DIVISION 4 BUILDING WORKS

4.1 SURVEY AND LAYOUT WORK

4.1.1 GENERAL

1. Work under this Contract shall be subject to Division 1,"General Requirements," which contain provisions and requirements essential to these specifications and apply to this section, whether or not referred to herein.

2. This Section sets forth provisions relating to general surveying and other layout Works required under this Contract.

4.1.1.1 GENERAL REQUIREMENTS FOR SURVEY AND LAYOUT WORK

1. Data and information developed as work herein shall be reviewed with the Engineer when requested.

2. Survey and layout works may be reviewed, verified or checked at any time by and at discretion of the Engineer.

3. Field work or calculations found incorrect, and any work installed improperly due to incorrect field and layout work or calculations, shall be corrected by the Contractor as directed by the Engineer.

4. Checking or verifications of work herein by the Engineer shall not relieve the Contractor from responsibility for providing work in compliance with requirements of contract documents.

5. No work under this Contract shall be permitted to proceed until respective survey and layout work have been provided and verified correct.

4.1.1.2 GENERAL REQUIREMENTS

1. Survey work under this Section shall be under direct control and continuous supervision of a registered Civil/Geodetic Engineer or Licensed Surveyor; qualified and experienced in type of work herein required; retained and paid by Contractor as part of work under this Contract.

2. Survey calculations and drawings shall be developed as necessary for work required.

4.1.2 SURVEY FIELD WORK

1. Survey field work shall be performed using established surveying, measuring and leveling methods; and using orderly and methodical procedures.

2. Surveying instruments and measuring equipment shall be precision made, with standard calibration, accurately adjusted, and of types sufficiently refined for work as required.

3. Field markings, lines, colored markers or other indicators shall be materials not readily faded by sun or washed away by water.

4. Stakes, markers, survey pins, and other devices shall be provided as necessary to enable setting or erecting various structures, items or portions of work without resorting to any further special calculations or particularly difficult measurement or use of other than regular straight edge, rule, snap-line and plumb bob methods.

5. Datum for the work shall be as indicated on drawings or as established in the field under separate Civil Engineering Works Contract.

4.1.3 CONSTRUCTION SURVEY REQUIREMENTS

Following herein are items which the Contractor shall provide prior to commencement of and during construction operations at premises for work under this Contract.

1. Establishment in the field of a building column/grid reference system; and boundary or primary perimeter lines of buildings and various other structures included under this Contract.

2. Utility entrance points at perimeters of buildings or other structures or areas as applicable.

3. Establishment and control of floor and other structures; and finish grades or areas, as applicable.

4.1.4 OTHER LAYOUT WORK

1. Other layout work required of Contractor shall be based upon lines and levels developed and provided under Survey Work.

2. Primary layout work extended in from survey layouts shall be performed by a civil, geodetic engineer or a licensed surveyor.

3. Layout work herein shall be provided to the extent as necessary to assure all work is placed and positioned as required by Contract drawings, approved shop drawings or other related instructions issued by the Engineer.

4. Interior Layout Work

   Layout, locations and dimensions shall be rechecked and verified with the drawings prior to making roughing-ins or setting of other work.

4.1.5 MEASUREMENT AND PAYMENT

The method of measurement and payment under this Section shall be in accordance with Section 2.3 under Division 2, Site Works of these Specifications.

4.2 EXCAVATION AND BACKFILLING FOR BUILDINGS

4.2.1 GENERAL

Division 1, "General Requirements", contain provisions and requirements essential to these specifications; and apply to this Section, whether or not referred to herein.

4.2.1.1 SCOPE OF WORK

1. This Section sets forth general requirements applicable to excavation and backfilling works required for the foundation of buildings.

2. Each Section in which this Section is referenced shall include same as part of that Section; unless otherwise specified.

4.2.1.2 GENERAL PROVISIONS

1. Excavated materials required and approved for backfill shall be stockpiled in areas approved by the Engineer.

2. Remove all unsuitable or excess materials from the site.

3. Each phase of excavation and backfilling work shall be approved by the Engineer as completed prior to removing earthwork equipment from the site or prior to proceeding with subsequent operations which cover or disturb completed phases of works.

4.2.2 EXCAVATION

1. General: The excavation shall conform to the dimensions and elevations indicated for each building and structure, except as specified hereinafter, and shall extend a sufficient distance from walls and footings to allow for placing and removal of forms, installation of services and for inspection, except where the concrete for walls and

footings is authorized to be deposited directly against excavated surfaces. Excavations below indicated depths will not be permitted except to remove unsatisfactory material. Unsatisfactory materials encountered below the grades shown shall be removed as directed and replaced with satisfactory materials; satisfactory materials below the depths indicated without specific direction of the Engineer shall be replaced at no additional cost to PPA to the indicated excavations grade with satisfactory materials, except that concrete footings shall be increased in thickness to the bottom of the overdepth excavations. Satisfactory/backfill shall be placed and compacted as specified in paragraph: "Backfilling." Determination of elevations and measurements of approved overdepth excavation of unsatisfactory material below grades indicated shall be done as directed by the Engineer.

2. Drainage: Excavation shall be performed such that the areas of the site including its immediate surroundings and other areas affected by the operation, will be continually and effectively drained. Waters shall not be permitted to accumulate in the excavation. The excavation shall be drained by pumping or other satisfactory methods to prevent softening of the foundation bottom, undercutting of footings, or other actions detrimental to proper construction procedure and stability of the structures.

3. Classification of Excavation: Excavation will be unclassified regardless of the nature of material encountered and excavated.

4. Blasting will not be permitted.

5. Excavated Material: Satisfactory excavated material required for fill or backfill shall be placed in the proper sections of the permanent work as required. Satisfactory excavated material in excess of that required for the work under this section shall be made available for use in other portions of the permanent site work required for the permanent work; and unsatisfactory material shall be Contractor's responsibility. No satisfactory material shall be wasted or used for the convenience of the Contractor unless so authorized. Stockpiles and waste materials shall be placed, graded, and shaped for proper drainage giving due consideration to drainage from adjacent properties.

6. Final grade of surfaces to support concrete: Care shall be taken not to disturb the bottom of the excavation. Excavation to final grade shall not be made until the concrete is just ready to be placed.

4.2.3 BACKFILLING

1. Satisfactory materials shall be used in bringing fills to the lines and grades indicated and for replacing unsatisfactory material. Satisfactory material shall be free from roots and other organic matter, trash, debris, and stones larger than 75mm in any dimension.

2. Backfilling shall not begin until construction below finish grade has been approved, underground utilities systems have been inspected, tested and approved; forms removed and the excavation cleaned of trash and debris. Backfill shall be brought to indicated finish grades and shall not be placed in wet, muddy or spongy areas. Backfill shall be of satisfactory materials placed and compacted as specified.

   Heavy equipment for spreading and compacting backfill shall not be operated closer to foundation or retaining walls than a distance equal to the height of backfill above the top of footing; the area remaining shall be compacted to required thickness with power driven hand tampers suitable for the material being compacted. Backfill shall be placed carefully around pipes to avoid damage to coatings or wrappings. Backfill shall not be placed against foundation walls prior to seven (7) days after completion of the walls. As far as practicable, backfill shall be brought up evenly on each side of the wall and sloped to drain away from the wall.

3. Placing: Satisfactory material shall be placed in horizontal layers not exceeding 20cm in loose depth and then compacted. No material shall be placed on surfaces that are wet, muddy or spongy.

4. Compaction shall be accomplished by sheep-foot rollers, or other approved equipment well suited to the soil being compacted. Material shall be moistened or aerated as necessary to provide the moisture content that will readily facilitate obtaining the specified compaction with the equipment used.

5. Tests shall be performed on backfill as required by the Engineer. Compaction shall be up to 95 percent maximum dry density per ASTM.

4.2.4 PROTECTION

Settlement or washing that occurs in graded or backfilled areas prior to acceptance of the work shall be repaired and graded re-established to the required elevations and sloped at no additional cost to PPA.

4.2.5 GRAVEL BEDDING

Gravel bedding shall be in accordance with Sub-section 5.9.2 of these specifications.

4.2.6 MEASUREMENT AND PAYMENT

1. Quantities of structure excavation to be paid for shall be the number of cubic meters of unclassified excavation removed and disposed at locations specified or directed. Prior to excavation, drawings, showing paylines for excavation shall first be submitted to the Engineer for approval. Measurement shall be made by cross sectioning ground surface prior to excavation work, and later estimating the volume of materials excavated by computation. No additional payment shall be made for excavating beyond the approved payline.

2. Backfilling for building foundations shall be measured and paid for in cubic meters based on the volume of excavation less volume of concrete and other filling materials or as directed by the Engineer.

   Backfilling of trench shall be measured and paid for by volume in cubic meters of backfill work completed. Measurement shall be based on the volume of excavation less volume of pipes and other materials placed before backfilling.

   Filling above the original ground level shall be measured and paid for by volume in cubic meters. Watering for compacting is considered incidental to filling and backfilling.

   The unit price shall constitute full payment for all labor, materials, equipment, testing, and all incident work called for to complete the work.

   The quantity of gravel bedding to be paid for shall be measured by the design volume in cubic meters as shown on the drawing, placed and completed in accordance to this specification and accepted by the Engineer.

4.3 TERMITE PROOFING, BUKBOK PROOFING

4.3.1 GENERAL

Division 1, "General Requirements", contain provisions and requirements essential to these specifications; and apply to this Section, whether or not referred to herein.

4.3.1.1 SCOPE OF WORK

The Contractor shall hire the services of an approved or accredited pesticide company to furnish all labor, materials, equipment, tools, plant, and services to complete the termite and “bukbok” proofing work hereinafter described.

4.3.1.2 EXAMINATION OF SITE

Inspect the site of work and examine the premises to fully understand existing conditions with respect to the work involved. Prior to soil stripping, excavation or filling all termite mounds within the area should be demolished, removed and treated.

4.3.2 MATERIAL REQUIREMENTS

4.3.2.1 CHEMICALS AND EQUIPMENT

For termite proofing, use LENTREK TC Termiticide Concentrate or approve equal.

For “bukbok” proofing of kiln dried wood, use Penthachlorophenon while for untreated wood, use chemical name accredited name/or acceptable to the PPA and should have valid license from Fertilizer and Pesticide Authority (FPA).

The pest control Contractor shall submit the specified chemicals in their original manufacturer sealed containers to the Project Inspector of inspection, sampling and safekeeping. Containers with broken seal shall not be accepted.

Dilution ratings (for LENTREK TC):

1 part LENTREK TC to 50 parts water

Penthachlorophenon – 1 : 100 concentration

Dilutions shall be done only at the jobsite in the presence of the Project Inspector. The strength of the mixture or solutions shall be made uniform by thorough stirring. All solutions prepared for termite proofing shall be used within 24 hours.

4.3.3 EXECUTION

4.3.3.1 CONTRACTOR LICENSE AND CERTIFICATION REQUIREMENT

The pesticide company should have a valid license from Fertilizer and Pesticide Authority of the Department of Agriculture.

All pesticide shall be applied by or under the direct supervision of a certified pesticide applicator.

4.3.3.2 ENVIRONMENTAL AND SAFETY CONDITIONS

Formulation, treatment, storage and disposal of pesticide shall be in accordance with label directions. Water for formulation shall be drawn only form site(s) designated by the Project Inspector, and the filling hose shall be fitted with a backflow preventor meeting local plumbing codes/standards. The filling operation shall be under the direct and continuous observation of the Project Inspector to prevent overflow.

4.3.3.3 APPLICATION

1. Termite Control

Application of solution shall be done by means of power sprayers fitted with flow meters for accurate monitoring of actual quantity used. At the time of soil treatment application, the soil shall be preferably in a friable condition with low moisture content to allow uniform distribution of the treatment solution throughout the soil. Do not apply pesticide during or immediately following heavy rains, or when conditions will cause runoff and create an environmental hazard. Cover treated area with waterproof sheeting if concrete is not poured on the same day as the soil treatment. Take precautions to prevent disturbance of the pesticide barrier. Before the placement of structural components, re-treatment where soil or fill is disturbed after treatment. Apply pesticide prior to placement of gravel base, vapor barrier or waterproof membrane.

a. Slab on Grade Construction: Establish a horizontal pesticide barrier over areas intended for covering by floors, porches, attached entryways, garages, carports and terraces. Apply treatment solution with a low pressure coarse spray at the rate of four (4) liters solution per square meter. Apply at the rate of seven (7) liters solution per square meter if the fill is washed gravel or other course material. Establish a continuous chemical barrier in the voids of hollow block foundation or voids of masonry. Apply treatment at the rate of seven (7) liters per 3 linear meter. Make pesticide band at least 15 cm wide the pesticide evenly distributed throughout. Treat buildings constructed with basement slabs in the same manner.

b. Crawl Space Construction: Establish a vertical pesticide barrier inside of foundation walls, both sides of interior partition walls, around piers, plumbing, and rodding and utility conduits. Apply treatment solution by rodding or rodding and trenching the fill at the rate of 15 liters solution per 3 linear meter, and 30 cm deep from grade to bottom of foundation. Treat both sides of foundation and around all piers and pipes. Make treated barrier of fill at least 15 cm wide with the pesticide evenly distributed throughout.

c. Dry Pipes and Conduits: Establish pesticide barrier on various dry pipes and conduits such as electrical service entrance, raceways, pipe chase, vents. Use powder type termiticide by injecting it inside the pipe.

d. Termite Mounds: Demolish and treat all termite mounds within the property found after the construction.

2. "Bukbok" Proofing

Kiln-dried wood, plywood, tanguile, apitong, cabinets, dividers, and paneling shall be brushed generously with Penthachlorophenon before painting or varnishing.

3. Sun-Dried Wood Treatment

Sun-dried lumber to be used for ceiling joint runners, nailer, etc. shall be brushed with Penthachlorophenon before installation of plywood or ceiling panels.

4.3.3.4 ENGINEERS

The Contractor shall submit to the Engineer for approval, a copy of the pest control company's proposal and chemical application, method/procedure including the description of the equipment to be used before start of work.

4.3.3.5 INSPECTION AND TEST

Sampling shall be done only in the presence of the Project Inspector.

Amount of sample to be taken: LENTREK TC (From Original container) 50 cc each.

4.3.3.6 CONTRACTOR'S GUARANTEE

Upon completion of work, and on a condition for final acceptance, the Contractor shall submit to PPA a written guarantee from the pesticide company which shall provide that:

1. The soil poisoning treatment shall prevent subterranean termites from attacking the building on its contents for a period of not less than five (5) years.

2. The Contractor shall thereby warrant all works in pest control that all materials and workmanship applied under the contract are of good quality in every respect and will remain as such for not less that five (5) years.

Should there be termite and “Bukbok” infestation within the one (1) year period the Contractor thereby agrees to do all necessary repairs on the damaged portions of the buildings caused by termite infestation to the satisfaction of PPA, at the Contractor’s expense. Retreatment shall also be done by the Contractor after completion of the repairs and at his expense. Such repairs and corrective works shall be done within five days after a written notice from the Owner has been received by the Contractor.

Should there be infestation after the one (1) year period up until the five (5) year guarantee, the pesticide company agrees to do all the necessary repairs at their expense. The pesticide company shall conduct annual inspection of the building and surrounding to check any infestation during the guarantee period. Notice shall be given by the pesticide company to PPA in case there is presence of termites in the surroundings.

4.3.4 MEASUREMENT AND PAYMENT

1. The work done under this Section shall be measured per square meters of the area of wood surfaces where the liquid termite control chemicals is applied. The quantity to be paid for shall be determined and accepted by the Engineer.

2. The accepted quantities, measured as prescribed above shall be full compensation for furnishing and applying termite control chemicals including the use of equipment and tools, labor and incidentals necessary to complete the work prescribed in this Section.

4.4 CONCRETE WORKS FOR BUILDINGS

4.4.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these specifications; and apply to this Section, whether or not referred to herein.

4.4.1.1 SCOPE OF WORK

The work shall include reinforced concrete structures such as reinforced concrete footings with or without tie-beams, reinforced concrete columns girders, slabs, other cast-in-place and precast concrete including excavation and backfilling work.

The work shall consist of furnishing of all labor, materials, equipment and other incidentals necessary for the supply of concrete materials and the complete construction of the concrete structures for the building shown on the drawings in accordance with these specifications and as directed by the Engineer.

4.4.1.2 GENERAL REQUIREMENTS

Concrete works shall conform with the requirements of Section 3.2 “Concrete Works” except noted otherwise in this Section.

4.4.1.3 SHOP DRAWINGS

Together with requirements in sub-section 3.2.1.3.3, the Contractor shall show the following in the shop drawings:

1. Surface finish

2. Fitting to be embedded

4.4.2 MATERIAL REQUIREMENTS

1. Concrete shall consist of Portland cement, fine and coarse aggregates and water and shall conform with the requirements of Section 3.2, “Concrete Works”.

2. Deformed bars to be used shall conform with the reinforcement requirements in Section 3.2, “Concrete Works.” The size shall be as shown on the drawings.

4.4.3 FORMWORKS

4.4.3.1 GENERAL REQUIREMENTS

Materials and construction of formwork shall be in accordance with formwork requirements in Section 3.2, “Concrete Works.”

4.4.3.2 REMOVAL OF FORMWORK

The minimum stripping and striking time for formwork shall be as follows unless otherwise approved by the Engineer.

Conditions	Minimum Period
Vertical sides of beams, wall, piles, pile caps and columns, lift not exceeding 1.2m	24 hours
Vertical sides of beams and walls, lift exceeding 1.2m	48 hours
Soffits of main slabs and beams (props left under)	5 days
Removal of props from beams and main slabs and other works	10 days

4.4.4 CONCRETE

4.4.4.1 CLASSES OF CONCRETE AND USAGE

1. Strength Requirement

Classes	Size of Aggregate (mm)	fc' = MPa	Specified Compressive Strength – 28 days fc’ = Psi
C	19	21	3,000
D	25	17	2,500

2. Usage: The class of concrete to be used shall be as follows:

   a. Class C Concrete : For beams and concrete pedestals, slabs on fill

   b. Class D Concrete : Leveling concrete

4.4.4.2 SLUMP TEST

Tests shall be made in conformity with ASTM C 143, and unless otherwise specified by the Engineer, slump shall be within the following limits:

Structural Element	Slump for Vibrated Concrete	
	Minimum (mm)	Maximum (mm)
Precast concrete	80	180
Wall, column and beam 25cm max. thickness	80	180
Concrete slab	80	150
Lean concrete	70	150

4.4.4.3 CONCRETE COVER FOR REINFORCEMENT

Minimum concrete cover for reinforcement shall be as follows:

Net Concrete Cover	Minimum Cover (mm)
- Concrete cast against and permanently exposed to earth	75
- Concrete exposed to earth or weather:	
Primary reinforcement	50
Stirrups, ties, and spirals	40
- Concrete deck slabs:	
Top reinforcement	50
Bottom reinforcement	35
- Concrete not exposed to weather nor in contact with ground:	
Primary reinforcement	40
Stirrups, ties and spirals	25

4.4.5 CONSTRUCTION JOINTS AND WATERSTOPS

Construction joints shall be provided where shown on the drawings or when approved with written permission of the Engineer. Special care shall be used in preparing concrete surfaces at joints where bonding between two sections of concrete is required. Unless otherwise indicated on the drawings, such bonding will be required at all horizontal joints in walls.

Waterstop material shall be an elastomeric plastic compound, the basic resin of which shall be polyvinyl chloride, and containing any additional resins, plasticizers or other materials needed for the material to comply with the requirements specified.

The waterstop shall be fabricated by an extrusion process such that it will be dense, homogeneous, free from holes and other imperfections. The cross section of the waterstop shall be uniform and symmetrical along its entire length.

Surfaces shall be prepared as follows:

The surface of concrete upon or against which the placement of contiguous concrete or masonry is later required shall be struck off true to the elevations indicted on the drawings after the concrete has been placed. Thereafter as soon as the condition of the concrete permits it, and before the concrete has hardened appreciably, i.e. normally within 2 hours after being deposited, all water, scum, laitance and loose aggregate shall be removed from the surface by means of wire or bristle brooms in such a

manner that the course aggregate is left lightly exposed, and the surface cleaned. No raking will be permitted.

The Contractor shall then take all necessary precautions to ensure that all surfaces thus prepared shall be kept free from storage piles, drippings, staining or foreign matter, which could adversely affect the concrete or the bond between the concrete layers.

Waterstops for all joints shall be continuous around the corners and at intersections, either in horizontal or vertical direction, as indicated on the drawings. Field splices and joints shall be made in accordance with the waterstops manufacturer's instructions, using a thermostatically controlled-heating iron.

4.4.6 MEASUREMENT AND PAYMENT

1. Setting out the Work shall not be measured separately. The cost shall be deemed as part of and incidentals to the foundation works.

2. Excavation, backfilling and gravel fill to be paid for shall be measured in Section 4.2 “Excavation and Backfill for Buildings”.

3. The price to be paid shall constitute full payment for all labor, materials and equipment and all testing and incidental works necessary for the completion of the work.

4. Structural concrete, unless noted otherwise, shall be measured in cubic meters calculated from neat dimensions shown on drawings or authorized in writing by the Engineer.

   No deductions shall be made for the volume of concrete displaced by reinforcing steel and structural steel.

   No deductions shall be made for the volume of concrete displaced by drainage openings less than $0.1m^2$ in cross sectional area.

   Cooling of concrete and providing protection against hot weather shall not be measured for payment and are considered incidental to work.

   Supply and installation of concrete fasteners, anchor bolts, washers and nuts shall not be measured and shall be considered incidental to work unless otherwise specified.

   Supply and placement of grout, joint filler, sealants at joints, waterstops, saw-cutting, neoprene pads, and synthetic fibrous reinforcement / admixture where required shall be incidental to relevant work and shall not be measured for payment.

5. Formwork shall be incidental to work and shall not be measured for payment.

   Scaffolding and falsework shall be incidental to work and shall not be measured for payment.

6. Reinforcing steel bars shall be measured in kilograms incorporated into work, computed from the theoretical unit mass for sizes of bars multiplied by length of bars as shown on approved shop drawings except where specified otherwise.

7. Chairs, spacers and hangers shall be incidental to work and shall not be measured for payment.

8. Cost of all testing and records to be made shall be deemed included in the unit cost of concrete.

4.5 MASONRY

4.5.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these Specifications and apply to this Section, whether or not referred to herein.

4.5.1.1 SCOPE OF WORK

This Section includes the furnishing of all labor and materials to complete the work as shown on the drawings and specified herein. The works shall include but not necessarily be limited to the following:

1. Supply and installation of concrete hollow block (CHB) walls with reinforcement

2. Plastering

3. Installing temporary works like scaffolding, platforms, steps, etc.

4.5.1.2 GENERAL PROVISIONS

The following publications of the issues below but referred to thereafter by basic designation only, form a part of these specifications to the extent indicated by the reference thereto:

American Society for Testing and Materials (ASTM) Publications:

A 615 Deformed and Plain Billet-Steel Bars for Concrete Reinforcement

A 33 Concrete Aggregates

C 129 Specification for Non-Load Bearing Concrete Masonry Units

C 144 Specification for Aggregate for Masonry Mortar

C 270 Mortar for Unit Masonry

4.5.2 MATERIAL REQUIREMENTS

Materials shall conform to the respective specifications and other requirements specified below:

4.5.2.1 CONCRETE HOLLOW BLOCKS (CHB):

CHB shall be of standard manufacture, machine vibrated with fine and even texture and well-defined edges and conforming with the requirements of ASTM C 129. Unless otherwise specified on the Drawings, It shall have a minimum compressive strength of *[2.45 MPa (350 psi)/4.5MPa (650 psi)].* CHB shall be uniform and essentially smooth as normally achieves by standard molding methods and shall be free from any cracks, flaws or other defects.

4.5.2.2 BEDDING MORTAR:

Mortar shall be composed of 1 part of Portland cement, 3 parts of sand and ½ part of lime. It shall have a compressive strength of *[14 MPa (2,000 psi)]* at 28 days and shall comply with property specifications for type N mortar set forth in ASTM Specification C 270 and as modified herein, proportioned and tested in an approved laboratory at the expense of the Contractor. When tested for water retention, the mortar shall have a flow after suction, of 75 percent or more when mixed to an initial flow of 125 to 140 percent. When tested for compressive strength, mortar shall be mixed to a flow of 100 to 115 percent. Aggregate for mortar shall conform to ASTM C 144.

4.5.2.3 PLASTER:

Plaster shall comply with the same specification as those for bedding mortar and will include the use of synthetic fibrous reinforcement of type and dosage recommended by the manufacturer.

4.5.2.4 REINFORCING STEEL BARS AND RODS:

ASTM Specification A 615 with minimum yield strength of *[230 MPa (33,400 psi]* for 10 mm diameter and *[276 MPa (40,000 psi)]* for 12 mm diameter.

4.5.3 SAMPLES AND TESTING

1. The following shall be submitted for approval and in addition, representative samples shall be taken periodically from on-the-site stockpiles as required for testing or checking during the progress of the work.

Anchors and ties	:	Two of each type proposed for use.
Concrete Hollow Blocks	:	Shapes, sizes and kinds in sufficient numbers to show full range of quality and texture.

2. Sampling and testing, unless otherwise specified, shall be performed by an approved independent commercial testing laboratory at the expense of the Contractor. Certified copies of laboratory test reports, including all test data, shall be submitted at least 10 days before delivery of the units or mortar materials represented by the tests to the project site.

3. Mortar shall be laboratory-proportioned and tested. Certified copies of approved laboratory-established proportions shall be submitted with the required test reports and test data. Approved laboratory-established proportions shall not be changed and materials with different physical or chemical characteristics shall not be used in mortar for the work unless additional evidence is furnished that the mortar meets the specified requirements.

4.5.4 ERECTION

1. GENERAL

No unit having a film of water on its surface shall be laid. Masonry shall be laid plumb, true to line, with level courses accurately spaced. Bond pattern shall be kept plumb throughout. Corners and reveals shall be plumb and true. Vertical joints shall be shoved tight. Each unit shall be adjusted to final position while mortar is still soft and plastic. Any unit that is disturbed after mortar has stiffened shall be removed and relaid with fresh mortar. Courses shall be so spaced that backing masonry will level off, flush with the face work at all joints where ties occur. Chases and rake-out joints shall be kept free from mortar or other debris.

2. Anchorage to concrete. Anchorage to abutting columns shall be provided only where indicated. Details shall be as indicated including anchorage to underside of beams and slabs.

3. Cutting and fitting, including that required to accommodate the work of others shall be done by masonry mechanics. Wherever possible, full units of the proper size shall be used in lieu of cut units. Cut edges shall be clean, true and sharp. Openings shall be carefully cut, formed or otherwise neatly made for recessed items and for electrical, plumbing, or other mechanical installations so that wall plates, cover plates, or escutcheons required by the installation will completely conceal the openings and will have bottoms in alignment with lower edge of masonry joints. Webs of hollow masonry units shall be cut to the minimum required for the installation. Reinforced masonry lintels shall be provided as indicated above openings over 300mm wide, for pipes, ducts and cable trays, unless steel sleeves are used.

4. Embedded Items: Spaces around built-in items shall be filled with mortar. Openings around flush-mounted electrical outlet boxes in wet locations shall be pointed flush with mortar including flush joints above the boxes. Anchors, ties, accessories, flashing, pipe sleeves and other items required to be built-in shall be built-in as the masonry work progresses. Anchors, ties, and joint reinforcement shall be fully embedded in mortar.

5. Unfinished work shall be stepped back for jointing with new work. Toothing may be resorted to only when specifically approved. Before laying new work, loose mortar shall be removed and the exposed joint shall be thoroughly cleaned.

6. Protection: Surfaces of masonry not being worked on shall be properly protected at all times. At the end of each workday period and when rain is imminent, the top of exposed masonry shall be covered with a strong non-staining waterproof membrane well secured in place and in a manner that will prevent moisture. Adequate provisions shall be made during construction to prevent damages by wind.

7. Mortar: Materials shall be accurately measured in laboratory-established proportions and mixed with as much water as may be necessary to produce the wettest workable consistency possible. Mortar shall be placed in final position within one hour after mixing. Mortar not used or that has started to set within this time interval shall be discarded.

8. Jointing: Joints in exposed-to-view except control joints, joints to be pointed or caulked or sealed, and openings around flush-mounted electrical outlet boxes in wet locations shall be tooled slightly concave with the mortar thoroughly compacted and pressed against the edges

of the units. Tooling shall be done when the mortar has been thumbprint hard. The tooled joint shall be finished to uniformly straight and true lines and surfaces, smooth and free of tool marks.

9. Placing Reinforcing Steel

Prior to placing grout, all reinforcement shall be cleaned of loose, flaky rust, scale, grease, mortar, grout or other coating which might destroy or reduce its bond with grout. Details of reinforcement shall be as indicated in the drawings. Reinforcing shall not be bent or straightened in a manner injurious to the steel. Bars with kinks or bends not shown on the drawings shall not be used. Placement of reinforcement shall be inspected and approved prior to placing grout. One piece vertical bars extending from floor to floor or roof above shall be provided. Vertical bars shall be spliced only where indicated.

a. Positioning Bars

Vertical bars shall be positioned accurately at the centerline of the wall. A minimum clearance between the bars and masonry units of 12mm and between parallel bars of one diameter of the reinforcement shall be maintained. Vertical reinforcing shall be held in place using metal supports, centering clips, spacers, ties or caging devices located near the ends of each bar and at intermediate intervals of not more than 192 diameters of the reinforcement.

b. Splices

Splices shall be located only as indicated. Splices shall be staggered in adjacent bars at least 600 mm. Bars shall be lapped a minimum of 40 diameters of the reinforcement.

4.5.5 PAINTING AND CLEANING

Mortar daubs or splashing, before setting or hardening, shall be completely removed from masonry unit surfaces that will be exposed or painted. Before completion of the work, all defects in joints or masonry to be exposed or painted shall be raked out as necessary, filled with mortar, and tooled to match existing joints. Masonry surfaces shall not be cleaned, other than removing excess surface mortar until mortar in joints has hardened. Masonry hardened surfaces shall be left clean, free of mortar daubs, dirt, stain and discoloration, including scum from cleaning operations and with tight mortar joints throughout. Metal tools and metal brushes shall not be used for cleaning.

4.5.6 MEASUREMENT AND PAYMENT

1. Quantities of unit masonry to be paid for shall be units or number of square meters of various thicknesses, types, kinds and/or sizes of respective items of work required as shown or specified and as installed and accepted in completed work.

2. Measurement of unit masonry shall be the area of one face of each respective type and thickness of walls and partitions required, determined by overall horizontal and vertical dimensions thereof.

3. No separate measurement will be made for grouting, forming of joints to be sealed, base stud lintel, and other auxiliary work required except for reinforcing steel bars which shall be measured for payment in kilograms computed from the theoretical unit mass for sizes of bars multiplied by length of bars as shown on approved shop drawings except where specified otherwise.

4. No separate measurement will be made for individual detail items of this work not listed herein nor for compliance with various detail requirements applicable to this work; as such shall be considered incidental to work as specified above.

4.6 STEEL AND METAL WORKS

4.6.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these specifications; and apply to this Section, whether or not referred to herein.

4.6.1.1 SCOPE OF WORK

The work includes the furnishing of all labor, materials, equipment and other incidentals necessary for the fabrication and installation of structural steel and miscellaneous metal works as specified in relevant items of these specifications and as indicated on the drawings.

4.6.1.2 SUBMITTAL

1. Before placing orders for materials for the steel and metal works, the Contractor shall submit to the Engineer for approval shop drawings for all steelwork. All project shop drawings shall show the dimension of all parts, method of construction, bolts, welding sectional areas and other details.

2. The detail of connections shown on the shop drawings shall be such as to minimize formation of pockets to hold condensation, water or dirt. A minimum gap between abutting angles and the like shall be provided wherever possible to eliminate any traps and facilitate maintenance painting.

3. No materials shall be ordered nor fabrication commenced until the shop drawings are approved by the Engineer.

4.6.1.3 STORAGE OF MATERIALS

Structural materials, either plain or fabricated, shall be stored above the ground upon platforms, skids, or other supports. Materials shall be kept free from dirt, grease, and other foreign matter and shall be protected from corrosion.

4.6.2 MATERIAL REQUIREMENTS

1. Unless specified herein all steel structures and metals shall conform with the requirements of Section 3.15, “Steel and Metal Works.” Connections where details are not specified or indicated herein, shall be designed in accordance with the American Institute of Steel Construction (AISC), Manual of Steel Construction, latest edition.

2. Structural steel works consisting of channels, gusset plates and other structural steel shape shall be as indicated on the drawings and shall be structural carbon steel conforming to ASTM A 36. Shapes shall be as given in AISC, Manual of Steel Construction.

3. High strength structural bolts, shall conform to ASTM A 325, Types 1 or 2. Nuts shall conform to ASTM A 560, Grade A, heavy hex style, except nuts 38 mm (1- 1/2 inch) may be provided in hex style. Washers shall conform to ANSI B 18.22.1, Type B.

4. Electrodes for arc welding shall be E70 series conforming to American Welding Society Specifications A5.1.

5. Tests are required under the ASTM Standards for steel to be used in the Works and shall be carried out in the presence of the Engineer and at least four (4) days notice must be given to him of the dates proposed for such tests. Four (4) calendar days notice on which fabricated steelwork will be ready for inspection in the Contractor’s yard.

6. Standard bolt shall conform to ASTM A 307 Carbon Steel Externally Threaded Standard Fasteners.

4.6.3 **EXECUTION**

4.6.3.1 QUALIFICATION

Qualification of steel fabricators, erectors and welders shall comply with the requirements of sub-section 3.15.3.1.

4.6.3.2 FABRICATION REQUIREMENTS

1. Workmanship

   Fabrication shall be performed within the permissible tolerance by the approved fabricator. All workmanship shall be of the best quality with respect to internationally recognized standards of practice.

2. Cutting

   Low-carbon structural steel may be cut by machine-guided torch instead of by shears or saw.

   Harmful notches, burrs, irregularities, etc., shall not be developed at the cut surface.

3. Contact Faces

   Contact surfaces between bases or other elements bearing directly upon bearing plates shall be ground or milled as necessary for full effective bearing.

   Edges for welding shall likewise be properly prepared.

4. Bolt Holes

   Bolt holes shall be according to engineering practice and as specified in these specifications.

   Gas burning of holes will not be permitted.

5. High Strength Bolt Assembly Preparation

   Surfaces of high strength bolted parts in contact with bolt heads and nuts shall not have a slope of more than 1:20 with respect to a plane normal to the bolt axis.

   Where the surface of a high strength bolted part has a slope of more than 1:20, a beveled washer shall be used to compensate for lack of parallelism.

High strength bolted parts shall fit solidly together when assembled and shall not be separated by gaskets or any other interposed compressible materials.

When assembled, all joint surfaces including those adjacent to washers shall be free of scale except tight mill scale, and shall be free from dirt, loose scale, burrs, and other defects that would prevent solid seating of parts.

Contact surfaces of friction-type joints shall be free from oil, paint, lacquer or galvanizing.

6. Welding

All welding shall be done only by welders certified as to their ability to perform in accordance with accepted testing requirement.

Welding of parts shall be in accordance with structural standards and the Standard Code for Arc and Gas Welding in Building Construction of AWS, and shall only be done where shown, specified, or permitted by the Engineer.

Damage to galvanized areas by welding shall be thoroughly cleaned with wire brushing and all traces of welding flux and loose or cracked zinc coating shall be removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight. As an alternative to the above, the Contractor may submit for approval the use of a galvanizing rod or galvanizing solder to repair damaged areas.

The welding machine shall be a stable welder, and have suitable functions for the dimension of materials to be welded. The auxiliary tools used for welding shall perform sufficiently and adequately.

The welding machine used for field welding shall be of readily adjustable for electric current.

7. Shop Assembly

Structural units furnished shall be assembled in the shop.

An inspection shall be made to determine that the fabrication and the matching of the component parts are correct.

Jigs shall be used for the assembly of units as much as possible to maintain appropriate position of mutual materials.

Approval of the Engineer shall be required when drilling temporary bolt holes or welding temporary support to the assembled structure.

The tolerances shall not exceed those allowed by codes and each unit assembled shall be closely checked to insure that all necessary clearances have been provided and that binding does not occur in any moving part.

In order to maintain accurate finished dimensions and shape, appropriate reverse strain or restraint shall be provided as required.

Assembly and disassembly work shall be performed in the presence of the Engineer, unless waived in writing by the Engineer any errors or defects disclosed shall be immediately remedied by the Contractor.

Before disassembly for shipment, component parts of the structures shall be match marked to facilitate erection in the field.

4.6.3.3 FABRICATION TOLERANCES

1. Dimensional Tolerances for Structural Work

   Dimensions shall be measured by means of an approved calibrated steel tape at the time of inspection. Unevenness of platework shall not exceed the limitation of the standard mill practice as specified in the American Institute of Steel Construction, “Manual of Steel Construction”.

2. Camber

   Reverse camber in any structural steel members in excess of 1/1,000 of the span length shall cause rejection. The minimum dead load camber for any structural steel member shall be as allowed by Code, or otherwise specified.

4.6.3.4 INSPECTION AND TEST OF WELDING

1. Inspection of Welding

   Inspection of welding shall be executed for the following work phases.

   a. Before Welding

      Scum, angle of bevel, root clearance, cleaning of surface to be welded, quality of end tab, drying of welding rod.

b. During Welding

Welding procedure, diameter of coil and wire, type of flux, welding current and voltage, welding speed, welding rod position, length of arc, melting, cleaning of slag of each level under surface chapping, supervision of welding rod.

c. After Execution of Welding

Assurance of bead surface, existence of harmful defects, treatment of crater, quality of slag removal, size of fillet, dimension of extra fill of butt welding, treatment of end tab.

2. Testing of Welding

Twenty percent (20%) of welds contributing in the overall strength of the structure and which will be inaccessible for the inspection in service shall be tested.

Welding shall be tested by ultrasonic test to the extent specified herein or as directed by the Engineer.

Where partial inspection is required, the ultrasonic test shall be located at random on the welds so as to indicate typical welding quality.

If ten percent (10%) of the random ultrasonic tested indicate unacceptable defect, the remaining eighty percent (80%) of the welding shall be tested.

Repair welding required shall be ultrasonic tested after the repairs are made.

4.6.3.5 CORRECTIONS

In lieu of the rejection of an entire piece or member containing welding which is unsatisfactory or which indicates inferior workmanship, corrective measures may be permitted by the Engineer whose specific approval shall be obtained for making each correction. Defective or unsound welds or base steel shall be corrected either by removing and replacing the entire weld, or as follows.

1. Excessive convexity or overlap shall be reduced by grinding.

2. Undercuts, lack of weld shall be repaired with necessary reinforcement of weld after removal of any foreign materials such as slag, dust, oil, etc.

3. Any defects such as slag inclusions, incomplete fusion, or inadequate joint penetration, shall be completely removed, cleaned and re-welded.

4. Cracks in welds or base steel, shall be removed to sound steel throughout their length and 5cm beyond each end of the crack, followed by welding. The extent of the crack, depth and length, shall be ascertained by the use of acid etching, magnetic particle inspection or other equally positive means.

The removal of welded steel shall be done by chipping, grinding, oxygen cutting, oxygen gouging, or air carbon arc gouging and in such a manner that the remaining welded steel or base steel is not nicked or undercut. Defective portions of the welding shall be removed without substantial removal of the base steel.

4.6.3.6 INSTALLATION

1. Installation Program

   a. Prerequisite Condition

      Prior to executing steel fabrication and field installation, the Contractor shall prepare a comprehensive installation program including engineering supervision organization, fabrication procedures, field installation procedures, material application, machinery applications, inspection procedure, scope and standard of quality judgment, and submit to the Engineer for approval.

   b. Special Technical Engineering

      Special technical engineering different from contract specifications can be applied upon receiving approval of the Engineer.

2. Installation Requirement

   a. Setting of Anchor Bolt and Others

      1) Anchor bolts shall be set in accurate position by using templates.

      2) The setting method shall be proposed to the Engineer for his approval before setting starts.

      3) The threads of bolt shall be cured with an appropriate method against rust and/or any damage before tightening.

      4) Non-shrink mortar shall be placed under base plates, well cured to obtain the sufficient strength before bearing loads are applied to base plates.

b. Temporary Bracing

1) Temporary bracing shall be installed as necessary to stay assemblies and assume loads against forces due to transport, erection operations or other work.

2) Temporary bracing shall be maintained in place until permanent work is properly connected and other construction installed as necessary for support, bracing or staying of permanent work.

3) Extent and quality of temporary bracing shall be as necessary against wind and other loads, including seismic loads not less than those for which the permanent structure is designed to resist.

c. Adequacy of Temporary Connections

During erection, temporary connection work shall be securely made by bolting and/or welding for all dead load, wind and erection stresses.

d. Alignment

No permanent bolting or welding shall be done until the alignment of all parts with respect to each other shall be true within the respective tolerances required.

e. Field Welding

1) Any shop paint or surfaces adjacent to joints where field welding is to be executed shall be wire brushed to remove paint/primer.

2) Field welding shall conform to the requirements specified herein, except as approved by the Engineer.

f. High Strength Bolts

1) Final tightening of high strength bolts shall be done by using manufacturer’s power operated equipment without any overstress to the threads.

g. Correction of Errors

1) Corrections of minor misfits by use of drift pins, and reaming, chipping or cutting will be permitted and shall be provided as part of erection work.

2) Any errors to be corrected or adjusted, preventing proper assembly, shall be immediately reported to the Engineer, and such corrections or adjustments shall be made as necessary and approved by the Engineer.

3) Cutting or alterations other than as approved will not be permitted.

h. Erection

1) Erection and installation shall be as per approved shop drawings.

2) Each structural unit shall be accurately aligned by the use of steel shims, or other approved methods so that no binding in any moving parts or distortion of any members occurs before it is finally fastened in place.

3) Operations, procedures of erection and bracing shall not cause any damage to works previously placed nor make overstress to any of the building parts or components. Damage caused by such operations shall be repaired as directed by the Engineer at no extra cost to the Employer.

4.6.4 **GALVANIZING**

4.6.4.1 PREPARATION

All mild steel parts exposed to weather shall be hot-dipped galvanized after fabrication in accordance with the requirements of ASTM A 123 or ASTM A 153. Prior to galvanizing, the surfaces shall be cleaned of dirt, weld splatter, grease, slag, oil, paint or other deleterious matters. The steel surfaces shall be chemically de-scaled and cleaned with the same abrasive blast or other suitable method as approved by the Engineer.

4.6.4.2 COATING

The zinc coating shall consist of uniform layers of commercially pure zinc free from abrasions, cracks blisters, chemical spots or other imperfections, and shall adhere firmly to the surface of the steel. The weight of zinc coating per square meter of actual surface shall not be less than 550 grams. Any surface damaged subsequent to galvanizing shall be given two coats of approved zinc rich paints.

4.6.5 **PAINTING**

This work shall consist of the preparation of the metal surfaces, the application, protection and drying of the painted surfaces, and supplying of all tools, tackle, scaffolding, labor and materials necessary for the entire work. Painting shall be applied in the field or shop as approved by the Engineer.

Unless otherwise specified or approved, all painting work for structural steel shall comply with the requirements of this Section.

4.6.5.1 SHOP PAINTING

All structural steel shall be given a shop primer after fabrication and cleaning before delivery to the site.

All steel work shall be thoroughly dried and cleaned of all loose mill scale, rust and foreign matters by means of sand blasting or other suitable methods approved by the Engineer before shop painting shall be applied. Each individual piece shall be painted prior to assembly. Portions where field welding or field contact with concrete is required, shall not be painted.

Shop Paintings - Except for galvanized surfaces and items to be encased in concrete, clean ferrous metal surfaces shall be given one coat of Amerlock 400 Epoxy Primer at 100 Microns or approved equal. Additional coat shall be applied to surfaces that will be concealed or inaccessible for finish painting by Amerlock 400, Top Coat at 150 Microns with color or equivalent.

4.6.5.2 FIELD PAINTING

After erection, the Contractor shall thoroughly prepare and clean the entire surface of all structural steel from all dirt, grease, rust or other foreign matters. The entire surface of all members shall then be field painted.

4.6.5.3 MATERIALS

1. Structural Steel Work

    a. After surface preparation, steelwork shall be given one coat of approved prefabricating primer.

    b. Before final assembly of steelwork at the fabricator’s shop, two shop coats of special red lead primer shall be applied to the surface of sections to be in permanent contact, meeting faces and all other concealed surfaces. After final assembly, but before delivery to the project site, the steelwork shall likewise be given two shop coats of special red lead primer.

2. Galvanized Steelwork

All galvanized steelwork shall be treated with zinc chromate two-pack etch primer followed by one coat of non-etch zinc chromate primer.

3. Miscellaneous Metal Work

Unless otherwise specified in other Sections of the Specifications or shown on the drawing, miscellaneous metal works such as ladders, structural steel ladder rungs, etc. shall be given two shop coats of epoxy primer and two coats of epoxy enamel.

4.6.5.4 CONSTRUCTION METHODS

1. Cleaning of Surfaces

Surfaces of metal to be painted shall be thoroughly cleaned; removing rust, loose mill scale, dirt, oil or grease, and other foreign substances. Unless cleaning is to be done by sand blasting, all weld areas, before cleaning is started, shall be neutralized with a proper chemical, after which they shall be thoroughly rinsed with water.

Three methods of cleaning are provided herein. The particular method to be used shall be as directed by the Engineer.

2. Hand Cleaning

The removal of rust, scale, and dirt shall be done by the use of metal brushes, scrapers, chisels, hammers or other effective means. Oil and grease shall be removed by the use of gasoline or benzene.

Bristle or wood fiber brushes shall be used for removing loose dirt.

3. Sandblasting

All steel shall be cleaned by sandblasting. The sandblasting shall remove all loose mill scale and other substances. Special attention shall be given to cleaning of corners and re-entrant angles. Before painting, sand adhering to the steel in corners and elsewhere shall be removed. The cleaning shall be approved by the Engineer prior to any painting which shall be done as soon as possible before rust forms.

4. Flame Cleaning

All metal, except surface inside boxed members and other surfaces which shall be inaccessible to the flame cleaning operation after the member is assembled, shall be flame cleaned in accordance with the following operations.

a. Oil, grease, and similar adherent matter shall be removed by washing with a suitable solvent. Excess solvent shall be wiped from the work before processing with subsequent operations.

b. The surface to be painted shall be cleaned and dehydrated (free from occluded moisture) by the passage of oxyacetylene flames which have an oxygen to acetylene ratio of at least 1.0. The oxyacetylene flames shall be applied to the surfaces of the steel in such a manner and at such speed that the surfaces are dehydrated; dirt, rust loose scale in the form of blisters or scabs, and similar foreign matters are freed by the rapid, intense heating by the flames. The number arrangement and manipulation of the flames shall be such that all parts of the surfaces to be painted are adequately cleaned and dehydrated.

c. Promptly after the application of the flames, the surfaces of the steel shall be wire brushed, hand scraped wherever necessary, and then swept and dusted to remove all free materials and foreign particles.

d. Paint shall be applied promptly after the steel has been cleaned and while the temperature of the steel is still above that of the surrounding atmosphere.

5. Weather Conditions

a. Exterior Coatings: Coatings to surface shall not be applied during foggy or rainy weather, or under the following surface temperature conditions: below 4°C, or over 35°C, unless approved by the Engineer.

b. Interior Coatings: Coatings shall be applied when surfaces to be painted are dry and the following surface temperatures can be maintained: between 18 to 35°C during the application.

6. Application

a. Paint shall be factory tinted and mixed. All paint shall be field mixed before applying in order to keep the pigments in uniform suspension.

b. Field Painting

When the erection work is complete, including all bolting and straightening of bent metal, all adhering rust, scale, dirt, grease or other foreign materials shall be removed as specified above.

As soon as the Engineer has examined and approved each steel and metal works structures, all field bolts, all welds, and any surfaces from which the top or first coat of paint has become worn off, or has otherwise come defective shall be cleaned and thoroughly covered with one coat of paint.

Surfaces to be bolted and surfaces which shall be in contact with concrete, shall not be painted. Surfaces which shall be inaccessible after erection shall be painted with such field coats as are required. When the paint applied for retouching the shop coat has thoroughly dried, and the field cleaning has been satisfactorily completed, such field coats as are required shall be applied. In no case shall a succeeding coat be applied until the previous coat is dry throughout the full thickness of the paint film. All small cracks and cavities which were not sealed in a watertight manner by the first field coat shall be filled with a pasty mixture of red lead and linseed oil before the second coat is applied.

The following provision shall apply to the application of both coats. To secure a maximum coating on edges of plates or shapes, bolt heads and other parts subjected to special wear and attack, the edges shall first be striped with a longitudinal motion and the bolt heads with a rotary motion of the brush, followed immediately by the general painting of the whole surface, including the edges and bolt heads.

The application of the second field coat shall be deferred until adjoining concrete work has been placed and finished. If concreting operations have damaged the paint, the surface shall be re-cleaned and repainted.

c. General Manners

Painting shall be done in a neat and workmanlike manner. Paint may be applied with hand brushes or be spraying, except aluminum paint which preferably shall be applied by spraying. By either method the coating of paint applied shall be smoothly and uniformly spread so that no excess paint shall collect at any point. If the work done by spraying is not satisfactory to the Engineer hand brushing shall be required.

d. Brushing

When brushes are used, the paint shall be so manipulated under the brush as to produce a smooth, uniform, even coating in close contact with the metal or with previously applied paint, and shall be worked into all corners and crevices.

e. Spraying

Power spraying equipment shall be used to apply the paint in a fine spray. Without the addition of any paint, the sprayed area shall be immediately followed by brushing, when necessary, to secure uniform coverage and to eliminate wrinkling, blistering and air holes.

f. Removal of Paint

If the painting is unsatisfactory to the Engineer the paint shall be removed and the metal thoroughly cleaned and repainted.

4.6.6 MEASUREMENT AND PAYMENT

For structural steel the method of measurement shall be in accordance with Section 3.15 “Steel and Metal Works”.

Measurement of the total quantities of work completed under this section shall be the total weight in kilograms of structural steel framing complete with gusset plates, bolts and accessories. Payment shall be the unit price for every unit of measurement listed in the Bill of Quantities of which shall include materials, labor, tools, equipment, and all appurtenances necessary to complete the work.

Payment includes all materials, labor, tools, equipment and all appurtenances for the completion of the work.

4.7 CARPENTRY AND JOINERY

4.7.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these specifications; and apply to this Section, whether or not referred to herein.

4.7.1.1 SCOPE OF WORK

The work shall consist of furnishing all materials, tools, labor, equipment and incidentals necessary to perform and complete the carpentry works as indicated on the drawings and specified herein together with the supervision necessary to the work involved.

The work shall include the doors jambs and other wood works under various items of the specification.

4.7.1.2 DELIVERY AND STORAGE

The Contractor shall protect lumber against dampness and from the weather during and after delivery.

The Contractor shall stack lumber in a manner to insure proper ventilation and drainage, at least 150 mm above ground. Lumber shall be stored under cover, not exposed to extreme temperature and humidity and in a manner to provide air circulation around all surfaces of each piece.

Interior millwork product such as doors, etc. shall not be stored or installed into the buildings until concrete masonry work and plaster are thoroughly dry.

4.7.1.3 SHOP DRAWING

Shop drawings for all carpentry and other woodwork items as required shall be submitted sufficiently in advance of need to allow for review and approval. Shop drawings shall indicate materials and details of construction, methods of fastening, and erection details.

Materials shall not be delivered to the site until after the approved shop drawings have been returned to the Contractor. The Contractor shall be responsible for all errors of detailing and fabrication, and for the correct fitting of fabricated items shown on the shop drawings.

4.7.1.4 WORKMANSHIP

All wood finish works shall be true to details, clean and sharply defined. Panels must be set to allow for free movement in case of swelling or shrinkage. Means of fastening various parts together shall be concealed and as shown on the drawings or as directed by the Engineer.

4.7.2 MATERIAL REQUIREMENTS

4.7.2.1 GENERAL

1. Lumber shall either be kiln dried or as directed by the Engineer and shall be free from imperfections that will impair its strength and finish.

2. Lumber shall be of the best grade available of the respective kinds required for the various parts of the work, well-seasoned, thoroughly dry, sound, straight, free from warps, loose or unsound knots. Lumber with cuts, shakes or other imperfections impairing its strength, durability or appearance shall not be used. All exposed surfaces shall be smooth unless otherwise indicated on the drawings or specified.

3. Any lumber equally good for the purpose intended may be substituted for the kind specified upon prior written approval of the Engineer.

4.7.2.2 MATERIALS

1. Kiln dried tanguile lumber, sound, hard and free from defects shall be used for:

   a. Exterior and interior millwork, siding and finish and trim, as shown on the drawings;

   b. Wood doors, frames and panels,

   c. Cabinet works;

2. Yakal shall be used for all doors and window jambs, transom bars, wood plates and other woodwork in contact with concrete or masonry.

3. Apitong: Sound and thoroughly seasoned, warp free, treated with pressure impregnated preservative, smooth and level on one side or whenever in contact with paneling.

   Unless otherwise indicated on the Drawings, use Apitong, pressure treated for all truss members and rafters; and carpentry; except where in contact with concrete.

4. Plywood

   Plywood shall conform to Commercial Standard PSI and shall be of local manufacture.

   Plywood to be varnished shall be tanguile or kalantas veneers (as indicated), ribbon grained, water resistant, Class B and of the thickness indicated.

   Plywood to be painted shall be tanguile veneer ordinary rotary-cut, water resistant, Class C and of the thickness indicated.

   Plywood exposed to the outside elements or where indicated shall be waterproof or marine plywood and of the thickness indicated.

   The minimum number of plies required for plywood shall be as follows: 3 plies for 4mm to 9mm thick, and 4 plies for 11mm to 19mm thick. Plywood to be pressure-preservative treated shall be fully-waterproof-flue type. Grade for preservative-treated plywood shall not be less than that specified for the specific use. Plywood shall be clean and smoothly sanded on 2 sides. Shelves are considered exposed.

a. 19mm thick plyboard for built-in cabinets

b. 6 mm thick tanguile plywood for ceilings on wood frame and elsewhere as shown in drawings, and for flush type marine hollow core doors for toilets as shown in drawings.

Skeletal wood framing and other woodworks not otherwise specified herein shall be coated/treated with wood preservative.

Grading of Plywood - Each sheet of plywood shall bear the mark identifying the plywood as to wood species, glue type, and grade.

5. Fastenings

Fastenings shall be common nails, glue or specified, flat-head wood screws (F.H.W.S), round-head wood screws (R.H.W.S), bolts or lag screws where specified or called for shall be used. Conceal fastenings as much as possible; where not possible, locate them in inconspicuous places. Where nailing is permitted through woodwork smooth-finished face, conceal nail heads.

Nails - shall be of the smooth shank, zinc coated, common wire nails of local manufacture, and of types and sizes best suited for the purpose.

Wood Screws - shall be brass or cadmium plated, of the best available commercial quality, and of types and sizes suited for the purpose.

4.7.2.3 MOISTURE CONTENT

1. Lumber treated with water-borne preservatives shall be dried to a moisture content not exceeding 19 percent after treatment.

2. Interior finishing lumber shall be kiln-dried, and at the time of delivery to the building site, the moisture content shall not exceed 12 percent for material 25mm or less in thickness, and shall not exceed 15 percent for material over 25mm in thickness.

3. Woodwork that is assembled or built-up of more than one piece at the mill, except doors, shall have a moisture content not in excess of 12 percent at time of delivery to the site.

4.7.2.4 SUBSTITUTION

Any lumber equally good for the purpose intended may be substituted for the kinds specified, subject to the approval of the Engineer. Provided, however, that in the substitution of a cheaper kind of lumber to that which is specified, a reduction in the contract price equal to the difference in the cost of the two kinds of lumber will be made.

4.7.3 **EXECUTION**

4.7.3.1 ERECTION

1. Timber construction assembled with nails and spikes.

    a. For wire nails, the tensile strength shall be not less than 60kg/mm^2 and for wrought and pressed nails not less than 40kg/mm^2.

    b. Unless otherwise specified, square spikes with countersunk square heads shall be used of a length not less than 2 ½ times the minimum dimension of the timbers to be fastened together.

    c. When nailing timbers together, the units to be fastened shall be butted together and be nailed perpendicularly to their surfaces. Heads of nails and spikes shall be driven flush with the surface of the timber.

    d. Points of spikes or nails emerging from the timber shall be turned over transversely to the wood fibers. Care shall be taken that the timbers do not split during nailing.

2. Timber construction assembled with bolts

    a. The bolts used for assembling timber shall be of steel conforming to the requirements of ASTM Designation A307. The tensile strength of bolt steel shall be between 34 and 55kg/mm^2. Members shall be drilled accurately for bolting with suitable washers provided under heads and nuts.

    b. Bolts, washers, nuts, and fish-plates shall be galvanized.

    c. Washer plates for bolt heads and nuts shall have the following dimensions:

        For 13mm bolts use 7.5 x 75mm washers
        For 19mm bolts use 10 x 100mm washers
        For 25mm bolts use 13 x 130mm washers
        For 38mm bolts use 20 x 200mm washers

    d. Bolt holes in timber shall be drilled with a drill having a diameter slightly smaller than that of the bolt so that the bolt has to be forced into the hole. The bolts shall be re-tightened several times as requested by the Engineer in order to ascertain that the bolts have obtained a suitable and stable degree of tension.

3. Timber construction assembled with screws

   a. The screws used for assembling the timer shall comply with relevant ASTM Designations.

   b. Undersized screw holes shall be drilled in advance. Screws shall not be hammered into holes.

4.7.3.2 FINISH

The Contractor shall mill, fabricate and erect interior finish products as indicated on the drawings. Machine-sand cut joints at the mill shall be hand sand smooth.

Joints shall be made tight and in a manner to prevent shrinkage. The Contractor shall secure trim with fine finishing nails, screws, or glue where required and nails shall be set for putty topping.

4.7.3.3 WOOD DOORS, JAMBS AND HEADERS

Door frames shall be set plumb and level and braced until built-in.

Anchor wood frames in masonry with approved metal anchors on each side of jamb. Top and bottom anchors shall be placed 200mm from head and floor unless indicated on the drawings or directed by the Engineer.

4.7.3.4 HARDWARE INSTALLATION

Accurately fit and finish hardware items required.

If surface-applied hardware is fitted and applied before painting, remove all such items except butts and re-install after painting.

4.7.3.5 PRESSURE TREATED LUMBER

Preservative Treatment - All lumber indicated to be pressure treated, shall contain any of the following net retention of solid preservative.

Boliden salts	-	45.5 kg. dry chemical per cubic foot of wood.
Wolman salts	-	.31 kg. dry chemical per cubic foot of wood.
Tenalith salts	-	.34 kg. dry chemical per cubic foot of wood.

The Contractor shall submit an affidavit signed by an official of the preservative treatment company to the Engineer. This affidavit shall indicate the net retention of solid preservatives obtained and shall certify that pressure treated lumbers have a moisture content that does not exceed 17 percent upon shipment from the treatment plant.

Where it is necessary to cut or bore pressure-treated lumber on the job, two coats of prepared concentrated preservatives solution shall be applied to the end-cut or bored surfaces.

4.7.3.6 ROUGH CARPENTRY

All works shall be well fitted, accurately set, and rigidly secured in place.

Cutting and fitting to accommodate other works shall be done as required and in a neat workmanlike manner, and cut or damage works shall be patched and made good.

Framing and structural lumber shall be well-seasoned, straight, square-edged stacked, and free from loose or unsound knots, back edges or other defects that will impair its strength.

Anchors, connectors and fastenings not indicated or specified shall be of the types and size necessary to suit the conditions encountered. Size, type and spacing of nails, screws and/or bolts for installation of manufactured building materials shall be as recommended by the approved manufacturer unless indicated or specified otherwise.

All lumber surfaces in contact with concrete or masonry shall be given a brush coat of bituminous paint.

4.7.3.7 JOINERY WORK

All lumber used for joinery work shall be of the kinds and grades specified and shall have the contours, patterns and profiles indicated.

All joints shall be made in an approved manner, installed tight and securely fastened. Exterior joints shall be mitered and interior angles coped. Panels shall be fitted to allow for shrinkage, avoid swelling and insure that the work remains in place without warping, splitting and opening of joints.

All exposed surfaces shall be machined and hand sanded to an even smooth surface, ready for finish. No hammer marks or other unsightly marks shall be allowed on any wood panel or veneer.

4.7.4 MEASUREMENT AND PAYMENT

No separate payment shall be made for carpentry or joinery work as such work is deemed part of the specified wood work items as indicated in the Bill of Quantities.

4.8 ROOFING AND TINSMITHRY

4.8.1 SCOPE OF WORK

The work shall include but not limited to all labor, materials, tools, equipment and incidentals necessary to furnish and install the roofing sheets including fittings, flashing caps, ridge rolls, gutters and construction of concrete eaves and canopy excluding waterproofing, to provide completely sound water tight roof for the buildings as shown on the Drawings and specified herein.

4.8.2 MATERIAL REQUIREMENTS

4.8.2.1 ROOFING SHEETS

a. Galvanized Iron Roofing

Long span, pre-painted with high grade polyester paint over epoxy primer Galvanized iron roofing [rib/corrugated] type, highly resistant to corrosion and shall comply with the following:

1. Minimum metal base thickness of 0.60mm
2. Minimum paint thickness

   10 microns for bottom coat

   25 microns for top coat
3. Minimum metal base yield stress of 550 MPa

4.8.2.2 FASTENERS AND ACCESSORIES

Roofing sheet fastener shall be 0.025 GI straps and units with washers and cutting screws with neoprene washers or as recommended by the approved manufacturer.

4.8.2.3 TRANSLUCENT FIBERGLASS SKYLIGHTS

Skylights panels shall be fibrous glass translucent panels consisting of a reinforcing mat of 25% glass by weight bonded between surface mats made by borosilicate glass with less than 7% alkali. The binding material shall be of 100% acrylic bonding resins. Panels shall not be less than 3.00mm thick, rib-type to suit the rib of roofing sheets to be used.

Fasteners shall be cadmium plated stove bolts with 1.8mm cadmium washer and rubber washer.

4.8.2.4 HANDLING AND STORAGE

Sheet shall be lifted directly and shall not be dragged over the other sheets or over rough surfaces.

When working on a roof, the workers shall wear flat rubber soled shoes.

Tool shall be handled carefully to prevent them from sliding over the coated surface.

When installation work is completed, all metal off-cuts, used nails and other metallic scrap shall be removed from roof area.

When using drills, hacksaws, or files in the roof area, care shall be taken that metal particles and fillings are swept off the roof immediately.

If not required for immediate use, sheets or bundles shall be staked and clear off the ground. If left in the open, sheets shall be protected by loose tarpaulin or similar covers.

Bundles shall not be left expose to the weather.

4.8.2.5 CONCRETE EAVES AND CANOPY MATERIALS

Concrete materials shall comply with the requirements in Section 3.2, Concrete Works.

Reinforcing Steel bars shall likewise conform with the requirements in Section 3.2, Concrete Works.

4.8.2.6 FIXED METAL LOUVER VENTILATOR

Louver blades shall be gauge # 18 pressed steel.

4.8.2.7 SAMPLES

Samples shall be submitted for Engineer's approval before any order for roofing materials be made by the Contractor.

4.8.3 **INSTALLATIONS**

4.8.3.1 ROOFING SHEETS

1. GI Sheets

   At least 28 days before laying of roofing sheet start, the Contractor shall submit for approval of the Engineer, shop drawings indicating materials and method of installation. No roofing sheets laying work

shall commence without the Engineer's approval of the shop drawings and work method.

Laying shall start from the end opposite the side from where the prevailing monsoon is coming from. The first sheet shall be laid and installed with the turned-down edge towards the outside of the area to be covered. The next sheet shall be overlapped to the previous sheet in such a manner that the exposed edge is turned down and the covered edge is turned up. The overlapped edge in the side shall be with the rib having the anti-capillary groove. End and side laps including flashing shall be as approved by the Engineer.

The straps shall be fixed and fastened with the fastener and washer as shown on the Drawings.

2. Translucent Fiberglass Skylights

Installation of skylights shall be coordinated with and shall follow the sequence of the laying of the roofing sheets. Overlap of skylight panels shall not be less than 300mm at the ends and 2-1/2 corrugations at the sides. No nails shall be used for fastening the skylights panels. All the sheets shall be secured to the purlins with stove bolts and clips complete with one cadmium washer and one rubber washer on top and below the sheet.

All sheets shall be secured to the purlins. Side laps shall be bolted at the center of purlin spaces. Mastics solvents and sealers listed as unsatisfactory to acrylic panels shall not be used.

4.8.3.2 CONCRETE EAVES AND CANOPY

Construction of concrete eaves and canopy shall be in accordance with Section 3.2, "Concrete Works" as shown on the Drawings and as directed by the Engineer.

Waterproofing shall be in accordance with Section 4.9, "Concrete Waterproofing".

4.8.4 MEASUREMENT AND PAYMENT

The quantities to be paid for shall be measured as follows and as indicated on the pay items

1. Roofing sheets and sidings by the area in square meters of roofing sheets or sidings.

2. Ridge rolls by the length in linear meter of ridge rolls

3. Flashing by the length in linear meter of flashing

4. Steel fixed louver vents by the area in square meter of fixed metal louver ventilator

5. The quantity of concrete eaves and canopy to be paid for shall be measured in accordance with Section 3.2, “Concrete Works”.

Payment shall constitute full compensation for furnishing all labor, materials, tools and equipment and other incidentals necessary to complete the work.

4.9 CONCRETE WATERPROOFING

4.9.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these specifications; and apply to this Section, whether or not referred to herein.

4.9.1.1 SCOPE OF WORK

The work shall cover the waterproofing requirements for buildings as shown on the drawings.

The work shall consist of furnishing all labor, materials, equipment and other incidentals necessary for the membrane waterproofing works where required as shown on the drawings and in accordance with the requirements of these specifications and as directed by the Engineer.

4.9.1.2 SUBMITTAL

1. The Contractor shall submit for approval of the Engineer the name of the manufacturer nominated for the supply of materials and installation. Sub-contracting documents shall be submitted to the Engineer by the Contractor.
2. The Contractor shall submit the procedure of waterproofing installation/construction for approval of the Engineer.
3. Membrane waterproofing materials shall be installed only by an experienced installer and shall be installed in accordance with the approved manufacturer's installation procedures or methods, approved by the Engineer.

4.9.1.3 PRODUCT HANDLING

Materials shall be delivered to site in the original sealed containers and packages bearing the manufacturer's name.

4.9.1.4 ALTERNATIVE

No substitution of materials shall be made unless authorized in writing by the Engineer prior to starting the work of waterproofing.

4.9.1.5 MINIMUM GUARANTEE PERIOD

The Contractor shall guarantee the work for a minimum guarantee period of five (5) years. The Contractor shall make sub-contract agreement with approved manufacturer in which following conditions shall be included:

1. Minimum guarantee period of five (5) years after the issuance of Taking-Over Certificate.

2. The Contractor shall transfer all the rights to the Employer, free of charge after the issuance of Taking-Over Certificate.

4.9.2 MATERIAL REQUIREMENTS

4.9.2.1 MEMBRANE SHEETS

Membrane sheets shall be pre-formed elastic, self-sealing, cold-applied bituminous membrane sheet made of a combination of selected asphalt, high-grade plasticizers and 0.075 mm thick polyethylene sheet with the following thickness:

1. 3-ply, 2 mm thick, elastic self-sealing bituminous membrane reinforced with 0.075 mm (3 mils) thick polyethylene sheet which is sandwiched between layers of 1.00 mm thick each elastic self-sealing membranes.

2. Primer

   Priming substrate shall be emulsified asphalt (cutback type) applied at a minimum rate of 4 liters per 9 sq.m.

3. Sealant

   Sealant to seal membrane joint overlaps and termination edges shall constitute 2-component mixture of selected asphaltic material and special grade of mineral matter, applied at a minimum rate of 1.2 kg per sq.m. or 3 kg per membrane sheet.

4.9.2.2 CONCRETE TOPPING

1. For RC eaves, cement mortar topping shall have a minimum 28 day compressive strength of 17 MPa (2500 psi) and shall be in accordance with ACI Specifications. Topping shall be 50 mm thick concrete with synthetic fibrous reinforcement or reinforced with hyrib mesh wire at the sides.

2. For roof decks and canopies, cement mortar topping shall have a minimum 28-day compressive strength of [21] MPa [(3000] psi) with a thickness of 50 mm topping with synthetic fibrous reinforcement or reinforced with hyrib mesh wire.

3. For Toilets, cement mortar topping/mortar setting beds shall have a minimum 28 day compressive strength of [17.2] MPa ([2,500] psi) and shall be in accordance with ACI specifications. Topping shall be 25 mm think and side topping reinforced with hyrib mesh wire.

4. All concrete and mortar materials shall conform to Section 3.2, "Concrete Works."

4.9.3 **EXECUTION**

4.9.3.1 SURFACE PREPARATION

1. Horizontal and vertical concrete and masonry substrate surfaces shall be steel troweled to smooth finish, fully cured, dry, clean and free of rubbish, loose or foreign materials.

2. Surfaces shall be properly sloped (1.5%) to drain water freely into drain lines, gutters and downspouts.

3. Inside corners shall be provided with cement mortar cants of 50 mm x 50 mm (min.) or rounded off at 50 mm (min.) radius.

4. Outside corners shall be curved at approximately 50 mm radius.

5. Reglets about 40 mm deep x 40 mm wide at 0.25 m above floor finish shall be provided along walls or concrete fascia for the termination of the waterproofing system (flashing).

4.9.3.2 PRIMING

A primer shall be applied to impregnate the surface of the base substrate by brush or roller at a coverage of not less than 9 sq.m per 4 liters from a pre-selected side of the area towards the other end of the surface area. The Contractor shall allow the primer to dry or become tacky for at least one hour.

4.9.3.3 MEMBRANE INSTALLATION

1. Membranes shall be installed by peeling off the plastic covering of the sticky side and unrolling slowly into place. The sheets shall be pressed firmly to the surface and forced out any entrapped air. Membranes shall be applied from the low point to the high point across the fall line so that the laps shed water.

2. Subsequent sheets shall be installed with 50 mm minimum overlaps on all sheet joints. All overlaps shall be bonded using a sealant of a 2-component mixture of selected asphaltic material and special grade of mineral matter or sealant for joint overlaps and termination edges.

3. Construction and expansion joints shall be double-covered with a strip of the same grade of membrane of about 300 mm wide centered on the axis of the corner or joint.

4. Membrane edges shall be extended over the edge of slabs or over the top of concrete fascia. All edges shall be sealed with a troweled bed of sealant.

5. For drains, membranes shall be extended down the drains over about a 30 mm length, and edges bonded and sealed with the sealant.

6. For protrusions, membrane shall be extended about 200 mm high. The vertical sheet shall be bonded and sealed with sealant.

7. For high vertical walls, membrane shall be terminated into reglets as described in item 5 of sub-section 4.9.3.1.

8. After the membranes are installed, the Contractor shall inspect carefully for punctures and damages on the installed membranes. Any punctured or damaged membrane shall be patched up with the same grade of membrane strip.

4.9.3.4 FLOODTESTING

Floodtest for a duration of 48 hours shall be undertaken upon completion of waterproofing installation to determine any leakage or defect on the materials and/or workmanship.

4.9.3.5 PROTECTIVE LAYER

The required topping as shown on the drawings, shall be made after acceptance of the floodtesting.

4.9.4 MEASUREMENT AND PAYMENT

The quantity of waterproofing works shall be measured by the area of waterproofing in square meters including cement or concrete leveling and topping and reglets, installed, completed and accepted by the Engineer.

The quantity determined above shall be the basis of payment of the unit price for the pay items shown in the Bill of Quantities which price and payment shall be the full compensation for furnishing all materials, labor, equipment, tools and other incidentals necessary including tests to complete the waterproofing work, accepted and certified for payment by the Engineer.

4.10 CEILING AND WALL INSULATIONS

4.10.1 GENERAL

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

4.10.1.1 SCOPE OF WORK

The work covered in this section shall include all labor, materials, tools, equipment and incidentals necessary to furnish and install pre-fabricated insulated panels and door including aluminum cobing angle, joiner mould, capping and ceiling suspension system, door hardware and other accessories to provide a completely sound watertight ice storage as shown on the Drawings and specified herein.

4.10.1.2 GENERAL PROVISIONS

1. Pre-fabricated insulated panels and door shall be a product of a single manufacturer.

2. Trade names of the materials or components indicated in the specifications are intended only to show the standard of the materials or component on which the design of the particular work is based and also to avoid ambiguous descriptions of the materials or components on the drawings.

   The indication of trade names, therefore, shall in no way be considered to limit the acceptability of other products of equal or better functions, performances, reliability and durability.

4.10.1.3 SUBMITTALS

Samples, specifications and construction procedures proposed for use shall be submitted to the Engineer for approval.

4.10.1.4 DELIVERY AND STORAGE

Pre-fabricated insulated panels and door shall be supplied and delivered in their finished form. They shall be stored at a place properly protected from rain and sunlight. Extended, outdoor exposure shall not be allowed. Insulation materials shall not become wet or soil. Contractor shall comply with manufacturer’s recommendation for handling, storage and protection during installation.

4.10.2 MATERIAL REQUIREMENTS

1. 100 mm thick pre-fabricated insulated panels for wall, ceiling and door with a core of polystyrene foam, machine laminated onto pre-painted continuous steel sheets.

Technical Description

Specifications	
Dimension	1200 mm width by any length
Thickness	100 mm
Weight	13.2 kg/m^2
Surface	Plain
Skins	0.60 mm thick steel, 350 g/m^2 (nominal) zinc coating with oven baked epoxy primer and polyester finish. Color – off white
Core	Self-extinguishing polystyrene foam, density 16 kg/m^3
Structural Properties	
Compressive Strength	110 kn/m^2 at 10% compression
Shear Strength	670 kn/m^2
Insulation Properties	
Vapor Permeability	NIL
Temperature Range	+80°C to –150°C
Thermal Conductivity	3.5 x 10^{-2} with m/°C @ 25°C
Fire Properties (Composite Panel)	
Surface Flame Spread	Class O (BS476, Pt7 1971)
Early Fire Hazard Properties	Range 0-20 (ASK 1530 Pt3)
Surface Properties	
Surface Scratch Resistance	2000 g (DEF 1053)
Corrosion Resistance	
Salt Spray test	No blistering, undercutting or loss of paint adhesion after 1200 hours (ASTM B 117-64)
Humidity resistance	Paint unaffected after 3000 hours (ASK 41 Method 452.1)
Water Immersion	Paint unaffected after 3000 hours
Weather Resistance	Surface unaffected after 5 years exposure to industrial, marine and sub-tropical conditions.

2. Accessories

   Manufacturer's standard for the item required or type best suited for the intended use.

4.10.3 EXECUTION

Install pre-fabricated insulated panels and door according to the direction of the manufacturer.

4.10.4 MEASUREMENT AND PAYMENT

Quantities of pre-fabricated insulated wall and ceiling panels including insulated door and accessories to be paid for shall be measured by lump sum for each building installed, completed, tested, approved and certified for payment by the Engineer.

Payment shall constitutes full compensation for furnishing and installation of pre-fabricated insulated panels and door including all labor, equipment, tools, accessories and other incidentals necessary to complete the work prescribed in this item.

4.11 DOORS AND WINDOWS

4.11.1 GENERAL

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

4.11.1.1 SCOPE OF WORK

The work shall cover the fabrication, delivery and complete installation of doors and windows including glazing for the buildings.

The works shall consist of furnishing all labor, materials, tools, equipment and other incidentals necessary for the complete installation of the above mentioned doors and windows, including glazing, as shown on the drawings and in accordance with this specifications or as directed by the Engineer.

4.11.1.2 SUBMITTAL

The Contractor shall submit the shop drawings for the fabrication of the doors and windows to the Engineer for approval, twenty eight days before the start of works.

The shop drawings shall indicate the following:

1. Elevations for each type;

2. Details for each type;

3. Location in the building for each item;

4. Typical and special details of construction; and

5. Location and installation requirements for hardware.

4.11.1.3 HANDLING AND STORAGE

All doors and windows and door frames shall be delivered, stored and handled so as not to be damaged or deformed. All doors and windows and door frames stored at the site before installation shall be stocked vertically on non-absorptive strips or wood platforms and covered with suitable covering to provide weathertight protection and proper air circulation.

4.11.2 MATERIAL REQUIREMENTS

4.11.2.1 WOOD DOORS

1. Wood doors shall be of the following types where indicated on the drawings with complete locksets, hinges and accessories.

   a. Flush-type marine hollow core plywood doors.
   b. Flush type marine plywood with fixed wood louver door
   c. Panel type wood tanguile doors
   d. Louver type wood door

2. Frame wood block insets shall be kiln-dried tanguile, as shown on the drawings.

3. Facings shall be raised wood panels, ordinary plywood, marine plywood where shown on the drawings. Plywood shall be first quality, grain and color suitable for natural finish and of the thickness indicated on the drawings.

4. Door jambs and headers shall be well-seasoned yakal.

5. Nails shall be of the smooth shank, zinc-coated, common wire nails of the types and sizes suited for the purpose and as directed by the Engineer.

6. Wood screws shall be brass or cadmium plated of the best available commercial quality of the types and size suited for the purpose.

4.11.2.2 STEEL DOORS

1. Swing type metal door shall be gauge 20 metal door with mineral core, as indicated in the drawings.

2. Gauge 20 metal door with baked enamel finish and stainless steel trim and fitting shall be used for toilets. It shall be connected to a cubicle type partitions as indicated in the drawings.

4.11.2.3 ROLL-UP DOOR

1. Roll up door shutters shall be made of cold rolled pre-painted, galvanized steel or black Iron and must be of structural section to withstand all conditions of stresses to which it may be subjected during opening and closing operations and wind pressure of 196 kg/m^2.

   Roll-up door shall be ball bearing mounted to suspend the heavy rotating members. Full door weight shall be carried by side guides.

2. Guides shall consist of steel structural shapes or formed steel not less than 50mm deep and 1.2mm to 1.4mm thick (Pre-painted galvanized steel/black iron) Guide shall be securely attached to wall or column by 10mm diameter by 83mm hexagonal bolts with expansion shield spaced at 600mm on center. Pre-painted and galvanized side guides shall be installed with PVC reinforcement as sound reducer.

3. Curts shall be formed by interlocking steel slots, roll formed from 0.80mm to 1.20mm, depending on the requirements, pre-painted, galvanized steel or B Iron sheets.

   Windlocks shall be provided as required by door size and shall withstand wind pressure of 196 kg/m^2.Windlocks shall be galvanized malleable cast iron and fastened to curtains slats with three or more zinc-plated steel rivets per lock..

4. Bottom bar of the curtain will be reinforced with two (2) pieces of angular bars of not less than 44mm x 44mm x 1.60mm thick pre-painted, galvanized steel or black iron. Compressible and replaceable rubber vinyl weather strip shall be attached on the bottom rail.

5. Brackets shall be fabricated of heavy cast iron or steel, designed to close the end of the roller shaft housing and to form a supporting ring or hood. Bracket hubs or shaft plugs shall be equipped with pre-lubricated ball bearings, shielded or sealed.

   Endlocks made of malleable cast iron, galvanized and fastened to alternating slats shall be installed to prevent slats from wearing at the surface coming in contact with the side guides.

   Roller shaft shall be constructed of steel pipe or commercial steel tubing of proper diameter and thickness for the size of the curtain. Deflection shall not exceed 0.030 inch per foot of span. End of roller shall be closed with cast iron plugs machine to fit the pipe.

6. Rubber bumpers shall be installed to protect the base of the roll-up doors even when ample pressure is applied on pushing the door up. The bumpers shall also minimize the load, clashing sound when the doors are lifted.

4.11.2.4 ALUMINUM DOOR

1. All frames for aluminum door shall consist of aluminum shapes and materials extruded from alloy 6063-T5 to ASTM B 221. Frames shall be coated with polyester powder and with shade as shown on the Drawing or as directed by the Engineer. Powder coating shall satisfy the following requirements:

Pre-treatment	:	zinc chromating and acid rinsing
Powder application	:	one operation using electrostatic gun
Oven curing temp	:	200ºC for 20 min,
Coating thickness	:	min. 60 microns
Impact resistance (ASTM D 2794)	:	min. 20 in/lb

2. Door panels shall either be clear or tinted glass with panel thickness as shown on the Drawings.

4.11.2.5 PVC DOORS

Vinyl: Integral color PVC compound containing impact-resistant solid plasticizer.

Comply with ASTM D 4216.

4.11.2.6 MELAMINE FACED PARTICLE BOARD FOR TOILET ENCLOSURE

Toilet enclosures shall be 33 mm thick H.M.R. (High Moisture Resistant) Melamine Faced Practice Board.

Colors shall be as designated by the Engineer. Submit samples for each type of toilet enclosure for approval prior to installation.

4.11.2.7 JALOUSIE GLASS TYPE WINDOW WITH SECURITY GRILLES

Glass slats shall be 5.5 mm thick obscured glass 100 mm wide smooth edged glass.

The vertical operating mechanism shall be of extruded aluminum conforming to ASTM B 211 with paired zigzag cut members one fixed to the concrete jambs.

Lower handles shall also made of aluminum that lock the unit in closed position.

Wrought iron grilles shall be manufactured from 12 mm square bars conforming to the shop drawing submitted and approved by the Engineer.

4.11.2.8 ALUMINUM WINDOWS

All frames for window shall consist of aluminum shapes and materials extruded from alloy 6063-T5 conforming to ASTM B 221. Frames shall be coated with polyester powder conforming to the requirements of Section 4.11.2.5. (exterior use) or epoxy/polyester powder coated (interior) aluminum window frame. It shall be of fixed window, half-fixed and half-open sliding window, half-fixed and half-open sliding window below a fixed window as indicated in the drawings.

Glass for window shall either be clear, obscured or tinted with pane thickness as shown on the Drawings.

4.11.2.9 FIXED GLASS COUNTER WINDOWS

Window frames shall either be wood or aluminum conforming to Section 4.11.2.1. or 4.11.2.5 or as shown on the Drawings.

Glass shall be clear glass not less than 5.5 mm thick.

Nails shall be as provided in Section 4.11.2.1.5.

4.11.2.10 FIXED LOUVER WINDOWS

Fixed louver windows shall be of the thickness and dimensions indicated. The fixed louvers shall be fabricated from gauge 16 G.I. sheet. Unless otherwise indicated, metal louver windows shall be constructed to withstand a minimum of 240 kg/m2 windload.

4.11.2.11 GLASS

Glass for window sashes shall be of the best quality of its respective kind and shall be free from internal or surface defects. It shall not be clouded, cracked or imperfect.

Glass shall be provided in locations as indicated and the corresponding type specified on architectural drawings. Each glass has the manufacturer’s label showing the type, thickness, and quality of glass. Labels shall not be removed until the glazing has been approved.

1. Clear glass shall be 6.35 mm thick for doors and 5.50 mm thick for windows. It shall be heat-strengthened for fixed window panes with a clear rubber sealant nearly and properly installed.

2. Reflective type glass shall be 6.35 mm thk for doors and windows and shall be heat strengthened tempered glass.

3. Wired glass or fire-rated glass shall be 6.30 mm thick.

4. Glazing materials and accessories such as weather-stripping, glazing sealant, gasket, channel, beads, clips, primer, masking tape, edge spacer and others shall comply with all pertinent codes and regulations and shall be as recommended by the glass manufacturer as approved by the Engineer.

5. Hardware - All items of finish hardware shall be furnished, packaged and labeled in sets. All items of finish hardware of like kind and purpose shall be the same manufacturer and shall be made of 630 Stainless steel.

4.11.2.12 WEATHERSTRIPING

Weather strips shall be continuous wool pile, silicon treated weather stripping or any type of weatherstripping recommended by the approved door manufacturer to be fitted of stile rails and bottoms of doors.

Extruded aluminum snap-in glazing beads with vinyl inert glazing gaskets shall be provided on the exterior side of doors and windows.

4.11.2.13 MIRRORS

Mirrors shall be plate glass, not less than 6.35mm thickness, mirror glazing quality or better, free from imperfection with silvering, electro-copper plated back coating and shall be of the best commercial quality. Edges shall be ground smooth and polish. 6mm marine plywood backing shall be provided. Size shall be as shown on the drawings.

4.11.3 **EXECUTION**

4.11.3.1 WOOD DOORS

1. Wood panel doors shall be of the designs, sizes and thickness as shown on the drawings. Frames shall be set plumbed and true and braced to prevent distortion.

   Frames in concrete and masonry walls shall be secured by anchor bolts or as shown on the drawings or as directed by the Engineer.

2. Wood panel doors shall be of the types, sizes and thicknesses as shown on the drawings. Top and bottom edges of all interior and exterior doors shall be given a coat of lead and oil priming paint or a coat of water-resistant spar varnish after cutting, fitting and prior to installation in the work. Doors shall be glazed as indicated. Doors shall be primed before glazing.

3. Flush wood doors shall be fabricated such that the entire core and frame assembly shall be bonded to the face veneers with approved type of water resistant adhesives, and cured under controlled heat and pressure. Facing shall be waterproofed plywood or ordinary plywood as shown on the drawings. Items of finishing hardware specified in other sections of the specifications shall be fitted carefully and attached securely. Care shall be exercised so as not to mar or injure the work.

4. Hinged doors shall be plumbed and fitted accurately allowing 1.5 mm clearance at the jambs and heads and 3.0 mm over thresholds. Clearance at the bottom of the door having no thresholds shall be 9.5 mm. Lock stiles of door 44.5 mm thick and thicker shall be beveled 3 mm. Knob locks and latches shall be installed 1.75 mm from the finished floor to the center of the locks.

4.11.3.2 STEEL DOOR

The installation of steel door and frames shall be performed by the Contractor under the supervision of the manufacturer. Frames shall be prepared to receive standard hardware, provided with anchors for building into masonry, and shall extend 63 mm (2-1/2") below finished floor lines.

All steel doors shall be checked for warps and when installed shall be hung plumb and true and when closed shall contact the joint over its entire length.

4.11.3.3 GLASS JALOUSIE TYPE WINDOWS

Jalousie frames shall be temporarily fixed at bottom and top ends using wood screws or concrete nails.

Glass slats shall be placed into the slat chips starting below until the whole units are entirely glazed.

Units shall be operated and adjustments made when required taking into consideration that all units shall be properly aligned and satisfactorily operational.

The slats chips shall be closed so that the glass slats are securely fixed then the units shall be permanently fixed with wood screws or approved fastening device.

4.11.3.4 ALUMINUM DOORS AND WINDOWS

1. Fabrication

   All frames shall be factory prefabricated in accordance to the designs and dimensions indicated in the Drawings. Minimum metal wall thickness shall be 3mm except glazing beads, moldings, and trim which shall not be less than 1.5mm. Frames that are to receive fixed glass shall have removable glass stops and glazing beads.

   Cut, join and fit rails and stiles to hairline joints securely reinforced and joined by means of concealed fastening wherever possible.

   Protective Coating: Clean all surfaces and apply a protective coating of clear, water-white methacrylate-type lacquer, resistant to alkaline mortar and plaster immediately after fabrication. Covering shall not chip, peel or flake due to temperature or weather, and shall protect against discoloration and surface damage from transportation, storage, and construction activities. Covering shall be readily removable without affecting the finish. Covering shall either be adhesive paper, waterproof tape, or strippable plastic and may not be removed even after completion of installation.

2. Installation

   Set and anchor frames as shown in details and in approved shop drawings.

   Set frames plumb and square and brace where necessary to prevent distortion. Set frames without springing, forcing or distorting the product.

   Secure frames in accordance with the manufacturer's instructions.

   Wedge clear of masonry all frames set in prepared openings 4.76 mm (3/16”) to 6.35 mm (1/4”) to allow for caulking. Aluminum louvers can be installed flush-mounted to fit masonry or as free standing barriers or screens.

   Protection of aluminum from dissimilar materials:

   Aluminum to dissimilar metals: where aluminum surfaces come in contact with metals other than stainless steel, zinc or white bronze of small area, keep aluminum surfaces from direct contact with incompatible metals by the following methods:

   - Painting the dissimilar metal with one coat of heavy-bodied bituminous paint.

- Applying good quality caulking materials between the aluminum and the dissimilar metal.

Drainage from dissimilar metals: Paint dissimilar metals used in location where drainage from them passes over aluminum as specified above, to prevent staining of aluminum.

Aluminum to masonry and concrete: Give aluminum surfaces in contact with mortar, concrete, or other masonry materials one coat of heavy-bodied bituminous paint.

Adjust all frames and attach hardware before glazing. Secure all windows and doors to be watertight and all hardware operating free and easy.

Upon completion and installation, thoroughly clean surfaces of doors and frames in accordance with the recommended procedure of the manufacturer. Do not use abrasive, caustic or acid cleaning agents.

4.11.3.5 SPECIAL INSTALLATION PROCEDURE FOR GLASS JALOUSIE WINDOWS

Jalousie metal frames shall be temporarily fixed at bottom and top end using wood screw.

Place glass slats into the slat clips starting below until the whole units are entirely glazed.

Operate units and make adjustment where required taking into consideration that all units are properly aligned and satisfactorily operational.

Close the slats clips in a manner that the glass slats are securely fixed with wood screws.

4.11.3.6 PVC DOORS

1. Fabrication

Fabricate frames and panels with mitered and fusion welded corners and joints. Trim and finish corners and welds to match adjacent surfaces.

Provide concealed metal reinforcement in sash frame for attaching lock mechanism.

2. Examination

   a. Examine openings in which doors will be installed.

   b. Verify that fasteners in framed walls are fully driven and will not interfere with door installation.

   c. Verify that sill is flat and level.

3. Installation

   Install doors in framed walls in accordance with manufacturer's installation instructions.

4. Adjusting

   Adjust operating panels and hardware for smooth operation and tight fit with weatherstripping.

5. Cleaning

   Clean soiled surfaces using a mild detergent and warm water solution with soft, clean cloths.

4.11.3.7 TOILET DOORS AND PARTITIONS

1. Install toilet partitions on the locations and heights indicated on the drawings and according to manufacturer's recommended instructions.

2. Hardware shall be checked and adjusted for smooth operation after installation.

4.11.3.8 ADJUSTMENTS

1. Adjust all frames and attach hardware before glazing.

2. Secure all windows and doors to be watertight and all hardware operating free and easy.

4.11.3.9 CLEANING

Upon completion and installation, thoroughly clean surfaces of doors and frames in accordance with the recommended procedure of the manufacturer. Do not use abrasive, caustic or acid cleaning agents.

4.11.4 MEASUREMENT AND PAYMENT

The quantity of doors and windows to be paid for shall be measured and paid for by the number of sets of various kinds, types and size of doors and windows, properly installed, complete with all the necessary hardware, jambs, and other incidentals as shown on the drawings ready to function and as indicated in the Bills of Quantities and accepted and certified for payment by the Engineer.

No separate payment for glass and glazing shall be made. The cost shall be deemed as part of and incidental to the supply and installation of each corresponding set of doors or windows.

4.12 FINISH HARDWARE

4.12.1 GENERAL

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

4.12.1.1 SCOPE OF WORK

The work covered shall include all labor, materials, tools, equipment and incidentals necessary to furnish and install all finish hardware as shown on the drawings and as specified herein.

4.12.1.2 SUBMITTAL

A complete hardware schedule and shop drawings, together with manufacturer's catalogs, shall be submitted by the Contractor to the Engineer for approval.

The hardware schedule shall indicate the manufacturer's catalog number, function, material, finish and other information required. Samples shall be submitted upon request of the Engineer.

The hardware's furnished shall conform to the approved hardware schedule, shop drawings or samples.

4.12.2 MATERIAL REQUIREMENTS

1. All items of finish hardware of like kind and purpose shall be of the same approved manufacturer.

   The Contractor shall measure and verify all dimensions and conditions before proceeding with the work in connection with finish hardware. Hardware applied on metal shall be made to standard templates. The

Contractor shall furnish and install all finish hardware to complete the work as indicated on the drawings. Finish hardware shall be suited and adopted to its required use and shall fit its respective location. Finish hardware not specified shall be as directed by the Engineer.

2. Items of hardware shall be delivered to the job site in their original individual containers, complete with the necessary appurtenances including screws, keys and instructions. Each individual container shall be marked with the manufacturer's name and catalog number as they appear in the hardware schedule.

3. Unless otherwise shown on the drawings or specified, butt hinges shall be brass for interior and for exterior doors, with oil-impregnated bearings, non-rising loose steel pins with button tips and mounting screws of the same material. Butt hinges shall have five knuckles and shall be of the type specified under hardware schedule.

4. Locksets shall have cylindrical type case 50 mm (2") to 63 mm (2-1/2") diameter, with separate latch bolt cast, 19 mm (3/4") to 25 mm (1") diameter, with chromium plated dull finish. Cylindrical case locks and latches shall be applied to doors by inserting cylindrical type case into a hole bored through the face of the door stile, and separable latch bolt case into a hole bored in the edge of the stile. Cylindrical cases shall be secured in doors by means of flanges attached to the case; and the latch bolt case shall be secured by attachment to the edge of the door and to cylindrical case of operating mechanism. Brands shall be "YALE" or "SCHLAGE" or approved equal.

   Cylindrical rim type deadlock and latches shall be with cast iron case and strike. Operation shall be by key from outside and turn knob from inside. Special locksets shall be furnished for installation of locks as required.

5. Tubular cylinder type deadlock and latches shall be with cast bronze bolts, cast bronze cylinder and bronze cases. Deadlocks shall be operated by key from either side. Night latches shall be operated by key from outside and turn knob from inside, with mechanisms to hold latch retracted when desired. Special cases welded to stile shall be furnished for installation of locks and latches, as required.

6. Hinge hasps for lockers shall be zinc-coated wrought steel with pin. Unless otherwise shown or specified, width shall be 48 mm (1-7/8") and length shall be 100 mm (4 inches).

   Fasteners of proper type, quality, size, quantity and finish shall be supplied with the hardware. All fasteners exposed to the weather shall be non-ferrous metal and shall match the trim finish as closely as possible.

Spring hinges shall be 75 mm x 75 mm (3" x 3") plated wrought steel with steel pins and fully enclosed coil springs with adjustable tension. Cylinders shall be integral with one leaf.

7. Padlocks shall be of pin tumbler type with solid or laminated brass case, and steel hardened shackles.

8. Butt Hinges

   a. Each panel of hinged doors shall be provided with two (2) butts for doors 1.5 m or less in height; three (3) butts, over 1.5 m high and not over 2.10 m; four (4) butts, above 2.10 m in height.

   b. Doors of a greater height than 2.10 m, unless otherwise specified, shall be provided with an additional one (1) butt for each 0.65 m or fraction thereof.

   c. Size of Butt Hinges required:

Thickness of Door	Width of Door	Size of Butt Hinges
21 mm or 25 mm (7/8" or 1")		63 mm (2-1/2")
28 mm (1-1/8")		75 mm x 75 mm (3" x 3")
35 mm (1-3/8")	0.90 m (3") or less	89 mm x 89 mm (3-1/2" x 3-1/2")
44 mm (1-3/4")		100 mm x 100 mm (4" x 4")
56 mm (2-1/4") and greater		125 mm x 125 m (5" x 5")

   d. Where the size of the butt hinges is not sufficient to allow door to clear door trim in open position, same shall be increased.

4.12.3 EXECUTION

1. All hardware, shall be installed in a neatly, workman-like manner following the manufacturer's instructions and as shown on the drawings. Fasteners supplied with the hardware shall be used to secure the hardware in place. Wood screws shall be used for securing hardware to wood surfaces. Machine screws, set in expansion shields, shall be used for securing hardware to masonry or concrete surfaces.

2. The bolts shall be used where specified or where necessary for satisfactory installation. After installation hardware shall be protected by the Contractor from paint, stains, blemishes and damages until issuance of Taking-Over Certificate of the work. All hardware shall be properly adjusted and checked-out in the presence of the Engineer to see that the hinges, locks, latches and bolts operate properly. After the hardware is checked, keys shall be tagged, identified and delivered. Any error in cutting and fittings, or any damages to adjoining work shall be replaced, as directed by the Engineer.

4.12.4 MEASUREMENT AND PAYMENT

No separate payment shall be made for finish hardware as such shall be deemed part of the particular set of doors, windows and other fixtures.

4.13 FINISHES

4.13.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

4.13.1.1 SCOPE OF WORK

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

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

1. Plain cement plaster (steel trowel) finish painted with acrylic latex paint for exterior and interior CHB (Concrete Hollow Blocks) wall;

2. Glazed tile wainscoting for toilet;

3. Vinyl tile finish;

4. Vitrified ceramic tiles for toilet floor;

5. Pebble wash-out finish;

6. Non-skid Ceramic Tiles

7. Plain cement steel trowel floor finish with non-metallic floor hardener;

8. Rubbed concrete finish, painted with acrylic latex paint for exposed R.C. Ceiling (bottom of roof slab and beams)

9. Fiber Cement Board for Ceiling

4.13.1.2 SUBMITTAL

1. Shop drawings for all finishing and painting works for the building shall be submitted in advance to allow twenty eight days for review and approval. Shop drawings shall indicate materials and details of finishing works. The Contractor shall be responsible for all errors of detailing and fabrication, and for the correct finishing work items shown on the shop drawings.

2. The Contractor, before placing order for the finishing materials shall submit to the Engineer for approval representative samples of finishing materials. No placing of orders for material for finishing works shall be made without his approval.

3. Samples of all walls finishes, measuring not less than 1000 mm x 1000 mm shall be submitted to the Engineer for approval as to its finish texture and workmanship.

4.13.2 **MATERIAL REQUIREMENTS**

4.13.2.1 WALL FINISHES AND COUNTERTOPS

1. Plain Cement Plaster Finish

   a. Sand shall be clean and hard material. Sand shall be free from deleterious substances and conforming with the requirements of ASTM C 33.

   b. Cement shall be Portland cement conforming with the requirements of ASTM Designation C 150.

   c. Water shall be clean and potable.

   d. Bonding compound shall conform to ASTM C 631.

   e. Hydrate lime shall conform to ASTM C 206.

   f. Synthetic fibrous reinforcement shall conform to BS 5139 or ASTM C 1116.

2. Wall Ceramic Tiles

   a. Wall tiles shall be 100 mm x 100 mm glazed ceramic wainscoting Color as per Engineer's approval.

   b. Trimmers and moulding shall be lustrous, glazed with size and color corresponding to wall tiles.

   c. Portland cement, sand, bonding compound, lime and water shall conform with Sub-section 4.13.2.1.1 above.

3. Marble

   a. Marble shall be local natural mined and polished for toilet countertops, fascia and splashboard. Dimensions as shown on the Drawings.

   b. Shall be sound material with uniform and favorable working qualities and with very limited natural faults.

   c. Color, veining and quality shall be approved by Engineer.

   d. Veining shall run vertically on all vertical surfaces and direction of veining shall continue in same directions over horizontal surfaces except as directed by the Engineer.

   e. Marble components shall be factory fabricated and finished and delivered ready for installation without further preparation or modification.

   f. Sealer

      1) Shall be a commercial penetrating type free from harmful alkali or acid content and especially prepared for marble work.

      2) Shall have a Ph factor between 7 and 9.

      3) Shall not discolor.

      4) Shall produce a slip resistant surface.

      5) Shall have a flash point not less than 35 degree C.

   g. Cleaning fluid

      1) Shall be commercial neutral liquid type especially prepared for marble work.

      2) Shall have a Ph factor between 7 and 9.

      3) Shall be free from crystallizing salts or water soluble alkaline salts.

      4) Shall be biodegradable and phosphate free.

4.13.2.2 FLOOR FINISHES

1. Vinyl Tile Finish

    a. Vinyl tiles shall be 3 mm thick x 300 mm x 300mm. Samples of the tile for color selection shall be submitted and approved by the Engineer.

    b. Waterproof contact adhesive shall be as recommended by the tile manufacturer and approved by the Engineer.

2. Vitrified Ceramic Unglazed Tiles

    a. Vitrified ceramic unglazed floor tiles shall be 100 mm x 100 mm, white for toilets and as shown on the drawings or to be designated by the Engineer.

    b. Portland cement, sand and water shall conform with the requirements specified in Sub-section 4.13.2.1.1 above.

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

3. Plain Cement Floor Finish

    a. Portland cement, sand, bonding compound and water shall conform with the requirements specified in Sub-section 4.13.2.1.1 above.

    b. Mortar shall be one part of Portland cement to three parts sand.

    c. Hardener shall be non-metallic floor hardener, delivered in cartons, cans or bags to the construction site with the labels installed and seals unbroken.

4. Non-skid ceramic floor tiles

    Non-skid ceramic tiles shall be 100mm x 200mm white ceramic tiles to be used [for kitchen] as shown on the Drawings.

5. Pebble Washout Finish

    a. Pebble shall be no. 10, and in black color, sound pea gravel, clean, hard, wash river gravel, well selected and graded, rounded non-slip type and not flaky.

Portland cement shall be the best commercial standard conforming to ASTM C 150, type I. Black cement of U.S. brand shall be added to Portland cement base for desired effect.

4.13.2.3 CEILING FINISHES

1. Rubbed Concrete Finish

   Portland cement, sand, bonding compound and water shall conform with the requirements specified in Sub-section 4.13.2.1.1 above.

2. Gypsum Ceiling Board

   Gypsum board to be used for ceiling shall be 13 mm thick and 1.2 m wide and shall conform with ASTM C36. Joint treatment materials and fastening system shall be as recommended by the gypsum board manufacturer and as approved by the Engineer.

3. Fiber Cement Board

   Plain fiber cement board on metal frame shall be 6mm thick for interior ceiling and 9 mm thick of exterior ceiling.

4. Fiberglass Ceiling Board

   Fiberglass ceiling board shall be fashionetone, fissured design, and 600mm x 600mm x 19mm in dimension.

4.13.3 **EXECUTION**

4.13.3.1 WALL FINISHES

1. Plain Cement Plaster Steel Trowel Finish

   a. Preparation of Surfaces

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

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

      All surfaces shall be thoroughly wetted before plastering.

b. Trial Mix

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

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

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

c. Cement Plaster Finish Application

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

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

Final plaster finishes shall be rubber sponged.

d. Tolerance

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

e. Patching and Cleaning

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

2. Wall Tiles

a. Mortar Preparation

All mortar setting beds shall be mixed by volume in the proportion of 1 part Portland cement and 3 parts dry sand and not more than 1/10 part hydrated lime.

Mortar materials shall be measured in approved containers, which will insure that the specified proportions of materials will be controlled and accurately maintained during the progress of the work. Measuring materials with shovels, "shovel count", will not be permitted. Unless specified otherwise, mortar shall be mixed in proportions by volume, in an approved mortar box.

The quantity of water shall be controlled accurately and uniformly. The aggregates shall be introduced and mixed in such manner that the materials will be distributed uniformly throughout the mass. A sufficient amount of water shall be added gradually and the mass further mixed until a mortar of the elasticity necessary for purpose intended is obtained. Mortar boxes, pans and wall surfaces shall be kept clean and free from debris or dried mortar. The mortar shall be used before the initial set of the cement has occurred. Re-tempering of mortar in which cement has started to set will not be allowed.

b. Application of Wall Tile

Interior masonry shall be clean, thoroughly dry, sound and sufficiently rough to provide strong mechanical bond. Surfaces shall be evenly damped immediately prior to the application of the scratch coat.

Scratch coat shall be applied to masonry, as backing for wall tile, not less than 24 hours or more than 48 hours before starting the tile setting. The scratch coat shall not be less than 6 mm from the face of the masonry. The scratch coat shall be applied with sufficient pressure to ensure a proper bond with the base for the setting bed. While the mortar is still plastic, the scratch coat shall be cut with a trowel at all internal vertical angles for the depth of the coat with the full height of the tile bed and shall be cross-scratched, in 25 mm centers for the extent of the tile bed.

Immediately before the application of mortar setting bed, the scratch coat shall be moistened thoroughly but not saturated. Temporary screeds shall be applied to the scratch coat with mortar to provide a true and plumb surface, the proper distance back from the finished wall line. The setting bed shall be applied, rodded and

floated flush with the screeds over an area not greater than the area to be covered with the tile while the bed remains plastic. The thickness of the setting bed shall not exceed 15 mm and the mortar shall not be retempered. The setting bed shall be cut with a trowel at all internal corners as specified for the scratch coat.

Mounted tiles shall be soaked in clean water a minimum of one hour before they are set. Absorptive mounted tiles shall be damped by placing sheets on a wetted cloth in a shallow pan before setting. A skim coat of neat Portland cement mortar, mixed with water to the consistency of a pasty, thick cream, shall be applied 0.8 mm to 1.6 mm thick to the mortar setting bed, or to the back of each tile as laid. The tiles shall then be pressed firmly on the setting bed and tamped until flush and in the plane of the other tiles. The tiles shall be applied before the mortar bed has taken its initial set.

Intersections and returns shall be formed accurately. Where cutting of tiles is necessary it shall be done at the internal angles of the walls or wainscots. Cutting and drilling tiles shall be done neatly without marring the surfaces. The cut edges of tiles against trim, built-in fixtures, and similar surfaces shall be ground and jointed carefully. The tiles shall fit closely with plumbing fixtures and around electric outlets, pipes and fittings, so that the plates or escutcheons will properly overlap the tiles. Wainscots shall be within one half of the heights indicated without cutting of the tiles.

Bases, caps, bull-nose corners, and all other trimmers moulded or shaped features, and accessories shall be backed thoroughly with mortar and set firmly into place. All lines shall be kept straight and true, and all finished surfaces brought to true and even planes, straight and plumb, and internal corners squared and external corners rounded.

Horizontal joints shall be maintained level and vertical joints plumb and in alignment. The completed work shall be free of broken, cracked, damaged or otherwise faulty tiles.

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

Joint widths shall be uniform and spaced to accommodate the tile in the given spaces with a minimum of cutting. Tiles shall be wetted, if they have become dry, before applying grout. Joints 3

mm or less in width shall be grouted with a neat Portland cement grout of the consistency of thick cream. Other joints shall be pointed with mortar consisting of one part Portland cement and two parts pointing sand. The grout for walls and other vertical surfaces shall contain non-staining white Portland cement. Grout and pointing mortar shall be forced into joints by using trowel, brush or finger application.

Before the grout or mortar sets, the joints of cushion edge tiles shall be struck or tooled to the depth of cushion, filling all skips or gaps, and the joints of square edge tiles shall be filled completely flush with their surface. Dark cement shall not show through grouted white joints. Care shall be taken to avoid scratching glazed finishes. All mortar or grout shall be removed before it has set or hardened.

c. Cleaning and Curing

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

d. Protection

Tiled walls outside corners (external angles) shall be protected with board corner strips in areas used as passage ways by workmen. Extreme care should be taken not to disturb walled tiled until mortar has fully set.

4.13.3.2 FLOOR FINISHES

1. Vinyl Tiles

No vinyl tile work shall start until the Engineer has approved the time when such work shall start.

The Contractor shall furnish and install all vinyl tiles and base where and as shown on the drawings or as specified. The temperature shall be maintained at 22°C for 48 hours before, during and 48 hours after the application of tiles.

Vinyl tile shall be laid in accordance with the approved manufacturers recommended method of laying.

Waterproof contact adhesive shall be applied both on the floor and tile, spread evenly and allowing 10 minutes drying time prior to installation.

Tiles shall be laid with close, straight joints, bedded in contact adhesive in accordance with method approved and rolled with roller of sufficient weight to press tile firmly in place and provide smooth, plush surfaces at the joints. Tiles shall be fitted close to all pipes, base and other intersection surfaces.

All finished floors shall be protected in a manner that will prevent the finish from any damage. The Contractor shall remove and replace any defective materials and/or workmanship or damage of the finished floors.

2. Vitrified Ceramic Tiles

   a. Mortar Preparation

      Mortar mix proportion and preparation shall be in accordance with the requirements in paragraph b of sub-section 4.13.3.1.

   b. Surface Preparation

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

   c. Placing of Setting Beds and Floor Tile

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

      A skim coat of neat Portland cement mortar shall then be applied not more than 4 mm thick. The mortar shall be spread until its surface is true and even and thoroughly compacted, either level or sloped uniformly for drainage, as the case requires. A setting bed,

as large as can be covered with tile before the mortar has reached its initial set, shall be placed on one operation; but in the event that more setting mortar has been placed than can be covered, the unfinished portion shall be removed and cut back to a clean beveled edge.

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

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

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

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

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

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

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

d. Cleaning and Curing

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

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

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

3. Plain Cement Floor Finish with Non-metallic Floor Hardener

a. Trial Mix

No plain cement floor finish work shall be started without the approval of the Engineer of the trial mix.

b. Application

The concrete sub-floor shall be cleaned and projection, dust, loose particles and other materials which would prevent good bond shall be removed. The sub-floor surface shall be moistened but not soaked, dry cement shall then be sprinkled over it and the mortar shall be spreaded on the setting bed. The surface shall be tamped to assure a good bond over the entire area and screeded to provide a smooth and level bed at proper height.

Mortar mix shall be one part Portland cement to three parts sand. Following the placing of leveling concrete on the floor and after the concrete is free from excess water, a dry mixture of 2 parts of floor hardener and 1 part Portland cement shall be uniformly dusted over the floor. Three kilograms of floor hardener shall be used for every square meter of flooring or in accordance with approved manufacturer's specifications. The dry mixture shall be floated thoroughly into the surface which shall be finished by steel trowelling and cured by water or curing compound for seven (7) days.

4. Pebble washout Finish

a. Trial Mix

No exposed aggregate or pebble wash-out finish shall be started without the approval of the Engineer of the trial mix.

b. Preparation of Surface

All surface shall be cleansed and projections, dust, loose particles and other material which would prevent the good bond shall be removed.

c. Placing

The well graded “pea” gravel shall be trowelled or floated into the cement-mortar finish (1:2 mix), pressed into it to an even surface after the mortar has been placed even but before the initial set.

All exposed gravel, covering about 90-95% of the mortar surface shall not be fully embedded into the cement mortar bedding.

At the proper time, “pea” graven finish of mortar splatter shall be cleaned and exposed with brush and water leaving it clean in its natural color and texture.

5. Protection

   a. Before turn over of the building to the Owner, wash pebble surfaces with 1 part muriatic acid to 6 parts clean water.

   b. Apply an overlapping strokes of watershield using brush or by low pressure spraying. Dries to a tack-free surface in 4-6 hours and cures to form an effective water repellant film in approximately 24 hours.

   c. Protect finished surface with specified hardeners and sealants.

4.13.3.3 CEILING FINISH

1. Rubbed Concrete Finish

   After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of three hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used in the pointing of holes, honeycomb spots, broken corners or edges and other defects to thoroughly set. Surfaces to be finished shall be rubbed with a minimum coarse carborundum stone using a small amount of mortar on each face. The mortar shall be composed of cement and fine sand mixed in the proportions used in the concrete being finished. Rubbing shall be continued until all form marks, projections and irregularities have been removed, all voids have been filled, and a uniform surface has been obtained. The face produced by this rubbing shall be left in place at this time.

   After all concrete above the surface being created has been cast, the final finish shall be obtained by rubbing with a fine carborundum stone and water. This rubbing shall be continued until the entire surface is of smooth texture and uniform color.

   After the final rubbing is completed and the surface has dried, it should be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks.

2. Gypsum Ceiling Board

   The board shall be installed in accordance with ASTM C 840 and the requirements specified on the Specifications and Drawings. Neatly fit abutting end and edge joints. Use gypsum board of maximum practical length. Cut out gypsum board as required to make neat close joints around openings. Apply gypsum board in accordance with ASTM C840.

3. Fiber Cement Board

   a. Install fiber cement board in accordance with approved layouts on metal grid supports not more than 50 cm apart. When structural supporting members are set at such spacing that the above requirements cannot be complied with, adequate intermediate supports shall also be provided.

   b. Each board shall be tightly and rigidly secured in place and free from unnecessary movement.

   c. Each board shall be set square, straight, plumb and/or level, accurately positioned at locations and to layouts required, with adjacent like units or members accurately aligned.

   d. Board joints shall be tightly abutting and flush across adjacent units.

   e. The installation shall be free from exposed fastenings, unnecessary cuts or holes, other than as particularly shown, specified or approved.

   f. Exposed surfaces shall be completely clean and free from dust, dirt, smudges, fingerprints, scratches, dents, warping, waviness, buckling, broken parts or units, chips, cracks, misaligned or improperly fitted joints, stains, discoloration or other defects or damage.

4. Fiberglass Ceiling Board

   Edges of ceiling board shall be in close contact with the metal supports and in true alignment. Arrange units so that units less than 1/2 width are minimized.

4.13.4 MEASUREMENT AND PAYMENT

The quantity of finishing work to be paid for shall be measured by the number of square meters of various types of finishes installed, applied, completed and accepted by the Engineer.

Payment of above item of work shall constitute full compensation for completed work and certified for payment by the Engineer.

4.14 PAINTING

4.14.1 GENERAL

Division 1, "General Requirements," contain provisions and requirements essential to these Specifications; and apply to this section, whether or not referred to herein.

4.14.1.1 SCOPE OF WORK

This Section covers the surface preparation, coating materials and application of coatings systems required for the Works.

The work shall consist of furnishing of all labor, materials, equipment and other incidentals necessary for the supply of painting materials and the complete painting of surfaces as shown on the drawings in accordance with this Specification and as directed by the Engineer.

The term paint as hereinafter used includes emulsion paints, varnishes, oils, pigments, thinner and dryers.

All exposed metal surfaces, except metal surfaces embedded in concrete, shall be painted unless otherwise specified.

4.14.1.2 STANDARD

The following publications listed below, but referred to thereafter by basic designation only, forms a part of these Specifications to the extent indicated by the reference thereto:

Steel Structures Painting Council (SSPC) U.S. Specification
JIS K 5628 Red-lead Zinc Chromate Anti-Corrosive Paint.

4.14.1.3 SUBMITTAL

1. The Contractor shall submit work method statements with lists of materials to the Engineer for approval twenty eight days before the starting of works. This statement shall include following items:

    a. Type of paint and manufacturer
    b. Manufacturer's specifications
    c. Storage and delivery of materials
    d. Surface preparation
    e. Finish painting and drying
    f. Touch-up painting, if any
    g. Equipment

2. The Contractor, before placing order for the painting materials, shall submit to the Engineer for approval samples of materials. No placing of orders for material shall be made without his approval.

4.14.1.4 STORAGE AND DELIVERY

1. The Contractor shall deliver all material to the site in the original labeled sealed cans and containers, with labels intact and seal unbroken.

   a. Seals shall remain unbroken until after inspection and acceptance of material by the Engineer.

   b. The Contractor shall deliver materials in ample quantities sufficiently in advance of the need to avoid any delay or interruptions in the works.

2. Paint in thinner shall be stored in accordance with the approved manufacturer's instructions.

   a. All regulations required for storage of paint shall be observed and all necessary safety signs required by governing codes shall be posted.

   b. Any damage caused by failure to exercise proper precautions in paint storage shall be repaired.

4.14.2 **MATERIAL REQUIREMENTS**

4.14.2.1 PAINT

Paints for the protective coating system shall be the product of a manufacturer approved by the Engineer.

4.14.2.2 SCHEDULE OF PAINTING

Paint manufacturers shall be BOYSEN, DAVIES or approved equal.

	M A N U F A C T U R E Boysen : Davies
<u>Architectural Items</u>	<u>Number : Number</u>
a) <u>Exterior Finishes</u>	
1. <u>On Concrete Walls</u>	
Two Coats, Concrete 1350/MEGACRYL Masonry Paint	BT01/B715 B710 or EL-0020/EL-2000

2. Unprimed Ferrous Metal including GI Roofing

First Coat:		
Rush inhibitive ferrous metal primer	B320	940
Second Coat:		
Exterior Enamel	B2501	DV-50-00

3. On Concrete Block Wall

First Coat:		
Concrete block primer sealer	B701	1350/EL-0020
Second Coat:		
Concrete Masonry Paint	B701	MEGACRYL-ACRYLIC LATEX-PAINT/EL-2000
Third Coat:		
Concrete Masonry Paint	B701	MEGACRYL-ACRYLIC LATEX-PAINT/EL-2000

4. On Wood

First Coat:		
Exterior Wood Primer	B800	300
Second Coat:		
Exterior Enamel	B600	400
Third Coat:		
Exterior Enamel	B600	400

b) Interior Finishes

Location of the various finishes are listed in the Finish Schedule on the Drawings or else will be confirmed by PPA.

1) On primer & coated metal two coats of interior semi-gloss enamel or as indicated in the schedule finish — B200 — 600

2) On Plaster

First Coat:		
Pigmented sealer		
Second Coat:		
Enamel undercoater	B701	MEGACRYL-ACRYLIC LATEX-PAINT/EL-2000
Third Coat:		
Interior flat enamel	B701	22

3) <u>On Wood</u>

First Coat:		
Enamel undercoater	B800	1360
Second Coat:		or
Enamel undercoater	B800	300/BIO-FRESH.001
Third Coat:		
Interior flat enamel	B800	300/BIO-FRESH.001

4) <u>Wood Stain Finish</u>

Oil Stain with Filler	B2700	25 (paste filler)
Boiled on top coat		20-91 (top coat)

5) <u>Wood Lacquer Finish</u>

Wood Paste Filler w/ natural	B60/B1258	77/701/702
Oil top coat of lacquer	B60/B1253	77/79/703

c) <u>Non-Architectural items</u>
(Piping, Valves, Equipment, etc.)

1) Piping, valves, equipment etc. in rooms are to be painted

2) Galvanized pipes & ducts

Primer - one coat	B320	940
Finish - one coat	B2501/B600	DV-50-00/400

3) Black Steel Pipes

Primer - one coat	B320	940
Finish - one coat	B2501/B600	DV-50-00/400

4) Mechanical Items

a) Ungalvanized Ferrous Metal

Primer - one coat	B320	940
Finish - one coat	B2501/B600	DV-50-00/400

b) Galvanized Ferrous metal

Primer - one coat	B320	940
Finish - one coat	B2501/B600	DV-50-00/400

c) Submerged Galvanized Ferrous Metal

Primer - one coat	B2200	92-00

d) Burried Miscellaneous Ferrous surface, valves, & flanged joints (excl. pipe)

Primer - one coat	B2199	Coal-tar enamel or match adjacent pipe coating (if any)

4.14.3 **EXECUTION**

4.14.3.1 SURFACE PREPARATION OF STEEL

1. Steel surfaces shall be cleaned as follows:

    a. All round welds, burrs and sharp surface projections shall be ground smooth and all weld splatter shall be removed prior to blast cleaning.

    b. Sand abrasives, if used, shall be clean, and free from salt and extraneous matter. The sand shall pass through a 2.0 mm test sieve, and be substantially retained on a 0.18 mm test sieve, with at least 25 percent retained on a 0.355 mm test sieve.

    c. Metallic abrasive, if used, shall be sharp, hard and free from dust, and shall pass through a 1.8 mm test sieve.

    d. Blast cleaning operations shall not be conducted on surfaces that will be wet after blasting and before coating, or when the surfaces are less than 10°C above degree points, or when the relative humidity of the air is greater than 95 percent.

    e. Any oil, grease, soil, dust or other foreign matter deposited on the cleaned surfaces shall be removed prior to painting. In the event that rusting occurs after completion of the surface preparation, the surfaces shall be cleaned again in accordance with the specified method.

    f. Particular care shall be taken to prevent the contamination of other corrosive chemicals before the application of the paint. Such contamination shall be removed from the cleaned surface by flash blasting and the paint applied immediately.

    g. Care shall be taken to prevent contamination of cleaned and painted surfaces by cleaning operations in an adjacent area.

    h. Surfaces not to be painted shall be suitably protected from the effects of cleaning and painting operations.

4.14.3.2 SURFACE PREPARATION OF WOOD

1. Wood surfaces shall be sanded to a fresh surface. Surface mould where present, shall be removed by washing, rubbing down and burning off as necessary. Resinous exudation and large knots shall be removed and replaced with filler or other materials approved by the Engineer.

2. Parts of timber to be enclosed in walls shall always be primed unless already impregnated. Priming shall be brushed on and a minimum of two coats applied to end grain. When the priming paint is hard, all cracks, holds, open joints, etc. shall be made good with hard stopping and rubbed down with fine abrasive paper. Priming of joinery shall be applied only on site after the Engineer has approved such joinery and before it is fixed. For internal surfaces primer coats shall be carefully flatted.

4.14.3.3 SURFACE PREPARATION OF CONCRETE AND PLASTER

Concrete and cement plaster surfaces to be painted shall be prepared by removing efflorescence, dust, dirt, grease, oil, asphalt, tar, excessive mortar and mortar dropping and by roughening to remove glaze. A zinc sulfate solution shall be applied before prime cost.

4.14.3.4 SURFACE PREPARATION FOR FIBER CEMENT SURFACES

Shall be dry and clean prior to application of the specified first-coat material. Oil, grease, or rust stains shall be carefully removed by the use of suitable solvent. Wire brushing will not be permitted. After the first coat has become dry and prior to application of finish coats, touch-up coats shall be applied to suction spots.

4.14.3.5 ADDITIONAL REQUIREMENTS FOR PREPARATION OF SURFACES WITH EXISTING COATINGS

Before application of coatings, perform the following on surfaces covered by soundly-adhered coatings, defined as those which cannot be removed with a putty knife:

1. Wipe previously painted surfaces to receive solvent-based coatings, except stucco and similarly rough surfaces clean with a clean, dry cloth saturated with mineral spirits, ASTM D 235. Allow surface to dry. Wiping shall immediately precede the application of the first coat of any coating, unless specified otherwise.

2. Sand existing glossy surfaces to be painted to reduce gloss. Brush, and wipe clean with a damp cloth to remove dust.

3. The requirements specified are minima. Comply also with the application instructions of the paint manufacturer.

4. Previously painted surfaces, specified to be repainted or damaged during construction shall be thoroughly cleaned of all grease, dirt, dust or other foreign matter.

5. Blistering, cracking, flaking and peeling or other deteriorated coatings shall be removed.

6. Chalk shall be removed so that when tested in accordance with ASTM D 4214, the chalk resistance rating is no less than 8.

7. Slick surfaces shall be roughened. Damaged areas such as, but not limited to, nail holes, cracks, chips, and spalls shall be repaired with suitable material to match adjacent undamaged areas.

8. Edges of chipped paint shall be feather edged and sanded smooth.

9. Rusty metal surfaces shall be cleaned as per SSPC requirements. Solvent, mechanical, or chemical cleaning methods shall be used to provide surfaces suitable for painting.

10. New proposed coatings shall be compatible with existing coatings.

4.14.3.6 EXISTING COATED SURFACES WITH MINOR DEFECTS

Sand, spackle, and treat minor defects to render them smooth. Minor defects are defined as scratches, nicks, cracks, gouges, spalls, alligatoring, chalking, and irregularities due to partial peeling of previous coatings. Remove chalking by sanding so that when tested in accordance with ASTM D 4214.

4.14.3.7 REMOVAL OF EXISTING COATINGS

Remove existing coatings from the following surfaces:

1. Surfaces containing large areas of minor defects;

2. Surfaces containing more than 20 percent peeling area; and

3. Surfaces designated by the Engineer, such as surfaces where rust shows through existing coatings.

4.14.3.8 SUBSTRATE REPAIR

1. Repair substrate surface damaged during coating removal;

2. Sand edges of adjacent soundly-adhered existing coatings so they are tapered as smooth as practical to areas involved with coating removal; and

3. Clean and prime the substrate as specified.

4.14.3.9 SURFACE PREPARATION FOR CONCRETE AND MASONRY - FOR OLD OR PREVIOUSLY PAINTED SURFACES

1. Scrape off loose, scaling and peeling old paints. Sand the whole surfaces including those where old paint still adheres very well.
2. For areas with extreme chalking problems, steel brush, blow air from a compressor or wipe with a clean rag pre-wetted with water. Let dry, then apply one (1) cost of concrete scaler. Dry for at least 4 hours before applying subsequent coats.
3. For areas affected by molds and mildew, wash the whole surface with water or with hypochlorite washing solution. Scrub using a stiff nylon brush, then rinse with water. Apply fungicidal washing compound. Leave overnight.
4. For areas with mapping problems, properly prepare the surface then apply concrete sealer. Dry for at least 4 hours.
5. Putty hairlines cracks.

4.14.3.10 STEEL/ALUMINUM DOORS AND WINDOWS

All metal surfaces shall undergo pre-treatment process which includes: desmutting, water-rinsing, degreasing/etching, water rinsing, zinc phosphating, water rinsing and acid rinsing.

Powder coating application, shall be factory applied and shall be done in one operation using an electro-static powder gun. The materials to be coated should be well connected to earth. Coating thickness should be kept to a minimum of 60 microns for exposed areas. On details which are to be treated mechanically after coating (drilling, sawing, etc.), the coating film must not exceed 100 microns.

The powder coating shall be oven cured in the range of 20 minutes at 220° Centigrade (metal temperature measured on the area with greatest metal thickness). The temperature variation in the oven should not exceed +/- 10° Centigrade.

Handling: Coated items should be cooled to no less than 40° Centigrade before handling. Precautions should be taken to avoid damages on the finished coating during stacking, storing and transportation.

Storage and Delivery: Inspect materials delivered to the site for damage. Unload and store with minimum handling. Provide storage space in dry location with adequate ventilation, free from dust or water and easily accessible for inspection and handling. Store materials neatly on the floor, properly stacked on non-absorptive strips or wood platforms. Protect finished surfaces during shipping and handling using manufacturer's standard method.

4.14.3.11 WOOD REPAIR

Badly decayed areas shall be removed and repaired. Areas and pieces decayed beyond repair shall be replaced with new pieces that match originals in all respects. Moderately decayed areas, weathered, or gouged wood shall be patched with approved patching compounds, and shall be sanded smooth. The source or cause of wood decay shall be identified and corrected prior to application of patching materials. Wet wood shall be completely dried to a moisture content not exceeding 12 percent, as measured by a moisture meter, to its full depth before patching, unless otherwise authorized. Wood that is to be patched shall be clean of dust, grease, and loose paint.

1. Epoxy Wood Repair

   Epoxy wood repair materials shall be applied in accordance with manufacturer's written instructions. Health and safety instructions shall be followed in accordance with the manufacturer's instructions. Clean mixing equipment shall be used to avoid contamination. Mix and proportions shall be as directed by the manufacturer. Batches shall be only large enough to complete the specific job intended. Patching materials shall be completely cured before painting or reinstallation of patched pieces.

2. Epoxy Consolidant and Epoxy Paste

   Epoxy liquid wood consolidant shall be used: 1) to penetrate and impregnate deteriorated wood sections in order to reinforce wood fibers that have become softened or absorbent. 2) as a primer for areas that are to receive epoxy paste filler. Epoxy paste shall be used to fill areas where portions of wood are missing such as holes, cracks, gaps, gouges, and other voids.

4.14.3.12 MIXING AND THINNING

Mixing and thinning of paint shall be done in accordance with the approved manufacturer's printed instructions. The pot life of each paint as stated by the manufacturer shall not be exceeded.

4.14.3.13 WEATHER CONDITION

The paint shall not be applied when the relative humidity is above 85 percent. The paint shall not be applied in rain, wind, fog, dust or mist.

4.14.3.14 APPLICATION

Workmanship shall be first class in every respect. All work shall be done in a workmanship manner so that the finished surfaces shall be free from

runs, chop, ridges, waves, laps and unnecessary brush marks. All coats shall be applied in such manner as to produce an even film of uniform thickness. Edges, corners, crevices, welds and rivets shall receive special attention to ensure that they receive an adequate thickness of paint.

All painting shall be done by thoroughly experienced workmen.

Safety regulations shall be adhered to at all times, including the wearing of respirators by persons engaged on assisting in spray painting. Adjacent areas and installation shall be protected by the use of cloths or other approved precautionary measures.
Plain enamel and varnish shall be applied carefully with good clean brushes or approved spraying equipment, except that the initial coat on any surface shall be applied with brush. Sufficient time shall be allowed between coats to assure thorough drying and each coat shall be in proper condition before receiving the next coat.

Sanding and dusting as required shall be performed between coats in varnishing work. Finish coat shall be smooth and free from runs, sags, and other defects. Exterior paint shall not be applied during rainy days.

All paint when applied shall provide a satisfactory film and smooth, even surface. Paint shall be thoroughly stirred and kept at a uniform consistency during application. Powdered metallic pigments added at the time of use shall be mixed by adding the powder in small increments to about one-third of the base paint or vehicle, with thorough mixing to obtain a smooth paste. The remainder of the base paint shall then be thoroughly stirred in.

Different brands of emulsion paints shall not be mixed prior to application of the materials.

Where necessary to suit conditions of surface temperature, weather and method of application, the package paint may be thinned immediately prior to application in accordance with the approved manufacturer's directions, but not in excess of 125 cc of suitable thinner per liter (one pint per gallon). Before using, the paint shall be mixed to a uniform consistency and shall be stirred frequently during application.

Paints other than water-thinned paints shall be applied only to surfaces which are completely free of moisture as determined by sight or touch and only such combinations of humidity to be painted as will cause evaporation rather than condensation.

Surfaces which have been cleaned, pretreated and/or otherwise been prepared for painting shall be primed or painted with one coat of finish paint as soon as practicable after such preparation has been completed, but in any event prior to any deterioration of the prepared surfaces.

The first coat of paint on all exterior surfaces shall be applied by brush. Interior prime coats and all other subsequent coats on either exterior or interior surfaces may be applied by brush or spray. Whenever spraying is permitted all areas inaccessible to spray painting shall be coated by brushing or other suitable means. Brushes to be used for application of water-emulsions shall be soaked in water for a period of 2 hours prior to use.

All cloths and cotton waste which might constitute a fire hazard shall be placed in closed metal containers or destroyed at the end of each day.

Upon completion of the work, all staging, scaffolding, and containers shall be removed from the site or destroyed in a manner approved by the Engineer. Paint spots, or stains upon adjacent surfaces shall be removed and the entire job left clean and acceptable to the Engineer.

No smoking shall be permitted in the vicinity where painting is going on.

4.14.3.15 TOUCH-UP PAINTING

Touch-up painting shall be done with the same paint as used for the original coat. The resulting minimum dry film shall be the same as for the original coat.

Touch-up painting shall include cleaning and painting of field connections, welds and all damaged or defective paint and rusted areas.

During touch-up painting, only loose, cracked, brittle or non-adherent paint shall be removed during cleaning. All exposed edges shall be feathered. Touch-up painting shall be performed in a manner which will minimize damage to sound paint. Rust spots shall be thoroughly cleaned and edges of the existing paint shall be scraped back to sound material.

4.14.3.16 DRYING

1. No primer or paint shall be forced to be dried under conditions which will cause cracking, wrinkling, blistering, formation of pores which would detrimentally affect the condition of the paint.
2. No drier shall be added to the paint unless specified in the approved manufacturer's instructions.
3. Painted surfaces shall be protected from dust, dirt, and the elements of the weather until dry to the fullest extent practicable.
4. After drying, any areas of paint damaged from any cause shall be removed, the surface again prepared and then touched-up with the same paint and to the same thickness as the undamaged areas as specified in sub-section 4.14.3.7 above.

4.14.3.17 HANDLING

1. Precautions shall be taken to minimize damage to paint films resulting from stacking for drying.

2. Paint which is damaged in handling shall be scraped off and touched-up with the same paint and in the same thickness as was previously applied to the damaged area at Contractor's expense.

4.14.3.1 INSPECTION

1. All works and materials supplied under this Specification shall be subject to inspection by the Engineer.

2. The Contractor shall correct such works or replace such materials found defective under these Specifications at his own expense.

4.14.4 MEASUREMENT AND PAYMENT

1. The quantity of painting work to be paid for shall be made by the area in square meters of painting works completed and accepted by the Engineer on each type of works, except marine works as indicated in the Bill of Quantities, which payment shall constitute full compensation for the completed work and certified for full payment by the Engineer.

2. Measurement for painting of materials of port facilities, Division 3 are included in the individual work items of structural steel, and fender systems. No separate measurement for painting will be made for port facilities.

4.15 PLUMBING AND SANITARY WORKS

4.15.1 SCOPE OF WORK

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

4.15.2 MATERIAL REQUIREMENTS

4.15.2.1 SUBMITTAL

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

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

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

2. The drawings shall indicate the general arrangement of all pipings, however, where actual conditions necessitate re-arrangement in opinion of the Contractor and/or the Engineer, the Contractor shall prepare and submit to the Engineer for approval, twenty eight (28) days before placing the order for materials, shop drawings of the proposed re-arrangement. Because of the small scale of the drawings, shop drawings to indicate all offsets, fittings and accessories shall be prepared. The Contractor shall carefully examine the drawings and shall carefully investigate actual structural and finish conditions affecting all his work.

3. The Contractor shall be responsible for the proper fitting of materials, equipment and accessories without substantial alteration and at no cost to the Employer.

4. The Contractor shall be responsible for the proper coordination of the work and shall provide all necessary clearance where necessary.

4.15.2.2 STANDARDS

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

4.15.2.3 MATERIALS

1. Identification of Materials

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

2. Alternative Materials

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

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

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

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

4. Jointing Material

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

5. Water Supply Pipes

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

6. Cleanouts, Plugs and Tee

   Cleanouts shall be of the same material as the pipe to be fitted. Cleanouts installed in connection with uPVC hubs and spigot pipes shall consist of a long sweep quarter bend of ¼ as shown on the drawings.

7. Pipe Sleeves

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

8. Downspout

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

9. Splash Block

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

10. Roof Strainers

    The Contractor shall provide fittings and install 100 mm 0 G.I. mesh wire strainers where shown or indicated on the drawings and/or where the Engineer directs. Each strainer shall fit the size of the corresponding downspout which is to be installed.

11. Shower, Floor and Urinal Drain

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

12. Pipe hangers, Inserts and Support

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

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

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

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

13. Unions

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

14. Valves

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

15. Fixtures

    a. Water Closets

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

    b. Lavatories

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

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

    c. Urinals

       1) Urinals for all comfort buildings shall be built-in urinal trough as shown on the drawings.

       2) Urinals: Shall be vitreous china, wall-hung washout urinal, flushing rim, integral trap, 19mm top and shall be provided with water saving flush system .

    d. Service Sinks

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

e. Slope Sinks

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

Hose bibb shall be of brass finish.

f. Soap Holder

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

g. Faucet for lavatory

Faucet for lavatory shall be in chrome-finish.

h. Bath and shower fitting

Bath and shower fitting shall be chrome-finish.

i. Towel Rail

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

j. Curtain rod

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

k. Grab Bar

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

16. Concrete, Reinforcing Steel, Pipe and Steel Plate

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

a. Concrete materials shall conform with the requirements of Section 3.2, “Concrete Works” and shall be Class C concrete with a 28-day minimum compressive strength of 21 MPa (3000 psi).

b. Reinforcing steel shall be as shown on the drawings and shall conform with the requirements of reinforcing steel bars in Section 3.2, “Concrete Works.”

c. Pipes shall be as shown on the drawings and shall comply with the relevant item of the particular pipe.

d. Steel plates shall be as shown on the Drawings and shall comply with Section 4.6, “Steel and Metal Works”.

17. Non-reinforced Concrete Pipe

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

18. Valve for Drinking Fountain

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

4.15.3 **EXECUTION**

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

4.15.3.1 EXCAVATION, TRENCHES AND BACKFILLING

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

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

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

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

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

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

4.15.3.2 INSTALLATION OF SOIL, WASTE DRAINS OR VENT PIPES

1. Horizontal Drainage Pipe and Vent Piping

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

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

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

2. Fittings

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

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

3. Joints

   a. PVC Soil Pipe

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

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

4. Cleanouts

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

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

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

5. Flashings

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

6. Traps

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

7. Pipe Sleeves, Hangers and Supports

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

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

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

4.15.3.3 INSTALLATION OF WATER PIPES, FITTINGS AND CONNECTIONS

1. Gate Valves and Outlets

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

2. Mains, Branches and Runouts

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

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

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

The use of long screws and bushings is prohibited.

3. Joints

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

After cutting and before threading all pipes shall be reamed and shall have burrs removed. All screwed joints shall be applied with an approved graphite compound or TEFLON tape to facilitate connections. Threads shall be full cut and not more than three threads on the pipe shall remain exposed.

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

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

4. Unions

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

5. Tests

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

a. Tests for Drainage and Venting System

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

b. Sterilization

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

c. Pressure Test for Water Lines

1) After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section, thereof, shall be subjected to hydrostatic pressure one and one half (1½) the designed working pressure of the system or as specified by the Engineer.

2) The duration of each pressure test shall be at least 20 minutes unless otherwise specified by the Engineer.

3) Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by means of a pump connected to the pipe in a manner satisfactory to the Engineer. During the filling of the pipe and before applying the test pressure, all air shall be expelled from the pipeline. To accomplish this, tap shall be made if necessary, at the highest point of the pipe under test and after completion of the test, the taps shall be tightly plugged unless otherwise specified. During the test, all exposed pipes, fittings, valves, joint and couplings will be carefully examined. If found to be cracked or defective, they shall be removed and replaced by the Contractor with sound materials at his expense. The test shall then be repeated until satisfactory results are obtained.

d. Leakage Test for Water Lines

1) Leakage test shall be conducted after satisfactory completion of the pressure test and shall consist of an examination of all exposed joints for leakage as well as an overall leakage test of the completed pipeline.

2) The pressure to be maintained during the test shall be the designed working pressure of the system.

3) Leakage test shall be made only after a minimum of 24 hours after the pipe to be tested has been filled with water.

4) The duration of each leakage test shall be two hours unless otherwise specified by the Engineer.

5) Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation shall be applied by means of a positive displacement type pump and reservoir connected to the pipe in a manner satisfactory to the Engineer.

6) Before starting the leakage test, all air shall be expelled from the pipe. All exposed pipes, fittings, valves and joints shall be examined for leakage during the test.

7) Allowable leakage rate per 100 joints per inch of Pipe Diameter at Pressure Stipulated.

PRESSURE		LEAKAGE RATE	
psi	**kg/cm^2**	**liters/hr**	**liters/2 hrs**
50	3.5	1.45	2.90
75	5.3	1.75	3.50
100	7.0	2.05	4.10
125	8.8	2.30	4.60
150	10.5	2.50	5.00
200	14.0	2.90	5.80

e. Defective Work

1) If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Engineer.

2) All repairs to piping shall be made with new materials at the expense of the Contractor.

3) No caulking of screwed joints or holes will be accepted.

4.15.3.4 ASSEMBLY, INSTALLATION AND CONNECTION OF FIXTURES

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

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

4.15.3.5 PROTECTION OF FIXTURES

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

4.15.3.6 FIXTURES AND FASTENING

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

1. Where secured to concrete or concrete hollow block walls, they shall be fastened with one quarter inch brass bolts with twenty threads to the inch and of sufficient length to extend at least 7.5 cm into solid concrete or hollow block work, fitted with loose tubing or sleeve insert and shall be securely anchored and installed flush with the finished wall and shall be completely concealed when the fixtures are installed.

2. Where through-bolts are used, they shall be provided with plates or washers back set so that heads, nuts and washers will be concealed by plaster. Bolts and nuts shall be hexagonal. Exposed bolts, nuts, capnuts and screw heads shall be provided with chromium plated brass washers.

4.15.3.7 GUARANTEE

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

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

4.15.3.8 AS-BUILT DRAWINGS

Upon completion of and before final acceptance of the work, the Contractor shall prepare, at his own expense, and submit to the Engineer as-built drawings showing conditions of the work actually performed.

Where as-built drawings are required for a submission to enforcing authorities, same shall be submitted first to the Engineer for verification and checking. One (1) set of the drawings duly approved by the proper enforcing authorities shall be submitted to the Engineer together with the reproducible originals.

4.15.3.9 CLEANING UP

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

4.15.3.10 PLUMBING, FIXTURES AND TOILET ACCESSORIES INSTALLATION

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

4.15.4 MEASUREMENT AND PAYMENT

The quantity of plumbing and sanitary works within the buildings and its premises to be paid for shall be measured as indicated in the Bill of Quantities as follows:

1. Water closets, urinals, lavatories and service sink by the number of fixtures installed, completed, tested and approved and certified for payment by the Engineer.

2. Complete plumbing system for water supply inside the building (PPR pipes, fittings and accessories) by the lump sum for each building installed, completed, tested, approved and certified for payment by the Engineer.

3. Complete sanitary sewer works inside the building including all sewer pipes, fittings, septic tank, earthwork, etc. by the lump sum for each building installed, completed, tested, approved and certified for payment by the Engineer.

4. Reinforced concrete pipes for building drainage systems by the number of linear meters installed, tested, approved and certified for payment by the Engineer.

5. No separate payment for concrete and reinforcing bars for urinal trough and catch basin as this is included under pay-item for concrete works.

4.16 SIGNAGES

4.16.1 GENERAL

4.16.1.1 SCOPE OF WORK

Furnish materials and perform labor to include miscellaneous works required for the installation of room identification for the toilets and port office (Multi-purpose Shed).

4.16.1.2 SAMPLE AND SHOP DRAWINGS

The Contractor shall submit samples for approval by the Engineer. For the room I.D. full size lettering layout and installation method shall be submitted to the Engineer for approval before start of work.

4.16.2 MATERIAL REQUIREMENTS

Room Markers: Black acrylic letters, 38 mm (1-1/2") high on white acrylic background, 63 mm (2-1/2") high, with clear acrylic cover. Lengths shall be as required by the full notation therein.

4.16.3 EXECUTION

4.16.3.1 WORKMANSHIP

Workmanship shall be executed in high quality comparable with artworks.

4.16.3.2 MOUNTING

For all mounted assemblies, appropriate mounting hardware and connectors which are concealed shall be sufficiently used.

Assemblies shall be mounted plumb, straight, level, and at prescribed heights.

4.16.3.3 INSTALLATION

Installation shall be done in a secure and permanent manner at prescribed heights and/or layout. The backwall shall not be mutilated. After the dowels are positioned, fill with expanding grout, or other approved fillers, and retouch, flashed to the backwall surface.

4.16.4 MEASUREMENT AND PAYMENT

Signages will not be measured and paid separately, as it is deemed included under pay-item on Doors where the signages shall be installed. Signages will be measured and paid by the number of quantities required

which shall include tools, labor, equipment, materials and all incidental to complete the works.

4.17 FACILITIES AND DEVICE FOR DISABLED PERSONS

4.17.1 GENERAL

4.17.1.1 SCOPE OF WORK

The work shall consists of furnishing materials, tools, labor and incidentals necessary for the construction/installation of facilities and device for disabled persons as shown on the Drawings and in accordance with the Implementing Rules and Regulations of Batas Pambansa Bilang 344 and this Specification.

4.17.2 MATERIAL REQUIREMENTS

4.17.2.1 GRAPHIC SIGNS

Graphic signs like the International Symbol of Access shall be fabricated from plastic materials, white color with either dark blue background. Letters and symbols shall be laminated and raised from the background.

4.17.2.2 HANDRAILS

Handrail for ramp shall be fabricated from galvanized iron pipe schedule 40, with a diameter of 38mm. It shall be provided with a small hole as of a Braille system.

4.17.2.3 GRABRAIL

Grabrail shall be manufactured from gauge 18 tubular stainless steel 25mm ∅ and provided with safety grip finish.

4.17.2.4 CONCRETE MATERIALS FOR RAMPS

1. Portland cement shall conform with the requirement of Section 3.2, “Concrete Works”.

2. Aggregates shall conform with the requirements of Section 3.2, “Concrete Works”.

3. Temperature bars shall have diameter of 10mm conforming with the requirements of Section 3.2, “Concrete Works”.

4.17.3 **EXECUTION**

4.17.3.1 GRAPHIC SIGNS

1. Directional and information signs, indicating the location of the ramp for physically handicapped persons, shall be installed/placed at the front of the main entrance of the Terminal Building. The signed board shall be 300mm x 300mm mounted on a 50mm Ø, schedule 40, signpost and the text and arrow shall be in accordance with the International Symbol of Access “B”.
2. Signs shall be placed at the entrance and exits of the ramps and toilets, installed at conspicuous locations. The signboards shall be 150mm x 150mm and the text shall be in accordance with the International Symbol of Access “A”.

4.17.3.2 RAMP

The ramp shall be constructed as shown on the Drawings and with a non-skid surface.

4.17.3.3 GRABRAILS

Lavatories, urinals and water closets of the Terminal Building where indicated on the Drawings shall be provide with grabrails. The position and distance from the floor shall be as shown on the Drawings.

4.17.4 **MEASUREMENT AND PAYMENT**

Graphic signs, and grabrails to be paid for shall be measured by the piece installed, completed as shown on the Drawings and accepted and certified for payment by the Engineer.

Handrails to be paid shall be measured by the linear meter of piece installed, completed as shown on the Drawings and accepted and certified for payment by the Engineer.