works.
- c) The contractor shall observe the required standards of safety and procedures and that its contract and workers shall be properly insured against all risks. He shall provide/equip its workers with Personal Protective Equipment (PPE) during the course of construction/installation. He shall observe the PSHS-MC's house regulations to be issued together with the Work Permit.
- d) The contractor shall be responsible for securing PSHS-MC issued work permits and compliance with other PSHS-MC rules and regulations related to the construction works such as the approved PSHS-MC House Rules for contractors. All workers/Engineers working at site are required to wear company uniforms indicating their company name.
- e) Contractor's workers are limited to the designated working area only. Loitering around and inside the PSHS-MC premises is not allowed.
- f) The Contractor shall be responsible for clearing and cleaning of the designated project site of unused materials, left over and other debris at the site and disposal of the same outside of the PSHS-MC premises. A daily inspection of the work area shall be conducted by the Contractor and PSHS-MC's authorized representative to ensure that the working area and storage area assigned to the Contractor is clean and in order at all times.
- g) The Contractor shall protect adjacent areas against any damage by his employees, or by his materials, equipment and tools during the execution of the

work. Any damage done by him or his employees shall be repaired at his own expense, without additional compensation beyond the contract.

- h) Permit, Laws, Ordinances and Standards – The installation provided for and specified herein shall comply with laws and regulations of Quezon City and any government agency having jurisdiction. All necessary permits and other requirements shall be secured and for the account of the contractor. Said requirements shall be turned-over to PSHS-MC upon project completion.
- i) The contractor shall assign a fulltime Engineer/Architect as Project-In-Charge (PIC) for the project to supervise the works mentioned herein. The PIC shall be a certified registered Civil Engineer or Architect designated for the project by the Contractor. Said PIC must be the one to report on a weekly/monthly basis of the status/progress of the project as agreed during the kick-off meeting and who shall be the one responsible for all coordination works with the PSHS-MC's authorized representative/s.
- j) All other items of work not specifically mentioned but are necessary to complete the works in accordance with the plans and specifications and other related documents shall be provided by the contractor at no additional cost to the PSHS-MC.

IV. CONTRACT DURATION/ COMPLETION TIME

Contractor/Supplier shall complete and turn-over the project within sixty **(60) calendar days** to be reckoned from the date the project was actually started or the 7th day after the issuance of the Notice to Proceed (NTP) by PSHS-MC.

V. SUBMITTALS

- a) Work Schedule

Before commencing any work or providing any materials at the jobsite for this project, the Contractor shall submit samples, project Bar Chart/S-Curve and PERT/CPM Network Diagram for the PSHS-MC's approval within five (5) calendar days upon receipt of Notice to Proceed.

- b) Contractor's All-Risk Insurance

The Contractor's All Risk Insurance (CARI) shall be submitted to PSHS-MC within ten (10) calendar days upon receipt of Notice of Award (NOA).

- c) The Contractor shall submit to PSHS-MC, the proposed delivery of materials, tools & equipment; and manpower schedules for proper monitoring five (5) calendar days after the Pre-construction/kick-off meeting.

- d) Materials Samples/Brochures/Certificates

The Contractor shall submit samples and/or technical brochures of all materials to be used in the project within ten (10) calendar days upon receipt of Notice to

Proceed which include but may not be limited to the following for PSHS-MC's approval:

1. Water Proofing Materials/Brochures with technical specifications.
 2. Manufacturer's printed Product Installation Instructions.
 3. Manufacturer's Warranty Certificate covering the five (5) years product warranty after application.
- e) Prior to issuance of the Certificate of Completion (COC) the following shall be submitted to PSHS-MC. PSHS-MC reserves the right not to issue a Certificate of Satisfactory Performance on the basis of the non-submission of any of the items below:
1. Test results/Report for leak test/s.
 2. As-built Plans – Plans should be approved by PSHS-MC. The Contractor shall submit shop drawings as may be required by the PSHS-MC. A complete set of As-Built Drawings in printed form (20" x 30") and an electronic copy (CD) in AutoCAD.
- f) Safety Program

The Contractor is required to have a suitable Construction Safety and Health Program, which must be in accordance with Occupation Safety and Health (OSH) Standard, rules and issuances by the DOLE and standards of the PSHS-MC. The program shall state the following:

1. Composition of Construction Safety and Health Committee
2. Specific safety policies which the contractor shall observe at the area of construction which include but not limited to Fall Protection, Chemical hazards, and Materials Handling and Storage.
3. Penalties and sanctions for violations of the program.
4. The Manner of disposing waste arising from the construction; and
5. Specification, installation and operation of gondolas.

The safety program shall also include the appointment of a full-time safety officer-in-charge of the implementation of the said program.

VI. WARRANTY

The Contractor shall guarantee the work done to be free from defects for a period of Five (5) years reckoned from acceptance of the project.

Form of warranty shall be in accordance with the provisions in Section 62 of the Revised Implementing Rules and Regulations (IRR) of R.A. 9184.

VII. PAYMENTS

- a) Payments to the Contractor will be made only for the actual accomplishment and or material utilized, certified by the PSHS-MC as performed by the

Contractor in accordance with the plans, specifications and program of works/construction schedule.

- b) Payments in accordance with the above paragraph shall be considered full compensation for furnishing materials, labor, tools and equipment, and for performing all work contemplated and embraced under the Contract.
- c) Payment shall be made upon complete submission of all documents required by the PSHS-MC as indicated in this Scope of Works and Specifications and other contract documents.
- d) It is the responsibility of the Contractor to ensure that their performance bond is updated and valid until the PSHS-MC issue the final Certificate of Acceptance. The Contractor shall submit the endorsement/amendments to PSHS-MC on extension or revisions to its validity, as maybe necessary, not later than seven (7) days before the expiration of the originally submitted Performance Bond. No payment shall be made unless the Performance is updated.
- e) All payments made shall be subject to ten percent (10%) retention and to PSHS-MC's Accounting Rules and Regulations.

VIII. SCOPE OF WORKS

a) WATERPROOFING

- 1. Investigation and documentation of the source of leaks to be indicated on the as built plans.
- 2. Removal and hauling of existing concrete topping and bituminous waterproofing membrane on areas to be applied with rolled bituminous waterproofing membrane;
- 3. Surface cleavage correction at the concrete deck of the SHB back area thru concrete topping;
- 4. Application of concrete primer and allow drying;
- 5. Application of bituminous waterproofing membrane at the SHB back concrete deck, concrete gutters and ASTB concrete deck and gutters.
Membranes are unrolled and laid in the position where they are to be bonded. During each stage the membrane should overlap the next by at least 10cm at the edges and at least 15cm at the ends;
- 6. Application of two coats liquid waterproofing membrane at the SHB front concrete deck as per manufacturers' recommended methodology;
- 7. Test waterproofed area for seventy-two (72) hours minimum and check for any water leak/seepage;

8. Application of 30mm minimum concrete topping with 1” wire mesh reinforcement.

Note: Areas not stated above but requiring waterproofing by Procuring Entity shall be included in the scope of work. Thickness should be as per Manufacturer's Specifications and Installation depending on the Areas to be applied with.

b) REPLACEMENT OF STAINLESS VALLEY GUTTERS

1. Removal of existing stainless valley gutter at the SHB Auditorium Area, proper turning over to the PSHS-MC shall be followed;
2. Installation of bended 0.60mm thick stainless steel valley gutter and restoration of the 150mm diam. PVC downspout at the SHB Auditorium Area;
3. Restoration of the affected roof sheets; including application of sealant on all joints, roof sheet fastener heads and touch-up paint.

c) REPLACEMENT OF CEILING BOARDS AT SHB 3RD FLOOR HALLWAY & 2ND FLOOR LIBRARY (SPECIFIC AREAS ONLY)

1. Removal and hauling of the dilapidated plywood ceiling boards;
2. Repair of loose ceiling joists;
3. Pre-painting of the fiber cement boards prior to installation;
4. Installation of 3.5mm thick fiber cement ceiling boards at the hallways, using the existing ceiling joists. Provision of manholes with fabricated covers;
5. Application of joint compound with application with primer along the joint lines;
6. Application of 2 coats flat latex paint topcoat on the retained ceiling boards;
7. Restoration of the affected electrical, CCTV, FDAS, data conduit pipes and light fixtures.

d) INSTALLATION OF PVC DOWNSPOUTS AT THE SHB CONCRETE GUTTERS

1. Chipping works and hauling of debris;
2. Installation of 107mm diam. sanitary PVC pipe downspouts as per plans and specifications;

3. Tapping of the 107mm diam. sanitary PVC downspouts to the existing catch basins;
4. Installation of 150mm diam. sanitary PVC pipe downspouts on the concrete gutter at the quadrangle area as per plans and specifications;
5. Restoration works on the affected portions of the concrete gutter;
6. Sealing of the concrete and PVC pipe contact point with torch applied bituminous waterproofing membrane.

IX. OTHERS

a) SIMILAR CONTRACT

A contract shall be considered “similar” to the contract to be bid if it involves application of waterproofing.

b) PENALTY CLAUSE FOR UNCOLLECTED DEBRIS AND UNCLEANED WORK AREA

Contractor shall not be issued with the Certificate of Satisfactory Performance as penalty for uncollected debris and uncleaned work/storage area. An amount equivalent to the cost of hauling shall likewise be deducted from the contract cost of the project.

c) CONSTRUCTION SAFETY

The Contractor shall be required to adhere to applicable safety provisions stated in the Occupational Standard for Safety and Health (OSSH) and with PSHS-MC House Rules and Safety Guidelines at all times for the duration of the project. The contractor shall be required to perform a regular tool box meeting among workers and their respective supervisors for the purpose of instructions, discussions, and proper briefing of planned works, the possibility or actual occurrence of accidents at the site and preclusions.

STANDARD SPECIFICATIONS

SECTION 09705 - FIBER CEMENT BOARD

PART 1 - GENERAL

1.1. SCOPE

This specification covers the furnishing of materials and labor including equipment necessary to complete the installation of fiber cement board panels/ceiling as shown on the drawings and as specified herein.

1.2. SUBMITTALS

a. Product data: Submit manufacturer's product data for each type of product specified.

b. Samples:

(1) Submit 300 mm x 300 mm for each board required, 2 sets of required mock up.

(2) Submit miscellaneous product samples such as joint tapes and compounds.

1.3. QUALITY ASSURANCE

a. Single Source Responsibility: Obtain each type of fiber cement panels and related treatment materials from a single manufacturer.

1.4. DELIVERY, HANDLING AND STORAGE

a. Delivery: Deliver materials in original-packages containers or bundles bearing brand name and identification of manufacturer or supplier.

b. Handling: Handle fiber cement boards to prevent damage to edges, ends and surfaces. Do not bend or otherwise damage metal corner boards and trim.

c. Storage: Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic and other causes. Neatly stack fiber cement panels flat to prevent sagging.

PART 2 - PRODUCTS

2.1. MATERIALS

Shall be Fiber Cement Sheets, Auto-cleaved, single faced sheets containing Portland cement, ground sand, cellulose fiber and water. Fiber Cement sheets shall be manufactured from asbestos-free materials.

a. 3.5 mm thick for internal wall and ceiling 6 mm thick cove light housing

b. Composition: Fiber cement board shall be asbestos free, fiber-reinforced cement sheets.

c. Density: 1380 kg/m³ minimum

2.2. STEEL FRAMING

a. Steel Studs and Runner: Ga. 25 minimum thickness of uncoated metal galvanized C-shaped or as otherwise indicated.

2.3. FASTENERS

a. Provide fasteners of type, material size, corrosion resistance, holding power and other properties required for fastening furring and framing members to substrates indicated.

b. Trim Accessories: Provide metal trims accessories of profile and materials as shown on the drawings, or as otherwise required by the Architect/manufacturer.

2.4. MISCELLANEOUS FRAMING AND SUPPORTS

a. General: Provide steel framing and supports for applications indicated.

b. Fabricate units to sizes, shapes, and profiles indicated and required to receive adjacent other construction retained by framing and supports. Fabricate from structural steel shapes, plates and steel bars of welded construction using mitered joints for field connection. Cut, drill, and tap units to receive hardware, hangers, and similar items.

(1) Equip units with integrally welded anchors for casting into concrete or building into masonry. Furnish insert, if units must be installed after concrete is placed.

(2) Except as otherwise indicated, space anchors at 600 mm O.C. and provides minimum anchor units in the form of steel straps 32 mm wide by 6 mm by 200 mm long.

2.5. MISCELLANEOUS MATERIALS

a. General: Provide auxiliary materials for fiber cement board construction, which comply with reference standards and the recommendations of the manufacturer of the fiber cement board.

b. Fastening Adhesive for Metal: Special adhesive recommended by manufacturer.

c. Screws: As per recommendation by manufacturer.

d. Bedding and Topping Cement: As per recommendation by manufacturer.

e. Perforated Paper Reinforcing Tape: As per recommendation by manufacturer.

f. Trim Accessories: Provide galvanized steel edge corner and joint trims as shown or otherwise required by the Architect/manufacturer as standard details.

PART 3 - EXECUTION

3.1. EXAMINATION

a. Examine substrates to which fiber cement panel construction attaches or abuts, preset hollow metal frames, cast-in anchors, and structural framing, with installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of fiber cement panel construction. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2. PREPARATION

a. General: Follow specifications of manufacturer.

3.3. INSTALLATION OF STEEL FRAMING GENERAL

a. General: Follow specification by manufacturer.

b. Install supplementary framing, blocking and bracing at terminations in the work and for support of fixture, equipment services, heavy trim, furnishings, and similar construction to comply with details indicated and with recommendations of fiber cement board manufacturer.

c. Isolate steel framing from building structure to prevent transfer of loading imposed by structural movement, at locations indicated below to comply with details shown on drawings.

d. Do not bridge building expansion and control joints with steel framing or furring members; independently frame both sides of joints with framing or furring members or as indicated.

3.4. INSTALLATION OF STEEL FRAMING

a. Installation Tolerances: Install each steel furring members so that fastening surface do not vary more than 3 mm from plane of faces of adjacent framing.

b. Extend steel furring full height to structural supports or substrates above suspended ceilings, except where partitions are indicated to terminate at suspended ceilings. Continue framing over frames for doors and openings and frame around ducts penetrating partitions above ceiling to provide support for fiber cement board.

3.5. APPLICATION AND FINISHING OF FIBER CEMENT PANELS GENERAL

a. Apply and finish fiber cement panels as per specifications by manufacturer for flush-jointed applications.

b. Install fiber cement panels in manner which minimizes the number of end-butt joints or avoids them entirely 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.

3.6. METHODS OF FIBER CEMENT PANEL APPLICATION

a. General: Follow specifications by manufacturer.

b. Single-layer Application: Install fiber cement panel as follows, and as indicated

c. Single-layer fastening Methods: Apply fiber cement panels to supports as follows:

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

3.7. INSTALLATION OF TRIM ACCESSORIES

a. General: Where feasible, use the same fasteners to anchor trim accessory flanges as required to fasten fiber cement board to the supports. Otherwise, fasten flanges to comply with specification by the manufacturer.

b. Install corner boards at external corners.

c. Install metal edge trim whenever edge of fiber cement board would otherwise be exposed or semi-exposed.

(1) Install U-type trim where edge is exposed, revealed, gasketed, or sealantfilled.

3.8. FINISHING OF FIBER CEMENT BOARDS

a. General: 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.

3.9. 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.

3.10. METHOD OF MEASUREMENT

Fiber cement board shall be measured by actual area in square meters installed and accepted to the satisfaction of the Architect / Engineer.

3.11. BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price per square meter of Fiber Cement Board which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

SECTION 07150 - POLYURETHANE BASED APPLIED WATERPROOFING SYSTEM

PART 1 - GENERAL

1.1. SCOPE

This specification covers the furnishing and supply of materials including equipment, and performing labor necessary to complete the installation of polyurethane based applied waterproofing system for canopy, suspended slab deck, toilets and as shown on plans and specified herein.

1.2. SUBMITTALS:

Submit the following for approval:

1.2.1. Manufacturer's Data

Includes material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.

1.2.3. Samples

Submit mock-up samples for each waterproofing type.

1.3. DELIVERY AND STORAGE

Deliver manufactured waterproofing materials in manufacturer's original, unopened containers, with labels intact and legible. Containers of materials covered by referenced specification number shall bear the specification number, type, and class of the contents. Store and protect materials in accordance with the manufacturer's instructions, and use within their indicated shelf life. Promptly remove from the site materials or incomplete work adversely affected by exposure to moisture. Use pallets and canvas tarpaulins to cover stored materials top to bottom.

1.4. ENVIRONMENTAL CONDITIONS

Apply materials when there is no surface moisture, or visible dampness on the substrate surface. Ensure the air temperature remains above the temperature recommended by the manufacturer. Moisture test for substrate is specified under Item 3.4, "Field Tests". Work may be performed within heated enclosures, provided the surface temperature of the substrate is maintained at a minimum temperature recommended by the manufacturer, for 24 hours prior to the application of the waterproofing, and remains above that the temperature during the cure period recommended by the manufacturer.

1.5. WATERPROOFING CONFERENCE

Prior to starting application of the waterproofing system arrange a pre-waterproofing conference to ensure a clear understanding of drawings and specifications. Give the Owner 7 days advance written notice of the time and place of meeting.

PART 2 - PRODUCTS

2.1. Exposed Type Trafficable Polyurethane Waterproofing

The polyurethane based liquid applied waterproofing is a single component, ready to use, highly elastic, cold applied polyurethane waterproofing which cures into a membrane with excellent abrasion, mechanical, chemical, thermal, and UV resistance.

2.2. Bitumen Modified Polyurethane Liquid Membrane

Liquid Applied Polyurethane waterproofing shall be one part coal-tar-free bitumen modified, moisture curing polyurethane coating. After curing it provides tough highly elastomeric membrane, impervious barrier to moisture.

PART 3 - EXECUTION

3.1. EXPOSED TYPE TRAFFICABLE POLYURETHANE WATERPROOFING

3.1.1. Surface Preparation

Substrate moisture should not exceed 5% (use moisture meter or polyethylene test in accordance with ASTM D 4263). New concrete structures need to dry until the required strength is acquired.

The substrate must be clean and free from all traces of loose materials, old coatings, curing compounds, release agents, laitance, oil grease etc. It should be saturated surface dry (SSD) condition.

Structurally unsound layers or surface contaminants must be mechanically removed by abrasive blast tracking, shot blasting, scarifying, or grinding. Substrates heavily impregnated with oil must be cleaned by torching, using suitable solvent or degreaser substance.

Weak concrete must be removed and surface defects such as blow holes and voids must be fully exposed.

All ducts, loose and friable material must be completely removed from all surfaces before application of product, preferably brush and/or vacuum.

3.1.2. For new Construction: (exposed-type roof deck application)

- a. For a well prepared and mechanically sound concrete slab, apply waterproofing screed to attain desired slope-to-drain surface level.
- b. Anticipate cold joints during Screed pouring. With these joints, create a V-cut profile using concrete grinder or router with the size of approximately 2 inches on both edge diagonally.
- c. Apply polyurethane sealant to fill completely the V-cut profile, about 1.5 inches in depth. Once the sealant is cured, create a strip of 25 wet mils waterproofing, 3 inches on each side.

3.1.3. For pipe vent or penetration:

- a. Seal the gap between pipe and slab using polyurethane sealant for about 2 inches in diameter.
- b. Apply a strip of 25 wet mils waterproofing, 3 inches each side of the sealant around the pipe.

3.1.4. For flashing and wall application:

Apply polyurethane sealant with approximate 20mm width and 20mm height in all corners where the floor meets the wall.

After the sealant has cured, create a strip of 25 wet mils waterproofing measuring 3 inches on each side.

3.1.5. Priming

For porous substrates like concrete, cement mortar, or wood, use primer, then apply waterproofing within 2-3 hours (not later than 4 hours) when the primer is still a little bit tacky.

For non-porous substrates like metals, ceramic tiles, use primer, then apply waterproofing within 6-12 hours (not later than 24 hours) when the primer is still a little bit tacky.

3.1.6. Mixing

Stir the material well by means of an electric stirrer (approx. 500 rpm). Mixing time at least 2-3 minutes until homogenous mixture is achieved.

3.1.7. Application

- a. After application of appropriate primer and observing its curing time, using brush or roller consistently cover the whole area with waterproofing coating system as per manufacturer's recommendation.
- b. Second coat has to be applied within 18 hours (not later than 48 hours), if necessary.
- c. Ensure that the waterproofing coating layers overlap by at least 3 inches beyond previously applied detailing strip.

3.2. BITUMEN MODIFIED POLYURETHANE LIQUID MEMBRANE

3.2.1. Surface Preparation

To ensure optimum results, the surface must be clean, dry and structurally sound, free from contaminants, including but not limited to dust, dirt, loose particles, rust, oil etc. before application of waterproofing. New concrete must have cured for 28 days.

3.2.2. Application

- a. Liquid Applied Polyurethane (PU) Waterproofing can be applied by brush, roller or squeegee.
- b. Seal all cracks or joints of up to 20 mm in width with polyurethane sealant before the application of liquid applied waterproofing.
- c. Waterproofing can be applied immediately over the polyurethane sealant and seal after initial set of approximately 60 minutes at 25°C.
- d. Waterproofing shall be applied to achieve a dry film thickness between 1.0 to 1.2 mm minimum for optimum performance. To achieve this dry film thickness apply waterproofing at 1.2m/liter/coat. Extremely porous surfaces should be filled prior to coating and a second coat of waterproofing shall be applied.
- e. Apply waterproofing evenly to avoid thin spots, air entrapment or pin holes. Any defects can be repaired by over coating and a second coat of waterproofing may be applied as needed.
- f. For applications where two coats of waterproofing are required, allow 24 hours between coats. Protection board must be used to protect the membrane before back filling or concreting. If applied waterproofing is damaged, it can be repaired by cleaning the surface and recoating with the said type of waterproofing.

3.3. METHOD OF MEASUREMENT

Polyurethane based waterproofing system shall be measured by actual area in square meter applied and accepted.

3.4. BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price for the polyurethane based waterproofing system which price and payment shall constitute full compensation for furnishing and placing all materials, including labor, equipment, tools and incidentals, necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

SECTION 09910 – PAINTING WORKS

PART 1 - GENERAL

1.1. SCOPE

This specification covers the furnishing of materials, equipment and labor necessary to complete all field painting works on buildings as shown and indicated on the drawings and schedule of finishes as well as specified herein.

1.2. DELIVERY AND STORAGE

Deliver coatings and coating materials in unopened original container bearing the manufacturer's name and brand designation, specification number, batch number, color, date of manufacture, and manufacturer's instruction for application. Restrict storage of coatings and coating materials and the mixing of coatings to the locations directed.

1.3. SELECTION OF COLORS

Colors of finish coats shall be as approved by the Architect / Engineer. Manufacturer's name and color designation, if indicated, are used for the purpose of color designations only and are acceptable for use on this project only if they conform to all specified requirements.

Products of other manufacturers are acceptable if the color closely approximate the colors indicated and the product conforms to all specified requirements.

1.4. DESCRIPTION OF WORK

Surfaces concealed by portable objects and by surface mounted articles readily detachable by removal of fasteners such as screws and bolts are included in the work. Surfaces concealed and made inaccessible by panel boards, fixed ductwork, machinery, and equipment fixed in place are not included. Remove articles obstructing access to those surfaces specified to be included in the work and restore to their original position on completion. Do not coat surfaces in concealed spaces unless specifically so stated. Do not coat surfaces of steel to be embedded in concrete. Do not coat copper, stainless steel, and aluminum except where specifically so stated and except where surfaces have existing coatings. Do not coat new factory finished material except those that require identification or color coding and those factory-finished surfaces which are damaged during installation.

Restore damaged factory-finished surfaces to their original condition. Do not paint zinc-coated ducts, zinc-coated pipe, or copper pipe in concealed spaces.

1.4.1. Exterior Painting

Includes new surfaces, including items on or a part of the roof which are not factory-finished.

1.4.2. Interior Painting

Includes new surfaces, and appurtenances of the types listed. Where a space or surface, supports, hangers, and miscellaneous metalwork, except as specified otherwise herein.

1.4.3. Mechanical and Electrical Painting

Includes the field coating as required of interior and exterior piping, conduit, ductwork, supports, hangers, air grilles, registers, miscellaneous, and coverings where required, except as specified otherwise herein.

PART 2 - PRODUCTS

2.1. MATERIALS

Paints enamels, coating, primers and stains shall be "best-in-line" product.

2.1.1. Lead Content

Do not use coatings having a lead content of over 0.06 percent by weight of non-volatile content.

PART 3 - EXECUTION

3.1. PROTECTION OF AREAS AND SPACES

Remove, mask, or otherwise protect prior to surface preparation and painting operations such items as hardware, hardware accessories, machined surfaces, radiator covers, plates, lighting fixture, and similar items in contact with coated surfaces. Following completion of painting, reinstall removed items utilizing workmen skilled in the trades involved for such removal and reinstallation. Protect from contamination by coating materials all surfaces not to be coated. Restore surfaces that are contaminated by painting materials to original condition.

3.2. PREPARATION OF SURFACES

Remove all dirt, rust, scale, splinters, loose particles, grease, oil and other deleterious substance from all surfaces which are to be coated or otherwise finished. Allow putty to set one week before coating. Caulking and glazing compounds shall be allowed to cure for times stated in manufacturer's literature prior to being coated. Sandpaper entire surface of existing enamel and other glossy surfaces before application of any coatings. Inspect surfaces after preparation and receive approval before application of any coatings. On surface to be coated with water thinned coatings, spot prime with a brush all exposed nails and other ferrous metal with zinc chromate primer.

3.2.1. Wood Surfaces

Surfaces shall be free from dust and in an approved condition to receive the paint or other finish. Do not use water on uncoated wood. Prior to application of paint, treat knots and resinous wood with an application of knot sealer. Putty cracks and nail-holes after the priming coat has been applied and has dried properly. Prime coat wood doors, frames and trim immediately following delivery to the job site. Sandpaper the entire area previously painted interior wood surfaces; scrape as necessary to remove loose coatings. Set and putty stop all nail heads. Where checking of the wood is present, sand the surface down smooth, wipe and apply a coat of pigmented orange shellac and allow to dry before additional paint is applied. Fill open joints and all other openings whitening putty.

3.2.2. Concrete and Masonry

Remove dirt, fungus, grease, and oil prior to application of coatings. Wash new surfaces with a solution composed of from 14 to 56 grams of tri-sodium phosphate per 1 liter of hot water and rinse thoroughly with fresh water. Wash previously coated surfaces with a suitable detergent and rinse thoroughly. Remove glaze, all loose particles, and scale by wire brushing. Remove efflorescence by scraping, wire brushing, and washing with 5 to 10 percent by weight aqueous solution of hydrochloric (muriatic) acid and then wash thoroughly with fresh water, removing all traces of the acid. Give all new surfaces to be painted with other than cement-water paint a neutralizing treatment consisting of 0.23 kg. of zinc sulphate in 1 liter of warm water. Apply the neutralizer liberally and allow to dry, then rinse the surfaces thoroughly with clean water and allow to dry for not less than 48 hours before paint is applied.

3.2.3. Plaster

Prior to painting, repair all joints, cracks, holes, and other surface defects with patching plaster or spackling compound and sand out smooth. New plaster to be coated shall have an instrument-measured moisture content of not more than 8 percent. In addition to moisture content requirements, allow new plaster to age a minimum of 30 days before application of coating.

3.2.4. New Unprimed Metal Surfaces

Solvent clean zinc-coated surfaces with mineral spirits and wipe dry with clean, dry cloths.

Immediately after cleaning and treating, apply pretreatment wash primer, to a dry film thickness of 0.2 to 0.5 mil on zinc-coated, and ferrous surfaces. Apply primer as soon as practicable after pretreatment has dried. Surface preparation shall be in strict compliance with Steel Structure Painting Council, SSPC SP-10, Near White Blast Cleaning also known as through blast cleaning using dry abrasive.

3.2.5. New Hot Metal Surfaces

Clean new surfaces down to clean bare metal free of mil scale, rust, oil, oxides, dust, coatings and contaminants. Apply new coatings before any new oxidation or contamination begins. Surface preparation shall be in strict compliance with steel structures. Painting SSPC-SP-10 near white metal blast cleaning also known as thorough blast cleaning using dry abrasive.

3.3. APPLICATION

Provide finished surfaces free from burns, drops, ridges, waves, laps, brush marks, and variations in colors. Avoid contamination of other surfaces and repair all damage thereto.

Allow sufficient time between coats to permit thorough drying and provide each coat in proper condition to receive the next coat. Each coat shall cover the surface of the preceding coat or surface completely; there shall be an easily perceptible difference in shades of successive coats. Thoroughly clean dust-free before and during the application of coating material. Prior to erection, used two coats of the designated primer to treat and prime wood and metal surfaces, which will be inaccessible after erection. Thoroughly work painting materials into all joints, crevices, and open spaces. Finished surfaces shall be smooth, even and free of defects. Retouch damaged painting before applying succeeding coats of paint.

Spray painting operations shall comply with the best procedural trade practice. Procure and utilize the engineering controls and/or personal protective equipment necessary for safe and effective application of specified paint systems. Apply strains in accordance with the manufacturer's printed instruction.

Storing, thinning, mixing, handling and applications of painting materials shall be in strict compliance with the manufacturer's recommendation and instruction. Unless otherwise recommended by the paint manufacturer, painting shall be done when:

- a. Metal surface temperature is at least 3°C more than dew point temperature
- b. Ambient temperature is above 10°C
- c. Relative humidity is less than 85%
- d. Application of paints shall be done by Airless Spray Equipment. Pigmented and catalyzed materials shall be thoroughly mixed and strained before applying. Materials that have not been applied within the pot life period specified by manufacturer shall be discarded and properly disposed of.

3.3.1. Equipment

Apply coatings carefully with good, clean brushes or approved spray equipment, except as specified otherwise. Spray areas made inaccessible to brushing by ducts and other equipment. Use airless type spray equipment. Use approved rollers for the application of flat latex coatings to interior walls and ceilings.

3.3.2. Thinning of Paints

Reduce to proper brushing consistency by adding fresh paint, except that when thinning is not mandatory for the type of paint being used.

3.3.3. Environmental Conditions

Do not apply exterior coatings in rainy weather or when the temperature of the air at the surface is over 35 degrees C. Apply interior coatings when the surfaces to be painted are dry and the temperature can be kept below 95 degrees F during the applications of ordinary paints, between 65 degrees F and 95 degrees F during the application of enamels and varnishes.

3.3.4. Special Requirements for Coating Concrete Masonry Surfaces with Acrylic Emulsion Paint Requires containers be marked for the formulation and mixing of fill coat. The fill coat shall conform to these markings except as specified herein.

a. Mixing of Fill Coat

The formula given in Acrylic Emulsion Paint for the content of the fill coat requires a definite amount of water to be added in preparation of the mixture. This requirement shall not apply. Deliver the sand, cement, and mixing liquids pre-proportioned and packaged so that field proportioning will not be required. Field mix the mixing liquid with the sand and cement; after this mixture is thoroughly blended, add water as necessary to produce a rich, creamy mixture of proper brushing consistency. Mix the fill coat materials by hand but do not vigorously agitate. After mixing, allow to set for 10 minutes to permit air to escape before applying. The fill coat mixture will gradually thicken with time; add small amounts of water, when necessary, to keep the mixture a rich brushing consistency. Do not begin mixing more than one hour before application.

b. Wetting of Surface

Before applying filler coat, thoroughly wet the masonry and concrete to control surface suction and provide a reserve of moisture to aid in curing the paint. A garden hose nozzle adjusted to a fine spray is adequate for the purpose. Do not dampen with a brush dipped in water. Dampen the masonry and concrete in one operation not more than one hour nor less than 30 minutes before painting. Apply the spray in such manner that each part is sprayed three or four times for about 10 seconds. Allow time between applications for the water to soak into the surface. If the surface tends to dry rapidly, as in hot weather, re-dampen slightly just in advance of painting. The surface shall be moist but without free water when paint is applied.

c. Application

Do not paint when the paint may be exposed to temperatures below 40 degrees F within 48 hours after application or when the temperature is over 95 degrees F. Rub the filler coat into the surface in such a manner as to fill all depressions, holes, voids, joints, and hollows. Apply the filler coat with stiff fiber bristle brushes with bristles not longer than 2-1/2 inches, using a circular motion. Give the surface a final stroke parallel to the course of block. Provide uniform coverage and laps well brushed out.

Apply the first finish coat at a rate of not less than one gallon per 250 square feet; apply the second finish coat at the rate of not less than one gallon per 300 square feet. Brush apply finish coats, except that behind large ducts and similar locations inaccessible to a brush they may be applied by rollers. Spray application will not be permitted. Deliver all paint to the job site prior to application. Compute the amount of finish coat paint required and submit calculations for approval. Do not begin painting until this amount has been approved and delivered to the job site. Apply all delivered paint. Keep paint in tightly covered containers when not in use; keep stirred to maintain uniform color and consistency during application. At least 24 hours shall lapse between coats; do not start another coat until the preceding coat has become so hard that it cannot be marked with the brushes used. In hot weather, slightly moisten the prior coat before applying the succeeding coat. Covering is not necessary.

3.3.5. Paint Systems

New surfaces made by cleaning operations, shall receive the following coatings. Apply paints, primers, varnishes, enamels, undercoats, and other coatings to a dry film thickness of not less than 1.0 mil. each coat except as specified otherwise. Where coating thickness is specified, it is the minimum dry film thickness.

a. Exterior and Interior Surfaces

(1) Exterior Concrete / Masonry and Plaster Surfaces

Primer: Acrylic solvent base coating primer

Putty: Acrylic solvent base putty

Two coats of 100% acrylic latex paint

(2) Metal Surfaces

1st Coat: Red Oxide Primer

2nd and Third Coat: Quick Dry Enamel

(3) Interior Concrete / Masonry and Plaster Surfaces

First Coat: Flat Latex

Putty: Masonry Putty

2nd and Third Coat: Odorless Water Base Interior Paint

(4) Interior/ Exterior Masonry

1st Coat: 100% Acrylic Water Based Putty:

- Acrylic Solvent Water Based Putty for Interior
- Masonry Water Base Putty for Exterior

2nd and Third Coat:
100% Acrylic Latex Paint

b. Interior Surfaces Not Specified Otherwise

(1) Wood Surfaces

1st Coat: Flat Alkyd Type Paint
Putty: Alkyd Type Putty

2nd and Third Coat: Alky Type Enamel Paint

c. Oil Wood Stain Lacquer Varnish Products that highlights wood grains, adds freshness and color and protect interior paneling, furniture, doors, cabinets and other woodworks.

1st Coat: Oil Wood Stain (any desired color)

2nd and Third Coat: Lacquer Sanding Sealer (Commercial Grade Nitrocellulose based sealer)

4th and 5th Coat: Clear glass Lacquer (nitro cellulose solvent based high gloss lacquer varnish finished)

d. Coat other surfaces for which the type of coating has not been specified herein as specified for surfaces having similar conditions of exposure.

e. Mechanical, Electrical and Miscellaneous Metal Items, Except Hot metal Surfaces and New Pre-finished Equipment

Pre-finishing of new mechanical and electrical equipment is specified in the section covering the particular item.

3.4. METHOD OF MEASUREMENT

Painting of concrete, wood and metal surfaces shall be measured by the number of square meters applied and accepted.

3.5. BASIS OF PAYMENT

The quantity measured as provided in Method of Measurement shall be paid for at the contract unit price, respectively for each of the Pay Items listed below and shown in the Bill of Quantities, which price and payment shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.

SECTION 15400 - PLUMBING WORKS

PART 1 - GENERAL

1.1 DESCRIPTION

The General Conditions apply to all work under this section of the Specifications.

1.1.1 Scope of Work:

Unless otherwise specified, the Contractor or his subcontractor shall furnish all materials, tools, equipment, apparatus, appliances, accessories, transportation, labor and supervision required for the complete installation and testing of the Plumbing System ready for use in accordance with the best practice of the Plumbing trade as listed herein but not limited to the following:

- a. The Plumbing Contractor is required to refer to all architectural, structural, mechanical, fire protection, and electrical plans and investigate all possible interference and conditions affecting his work.
- b. All work 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.
- c. Domestic water supply and distribution system (potable and non-potable) including supply pipes to the equipment, fixtures and hose bibbs inclusive of all valves, fittings, and other accessories to complete the system.
- d. All building sanitary drains, waste and venting systems including floor drains.
- e. Building storm drainage system including collection system from roof drains, mechanical drains, plant boxes drains, and storm drainage catch basins up to the street drainage system and non-potable (rainwater) water tank.
- f. Supply and installation of all plumbing fixtures, fittings, trims and accessories.
- g. Supply and installation of a triplex-type constant pressure booster system and a 34 gallon capacity bladder tank, to include concrete base, controls, valves, pipes, fittings, liquid level control, and other accessories for complete installation.
- h. Supply and installation of elevator pit pumps to include controls, valves, pipes, fittings, and other accessories for complete installation.
- i. Supply and installation of pipes, fittings, valves, miscellaneous metal works, and all required appurtenances for the Non-potable R.C. water tank, and elevator pits.
- j. Testing for leakage of all water supply and distribution system, drains, waste, sewer and venting system plus pressure testing and disinfection of the water supply and distribution system.
- k. Testing for leakage of the non-potable water tank.
- l. Test run of all pumps and other equipment under Plumbing Works.
- m. Securing of all permits and licenses as required.
- n. Excavation and backfilling in connection with the work shall be included.
- o. Preparation and submittal of two (2) sets of as-built plans.
- p. Furnishing of written one (1) year warranty on the plumbing system.

1.1.2 Work Not Included in this Section

- a. Construction of the Non-potable R.C. Water Tank and Booster Station.

b. Construction of all elevator pits.

1.2 NOTES ON DRAWINGS

a. The Drawings show the general arrangements of all pipings. However, where local and/or actual conditions at the job site necessitate a deviation or re-arrangement, the Contractor shall prepare and submit the new arrangement for the Engineer's approval.

b. Small scale Drawings do not possibly indicate all offsets, fittings and other parts of the system required. The Contractor shall arrange such work accordingly, furnishing such fittings, traps, valves and accessories as may be required to meet such conditions.

1.3 QUALITY ASSURANCE

a. The work covered in this contract is to be installed according to the specifications, codes, ordinances and requirements of the following:

(1) National Plumbing Code of the Philippines

(2) The Code on Sanitation of the Philippines

(3) Environmental Management Bureau, DENR

(4) Ordinance of Quezon City

b. All construction permits and fees required for the work shall be obtained by and at the expense of the Contractor. The Contractor shall furnish the Owner final certificates of inspection and approval from the proper government authorities after the completion of the Work.

1.4 WORKMANSHIP AND COORDINATION WITH OTHER TRADES

a. All work shall be performed in first class and neat workmanship by mechanics skilled in their trades and such mechanics and their work shall be satisfactory to the Engineer.

b. The Plumbing Contractor is required to refer to the General Conditions and to all architectural, structural, electrical, mechanical and fire protection plans and Specifications and shall investigate all possible interferences and conditions affecting his work.

PART 2 - PRODUCTS

2.1 MATERIALS

2.1.1 General

a. Except as specified, the Contractor shall submit for the Engineer's approval, four (4) copies of a complete list of manufacturer's names of all equipment and materials he proposes to use, within thirty (30) days after award of contract.

b. The Contractor shall assume the cost of materials and the entire responsibility for any change in the work as shown on contract drawings which may be occasioned by approval of materials other than those specified.

2.1.2 Pipes and Fittings Schedule

a. Cold (Potable) and Non-Potable Water Lines – for risers, downfeeds & distribution lines shall be Polypropylene (PP-R) pipe and fittings PN 20 conforming to DIN specifications DIN 8077 and DIN 8078 or ASTM 2389, forming polyfusion homogeneous joint. All threaded inserts should be made of nickel-plated brass conforming to DIN 2999.

b. Exterior Non-Potable Water Lines (Piping Works at Water Tank and Pump Room) - shall be Galvanized Iron Pipe (GIP), schedule 40. All GIP shall conform to ASTM A-53. Fittings shall be malleable iron, class 150, used screwed connection from 12mm dia. to 65 mm dia. and flanged connection from 75mm dia. and larger.

When buried underground, the GI pipe shall be coated with coal tar and wrapped with burlap for corrosion protection.

c. Soil, Waste and Vent Pipes - shall be Polyvinyl Chloride (PVC) pipes conforming to ASTM D2729, Series 1000.

d. Downspouts/Collector Pipes/ AHU and FCU Drains - shall be Polyvinyl Chloride (PVC) pipes conforming to ASTM D2729, Series 1000.

e. Storm Drainage Lines – shall be Polyvinyl Chloride (PVC) pipes series 1000 conforming to ASTM D2729 for sizes 100mm to 250mm diameter. Use reinforced concrete drain pipes (RCP), tongue and groove, mortar joints for sizes 300 mm diameter and larger conforming to ASTM C-76 Class IV Wall B.

2.1.3 Valves

a. Gate Valve - 75 mm & larger, shall be double disc type, iron body with bronze trim, flanged connection, rated 150 psig working pressure. Gate valves installed in vertical piping shall be of solid wedge type. Gate valves installed inside structures shall be of rising stem type with stuffing box stem seals. Gate valves, which are buried or submerged, shall be non-rising stem types with O-ring stem seals. For 65 mm and smaller, shall be solid wedge type, rated 150 psig working pressure. Valves shall be of bronze construction with screwed bonnet, rising stem, and teflon impregnated packing. PPR gate valves may be used at above ground interior installations.

b. Check Valve - Check valves 50 mm and smaller shall be rated 150 psig, of cast bronze body, Y-pattern, regrinding, horizontal swing check type, with threaded ends conforming to ASTM-B-62 or approved equal. Check valve larger than 65 mm shall be rated at 150 psig, of cast iron body, swing check type conforming to ASTM-A-216 or approved equal.

c. Float Valve - shall be hydraulically operated, diaphragm actuated valve with the pilot control and float mechanism mounted on the cover of the main valve. The float positions the pilot control to close the valve when float contacts the upper stop and to open the valve when the float contacts the lower stop.

d. Angle Valve - Angle valves 50 mm and smaller for water service shall be rated 125 psig with bronze body, seat and disc; screwed bonnet; rising stem; Teflon impregnated packing; and threaded ends.

e. Flap Valve - cast iron body, minimum 150 psig working pressure.

2.1.4 Other Materials

a. Drains – shall have cast iron body with integral trap and socketed end, brass strainer.

(1) Floor/Shower Drains – similar to METMA M200-D

(2) AHU Drains – similar to METMA M200-O

(3) Trench Drain – similar to METMA M200-U

(4) Planters Box Drains - similar to METMA M200-T (Standpipe to be covered with stainless wiremesh and be made longer to suit requirement).

b. Roof Strainers - Sanitary basket strainers shall be of brass wires constructed on slotted holes on brass ring with secondary strainer to insure continuous flow of water, similar to METMA M-319-58.

c. Cleanout

(1) Floor Level Cleanout: Shall be of cast bronze or brass with countersunk thread and screwed plug, all items chromium plated.

(2) Above Ceiling Cleanout: Shall be of cast bronze or brass with screwed plug and square head.

d. Hose Bibbs – 20 mm standard hose connection, 15mm male tapered threads, polished chrome plated, angle type with lock shield and hardwell.

e. Water Hammer Arrestors - shall be of stainless steel construction, with heavy duty balanced expansion bellows. Water hammer arrestors shall be provided in cold water (potable) and non-potable water piping.

f. Unions - unions for water piping 15 mm and larger in diameter shall be flange pattern of galvanized wrought iron. Gasket for flanged unions shall be of the best quality fiber, plastic or leather.

2.1.5 Outdoor Pipe Lines and Appurtenances

a. Drainage Junction Boxes/ Catch Basins and Area Drains - shall be cast-in-place 140 kg/cm² (13.73 MPa) reinforced concrete sections with pre-cast reinforced concrete cover and steel gratings, respectively.

b. Thrust Blocks - 140 kg/cm² (13.73 MPa) plain concrete.

2.1.6 Jointing

a. Flanged Joint Gasket – “GARLOCK” or approved equal.

b. Screwed Joints – U.S. Federal Specifications GG-P-251.

c. PVC Pipes and Fittings – socket type with PVC solvent cement, elastomeric rubber O-ring gasket, or as per the Manufacturer’s recommendations.

d. Polypropylene - High density pipes and brass fittings and joints shall be used.

e. G.I. Pipes and Fittings - Carefully reamed threaded joints. Apply seal tape, or paint with red lead paint at all joints lengths.

f. Dissimilar Pipes - Adaptor fittings shall be used.

g. Concrete Drain Pipe – Bell and spigot or tongue and groove with cement mortar.

2.2 IDENTIFICATION AND APPROVAL OF MATERIALS

a. Each length of pipe, fittings, traps, fixtures, and device used in the Plumbing System shall have cast, stamped or marked on it, the manufacturer’s trademark or name, the weight, type and class of products when so required by the Standards.

b. Within thirty (30) days after award of the Contract, the Contractor shall submit for the Engineer’s approval, the names of suppliers and materials proposed including trade names and/or samples of the materials if deemed necessary.

2.3 SUBSTITUTION AND TESTING OF MATERIALS

a. Materials intended to be substituted for those originally specified shall be accepted only after a formal request for substitution, accompanied by:

(1) Reasons for substitutions;

(2) Certificate of test indicating quality, compared to those originally specified.

(3) Cost comparisons with material originally specified. Request shall be submitted to the Engineer for evaluation at least 15 working days before installation of subject material is due, or at least 7 days before opening of bids.

b. Cost of testing of materials, whether on originally specified items or on substitutions, shall be to the account of the Contractor.

c. Results of tests shall be submitted to the Engineer for evaluation at least 15 days before the material is due for installation on the job.

2.4 SOIL, WASTE, DRAIN AND VENT PIPES

a. Installation

(1) All sewer lines shall be pitched 6 mm per 300 mm (1/4" per foot) for soil pipes and no case flatter than 3 mm per 300 mm (1/8" per foot) for waste pipes.

(2) All sanitary waste piping buried beneath floors shall be encased in concrete at least 150 mm thick.

(3) All changes in pipe sizes on soil, waste and drain lines shall be made with reducing fittings or reducers. All changes in direction shall be made by the appropriated use of forty five degree (45°) wyes, or long sweep bends, except that sanitary tees may be used on vertical stacks. Short quarter bends or elbows may be used in soil and waste lines where the change in direction is from the horizontal to the vertical and on the discharge from the water closet.

(4) Roughing-in for pipes and fixtures shall be carried along with the building construction. Correctly located openings of proper sizes shall be provided where required in the walls and floors for the passage of pipes all items to be embedded in concrete shall be thoroughly clean and free from all rust, scale and paint.

b. Traps

(1) Every plumbing fixture shall be separately trapped by a vented water sealed trap as close to the fixture outlets as the conditions allow, but in no case at a distance greater than 600 millimeters. In case of the upper or the only fixture on a soil pipe extended full size through the roof, a vent shall not be required when said fixture has its center stack. Traps shall be of the same diameter as the waste pipes from the fixtures which they shall serve, all traps shall have a water seal of at least 32 millimeters with a brass thumbscrew clean out at the bottom of the seal.

c. Vent

(1) Vents shall be taken from the crown of the fixtures, except for water closet traps, in which case, the branch line shall be vented below trap and above all small waste line inlets, so connected as to prevent obstructions. Each vent pipe shall be run separately above the fixtures into the adjacent soil pipes, a distance not more than 1.50 meters. If more than this distance, the vent shall run independently through the roof.

(2) A vent line shall be wherever practicable, direct extension of a soil or waste line.

(3) Main vent risers at 4.5 meters long or more shall be connected at the foot with the main water or soil pipes below the lowest vent outlet with a forty five degree connection.

(4) All vertical soil or vent pipes shall be carried up at least 600mm above the roof of the building and the open side ends are to be entirely and securely covered with a Ga. 16 mesh copper cloth.

(5) Vent pipes in roof spaces shall be run as close as possible to the underside of roof with horizontal piping pitched down to stacks without forming traps.

(6) Where an end or circuit vent pipe from fixtures it shall be connected into the main vent or vent stack.

d. Joints and Connections - All joints shall be air and water tight. For jointing pipes, see Item 2.1.6.

2.5 WATER DISTRIBUTION SYSTEM

a. Installation

- (1) The pipings shall be extended to all fixtures, outlets and equipment from the gate valves installed in the branch near the riser.
- (2) The water supply piping at each fixture shall be provided with a shutoff valve and union, whether indicated on the drawings or not, which will permit isolation and disconnection of each item without disturbing the remainder of the system.
- (3) An union shall be provided within 600 mm of each threaded end valve unless there are other connections which will permit easy removal of the valve. Unions shall also be provided in piping at locations adjacent to devices or equipment which may require removal in the future and at locations required by the drawings or specifications.
- (4) All necessary provisions shall be taken in laying out piping to provide throughout for expansion and contraction. Piping shall be held free of contact with building construction so as not to transmit noise resulting from expansion.
- (5) All pipes shall be cut accurately to measurement and shall be worked into place without springing or facing. Care shall be taken so as not to weaken the structural portions of the building.
- (6) All service pipes, valves and fittings shall be kept a sufficient distance from other work to permit finished covering not less than 15mm from such work or from finished covering on the different service.
- (7) Changes in sizes shall be made with reducing fittings.
- (8) Accessible Contraction - Expansion joint shall be made where necessary. Horizontal runs of pipes over 15 m in length shall be anchored to wall or the supporting structure about midway on the run to force expansion and contraction equally towards the ends.
- (9) Polypropylene (PP-R) Random (Type 3) PP-R pipes and fittings must be installed in accordance with the manufacturer's installation recommendation.

The maximum permissible support for (PP-R) spacing shall be as follows:

2.6 EXCAVATING, PIPELAYING AND BACKFILLING

- a. Trenches for all underground pipe lines shall be excavated to the required depths and grades. Bell holes shall be provided so that pipe will rest on well-tamped solid ground for its entire length. Where rock is encountered, excavation shall extend to a depth 150 mm below the pipe bottom and other approved filling materials.
- b. All pipes except concrete pipes and cast iron soil pipes that will run across the road shall be protected with Class B concrete casing, a minimum of 100 mm around the pipe perimeter and 250 mm below the finish grade.
- c. Materials for backfilling shall be free of debris or big rocks. Backfill shall be placed in horizontal layers, properly moistened and compacted to an optimum density that will prevent excessive settlement and shrinkage.

2.7 MISCELLANEOUS

- a. Cleanout shall be gas and watertight, and shall be provided with quick and easy plug removal to allow ample space for cleansing tools.
Cleanout shall be of the same size as the pipe up to and including 100mm, the location of which is extended to an easily accessible place.

b. Traps

1. Every plumbing fixture or equipment requiring connections to the drainage system shall be equipped with a trap.
2. Each trap shall be placed as near as possible to fixture. No fixture shall be double-trapped.

c. Valves

1. Valves shall be provided on all water supplies to fixtures as specified.

d. Pipe Hangers, Inserts and Supports

1. Horizontal runs of pipe shall be hung with adjustable wrought iron and malleable iron pipe hangers spaced not over 3 m apart, except hub and spigot soil pipes which shall have hangers spaced not over 1.52 m apart and located near the hub.

2. Hangers shall have short turn buckles or other approved means of adjustment.

3. Insert shall be of cast steel and shall be of type to receive a machine bolt or nut after installation.

4. Vertical runs of pipe shall be supported by wrought iron clamps or collars spaced not more than 9 m. apart.

5. Water and Vent Pipes - 65 mm and larger, band type 6.4 mm x 25 mm flat mild steel or black iron with 15 mm round rod with plates and nuts; 50 mm and smaller split ring type with 10 mm iron rods with insert plates; toggle bolts, clamps or expansion shield.

e. Pipe Sleeves

1. Pipe sleeves shall be installed and properly secured in place at all points where pipes pass through masonry or concrete.

2. Pipe sleeves shall be of sufficient diameter to provide approximately 6.4 mm clearance around the pipe or insulation.

3. Pipe sleeves in walls and partitions shall be of cast iron, wrought iron or steel pipe. Pipe sleeves in concrete beams or concrete slabs shall be wrought iron or steel pipe.

4. Pipe sleeves on footings shall be cast iron or steel and shall be not less than 100mm larger in diameter than the pipe to be installed.

5. Where pipes pass through waterproofing membrane, the sleeves shall be provided with an integral flange or clamping device to which a flashing shield can be soldered.

6. The space between the pipes and sleeves shall be made water tight by inserting a picked oakum gasket and filling the remaining space with poured lead caulking thoroughly.

f. Fixture and Equipment Supports and Fastenings

1. Where secured to concrete or filled hollow block walls, fastenings shall be brass and at least 76mm into solid concrete.

2. Inserts shall be securely anchored and the anchor shall be properly flushed with mortar.

g. Floor, Walls and Ceilings Plates:

Plates shall be large enough to completely close the hole around the pipes and shall be round with the least dimension hole 30mm larger than the diameter of the pipe.

h. Drains

All drains installed in connection with waterproofing of floors shall be equipped with a clamping device.

2.8 PLUMBING FIXTURES, FITTINGS AND ACCESSORIES

a. Materials and schedule of plumbing fixtures, fittings and accessories shall be as specified under Section 10810 (Toilet Accessories) and Section 15440 (Plumbing Fixtures) of these Specifications.

2.9 NON-POTABLE WATER TANK (CISTERN)

2.9.1 Reinforced Concrete Water Tank

a. Concreting works and placing of reinforcing steel bars shall be done in accordance with sections on concrete structures and reinforcing steel, respectively.

b. Piping, fittings and miscellaneous metal works.

1. Furnish and install all pipe fittings, valves, pipe supports, miscellaneous metal work and all required appurtenances as shown on the plans and as required to make the entire piping system operable.

2. All materials furnished and installed shall be new and guaranteed free from defect in design, materials and workmanship.

3. Adequate protective measures shall be provided to protect pipes, fittings, valves and all other materials from damage or injury during storage and installation.

c. Installation

1. All pipes shall be carefully placed and supported at the proper lines and grade where possible shall be sloped to permit complete draining.

2. Piping runs shown on the Drawings shall be followed as closely as possible, except for minor adjustments to avoid adverse-effect on architectural and/or structural features. If major relocations are required, they shall be subjected to the approval of the Engineer.

3. Carefully inspect all pipes and fittings before installation. Inspection of pipe shall include light tapping with a hammer to detect cracks or defects. No pipe fittings or valves which are cracked or showing defects shall be used.

4. Piping shall be properly supported by suitable anchor, brackets or hangers. Vertical pipes shall be anchored by suitable galvanized steel straps. Pipe supports shall be provided as shown on the Plans and whenever else necessary to prevent stain on joints or to facilitate taking down pipe.

d. Test for Water Tank Tightness

The completed reinforced concrete reservoir shall be tested for water-tightness by filling it up with clean water after cleaning out all dirt and debris inside the tank.

The water shall be allowed to stand for a minimum of 48 hours reckoned from the time the freeboard line was reached during filling up. After the 48 hour period there shall be no drop in water level in the tank more than 40 mm, otherwise the Contractor shall empty the tank to permit close examination for evidence of any cracking or other conditions that might be responsible for the leakage. Any cracks shall be "vee'd" and sealed with rubber sealant, and any evidence of leakage through the joints shall be repaired to the satisfaction of the Engineer. Following these operations, the test for water-tightness shall be repeated.

2.10 PUMPS

2.10.1 General

a. All equipment shall be supplied from reputable firms engaged in the manufacturer of each particular item. The entire assembly as installed shall be given a start-up and test run to prove that all the Specifications have been met before acceptance by the Owner. The test duration shall be 24 hours. Submittal of the Certificate of Test to the Owner shall be a condition of final payment.

b. The Specifications stated herein are basic guides only. Other items not so indicated but which are obviously necessary for the proper operation of system as intended shall be supplied in accordance with accepted engineering standards.

c. The equipment shall be guaranteed for a period of at least one year of trouble free operation. The supplier of equipment shall certify to the availability of spare parts locally and service in case of system breakdowns within a period of at least three years. Manuals of operation and maintenance and lists of spare parts shall be supplied together with the equipment. Submittal of Warranty Certificate shall be a condition for final payment.

d. The supplier shall submit at least two copies of pump performance curves showing, among others, the pump rating and pump efficiency properly marked thereon.

e. Accessories to be supplied for each pump shall include one non-slam type check valve and two (2) gate valves, of size equal to the size of pump discharge and suction, rated 150 psi. Also, one pressure gauge for each set of pumps and pipe fittings necessary for complete installation shall be provided. The pressure gauge shall be 100 mm face diameter and shall be reading from 0 psi (or 0 kg/cm²) to 100 psi (or 7 kg/cm²).

f. Price quoted shall include cost of delivery of all quoted items to the jobsite. Pump and motor installation dimension drawings shall be submitted together with the quotation.

g. The brands, names and place of manufacture of pump, motor, valves, controls and all accessories where applicable shall be indicated in the quotation. Also, a description of pump impellers being offered shall be included.

h. A metal nameplate indicating in indelible letters the correct Specifications of the pump and motor shall be properly attached to the assembly at a location such that the information written thereon can be conveniently read by all concerned.

i. Separate price shall be quoted for installation work, preparation and submittal of asinstalled Drawings.

2.10.2 Variable Speed Booster System

a. Scope

Supply and installation of a pre-fabricated and tested variable speed packaged system to maintain constant water delivery pressure.

b. Pumps

The pumps shall be in-line vertical multi-stage centrifugal pumps with one external frequency converter. The unit shall be rated for a total system capacity of 250 GPM at a discharge head of 100 feet when supplied with a working suction head of 1 foot. Each pump shall be sized as indicated:

Triplex System

Pump P1 = 50 GPM (33% of Total System Flow)

Pump P2 = 100 GPM (67% of Total System Flow)

Pump P3 = 100 GPM (Stand-by Unit)

The head-capacity curve shall have a steady rise in head from maximum to minimum flow within the preferred operating region. The shut-off head shall be a minimum of 20% higher than the head at the best efficiency point.

The pumps shall have the following features:

(1) The pump impellers shall be secured directly to the pump shaft by means of a splined shaft arrangement.

(2) The suction/discharge base shall have ANSI Class 250 flange or internal pipe thread (NPT) connections as determined by the pump station manufacturer.

(3) Pump Construction

- Suction/discharge base, pump head, motor stool: Cast iron (Class 30)
- Impellers, diffuser chambers,

outer sleeve: 304 Stainless Steel

- Shaft: 316 or 431 Stainless Steel
- Impeller wear rings: 304 Stainless Steel
- Shaft journals and chamber bearings: Silicon Carbide
- O-rings: EPDM

Shaft couplings for motor flange sizes 184TC and smaller shall be made of cast iron or sintered steel. Shaft couplings for motor flange sizes larger than 184TC shall be made of ductile iron (ASTM 60-40-18).

(4) The shaft seal shall be a balanced o-ring cartridge type with the following features:

- Collar, Drivers, Spring: 316 Stainless Steel
- Shaft Sleeve, Gland Plate: 316 Stainless Steel
- Stationary Ring: Silicon Carbide
- Rotating Ring: Silicon Carbide
- O-rings: EPDM

The Silicon Carbide shall be imbedded with graphite.

(5) Shaft seal replacement shall be possible without removal of any pump components other than the coupling guard, shaft coupling and motor. The entire cartridge shaft seal shall be removable as a one piece component.

Pumps with motors equal to or larger than 15 hp (fifteen horsepower) shall have adequate space within the motor stool so that shaft seal replacement is possible without motor removal.

c. Variable Frequency Drive

(1) The VFD shall convert incoming fixed frequency single-phase or three-phase AC power into a variable frequency and voltage for controlling the speed of three-phase AC induction motors. The VFD shall be a six-pulse input design, and the input voltage rectifier shall employ a full wave diode bridge; VFD's utilizing controlled SCR rectifiers shall not be acceptable.

The output waveform shall closely approximate a sine wave. The VFD shall be of a PWM output design utilizing current IGBT inverter technology and voltage vector control of the output PWM waveform.

(2) The VFD shall include a full-wave diode bridge rectifier and maintain a displacement power factor of near unity regardless of speed and load.

(3) The VFD shall produce an output waveform capable of handling maximum motor cable distances of up to 1,000 ft. (unshielded) without tripping or derating.

(4) The VFD shall utilize an output voltage-vector switching algorithm, or equivalent, in both variable and constant torque modes. VFD's that utilize Sine-Coded PWM or Look-up tables shall not be acceptable.

(5) VFD shall automatically boost power factor at lower speeds.

(6) The VFD shall be able to provide its full rated output current continuously at 110% of rated current for 60 seconds.

(7) An empty pipe fill mode shall be available to fill an empty pipe in a short period of time, and then revert to the PID controller for stable operation.

(8) Switching of the input power to the VFD shall be possible without interlocks or damage to the VFD at a minimum interval of 2 minutes.

(9) Switching of power on the output side between the VFD and the motor shall be possible with no limitation or damage to the VFD and shall require no additional interlocks.

(10) The VFD shall have temperature controlled cooling fans for quiet operation, minimized internal losses, and greatly increased fan life.

(11) VFD shall provide full torque to the motor given input voltage fluctuations of up to +10% to -15% of the rated input voltage.

(12) The VFD shall provide internal DC link reactors to minimize power line harmonics and to provide near unity power factor. VFD's without a DC link reactor shall provide a 5% impedance line side reactor.

(13) VFD to be provided with the following protective features:

- VFD shall have input surge protection utilizing MOV's, spark gaps, and Zener diodes to withstand surges of 2.3 times line voltage for 1.3 msec.
- VFD shall include circuitry to detect phase imbalance and phase loss on the input side of the VFD.
- VFD shall include current sensors on all three-output phases to detect and report phase loss to the motor. The VFD will identify which of the output phases is low or lost.
- VFD shall auto-derate the output voltage and frequency to the motor in the presence of sustained ambient temperatures higher than the normal operating range, so as not to trip on an inverter temperature fault. The use of this feature shall be user-selectable and a warning will be exported during the event. Function shall reduce switching frequency before reducing motor speed.
- VFD shall auto-derate the output frequency by limiting the output current before allowing the VFD to trip on overload. Speed can be reduced, but not stopped.
- The VFD shall have the option of an integral RFI filter. VFD enclosures shall be made of metal to minimize RFI and provide immunity.

(14) VFD to be provided with the following interface features:

- VFD shall provide an alphanumeric backlit display keypad, which may be remotely mounted using standard 9-pin cable. VFD may be operated with keypad disconnected or removed entirely. Keypad may be disconnected during normal operation without the need to stop the motor or disconnect power to the VFD.
- VFD shall display all faults in plain text; VFD's, which can display only fault codes, are not acceptable.
- All VFD's shall be of the same series, and shall utilize a common control card and LCP (keypad/display unit) throughout the rating range. The control cards and keypads shall be interchangeable through the entire range of drives used on the project.
- VFD keypad shall be capable of storing drive parameter values in nonvolatile RAM uploaded to it from the VFD, and shall be capable of downloading stored values to the VFD to facilitate programming of multiple drives in similar applications, or as a means of backing up the programmed parameters.
- A red FAULT light, a yellow WARNING light and a green POWER-ON light shall be provided. These indications shall be visible both on the keypad and on the VFD when the keypad is removed.
- A start guide menu with factory preset typical parameters shall be provided on the VFD to facilitate commissioning.
- VFD shall provide full galvanic isolation with suitable potential separation from the power sources (control, signal, and power circuitry within the drive) to ensure compliance with PELV requirements and to protect PLC's and other connected equipment from power surges and spikes.
- All inputs and outputs shall be optically isolated. Isolation boards between the VFD and external control devices shall not be required.
- There shall be three programmable digital inputs for interfacing with the systems external control and safety interlock circuitry. An additional digital input is preprogrammed for start/stop.
- The VFD shall have two analog signal inputs. One dedicated for sensor input and one for external set point input.
- One programmable analog output shall be provided for indication of a drive status.
- The VFD shall provide two user programmable relays with selectable functions. Two form 'C' 230VAC/2A rated dry contact relay outputs shall be provided.
- The VFD shall store in memory the last 5 faults with time stamp and recorded data.
- The VFD shall be equipped with a standard RS-485 serial communications port for communication to the multi-pump controller. The bus communication protocol for the VFD shall be the same as the controller protocol.

(15) VFD service conditions:

- Ambient temperature operating range, -10 to 45°C (14 to 113°F).
- 0 to 95% relative humidity, non-condensing.
- Elevation to 1000 meters (3,300 feet) without derating.
- VFD's shall be rated for line voltage of 380 to 480VAC; with +10% to - 15% variations. Line frequency variation of $\pm 2\%$ shall be acceptable.

- No side clearance shall be required for cooling of the units.

d. Fixed Speed Motors

- (1) Fixed Speed Motors are to be provided with the following basic features:
- (2) Designed for continuous duty operation, NEMA design B with a 1.15 service factor.
- (3) Totally Enclosed Fan Cooled or Open Drip Proof with Class F insulation.
- (4) Nameplate shall have, as a minimum, all information as described in NEMA Standard MG 1-20.40.1.
- (5) Motors shall have a NEMA C-Flange for vertical mounting.
- (6) Drive end bearings shall be adequately sized so that the minimum L10 bearing life is 17,500 hours at the minimum allowable continuous flow rate for the pump.

e. Pump System Controller

- (1) The pump system controller shall be a standard product developed and supported by the pump manufacturer.
- (2) The controller shall be microprocessor based capable of having software changes and updates via personal computer (notebook). The controller user interface shall have a VGA display with a minimum screen size of 3-1/2" x 4-5/8" for easy viewing of system status parameters and for field programming. The display shall have a back light with contrast adjustment. Password protection of system settings shall be standard.
- (3) The controller shall provide internal galvanic isolation to all digital and analog inputs as well as all fieldbus connections.
- (4) The controller shall display the following as status readings from a single display on the controller (this display shall be the default):
 - Current value of the control parameter, (typically discharge pressure)
 - Most recent existing alarm (if any)
 - System status with current operating mode
 - Status of each pump with current operating mode and rotational speed as a percentage (%)
- (5) The controller shall have as a minimum the following hardware inputs and outputs:
 - Three analog inputs (4-20mA or 0-10VDC)
 - Three digital inputs
 - Two digital outputs
 - Ethernet connection
 - Field Service connection to PC for advanced programming and data logging
- (6) Pump system programming (field adjustable) shall include as a minimum the following:
 - Water shortage protection (analog or digital)
 - Transducer Settings (Suction and Discharge Analog supply/range)
 - PI Controller (Proportional gain and Integral time) settings
 - High system pressure indication and shut-down
 - Low system pressure indication and shut-down
 - Low suction pressure/level shutdown (via digital contact)
 - Low suction pressure/level warning (via analog signal)
 - Low suction pressure/level shutdown (via analog signal)
 - Flow meter settings (if used, analog signal)
- (7) The system controller shall be able to accept up to seven programmable set-points via a digital input, (additional input/output module may be required).

(8) The controller shall have advanced water shortage protection. When analog sensors (level or pressure) are used for water shortage protection, there shall be two indication levels. One level is for warning indication only (indication that the water level/pressure is getting lower than expected levels) and the other level is for complete system shut-down (water or level is so low that pump damage can occur). System restart after shut-down shall be manual or automatic (user selectable).

(9) The system pressure set-point shall be capable of being automatically adjusted by using an external set-point influence. The set-point influence function enables the user to adjust the control parameter (typically pressure) by measuring an additional parameter. (Example: Lower the system pressure set-point based on a flow measurement to compensate for lower friction losses at lower flow rates).

(10) The controller shall be capable of receiving a remote analog set-point (4- 20mA or 0-10 VDC) as well as a remote system on/off (digital) signal.

(11) The pump system controller shall store up to 24 warning and alarms in memory. The time, date and duration of each alarm shall be recorded. A potential-free relay shall be provided for alarm notification to the building management system. The controller shall display the following alarm conditions:

High System Pressure
Low system pressure
Low suction pressure
Individual pump failure (warning and/or alarm)
VFD trip/failure
Loss of sensor signal (4-20 mA)
Loss of remote set-point
System power loss signal (4-20mA)

(12) The pump system controller shall be mounted in a UL Type 3R rated enclosure. A self-certified NEMA enclosure rating shall not be considered equal. The entire control panel shall be UL 508 listed as an assembly.

The control panel shall include a main disconnect, circuit breakers for each pump and the control circuit and control relays for alarm functions.

Control panel options shall include, but not be limited to:

Pump Run Lights
Pump Alarm Lights
System Fault Light
Audible Alarm (80 db[A])
Surge Arrestor Control Panel
Internal Illumination
Emergency/Normal Operation Disconnect Switches
Switches Service

(13) The controller shall be capable of receiving a redundant sensor input to function as a backup to the primary sensor (typically discharge pressure).

(14) The controller shall have a pump "Test Run" feature such that pumps are switched on during periods of inactivity (system is switched to the "off" position but with electricity supply still connected). The inoperative pumps shall be switched on for a period of two to three (2-3) seconds every 24 hours, 48 hours or once per week (user selectable).

(15) The actual pump performance curves (5th order polynomial) shall be loaded (software) into the pump system controller.

f. Hydropneumatic Pressure Tank

A 34 gallon nominal (or as recommended by pump manufacturer) bladder- type ("bag type") carbon steel hydropneumatic pressure tank, designed to ASME Code and stamped 200 psi working pressure shall be furnished mounted and piped at the factory. The bladder shall be made of heavy duty butyl rubber and FDA approved for potable water applications.

g. Sequence of Operation

The system controller shall operate from one to two pumps and one Variable Frequency Drive (VFD) to maintain a constant discharge pressure (system setpoint).

The system controller shall receive an analog signal [4-20mA] from the factory installed pressure transducer on the discharge manifold, indicating the actual system pressure. When a flow demand is detected (drop in system pressure) the VFD controlled pump shall start first. As flow demand increases, the speed of the VFD controlled pump shall be increased to maintain the system setpoint pressure. When the VFD controlled pump cannot maintain the system setpoint as flow increases (pressure starts to drop below system set-point), an additional pump will be started Direct-On-Line (DOL). The VFD controlled pump shall immediately adjust speed to maintain the system set-point. Additional DOL pumps shall be started as flow demand increases. As flow demand decreases, the pump speed shall be reduced while system set-point pressure is maintained. The system controller shall switch off DOL operated pumps as required with decreasing flow.

The system controller shall be capable of switching pumps on and off to satisfy system demand without the use of flow switches, motor current monitors or temperature measuring devices.

h. Low Flow Stop Function

The system controller shall be capable of stopping pumps during periods of lowflow or zero-flow without wasting water or adding unwanted heat to the liquid. Temperature based no flow shut-down methods that have the potential to waste water and add unwanted temperature rise to the pumping fluid are not acceptable.

Standard Low Flow Stop and Energy Saving Mode

If a low or no flow shut-down is required (periods of low or zero demand) a bladder type diaphragm tank shall be installed with a pre-charge pressure of 70% of system set-point. The tank shall be piped to the discharge manifold or system piping downstream of the pump system. When only one pump is in operation the system controller shall be capable of detecting low flow (less than 10% of pump nominal flow) without the use of additional flow sensing devices. When a low flow is detected, the system controller shall increase pump speed until the discharge pressure reaches the stop pressure (system set-point plus 50% of programmed on/off band). The pump shall remain off until the discharge pressure reaches the start pressure (system set-point minus 50% of programmed on/off band). Upon low flow shut-down a pump shall be restarted in one of the following two ways:

(1) Low Flow Restart: If the drop in pressure is slow when the start pressure is reached (indicating the flow is still low), the pump shall start and the speed shall again be increased until the stop pressure is reached and the pump shall again be switched off.

(2) Normal Flow Restart: If the drop in pressure is fast (indicating the flow is greater than 10% of pump nominal flow) the pump shall start and the speed shall be increased until the system pressure reaches the system set-point. It shall be possible to change from the standard low flow stop to the optional low flow stop (and vice-versa) via the user interface.

i. System Construction

(1) The suction and discharge manifolds shall be constructed of 316 stainless steel. Manifold connection sizes shall be as follows:

3 inch and smaller: Male NPT threaded

4 inch through 8 inch: ANSI Class 150 rotating flanges

10 inch and larger: ANSI Class 150 flanges

(2) Pump Isolation valves shall be provided on the suction and discharge of each pump. Isolation valve sizes 2 inch and smaller shall be nickel plated brass full port ball valves. Isolation valve sizes 3 inch and larger shall be a full lug style butterfly valve. The valve disk shall be of stainless steel. The valve seat material shall be EPDM and the body shall be cast iron, coated internally and externally with fusion-bonded epoxy.

(3) A spring-loaded non-slam type check valve shall be installed on the discharge of each pump. The valve shall be a wafer style type fitted between two flanges. The head loss through the valve shall not exceed 5 psi at the pump design capacity. Check valves 1-1/2" and smaller shall have a POM composite body and poppet, a stainless steel spring with EPDM or NBR seats. Check valves 2" and larger shall have a body material of stainless steel or epoxy coated iron (fusion bonded) with an EPDM or NBR resilient seat. Spring material shall be stainless steel. Disk shall be of stainless steel or leadless bronze.

(4) For systems that require a diaphragm tank, a minimum diaphragm tank connection size of 3/4" shall be provided on the discharge manifold.

(5) A pressure transducer shall be factory installed on the discharge manifold (or field installed as specified on plans). Systems with positive inlet gauge pressure shall have a factory installed pressure transducer on the suction manifold for water shortage protection. Pressure transducers shall be made of 316 stainless steel. Transducer accuracy shall be +/- 1.0% full scale with hysteresis and repeatability of no greater than 0.1% full scale.

The output signal shall be 4-20 mA with a supply voltage range of 9-32 VDC.

(6) A bourdon tube pressure gauge, 2.5 inch diameter, shall be placed on the suction and discharge manifolds. The gauge shall be liquid filled and have copper alloy internal parts in a stainless steel case. Gauge accuracy shall be 2 1/2 %. The gauge shall be capable of a pressure of 30% above its maximum span without requiring recalibration.

(7) Systems with a flooded suction inlet or suction lift configuration shall have a factory installed water shortage protection device on the suction manifold.

(8) The base frame shall be constructed of corrosion resistant 304 stainless steel. Rubber vibration dampers shall be fitted between each pump and baseframe to minimize vibration.

(9) The control panel shall be mounted on a 304 stainless steel fabricated control cabinet stand attached to the system skid.

2.10.3 Elevator Pit Pumps

Furnish and install where shown on the plans, four (4) sets of automatic, portable, and submersible dewatering sump pump, constructed with cast iron casing, hard cast iron impeller, mounted on ball bearing supported shaft, double mechanical seal, capable of delivering 15 GPM against 25 FT. TDH driven by a 3/4 HP submersible motor, 3500 RPM, 230 Volts, single phase, 60 hertz, equipped with thermal motor protector, automatic level control, and all necessary accessories.

PART 3 - EXECUTION

3.1 DRAINAGE SYSTEM TESTS

a. The entire drainage and venting system shall have all necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent and/or vent stack above the roof.

b. The system shall hold this water for a full thirty (30) minutes during which time there shall be no drop more than 100 mm.

c. If and when the Engineer decides that additional test is needed, such as an air or smoke test on the drainage system, the Contractor shall perform such test without additional cost.

3.2 PRESSURE TESTS FOR WATER LINES

a. 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 (1 1/2) the designed working pressure of the system or as specified by the Engineer.

b. The duration of each pressure test shall be at least 10 minutes unless otherwise specified by the Engineer.

c. 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.

3.3 LEAKAGE TESTS FOR WATER LINES

- a. 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.
- b. The pressure to be maintained during the test shall be the designed working pressure of the system.
- c. Leakage test shall be made only after a minimum of 24 hours after the pipe to be tested has been filled with water.
- d. The duration of each leakage test shall be two hours unless otherwise specified by the Engineer.
- e. Each section of pipe line 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.
- f. 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.
- g. Allowable leakage rate per 100 joints per inch of Pipe Diameter at Pressure Stipulated.

3.4 DEFECTIVE WORK

- a. 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.
- b. All repairs to piping shall be made with new materials at the expense of the Contractor.
- c. No caulking of screwed joints or holes will be accepted.

3.5 TEST CERTIFICATE

Test Certificate shall be filled up and signed by the Owner's representative.

3.6 DISINFECTION OF WATER DISTRIBUTION SYSTEM

- a. The entire water system shall be thoroughly flushed and disinfected with chlorine before it is placed on operation.
- b. Chlorination materials shall be liquid chlorine or hypochlorite, as specified and shall be introduced into the water lines in a manner approved by the Engineer.
- c. The chlorine dosage shall be such as to provide not less than fifty parts per million (50 ppm) available chlorine.
- d. Following a contact period of not less than sixteen (16) hours, the heavily chlorinated water shall be flushed from the system with clean water until the residual chlorine content is not greater than two tenth parts per million (0.20 ppm). All valves in water lines being sterilized shall be opened and closed several times during the 16-hour chlorinating period.

3.7 CLEANING

- a. All exposed metal surfaces shall be free of grease, dirt or other foreign materials.
- b. Chrome or nickel plated pipings, fittings and trimmings shall be polished upon completion.
- c. All plumbing fixtures shall be properly protected from use and damage during the construction stage. The fixtures shall be cleaned to the satisfaction of the Engineer upon completion and prior to acceptance of work.

d. All equipment, pipes, valves and fittings shall be cleaned of grease and sludge which may have accumulated. Any clogging, discoloration or damage to other parts of the building due to the system shall be repaired by the Contractor.

3.8 PAINTING AND PROTECTION

a. All exterior of pipings to be installed in or through concrete floor fill or fill floors and underground shall be given one coat of acid resisting paint having a bituminous base.

b. Pipe hanger supports and all other iron work in concealed spaces shall be painted with one coat of asphalt.

3.9 COLOR CODE FOR EXPOSED PIPES

a. All exposed pipings shall be adequately and durably identified by distinctive colored paints as follows:

Item Color Code

cold water (potable) line blue

non-potable water line white

storm water pipe aluminum

sewage pipe black

waste pipe gray

vent pipe green

3.10 WARRANTY AND "AS - BUILT" PLANS

a. All works, equipment and fixtures shall be guaranteed by the Contractor for satisfactory service for a minimum period of one (1) year.

b. The Contractor shall submit to the Owner, in reproducible form plus three (3) sets of white prints, the complete plans of the entire system as actually built. The cost of those shall be borne by the Contractor. Submittal of "AS BUILT" Plans shall be a condition to final payment.

3.11 RESPONSIBILITY

The general Contractor shall be responsible for the coordination among the different trades on the job in order to finish the work in the least possible time, in strict accordance with the Plans and Specifications.

a. Throughout the construction period open ends of all installed pipe lines shall be kept closed by temporary plugs.

b. Drainage lines shall not be used to conduct dirty construction washed water especially those with cement mixes to avoid possible clogging.

c. A temporary fire protection system shall be provided by the Contractor during the construction period. This shall be of sufficient capacity to put out any fire that may break out at any floors due to construction operations. This is in addition to temporary fire extinguisher required.

d. A temporary potable water supply shall be made available to construction workers as construction progresses.

e. A temporary human excreta disposal system shall be provided by the Contractor to serve the workers during the construction period.

3.12 METHOD OF MEASUREMENT

Measurement for payment of pipe fittings, valves, hose bibbs, drains, clean-outs, p-traps, and other accessories shall be the actual number furnished, placed and accepted. Measurement for payment of variable speed booster system and elevator pit pumps shall be the actual number of sets furnished, placed and accepted. Measurement for payment of pipes of the type and size specified including trenching, bedding and backfill, as required, shall be the linear meter installed and accepted.

3.13 BASIS OF PAYMENT

The quantities measured as provided in Method of Measurement, shall be paid for at the contract unit price, respectively, for each of the Pay Item shown in the Bill of Quantities, which price and payment shall be full compensation for trenching, bedding and backfilling for pipelines, for furnishing and placing all materials including labor, equipment, tools and incidentals necessary to complete the work prescribed in this Section.

Payment will be made in accordance with the Bill of Quantities.