

3. MIXING CONCRETE IN TRUCKS

- a. Truck mixers, unless otherwise authorized by the Engineer, shall be of the revolving drum type, watertight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank is not required. Truck mixers may be required to be provided with a means by which the mixing time can be readily verified by the Engineer.
- b. The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacture and stamped in metal on the mixer. Truck mixing shall, unless otherwise directed, be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.
- c. Mixing shall begin within 30 minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface-wet aggregate and when the temperature is above 32 °C, this limit shall be reduced to 15 minutes. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgment of the Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.
- d. When a truck mixer is used for transportation, the mixing time in stationary mixer may be reduced to 30 seconds and the mixing completed in a truck mixer. The mixing time in truck mixer shall be as specified for truck mixing.

JOINTS

1. No reinforcement, corner protection angles or other fixed metal items shall be run continuously through joints containing expansion-joint filler, through crack-control joints in slabs on grade and vertical surfaces.

2. Preformed Expansion Joint Filler

- a. Joints with Joint Sealant

At expansion joints in concrete slabs to be exposed, and at other joints indicated to receive joint sealant, preformed expansion-joint filler strips shall be installed at the proper level below the elevation with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a groove. When surface dry, the groove shall be cleaned of foreign matter, loose particles, and concrete protrusions, then filled flush approximately with joint sealant so as to be slightly concave after drying.

- b. Finish of concrete at joints

Edges of exposed concrete slabs along expansion joints shall be neatly finished with a slightly rounded edging tool.

c. Construction Joints

Unless otherwise specified herein, all construction joints shall be subject to approval of the Engineer. Concrete shall be placed continuously so that the unit will be monolithic in construction. Fresh concrete may be placed against adjoining units, provided the set concrete is sufficiently hard not to be injured thereby. Joints not indicated shall be made and located in a manner not to impair strength and appearance of the structure. Placement of concrete shall be at such rate that the surface of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon. Lifts shall terminate at such levels as are indicated or as to conform to structural requirements as directed. If horizontal construction joints are required, a strip of 25mm square-edged lumber, beveled to facilitate removal shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25mm above the underside of the strip. The strip shall be removed one hour after the concrete has been placed. Any irregularities in the joint line shall be leveled off with a wood float, and all laitance removed. Prior to placing additional concrete, horizontal construction joints shall be prepared.

Construction Joint which is not indicated in the Drawings shall be located as to least affect the strength of the structure. Such locations will be pointed out by the Engineer.

PREPARATION FOR PLACING

Hardened concrete, debris and foreign materials shall be removed from the interior of forms and from inner surfaces of mixing and conveying equipment. Reinforcement shall be secured in position, and shall be inspected, and approved before placing concrete. Runways shall be provided for wheeled concrete-handling equipment. Such equipment shall not be wheeled over reinforcement nor shall runways be supported on reinforcement.

Notice of any concreting operations shall be served to the Engineer at least three (3) days ahead of each schedule.

PLACING CONCRETE

1. Handling Concrete

Concrete shall be handled from mixers and transported to place for final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients until the approved unit of work is completed. Placing will not be permitted when the sun, heat, wind or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. Concrete shall be placed in the forms, as close as possible in final position, in uniform approximately horizontal layers not over 40cm deep. Forms splashed with concrete and reinforcement splashed with concrete or form coating shall be cleaned in advance of placing subsequent lifts. Concrete shall not be allowed to drop freely more than 1.5m in unexposed work nor more than 1.0 m in exposed work; where greater drops are required, tremie or other approved means shall be employed.

2. Time Interval between Mixing and Placing

Concrete mixed in stationary mixers and transported by non-agitating equipment shall be placed in the forms within 30 minutes from the time ingredients are charged into the mixing drum. Concrete transported in truck mixers or truck agitators shall be delivered to the

site of work, discharged in the forms within 45 minutes from the time ingredients are discharged into the mixing drum. Concrete shall be placed in the forms within 15 minutes after discharged from the mixer at the jobsite.

3. Hot Weather Requirements

The temperature of concrete during the period of mixing while in transport and/or during placing shall not be permitted to rise above 36 °C. Any batch of concrete which had reached a temperature greater than 36 °C at any time in the aforesaid period shall not be placed but shall be rejected, and shall not thereafter be used in any part of the permanent works.

a. Control Procedures

Provide water cooler facilities and procedures to control or reduce the temperature of cement, aggregates and mixing handling equipment to such temperature that, at all times during mixing, transporting, handling and placing, the temperature of the concrete shall not be greater than 36 °C.

b. Cold Joints and Shrinkage

Where cold joints tend to form or where surfaces set and dry too rapidly or plastic shrinkage cracks tend to appear, concrete shall be kept moist by fog sprays, or other approved means, applied shortly after placement, and before finishing.

c. Supplementary Precautions

When the aforementioned precautions are not sufficient to satisfy the requirements herein above, they shall be supplemented by restricting work during evening or night. Procedure shall conform to American Concrete Institute Standard ACI 305.

4. Conveying Concrete by Chute, Conveyor or Pump

Concrete may be conveyed by chute, conveyor, or pump if approved in writing. In requesting approval, the Contractor shall submit his entire plan of operation from the time of discharge of concrete from the mixer to final placement in the forms, and the steps to be taken to prevent the formation of cold joints in case the transporting of concrete by chute, conveyor or pump is disrupted. Conveyors and pumps shall be capable of expeditiously placing concrete at the rate most advantageous to good workmanship. Approval will not be given for chutes or conveyors requiring changes in the concrete materials or design mix for efficient operation.

a. Chutes and Conveyors

Chutes shall be of steel or steel lined wood, rounded in cross section rigid in construction, and protected from overflow. Conveyors shall be designed and operated and chute sections shall be set, to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients, loss of mortar, or change in slump. The discharged portion of each chute or conveyor shall be provided with a device to prevent segregation. The chute and conveyor shall be thoroughly cleaned before and after each run. Waste material and flushing water shall be discharged outside the forms.

b. Pumps shall be operated and maintained so that a continuous stream of concrete

is delivered into the forms without air pockets, segregation or changes in slump. When pumping is completed, concrete remaining in the pipeline shall be ejected and wasted without contamination of concrete already placed. After each operation, equipment shall be thoroughly cleaned and the flushing water shall be splashed outside the forms.

5. Wall and Abutments

No load shall be placed upon finished walls, foundations or abutments until authorized by the Engineer. Minimum time before loading shall be 7 days.

6. Concrete Placing on Wharf

When placing concrete on wharf decks, the Contractor shall:

Ensure that rate of placing is sufficient to complete proposed placing, finishing and curing operations within the scheduled time; that experienced finishing machine operators and concrete finishers are provided to finish the deck; that curing equipment and finishing tools and equipment are at the site of work and in satisfactory condition for use.

Immediately prior to placing, the Contractor shall place scaffolding and wedges and make necessary adjustments. Care shall be taken to ensure that settlement and deflection due to added weight of concrete will be minimal. The Contractor shall provide suitable means to readily permit measurement of settlement deflection as it occurs.

Should any event occur which, in opinion of the Engineer, would prevent the concrete conforming to specified requirements, the Contractor shall discontinue placing of concrete until corrective measures are provided satisfactory to the Engineer. If satisfactory measures are not provided prior to initial set of concrete in affected areas, the Contractor shall discontinue placing concrete and install a bulkhead at a location determined by the Engineer. Concrete in place beyond bulkheads shall be removed. The Contractor shall limit the size of casting to that which can be finished before beginning of initial set.

COMPACTION

1. Immediately after placing, each layer of concrete shall be completed by internal concrete vibrators supplemented by hand-spading, rodding, and tamping. Tapping or other external vibration of forms will not be permitted unless specifically approved by the Engineer. Vibrators shall not be used to transport concrete inside the forms. Internal vibrators submerged in concrete shall maintain a speed of not less than 7,000 impulses per minute. The vibrating equipment shall at all times be adequate in number of units and power to properly consolidate all concrete.
2. Spare units shall be on hand as necessary to insure such adequacy. The duration of vibrating equipment shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation. The vibrator shall not be inserted into the lower courses that have begun to set. Vibrator shall be applied vertically at uniformly spaced points not further apart than the visible effectiveness of the machine.

EPOXY BONDING COMPOUND

Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be re-tightened. The cleaned surfaces shall be moistened, but shall be without free water when concrete is placed. ASTM C 881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Class B if placement temperature is between 4 to 16 °C; or Class C if placement temperature is above 16°C.

FINISHES OF CONCRETE

Within 12 hours after the forms are removed, surface defects shall be remedied as specified herein. The Temperature of the concrete, ambient air and mortar during remedial work including curing shall be above 10 °C. Fine and loose material shall be removed. Honeycomb, aggregate pockets, voids over 13mm in diameter, and holes left by the rods or bolts shall be cut out to solid concrete, reamed, thoroughly wetted, brush-coated with neat cement grout, and filled with mortar. Mortar shall be a stiff mix of one part Portland cement to not more than 2 parts fine aggregate passing the No. 16 mesh sieve, with a minimum amount of water. The color of the mortar shall match the adjoining concrete color. Mortar shall be thoroughly compacted in place. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through the outside face. Holes which do not pass entirely through wall shall be packed full. Patchwork shall be finished flush and in the same plane as adjacent surfaces. Exposed patchwork shall be finished to match adjoining surfaces in texture and color. Patchwork shall be damp-cured for 72 hours. Dusting of finish surfaces with dry material or adding water to concrete surfaces will not be permitted.

CONCRETE FINISHING DETAILS

1. Concrete Paving

After concrete is placed and consolidated, slabs shall be screeded or struck off. No further finish is required.

2. Smooth Finish

Required only where specified; screed concrete and float to required level with no coarse aggregate visible. After surface moisture has disappeared and laitance has been removed, the surface shall be finished by float and steel trowel. Smooth finish shall consist of thoroughly wetting and then brush coating the surfaces with cement to not more than 2 parts fine aggregate passing the no. 30 mesh sieve and mixed with water to the consistency of thick paint.

3. Broom Finish

Required for paving; the concrete shall be screeded and floated to required finish level with no coarse aggregate visible. After the surface moisture has disappeared and laitance has been removed, surface shall be float-finished to an even, smooth finish. The floated surfaces shall be broomed with a fiber bristle brush in a direction transverse to the direction of the main traffic.

ITEM 08 : STEEL AND METAL WORKS**GENERAL**

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

SCOPE OF WORK

The work 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.

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.

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.

MATERIAL REQUIREMENTS

1. Unless specified herein all steel structures and metals shall conform with the requirements of "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.

EXECUTION

QUALIFICATION

Qualification of steel fabricators, erectors and welders shall comply with the requirements.

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.

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 plate work 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.

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.

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.

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

- a. 1. Anchor bolts shall be set in accurate position by using templates.
- a. 2. The setting method shall be proposed to the Engineer for his approval before setting starts.
- a. 3. The threads of bolt shall be cured with an appropriate method against rust and/or any damage before tightening.
- a. 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

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

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

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

f. High Strength Bolts

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

g. 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.

g. 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.

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

h. Erection

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

h. 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.

h. 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.

GALVANIZING

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.

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.

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.

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.

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.

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.

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.

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.

ITEM 09 : TERMITE PROOFING, BUKBOK PROOFING

GENERAL

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

SCOPE OF WORK

The 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.

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.

MATERIAL REQUIREMENTS

CHEMICALS AND EQUIPMENT

For termite proofing, use Termiticide Concentrate acceptable to the PPA and should have license from Fertilizer and Pesticide Authority.

For "bukbok" proofing of kiln dried wood and 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 Termiticide Concentrate):

1 part Termiticide Concentrate TC to 50 parts water

Pesticides - 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.

EXECUTION

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.

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 from 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.

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 coarse 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 Pesticides 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 Pesticides before installation of plywood or ceiling panels.

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.

INSPECTION AND TEST

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

Amount of sample to be taken: 50 cc each.

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 than 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.

ITEM 10 : MASONRY WORKS

GENERAL

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

SCOPE OF WORK

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.

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

MATERIAL REQUIREMENTS

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

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 4.14 MPa (600 psi). CHB shall be non-load bearing uniform and essentially smooth as normally achieves by standard molding methods and shall be free from any cracks, flaws or other defects.

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.

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.

REINFORCING STEEL BARS AND RODS

Minimum yield strength of reinforcement shall conform with the specifications in Section of Reinforced Concrete.

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.

EXECUTION

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 600mm. Bars shall be lapped a minimum of 40 diameters of the reinforcement.

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.

ITEM 11 : PLUMBING AND SANITARY WORKS**SCOPE OF WORK**

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

MATERIAL REQUIREMENTS**SUBMITTAL**

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

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

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

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

STANDARDS

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

MATERIALS

1. Identification of Materials

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

above.

2. Alternative Materials

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

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

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

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

4. Jointing Material

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

5. Water Supply Pipes

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

6. Cleanouts, Plugs and Tee

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

7. Pipe Sleeves

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

8. Downspout

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

9. Splash Block

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

10. Roof Strainers

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

11. Shower, Floor and Urinal Drain

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

12. Pipe hangers, Inserts and Support

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

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

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

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

13. Unions

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

14. Valves

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

15. Fixtures**a. Water Closets**

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

b. Lavatories**b. 1. Lavatory (Wall Hung)**

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

b. 2. Lavatory (Countertop Lavatory)

Shall be vitreous china, oval or round shaped countertop lavatory with front

overflow hole, complete with faucet, supply valve and fittings with P-trap. Fitting ledge suitable for single hole on center.

c. Urinals

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

d. Service Sinks

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

e. Slope Sinks

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

Hose bibb shall be of brass finish.

f. Soap Holder

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

g. Faucet for lavatory

Faucet for lavatory shall be in chrome-finish.

h. Bath and shower fitting

Bath and shower fitting shall be chrome-finish.

i. Towel Rail

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

j. Curtain rod

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

k. Grab Bar

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

l. Bidet Spray Combination

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

16. Concrete, Reinforcing Steel, Pipe and Steel Plate

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

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

17. Non-reinforced Concrete Pipe

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

18. Valve for Drinking Fountain

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

EXECUTION

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

EXCAVATION, TRENCHES AND BACKFILLING

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

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

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

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

Backfilling shall be brought to a suitable elevation above grade to provide for anticipated

settlement and shrinkage thereof.

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

INSTALLATION OF SOIL, WASTE DRAINS OR VENT PIPES

1. Horizontal Drainage Pipe and Vent Piping

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

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

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

2. Fittings

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

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

3. Joints

a. PVC Soil Pipe

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

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

4. Cleanouts

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

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

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

5. Flashings

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

6. Traps

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

7. Pipe Sleeves, Hangers and Supports

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

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

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

INSTALLATION OF WATER PIPES, FITTINGS AND CONNECTIONS

1. Gate Valves and Outlets

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

2. Mains, Branches and Runouts

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

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

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

The use of long screws and bushings is prohibited.

3. Joints

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

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

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

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

4. Unions

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

5. Tests

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

a. Tests for Drainage and Venting System

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

b. Sterilization

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

c. Pressure Test for Water Lines

1. After the pipe have been installed, the joints completed and with joints exposed for examination, all newly installed pipe or any valve section, thereof, shall be subjected to hydrostatic pressure one and one half (1½) the designed working pressure of the system or as specified by the Engineer.
2. The duration of each pressure test shall be at least 20 minutes unless otherwise specified by the Engineer.
3. Each section of pipeline shall be slowly filled with water and the specified test pressure, measured at the point of lowest elevation, shall be applied by

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

d. Leakage Test for Water Lines

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

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

e. Defective Work

1. If the inspection or test shows any defect, such defective work or material shall be replaced and the test shall be repeated until satisfactory to the Engineer.
2. All repairs to piping shall be made with new materials at the expense of the Contractor.

3. No caulking of screwed joints or holes will be accepted.

ASSEMBLY, INSTALLATION AND CONNECTION OF FIXTURES

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

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

PROTECTION OF FIXTURES

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

FIXTURES AND FASTENING

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

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

GUARANTEE

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

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

CLEANING UP

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

PLUMBING, FIXTURES AND TOILET ACCESSORIES INSTALLATION

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

ITEM 12 ARCHITECTURAL WORKS AND FINISHES**GENERAL NOTES:**

The contractor should observe special consideration to indent order items that require longer lead time and checking of material availability under specified conditions of sale, the acceptance of which by the supplier constitutes a contract of sale.

ITEM 12 a : FINISHES**GENERAL**

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

SCOPE OF WORK

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

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

WALLS**Exterior**

- a. Plain cement finished painted with elastomeric paint.
Location as shown in the plans and elevations.

Interior

- a. Plain cement finished painted with elastomeric paint.
- b. 300mm x 600mm Homogenous ceramic wall tiles.

Plain Cement Finish

- a. Surface Preparation

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

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

All surfaces shall be thoroughly wetted before plastering.

- b. Trial Mix

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

of Portland cement to two parts of sand.

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

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

c. Cement Finish Application

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

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

Final plaster finishes shall be rubber sponged.

d. Tolerance

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

e. Patching and Cleaning

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

Painting Works

a. Surface Preparation

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

Without mesh:

1st Coat: Elastomeric Base Wall Covering Sealer

2nd and 3rd Coat: Elastomeric Base Wall Covering Basecoat

4th Coat: Elastomeric Base Wall Covering Topcoat

With mesh:

1st Coat: Elastomeric Base Wall Covering Sealer

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

3rd and 4th Coat: Elastomeric Base Wall Covering Basecoat

5th Coat: Elastomeric Base Wall Covering Topcoat

Wall Ceramic Tiles

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

FLOORS

F1 Plain Cement Finish

- a. Generator Set Area
- b. Switch Gear Area

Locations are shown in the plan.

F2 600mm x 600mm Unglazed Ceramic Floor Tiles, (Ivory White Finish)

- a. Office

Locations are shown in the plan.

F3 600mm x 600mm Unglazed Ceramic Floor Tiles, (Beige)

- a. All Gender Toilet

Locations are shown in the plan.

F4 Non – skid rough cement Finish

- a. All Ramps

Locations are shown in the plan.

F5 Pre –cast paving block in herring bone pattern

- a. Remaining Areas outside the Development

Locations are shown in the plan.

Waterproof finish for all toilets.

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

EXECUTION

Floor Tiles

a. Mortar Preparation

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

b. Surface Preparation

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

c. Placing of Setting Beds and Floor Tile

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

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

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

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

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

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

Joint widths shall be uniform and spaced to accommodate the tile in the given spaces with a minimum of cutting. Tiles shall be wetted, if they have become dry, before applying grout. Joints 3.2 mm or less in width shall be grouted with a neat Portland cement grout of the consistency of thick cream. Other joints shall be pointed with mortar consisting of one part Portland cement and two parts pointing sand. The grout or mortar for joints on floors shall be white Portland cement or as specified by the Engineer. Grout pointing mortar shall be forced into joints by using trowel, brush or finger application. Before the grout or mortar sets, the joints of cushion edge tile shall be struck or tooled to the depth of the cushion, filling all skips or gaps, and the joints of square edged tiles shall be filled completely flush with their surface. Dark cement shall not be seen through grouted white joints.

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

d. Cleaning and Curing

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

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

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

Ceiling**1. Interior**

1. C1 - 600mm x 600mm x 0.70mm Aluminum Clipped-In Perforated Ceiling Panel, Bone White or Approved Equivalent
 - a. Office
 - b. All Gender Toilet

Locations are shown in the plan.

SUBMITTAL

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

GRANITE TILES

- a. Selected granite slabs for toilet countertops, fascia and splashboard. Dimensions as shown on the drawings.
- b. Shall be sound material with uniform and favorable working qualities and with very limited natural faults.

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

INSTALLATION OF DOORS

1. Surface Preparation

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

DOORS

- D-1 - 44mm thk. Metal door w/ louver, ga. 16 steel door jamb full mortise in heavy duty ball bearing hinges, orbit type lockset and floor mounted dome type bumper (0.90m x 2.15m)
- D-2 - 44mm thk. hollow core door w/ marine ply, full mortise in heavy duty ball bearing hinges. surface mounted door closer and floor mounted bumper (0.90m x 2.15m)
- D-3 - 44mm thk. hollow core door w/ marine ply and louver, full mortise heavy duty ball bearing hinges, orbit type lockset, surface mounted door closer, floor mounted dome bumper (0.80m x 2.15m)
- D-4 - 44mm thk. hollow core door w/ marine ply, full mortise in heavy duty ball bearing hinges. Orbit type lockset surface mounted door closer and floor mounted bumper (0.90m x 2.15m)
- D-5 - 44mm thk. hollow core door w/ marine ply, full mortise in heavy duty ball bearing hinges. Orbit type lockset (0.70m x 2.15m)

- D-6 - 44mm thk. 2-leaf metal door w/ louver, GA 16 steel door jamb, full mortise heavy duty ball bearing hinges, orbit type lockset, top & bottom flush bolts for inactive door
(2.0m x 2.15m)
- D-7 - Roll - up door, GA 18 galvalume finish, 1 - ton chain block w/ locking mechanism for pull chain (2.0m x 2.15m)

INSTALLATION OF WINDOWS

1. Surface Preparation

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

- W-1 - Metal fixed louver window from GA 18 sheet - epoxy primer, GA. 16 channel window jamb
(2.30m x 2.50m)
- W-2 - Aluminum awning window 4 - tiers, fixed at top tier/awning type for bottom three tiers. 6 mm thk. clear glass, 45 x 125 al. frame w/ powder coated finish
(2.50m x 1.60m)
- W-3 - Aluminum fixed window 3 panels, 6mm thk. clear glass standard aluminum frame w/ powder coated finish
(2.00m x 1.25m)
- W-4 - Aluminum awning window, 6mm thk. clear glass, standard aluminum frame w/ powder coated finish
(1.15m x 0.50m)

ITEM 12 b: CARPENTRY AND JOINERY WORKS**SCOPE OF WORK**

The work shall consist of furnishing all tools, labor, equipment and materials, unless otherwise specified to complete all carpentry and joinery works shown on the Drawings and specified herein.

GENERAL REQUIREMENTS**a. Lumber Grades**

Lumber shall be of the best grade available, of the respective kinds required for the various parts of work; well seasoned, thoroughly dry and free from loose or unsound knots, sap, shakes or other imperfections impairing its strengths, durability and appearance. All exposed woodwork shall be smooth by dressed and sandpapered unless otherwise indicated or specified. Framing lumber shall be of the rough dimensions unless otherwise shown on the drawings.

b. Substitution of Lumber

Any lumber equally good for the purpose intended maybe substituted for the kind specified, subject to prior written approval of the Engineer. Provided, however, that in the substitution of the cheaper kind of lumber than that specified, a reduction in the contract price equal to the difference in the costs of the two kinds of lumber shall be made.

c. Delivery and Storage

The Contractor shall deliver lumber to the site in undamaged condition. Lumber shall be stacked in such a manner as to insure proper ventilation and drainage, and shall be supported at least 150 mm above-ground. Lumber shall be protected against dampness before and after delivery, and enough protection under cover in well ventilated enclosure, not exposed to extreme changes of temperature and humidity; and in a manner as to provide air-circulation around all surfaces of each pile to insure thorough air-seasoning. Lumber or millwork in buildings shall not be finished until concrete, masonry work and plaster are dry. Lumber shall be delivered at least thirty (30) days before use.

d. Grading of Plywood

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

MATERIALS**a. Lumber**

Lumber for various uses shall be one of the species listed for the purpose indicated unless otherwise specified in the drawing. For any use not specified, the lumber shall be the best commercial grade normally used for the purpose, subject to the approval of the Engineer.

All framings shall be done as far as possible with carefully fitted mortise and tenon joints.

All doors, windows, transoms, or other opening where so indicated on plans, shall have frames and sills of the dimensions shown or as hereafter detailed, and all frames coming in contact with concrete shall be anchored by means of 20-d nails, spaced not more than 0.20m, apart, all around the contract surfaces. All frames shall be rabbetted, molded and cut with saw and cut under for water drips.

SPECIE	U S E
Yakal	All door jambs, headers and transom bars, wood plates and all other woodwork in contact with concrete or masonry and where indicated.
Apitong (pressure treated)	All truss members and rafters and where indicated; all wood framings and carpentry, except when in contact with concrete.
Tanguile (Kiln dried)	All exterior and interior mill work, siding, finish and trim, frame work and all other wood works not specifically mentioned; except when in contact with concrete.

b. 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 thickness indicated.

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

c. Fastenings

Fastenings shall be common nails, glue or specified, flat-head wood screws (F.H.W.S.), rough-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.

1. 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.

2. Wood Screws

Shall be brass or cadmium plated of the best available commercial quality, and of types and sizes suited for the purpose.

PRESSURE TREATED LUMBER

a. Preservative Treatment

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

- a. Boliden Salts - 45.5 kg. dry chemical per cubic foot of wood
- b. Wolman Salts - 0.31 kg. dry chemical per cubic foot of wood

- c. Tenalith Salts - 0.34 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.

ROUGH CARPENTRY

All work shall be well fitted, accurately set, and rigidly secured in place. Anchors and bolts (with nuts and washers) straps and tie rods shall be provided as required.

a. Cutting and Fitting

Cutting and fitting to accommodate other work shall be done in the required manner, and cut or damaged work shall be patched and made good.

b. Framing and Structural

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

c. Plates for Walls and Partitions

Plates for walls and partitions shall be of the same width as the studs and shall form continuous horizontal ties.

Structural members shall not be cut, bored or notched for the passage of pipes or conduits without prior approval of the Engineer. All members damaged by such cutting or boring shall be reinforced by means of specially formed and approved sheet metal or steel shapes or remove or replaced with new member as directed.

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

Rough hardware, exposed to weather or in contact with exterior walls or masonry or slabs shall be zinc-coated except as specified otherwise.

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

JOINERY WORK

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

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

Interior trims shall be approved standard stock moldings, except where special patterns or profiles are indicated.

Joints for cabinet work shall be glued in addition to nails or other fastening device required. Nailing shall be concealed where practicable. Where face nailing is used, nails shall be set for putty stopping.

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

WOOD LAMINATES AND WOOD PLASTIC COMPOSITE PANELS

INTRODUCTION

a. Wood Laminate

A wood laminate is a thin sheet of material used to cover the core of a wood project in order to change the appearance of the material. Laminates may be any material, but typically they are made veneers, which are thin sheets of wood.

High-pressure decorative laminates are characterized by their qualities, durability, and functional performance. High-pressure laminate sheets are available in a wide variety of colours, patterns and surface finishes. They are resistant to wear, scratching, impact, moisture, heat, and staining; and possess good hygienic and anti-static properties, being easy to clean and maintain.

b. Wood-plastic composite

Wood-Plastic Composite architectural products are a sustainable timber alternative with added benefits such as durability and strength.

SCOPE OF WORK

This item shall consist of furnishing all wood laminates and wood composite panels materials, labor, tools and equipment required in undertaking the proper installation as shown on the Plans and in accordance with this specification.

SPECIFICATIONS

- a. Wood Laminates: 6mm THK substrate laminated on HPL Accent Matte Finish for Interior Cladding or any approved equivalent by the designing Architect.
- b. Wood Composite Panels: Supply and Installation of Wood-Plastic Composite panels in sizes: 500mm X 45mm X 50mm including angle bracket support or any approved equivalent by the designing Architect.

SUBMITTALS

a. Product Data

Manufacturer's printed product literature, specifications, and data sheets

b. Shop Drawings

Indicate project layout; dimensions and thickness of panels; connections; details and locations of joints and sealant; methods of anchorage; number of anchors; supports; reinforcement; flashings; accessories; materials; and finishes.

c. Samples

- 1. Sample materials for selection and verification of finishes, colors, and textures.**
- 2. Sample of panel assembly.**

QUALITY ASSURANCE

- a. Fabricator / installer to be accepted by the manufacturer.**
- b. Fabricator / installer to have work similar in scope and size to this project.**
- c. Take field measurements prior to completion of shop manufacture or fabrication. Coordinate fabrication schedule with construction progress to avoid delay of work. Field fabrication should be allowed to ensure proper fit and keep it to minimum with majority of fabrication being done under controlled shop conditions.**

PREPARATION

Ensure surfaces to receive wood laminates and wood-plastic composite panels are structurally leveled, even, smooth, clean, dry, and free from defects detrimental to work. Notify consultant thru writing of conditions unfavorable to proper and timely completion of work. Do not proceed with erection until unsatisfactory conditions have been corrected.

ACCESSORIES

Screws, nuts, washers, bolts, rivets, angle bars and other miscellaneous fastening devices shall be made of non-corrosive materials such as aluminum and stainless steel.

ITEM 12 c : PAINTING

GENERAL

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

SCOPE OF WORK

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.

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.

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.

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.

MATERIAL REQUIREMENTS

PAINT

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

Paints for exterior finish must be with tile like durability and elegance, fast drying, solvent based acrylic, highly suitable for coastal or polluted areas with excellent anti-fungus properties and alkali resistance.

100% Acrylic, water based, quick-drying, easy to clean-up and environmentally friendly, resist dirt, stains, alkali, water, humidity, algae, mold and mildew growth and highly durable paint for interior finish.

An all-purpose synthetic quick dry paint for all types of wood and metal surfaces. It has high gloss, good color retention and outstanding durability.

For pipes, valves and equipment, galvanized and ungalvanized ferrous metal, use a 100% acrylic gloss paint, has excellent resistance to ultraviolet rays and resists chalking, cracking and color fading, dries fast and environmentally friendly.

SCHEDULE OF PAINTING

Architectural Items	
a. Exterior Finishes	
1. On Concrete Walls	
Three Coats, Concrete Masonry Paint	Elastomeric Paint or approved equal
2. Unprimed Ferrous Metal	
First Coat	Red Oxide Primer, #310 or approved equal
Second & Third Coat	Quick Dry Enamel or approved equal
3. On Concrete Block Wall	
Masonry Neutralizer	Masonry Neutralizer #44 or approved equal
Three Coats	Elastomeric Paint

Concrete Masonry Paint	or approved equal
4. On Wood	
First Coat Exterior Wood Primer	Flatwall Enamel or approved equal
Second & Third Coat Exterior enamel	Quick Drying Enamel or approved equal
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 and coated metal two coats of interior semi-gloss enamel or as indicated in the Schedule finish	Red Oxide Primer #310, Quick Dry Enamel or approved equal
2. On Plaster	
First Coat	Masonry Neutralizer #44 or approved equal
Three Coats	Elastomeric Paint or approved equal
3. On Wood	
First Coat Enamel undercoater	Flatwall Enamel or approved equal
Second & Third Coat Exterior enamel	Quick Drying Enamel or approved equal
4. Wood Stain Finish	
First Coat Second & Third Coats Fourth & Fifth Coats	Oil Wood Stain , Lacquer Sanding Sealer #1254 Clear Gloss Lacquer #1250 or approved equal
c. Non – Architectural Items (Piping, valves, equipment, etc.)	
1. Piping, valves, equipment etc. in rooms are to be painted	
2. Galvanized pipes and ducts	
Primer – one coat	Red Oxide Primer, #310 or approved equal
Finish – one coat	Quick Dry Enamel or approved equal
3. Black steel pipes	
Primer – one coat	Red Oxide Primer, #310 or approved equal
Finish – one coat	Quick Dry Enamel or approved equal
4. Mechanical Items	
a. Ungalvanized ferrous metal	
Primer – one coat	Red Oxide Primer, #310 or approved equal
Finish – one coat	Quick Dry Enamel or approved equal or approved

	equal
b. Galvanized ferrous metal Primer – one coat Finish – one coat	Red Oxide Primer, #310 or approved equal Quick Dry Enamel or approved equal or approved equal
c. Submerged galvanized ferrous metal Primer – one coat	Red Oxide Primer, #310 or approved equal
d. Buried miscellaneous ferrous surface valves, & flanged joints (excl. pipe) Primer – one coat	Red Oxide Primer, #310 or approved equal

EXECUTION

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 2.0mm test sieve, and be substantially retained on a 0.18mm test sieve, with at least 25 percent retained on a 0.355mm 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.

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 flattened.

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 coat.

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.

ALUMINUM FRAMES FOR 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° C (metal temperature measured on the area with greatest metal thickness). The temperature variation in the oven should not exceed $\pm 10^{\circ}$ C.

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.

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.

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.

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.

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.

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.

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.

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.

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.

ITEM 12 d : CONCRETE WATERPROOFING

GENERAL

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

SCOPE OF WORK

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

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

SUBMITTAL

1. Material description and physical properties, application details, and recommendations regarding shelf life, application procedures, and precautions on flammability and toxicity.
2. Samples for each waterproofing type.

DELIVERY AND STORAGE

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

PRODUCTS

I. DEEP PENETRATING SEALER

Deep Penetrating Sealer (DPS) is an environmentally friendly, non-toxic, odorless, clear, water-soluble liquid compound, which is safe and easy to use.

Deep Penetrating Sealer (DPS) penetrates below the surface and chemically reacts with the alkali and lime found in concrete. This reaction creates a silica gel membrane within the pores and capillaries of the concrete, permanently sealing it against the ingress of moisture yet

allowing the concrete to breathe. Over a period of time, the silica gel membrane hydrates and solidifies into a crystalline structure, increasing the hardness and strength of both new and old concrete while reducing moisture vapor emissions and permanently stopping the penetration and flow of water and water-borne contaminants such as chlorides and acids, both on the positive or negative side forging a waterproofed and preserved concrete structure.

EXECUTION

- All existing dirt and other surface contaminants adhering on the surface must be thoroughly removed. Apply Concrete Neutralizer using sufficient coats to completely neutralize the surface. Do not wash off. When sufficiently dry, dust lightly to remove crystalline deposits.
- Mix thoroughly the product mixture as per manufacturer's instruction. Any change from the recommended proportion will affect its quality. Scrape the bottoms, sides and corners of the container to ensure complete and full blending. Prepare only enough quantities that can be used within the pot-life period. Do not delay application. Apply DPS by brush or roller or by using an airless spray.
- Allow to cure overnight prior to application of topcoat.

II. FLEXIBLE MODIFIED CEMENTITIOUS

Flexible Modified Cementitious (FMC) is a two-component latex modified cementitious coating. It can be simply achieved by mixing the pre-packed dry-mixing powder with the formulated flexible latex admixture, and subsequent brushing the slurry on various substrates. It protects a wide range of buildings and structural concrete components with excellent resistance to water, aggressive chemicals, long-term weathering, and scratching. It is applicable for those structures subjected to long-term water immersion.

1. Free surfaces from dirt or foreign materials. For the waterproofing to work best, manufacturers recommend the surfaces be sand blasted, bush-hammered or acid-etched.
2. Apply 2 coats of the cementitious waterproofing. The first coat could include the manufacturer's materials only. The second coating will include a cement-sand mixture and also have chemical and metallic elements too. If supplementary waterproofing is required, then a third coat may be required. This typically includes sand and cement for that extra protection.

Methods of Application

Trowel

Application of the coating is done using the handheld trowel, by simply applying and spreading the coating using the trowel.

Spray

This method uses spraying equipment like the ones used in painting vehicles.

It is preferred due to its precise finish and efficiency. It is also faster to use the spray than the trowel method.

Brush

Use a typical brush similar to roll brushes that are used in painting houses. It also has a uniform finish and is faster to use compared to the trowel.

It is good to note that different surfaces will dictate the method of application.

ITEM 12 e: FACILITIES AND DEVICE FOR PERSONS WITH DISABILITY**SCOPE OF WORK**

The work shall consist 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.

MATERIAL REQUIREMENTS**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.

HANDRAILS

Handrail for ramp shall be 50mmØ tubular stainless steel buff finished. It shall be provided with a small hole as of a Braille system.

GRABRAIL

Grabrail shall be manufactured from gauge 18 tubular stainless steel 25mmØ and provided with safety grip finish.

CONCRETE MATERIALS FOR RAMPS

1. Portland cement shall conform with the requirement of "Reinforced Concrete".
2. Aggregates shall conform with the requirements of "Reinforced Concrete".
3. Temperature bars shall have diameter of 10mm conforming with the requirements of "Concrete Works".

EXECUTION**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 Building. The signed board size and dimensions shall be based on DOTr approved Standard Design, schedule 40, sign post and the text and arrow shall be in accordance with the International Symbol of Access "B". Manual (See attached drawings and tabulation).
2. Signs shall be placed at the entrance and exits of the ramps and toilets, installed at conspicuous locations. The signboards shall be based on DOTr approved Standard Design Manual (See attached drawings and tabulation).

RAMP

The ramp shall be constructed as shown on the drawings and with a nonskid surface and tactile strips.

ITEMS 12 f: ALUMINUM PERFORATED CEILING PANEL**GENERAL**

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

SCOPE OF WORKS

This Item covers the use of aluminum panel as perforated ceiling panel and shall consist of furnishing and installing materials, tools, labor and equipment necessary for aesthetic purposes as indicated on the Plans and in accordance with this Specifications.

Material Requirements**Aluminum**

The aluminum shall be high strength, heat-treatable alloy which provides good formability and weldability and good corrosion resistance. It shall be suitable for a wide variety of architectural applications and of commercial quality unless specified in the Plans. It shall conform to the applicable requirements of ASTM B 209M, Standard Specification for Aluminum and Aluminum Alloy Sheet and Plate.

Thickness

Thinner material perforates easier and faster. It shall have a gauge thickness tolerance of + 0.2 mm.

Panel Shape and Size

Panel shape and sizes shall be as indicated in the Plans or as approved by the Engineer.

Aluminum panels shall be equipped with perimeter welded metal frames, return edges, borders mounting holes attachment brackets and clips. It shall be dimensioned as indicated on the Plans and as approved by the Engineer with a width and length tolerances of + 2.0mm and + 4.0 mm respectively.

Perforations**Shape and Size**

The shape of perforations shall be as indicated on the Plans using the standard shapes

Size : 600mm & 600mm X 600mm, T = 0.70mm

Hole Diameter : 2.0mm

Weight : 1.94 kg/ sqm

Powder Coated Finish : Bone White Color with Black tissue felt in- fill to prevent penetration of dust.

In any cases that a custom shape perforations is needed for functional requirement spacing and size of perforation shall be provided.

The hole diameter should not be less than the thickness of the aluminum panel.

Pattern

Staggered pattern perforations shall have an unfinished end pattern that appears incomplete at both ends of the sheet.

For staggered perforations both Round and Square the pattern stagger shall be in the short dimension of the sheet. Holes in a straight row pattern shall be parallel to long dimension of sheet.

Slotted Perforation - Slots shall be identified if to be furnished parallel with either the length or width of the sheet.

Margin

The "margin" on a perforated sheet or plate refers to the distance from the edge of the sheet to the first perforation along the same dimension. "No margin" refers to the last row or set of perforations extending off the sheet or plate.

The long side of a sheet shall be supplied with minimum margins. The short side of a sheet will have either minimum margins or no margins.

Construction Requirements

Installation

Install in accordance with manufacturer's installation instructions and approved shop drawings.

1. Level the ceiling height by the use of water level or laser beam.
2. Perimeter trims shall be installed using screw, nails or other applicable fasteners depending on wall type.
3. The ceiling shall be set out from the center to the perimeter wall. The center to center spacing for Triangle Keel shall be 600mm.
4. The maximum distance from the wall to first suspension part shall be 600mm.
5. The Suspension Part Twin Clamps (together with drop –in anchor installed at the concrete slab) shall be spaced 600mm on center

Note :

The end of the threaded bolt shall be spaced on the drop – in anchor and the other end shall be attached to the suspension Party Twin Clamps using nuts.

6. Tringle Keel shall be attached to the Suspension Part Twin Clamps.
7. When the accessories have been installed, adjustment shall be made to ensure that

the whole suspension ceiling is leveled.

8. Slightly push the Aluminum Ceiling Panel upward the ends of the panel until it rest with the triangle keel.

Inspection

When items not meeting specification requirements are discovered, their existence shall be called to the attention of the manufacturer prior to installation. Possible use of such items may be adjudicated among the responsible parties involved, based on the nature of the deficiency and the effect on the performance of the ceiling.

When rejection occurs, the manufacturer shall have the right to examine the rejected material. After removal of the portion not conforming to the specification, resubmission of the lot shall be permitted.

The inspection of specific ceiling areas for acceptability shall be made with lighting conditions corresponding to that of final building occupancy. If temporary lighting must be used, care shall be taken to position lights such that temporary conditions will approximate the final lighting condition.

ITEM 12 g : FURNITURES, TABLES AND CHAIRS OF VARIOUS TYPE INCLUDING ACCESSORIES**GENERAL**

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

SCOPE OF WORK

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

MODULARS

<i>Modular System</i>	<i>Unit</i>	<i>Quantity</i>
Office Table	pc	3.00
Side table	pc	2.00
Office File cabinet	pc	2.00

CHAIRS

<i>Chairs</i>	<i>Unit</i>	<i>Quantity</i>
Mid back Chair / Clerical Chair	set	3.00
3-Seaters Sofa	set	1.00

SUBMITTAL

1. Shop drawings for all gang chair 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 supply 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.

EXECUTION

All materials will be delivered and installed (if needed to be installed) on site.

ITEM 12 h: ROOFING AND TINSMITHRY

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.

MATERIAL REQUIREMENTS

ROOFING SHEETS

Long span, pre-painted, pre-insulated roof panel system, composed of an exterior metal skin cladding using "snap on side overlap" fastening system and an interior liner cladding of either metal skin or aluminum kraft vapor barrier sandwiched between is, PIR "Polyisocyanurate" foam to provide a high level thermal insulation.

Base Metal thickness	:	0.37mm, 0.47mm, 0.57mm
Total Coated thickness	:	0.40mm, 0.50mm, 0.60mm
Anti-rust Coating	:	Alloy coating of aluminum and zinc. Alloy is comprised of 55% aluminum, 43.4% zinc and 1.6% silicon
Coating Standards	:	AZ 150 (150 gm/m ²) ASTMA A - 792 ASTM A - 792
Back Coat	:	5 – 8 microns bottom coat
Length	:	up to transportable length (long span), minimum chance of leaks
Color	:	To be Specified by the Architect
Material Finish	:	Pre-painted galvalume of 0.50mm thk. of metal with 25mm thk. Polyisocyanurate foam "PIR" insulated with aluminum kraft paper backing
Insulation Thickness	:	50mm thk. PIR / 75mm thk. polyisocyanurate foam (PIR)
Insulation Materials	:	composed of MDI (polymetric methyl diphenyl isocyanurate) with certain types of polyol

EXECUTION

ROOFING SHEETS

1. Roof, Long span

Spacing of purlins safe at 1.0m to 1.2m.

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.

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 filings 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.

C CHANNEL

Aluminum C-channel is often referred to as architectural angle and channel. Aluminum C-channel has uses in many industries and is often an ideal choice due to its non-corrosive properties and structural strength. Aluminum C-channel is considerably less expensive than wood, is lighter in weight, insect resistant, and resists warping and cracking from water damage.

C-sections

Height: 100, 120, 150, 200, 250, 300 mm

Thickness: 1.0–3.0 mm

Minimum length 1600 mm

Maximum length 18000 mm

ITEM 13 : INTERIOR LIGHTING

1. GENERAL

"Electrical General Requirements," applies to this section with additions and modifications specified herein.

DESCRIPTION OF WORK: The work includes providing lighting fixtures, and battery-powered units and systems for interior use, including lighting fixtures and accessories mounted on the exterior surfaces of buildings. Materials not normally furnished by manufacturers of these devices are specified in item "Interior Wiring Systems".

SUBMITTALS: Data, shop drawings, and reports shall employ the terminology, classifications, and method prescribed by the IES Lighting Handbook, as applicable, for the lighting system specified.

Manufacturer's Data:

- a. Lighting fixtures, including lamps and ballast 22

2. PRODUCTS

FLUORESCENT LIGHTING FIXTURE:

Fluorescent Lamps: Provide low-pressure mercury discharge 36 watts color corrected energy saving fluorescent lamp; TS, minimum lumens 3300 lumens (36w).

Fluorescent Ballasts: Ballast shall be high efficiency 230V/60HZ, warm start high frequency electronic ballast with harmonics noise suppression (standard), with Philippine standard quality & safety certification mark, 5 years warranty. Fixtures and ballasts shall be designed and constructed to limit the ballast case temperature to 90 degrees Celsius (C) when installed in an ambient temperature of 40 degrees C.

Lamp holder: White polycarbonate casing, 130°C - Temperature G13 push-through rotary type lamp holder for TS lamp.

Housing: Gauge 24 B.I. sheet chemically treated for rust prevention, in white powder coated paint finish.

Reflector: Extra bright rolled 0.4 mm thick anodized aluminum in mirror finish with minimum 95% total reflectance and 12% diffuse reflectance.

Louver: Multiline 0.7 mm thick anodized aluminum in matt finish, hinged type, 3-spring loaded latches.

HIGH-INTENSITY DISCHARGE (HID) LIGHTING FIXTURES:

HID Ballasts: UL 1029 and shall be constant wattage autotransformer (CWA), regulator, or electronic ballast high power factor type unless otherwise indicated. Ballast shall be designed to operate at 220 volts, for installation in a normal ambient temperature of 40 degrees C.

SUSPENDED FIXTURES: Provide hangers capable of supporting twice the

combined weight of the adjoining fixtures. Provide with swivel hangers to ensure a plumb installation.

EMERGENCY LIGHTING EQUIPMENT: PEC, NFPA 70, and NFPA 101. Provide lamps (in wattage indicated).

Fluorescent Emergency System: Each system shall consist of automatic power failure device, test switch operable from outside of fixture, pilot light visible from outside the fixture, and fully automatic solid-state charger in a self-contained power pack. Charger shall either trickle, float, constant current or constant potential type, or a combination of these. Battery shall be sealed electrolyte type with capacity to supply power to the 2x36W lamps for 90 minutes. Battery shall operate unattended, and require no maintenance, including no additional water, for a period of not less than 5 years.

3. EXECUTION

INSTALLATION Install lighting fixtures plumb, square, and level with ceiling walls, in alignment with adjacent lighting fixtures, and secure in accordance with manufacturer's directions and approved shop drawings. The installation shall meet with the requirements of PEC. Mounting heights specified or indicated shall be to bottom of fixture for ceiling or pendent mounted fixtures and to center of fixture for wall-mounted fixtures. Obtain approval of the exact mounting for lighting fixtures on the job before installation is commenced and, where applicable, after coordinating with the type, style, and pattern of the ceiling being installed. Provide rods or bars for lighting fixture support under this section of the specifications.

Exit and Emergency Lights: Wire exit lights on separate circuits and serve from an emergency panel. The lights shall have only one control which shall be the circuit breaker in the emergency panel. Wire emergency lights ahead of the switch to the normal lighting circuit located in the same room or area.

GROUNDING: Ground noncurrent-carrying part of equipment as specified in Section 16402, "Interior Wiring Systems." Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

FIELD TESTS: The Contractor will provide electric power required for field tests.

Operating Test: Upon completion of the installation, conduct an operating test to show that the equipment operates in accordance with the requirements of this section.

Insulation Resistance Test: Perform as specified in Item, "Interior Wiring Systems" both before and after connection of fixtures and equipment.

Ground Resistance Tests: Perform as specified in items.

ITEM 14 : INTERIOR WIRING SYSTEM

1. GENERAL

"Electrical General Requirements," applies to this section with additions and modifications specified herein.

SUBMITTALS:

Manufacturer's Data:

- a. Receptacles
- b. Circuit Breakers
- c. Switches
- d. Conduit and Fittings (each type)
- e. Device plates
- f. Insulated conductors
- g. Outlet and junction boxes

Shop Drawings:

- a. Panelboards
- b. Wireways
- c. Pullboxes

2. PRODUCTS

MATERIALS AND EQUIPMENT, GENERAL: All materials, equipment, and devices shall, as a minimum, meet the requirements of UL where UL standards are established for those items, and the requirements of the PEC. All items shall be new unless specified or indicated otherwise.

CONDUITS AND FITTINGS:

Rigid Steel Conduit or Intermediate Metal Conduit: Zinc coated steel only.

Rigid Non-Metallic Conduit: UL 651, Schedule 40, Neltex, Emerald

Flexible Metal Conduit:

- a. Liquid-Tight Flexible Metal Conduit (Steel):

Fittings for Metal Conduit, and Flexible Metal Conduit: All ferrous fittings shall be cadmium - or zinc-coated.

Fittings for rigid or intermediate conduit shall be threaded type. Split couplings are not acceptable.

OUTLET BOXES AND COVERS: Zinc-coated ferrous metal.

CABINETS, JUNCTION BOXES, AND PULL BOXES (WITH VOLUME GREATER THAN 100 CUBIC INCHES): Hot dip zinc-coated, sheet steel.

WIRES AND CABLES: Wires and cables shall meet the applicable requirements of the PEC and UL for the type of insulation, jacket, and conductor specified or indicated.

Conductors: Conductors 1.5 mm dia. and smaller shall be solid, and those larger shall be stranded. All conductors shall be copper.

Equipment Manufacturer Requirements: Where Contractor provides equipment whose manufacturer requires copper conductors at the terminations, or requires that only copper conductors be provided between components of equipment, it shall be the Contractor's responsibility to provide copper conductors or all necessary splices, splice boxes, and other work required to satisfy manufacturer's requirements.

Minimum Conductor Sizes: Minimum size for branch circuits shall 3.5 sq. mm; for Class 1 remote-control and signal circuits, 2.0 sq. mm. and for Class 2 low-energy remote-control and signal circuits, 1.25 sq. mm.

Color Coding: Provide for all low voltage feeder, branch, control, and signaling circuit conductors. Color shall be green for grounding conductors, and white for neutrals, except where neutrals of more than one system are installed in same raceway or box, the other neutral shall be white with a colored (not green) stripe. The color of the ungrounded conductors in different voltage system shall be as follows:

400/230 Volts, 3-Phase -Phase A - Black
Phase B – Red
Phase C - Blue

Insulation: Unless specified or indicated otherwise or required to be otherwise by PEC, 34.5 and 4.16kV feeders shall be XLPE insulated shielded single core cables while low voltage power and lighting wires shall be 600-volt, Type THW or THWN, except that grounding wire may be Type TW; remote-control and signal circuits shall be Type TW, THWN or TF.

Bonding Conductors: ASTM B 1, solid bare copper wire for sizes 2.6 mm dia. and smaller; ASTM B 8, Class B, stranded bare copper wire for sizes 8.0 mm sq. and larger.

SPLICES AND TERMINATION COMPONENTS: UL 486A, as applicable for wire connectors, and UL 510 for insulating tapes. Connectors for wires 2.6 mm dia. and smaller shall be insulated pressure-type, twist-on-splicing connector. Provide solderless terminal lugs on stranded conductors.

DEVICE PLATES: Provide one-piece device plates for outlets and fittings to suit the devices installed. Plates on unfinished walls and fittings shall be of zinc-coated sheet steel or cast metal having round or beveled edges. Plates on finished walls shall be satin finish stainless steel, minimum 0.75 mm thick. Screws shall be machine type with countersunk heads in a color to match the finish of the plate. Plates installed in wet locations shall be gasketed. Telephone outlet shall be modular jack type with six (6) position, four contacts and matching cover plate.

SWITCHES:

Toggle Switches: Totally enclosed with bodies of thermosetting plastic and a mounting strap. Wiring terminals shall be of the screw type, side wired. Switches shall be rated quiet-type ac only 220 volts, with the current rating and number of poles indicated.

Disconnect Switches: NEMA KSI, Switches serving as motor-disconnect means shall be horsepower rated.

RECEPTACLES: NEMA WDI, grounding type. Ratings and configurations shall be as indicated. Bodies shall be of thermosetting plastic supported on a metal mounting strap. Wiring terminals shall be of the screw type, side wired. Connect grounding pole to the mounting strap.

Weatherproof Receptacles: Provide in a cast metal box with a gasketed, weatherproof, cast-metal cover plate and a gasketed cap over each receptacle opening. The cap(s) shall be provided with a spring-hinged flap. Receptacles shall be UL approved for use in "wet locations"

Ground-Fault Circuit Interrupter (GFCI) Receptacles: UL 943 Duplex for mounting in standard outlet box. Device shall be capable of detecting current leak of 6 milliamperes or greater and tripping per requirements of UL 943 for Class A GFCI devices.

Special Purpose Receptacles: Receptacles serving water heater, etc. are considered special purpose for this project. Provide in ratings indicated. Furnish one matching plug with each receptacle.

PANELBOARDS Panelboards shall be circuit breaker equipped. Design shall be such that any individual breaker can be removed without disturbing adjacent units or without loosening or removing supplemental insulation supplied as a means of obtaining clearances as required by UL. Where "space only" is indicated, make provisions for the installation of a breaker sized as indicated. All panelboard locks included in the project shall be keyed alike. Directories shall be typed to indicate load served by each circuit and mounted in a holder behind protective covering. Enclosure shall be 2.0 mm thick (Ga. 14) minimum

Panelboard Buses: Support copper bus bars on bases independent of the circuit breakers. Main buses and back pans shall be designed so that breakers may be changed without machining, drilling, or tapping. Provide a separate ground bus as indicated, marked with a green stripe along its front and bonded to the steel cabinet for connecting grounding conductors.

Circuit Breakers: Bolt-on, thermal magnetic type with interrupting capacity as indicated. Breaker terminals shall be UL listed as suitable for the type of conductor provided. Plug-in circuit breakers are not acceptable.

- a. **Multipole Breakers:** Provide internal common-trip type with a single operating handle. Breaker design shall be such that an overload in one pole automatically causes all poles to open. Maintain phase sequence throughout each panel so that any three adjacent breaker poles are connected to Phase A, B, and C, respectively. Single pole circuit breakers provided with external tripping handles for multipole circuit breaker are not acceptable.

GROUNDING AND BONDING EQUIPMENT:

Ground rods shall be copper-encased steel, with a diameter of 20 mm dia. and total length as indicated

3. EXECUTION

INSTALLATION

General Requirements:

Electrical installations shall conform to the requirements of the PEC and to the requirements specified herein.

Wiring Methods:

Wiring method shall be insulated conductors installed in conduit, except where specifically indicated or specified otherwise, or required by the PEC to be installed otherwise. An insulated equipment grounding conductor shall be provided in all feeder and branch circuits, including lighting circuits. Provide insulated, green-colored conductor for grounding conductors installed in conduit or raceways.

Conduit in Floor Slabs:

Rigid steel or Intermediate Metal Conduit.

Nonmetallic Conduit: Do not use above ground floor slab except where specifically indicated or specified for special situations or systems.

Conduit Installation: Unless indicated otherwise, conceal conduit within finished walls, ceilings, and floors. Keep conduit at least 150 mm away from parallel runs of flues and hot-water pipes. Install conduit parallel with or at right angles to ceilings, walls, and structural members where located above accessible ceilings and where conduit will be visible after completion of project. Conduits in crawl space under slab shall be run as if exposed.

Where conduits rise through floor slabs, the curved portion of bends shall not be visible above the finish slab.

Conduit Support: Support conduit by pipe straps, wall brackets, hangers, or ceiling trapeze. Fasten by wood screws to wood; by toggle bolts on hollow masonry units; by concrete inserts or expansion bolts on concrete or brick; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Do not weld conduits or pipe straps to steel structures. The load applied to fasteners attached to concrete ceiling shall be vibration and shock resistant. Holes cut to a depth of more than 38 mm in reinforced concrete beams or to a depth of more than 20 mm in concrete joints shall not cut the main reinforcing bars. Fill holes that are not used. In partitions of light steel construction, use sheet-metal screws. In suspended-ceiling construction, run conduit above the ceiling and fasten only lighting system branch circuit conduits to the ceiling supports. Spring steel fasteners may be used for lighting branch circuit conduit supports in suspended ceiling in dry locations.

Make changes in direction of runs with symmetrical bends or cast-metal fittings. Make field-made bends and offsets with a hickey or conduit-bending machine. Do not install crushed or deformed conduits. Avoid trapped conduits. Prevent plaster, dirt or trash from lodging in conduit, boxes, fittings, and equipment during construction. Free clogged conduits of all obstructions.

Install pull wires in empty conduits in which wire is to be installed by others. The pull wires shall be 2.0 sq. mm. zinc-coated steel or plastic having not less than 90 kg. tensile strength. Leave not less than 300mm slack of each end of the pull wire.

Telephone and Signal System Conduits: Install in accordance with the previous requirements for conduit and with the additional requirement that no length of run shall exceed 45 m for trade sizes 50 mm and smaller and shall not contain more than two 90-degree bends or the equivalent. Provide pull or junction boxes where necessary to comply with these requirements. Inside radii of bends in conduits 25 mm trade size and larger shall not be less than two (2) times the nominal diameter. Terminate conduit in terminal cabinet with two locknuts and a plastic bushing.

Conduit Installed in Concrete Floor Slabs: Locate so as not to adversely affect the structural strength of the slabs. Install conduit within the middle one-third of the concrete slab. Do not stack conduits. Space conduits horizontally not closer than three diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Increase slab thickness as necessary to provide a minimum 25 mm cover over conduit. Conduit larger than one-inch trade size shall be run parallel with or at right angles to the main reinforcement; when at right angles to the reinforcement, the conduit shall be close to one of the support of the slab.

Fasten conduits to sheet metal boxes and cabinets with two locknuts where required by the PEC, where insulated bushings are used, and where bushings cannot be brought into firm contact with the box; otherwise, use at least a single locknut and bushing. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Install bushings on the ends of conduits and provide insulating type where required by the PEC.

Stub-Ups: Provide conduits stubbed up through concrete floor for connection to free-standing equipment with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Extend conductors to equipment in rigid steel, except that flexible metal conduit may be used 150 mm above the floor. Where no equivalent connections are made, install screwdriver-operated threaded flush plugs in conduit end.

Flexible connections of short length (maximum of 1.8 m) shall be provided for recessed and semi-recessed lighting fixtures; for equipment subject to vibration, noise transmission, or movement; and for motors. Liquid-tight flexible conduit shall be used in wet locations. A separate ground conductor shall be provided across flexible connections.

Boxes, Outlets, and Supports: Provide boxes in the wiring or raceway systems wherever required for pulling of wires, making connections, and mounting of devices or fixtures. Boxes for metallic raceways shall be of the cast-metal hub type when located in normally wet locations, when surface mounted on outside of exterior surfaces, when installed exposed up to 2.10 m above interior floors and walkways. Boxes in other locations shall be sheet steel. Each box shall have the volume

required by the PEC for the number of conductors enclosed in the box. Boxes for mounting lighting fixtures shall be not less than 100 mm square, except that smaller boxes may be installed as required by the fixture configurations, as approved. Boxes for use in masonry-block or tile walls shall be square-cornered tile-type, or standard boxes having square-cornered tile-type covers. Provide gaskets for boxes installed flush with the outside of exterior surfaces. Provide separate boxes for flush or recessed fixtures when required by the fixture terminal operating temperature; fixtures shall be readily removable for access to the boxes unless ceiling access panels are provided. Support boxes and pendants for surface-mounted fixtures on suspended ceilings independently of the ceiling supports or make adequate provisions for distributing the load over the ceiling support members in an approved manner. Fasten boxes and supports with bolts and expansion shield on concrete or brick, with toggle bolts on hollow masonry units, and with machine screws or welded studs on steel work. Threaded studs driven in by powder charge and provided with lock washers and nuts or nail-type nylon anchors may be used in lieu of wood screws, expansion shield or machine screws. In Open overhead spaces, cast boxes threaded to raceways need not be separately supported except where used for fixture support; support sheet metal boxes directly from the building structure or by bar hangers. Where bar hangers are not used, attach the bar to raceways on opposite sides of the box and support the raceway with an approved type fastener not more than 600 mm from the box. When penetrating reinforced-concrete members, avoid cutting any reinforcing steel.

Boxes for use with raceways systems shall not be less than 55 mm deep, except where shallower boxes required by structural conditions are approved. Boxes for other than lighting-fixture outlets shall be not less than 100 mm square, except that 100 mm x 50 mm boxes may be used where only one raceway enters the outlet. Telephone outlets shall be a minimum of 100 mm x 55 mm deep.

Pull Boxes: Construct of not less than the minimum size required by the PEC of code-gage galvanized sheet steel, except where cast-metal boxes are required in locations specified above. Furnish boxes with screw fastened covers. Where several feeders pass through a common pullbox, tag the feeders to indicate clearly the electrical characteristics, circuit number and panel designation.

Mounting Heights: Mount panelboards, circuit breakers, and disconnecting switches so that the height of the operating handle at its highest position will not exceed 1.8 m from the floor. Mount lighting switches, receptacles and other devices as indicated. Measure mounting heights of wiring devices and outlets to the center of device or outlet.

Conductor Identification: Provide conductor identification within each enclosure where a tap, splice, or termination is made. For conductors 14 mm sq. and smaller, color coding shall be by factory-applied plastic-coated, self-sticking markers, colored nylon cable ties and plates, or heat-shrink type sleeves. Identify control circuit terminations.

Splices: Make splices in accessible locations. Make splices in conductors 2.6 mm dia. and smaller with an insulated pressure type connector. Make splices in conductors 8 sq. mm and larger with a solderless connector and cover with an insulation material equivalent to the conductor insulation.

Covers and Device Plates: Install with all four edges in continuous contact with finished wall surfaces without the use of mats or similar devices. Plaster fillings will not be permitted. Plates shall be installed with an alignment tolerance of 2 mm. The use of sectional type device plates will not be permitted. Plates installed in wet locations shall

be gasketed.

Grounding and Bonding: In accordance with the PEC, Ground all exposed non-current-carrying metallic part of electrical equipment, metallic raceways systems, neutral conductor of wiring systems. Make ground connection to driven ground rods as shown on drawings.

Grounding Conductor: Provide an insulated, green-colored equipment grounding conductor in all feeder and branch circuits. This conductor shall be separate from the electrical system neutral conductor.

Telephone Service: Provide a main telephone service equipment ground wire in conduit between the equipment and a readily accessible grounding connection. The equipment end of the ground wire shall consist of a coiled length at least twice as long as the main distribution frame or backboard height.

Resistance: The maximum resistance to ground of the grounding system shall not exceed 25 ohms under normally dry conditions.

FIELD TESTS: The Contractor shall provide all test equipment and personnel and submit written copies of all tests results. As an exception to requirements that may be stated elsewhere in the contract, the engineer shall be given 5 working days' notice prior to each test.

Devices Subject to Manual Operation: Each device subject to manual operation shall be operated at least five times, demonstrating satisfactory operation each time.

Test on 600-Volt Wiring: Test all 600-volt wiring to verify that no circuits or accidental grounds exist. Perform insulation resistance test on all wiring using an instrument which applies a voltage of approximately 500 volts to provide a direct reading of resistance; minimum resistance shall be 250,000 ohms.

Grounding System Test: Test the grounding system to assure continuity and that the resistance to ground is not excessive. Test each ground rod for resistance to ground before making any connections to the rod; then tie entire grounding system together and test for resistance to ground. Make resistance measurements in normally dry weather, not less than 48 hours after rainfall. Submit written results of each test to the Engineer and indicate the location of the rods as well as the resistance and soil conditions at the time the measurements were made.

ITEM 15 : EXTERIOR LIGHTING

1. GENERAL

"Electrical General Requirements," applies to this section with additions and modifications specified herein.

SUBMITTALS: Data, shop drawings, and reports shall employ the terminology, classification, and methods prescribed by the IESNA Lighting Handbook, as applicable, for the lightingsystem specified.

Manufacturer's Data: When data that describe more than one type, size, model, or item is submitted, clearly mark the data to indicate which type, size, model, or item is being provided. Data shall be sufficient to show conformance to specified requirements.

- a. Luminaires
- b. Poles and brackets
- c. Photocell switch
- d. Lighting Contactor

Shop Drawings:

- **Luminaires:** Include dimensions, accessories, and installation and construction details. Photometric data, including Zonal lumen data, average and minimum ratio, aiming diagram and candlepower distribution data shall accompany shop drawings.

Certified Test Reports:

Luminaires:

- a. Distribution data according to IES classification type as defined in IESNA Lighting Handbook.

Field Test Reports: Submit test results as stated in paragraph entitled "Field Tests."

2. PRODUCTS

LUMINAIRES:

Provide luminaires as indicated. Provide luminaires complete with lamps of the number, type and wattage indicated. The details, shapes and dimensions are indicative of the general type of desired, **but** are not intended to restrict selection to luminaires of any particular manufacturer. Luminaires of similar designs and equipment, light distribution and brightness characteristics, and of equal finish and quality will be acceptable as approved.

Lamps: Provide the type and wattage indicated.

- a. Metal Halide
- b. High Pressure Sodium Lamp

Ballast for High-Intensity-Discharge (HID) Luminaires: UL 1029, and shall be constant wattage auto-transformer (CWA) or regulator, high power factor type. Ballast shall be designed to operate on the voltage system to which they are connected. Provide single lamp ballasts with a minimum starting temperature of minus 30°C. Ballast shall be constructed so that open circuit operation will not reduce their average life.

LIGHTING CONTACTOR: Electrically operated, mechanically held contactor rated as indicated. Provide in NEMA 1 enclosure conforming to NEMA ICS 6. Contactor shall have silver alloy double-break contacts and coil clearing contacts and shall require no arcing contacts. Provide contactor with hand-off-automatic selector switch.

PHOTOCELL SWITCH: Hermetically sealed cadmium-supplied cell rated as indicated in a high-impact-resistant, non-corroding and nonconductive molded plastic housing with an EEL- NEMA locking-type receptacle. The switch shall turn on below 3 footcandles and off at 3 to 10 footcandles. A time delay shall prevent accidental switching from transient light sources. Mount a directional lens in front of the cell to prevent fixed light sources from creating a turnoff condition. Aim according to manufacturer's recommendations.

POLES: Provide poles designed for wind loading of 100 miles per hour determined in accordance with ASSHTO LTS-2 while supporting luminaires having effective project areas indicated. Poles shall be anchor-base type designed for use with underground supply conductors.

BRACKETS AND SUPPORTS: Pole brackets shall be not less than 32 mm galvanized steel pipe secured to pole. Slip-fitter or pipe-threaded brackets may be used, but brackets shall be coordinated to the luminaires provided, and all brackets for use with one type of luminaires shall be identical. Special mountings or brackets shall be as indicated and shall be of metal which will not promote galvanic reaction with the luminaire head.

ANCHOR BASE ASSEMBLIES: Anchor bolts shall be steel rod having a minimum yield strength of 50,000 psi; the top 300 mm of the rod shall be galvanized per ASTM A 153. Anchor bases for steel poles shall be structural quality hot-rolled carbon steel plate having a minimum yield strength of 36,000 psi.

MANUFACTURER: Materials to be supplied shall be products of manufacturers listed.

Luminaires: G.E., Phillips or approved equal.

Lamps: G.E., Philips or approved equal.

Ballast: Philips, Advance, G.E. or approved equal.

3. EXECUTION

INSTALLATION: ANSI C2, PEC, and to the requirements specified herein.

- a. **Steel Poles:** Provide anchor bases with galvanized steel anchor bolts, threaded at the top end and bent 90 degrees at the bottom end. Provide galvanized nuts, washers, and ornamental covers for anchor bolts. Concrete for anchor bases, polyvinyl chloride (PVC) conduit ells, and ground rods shall be as specified in Item,

"Underground Electrical Work." Thoroughly compact backfill with compacting arranged to prevent any pressure between conductor, jacket, or sheath and the end of conduit ell. Adjust poles as necessary to provide permanent vertical position with the bracket arm in proper position for luminaire

- b. **GROUNDING:** Ground non-current carrying parts of equipment including metal poles as specified in Section 16301 "Underground Electrical Work". Where the copper grounding conductor is connected to a metal other than copper, provide specially treated or lined connectors suitable for this purpose.

FIELD TESTS: The Contractor shall provide electric power required for field tests.

Operating Test: Upon completion of installation, conductor an operating test to show that the equipment operates in accordance with the requirements of this specification section.

Insulation Resistance Test: Perform as specified in Item "Underground Electrical Work", both before after connection of fixtures and equipment.

Ground Resistance Tests: Perform as specified in Item "Underground Electrical Work".

ITEM 16 : ELECTRICAL GENERAL REQUIREMENTS

1. GENERAL

APPLICATION

This item applies to all items of "Electrical Division" of this project except as specified otherwise in each individual item.

SCOPE OF WORK

The work to be done under this item shall include the furnishing of all tools, labor, supervision, equipment, fixtures and all necessary materials, each complete and in proper working condition unless one or other is specifically excluded or stated otherwise in this specifications but not limited to the following items of works.

- a. First private pole, concrete pedestal, primary entrance conduits and 34.5kV cables up to high voltage switchgear
- b. 34.5/4.16kV main transformer and 4.16kV bus duct to 4.16kV switchgear
- c. 4.16kV switchgear, medium voltage conduits and cables distribution to pad mounted transformers, and cranes
- d. Pad mounted transformers and low voltage distribution switchboards and secondary feeders
- e. Distribution switchboards and lighting distribution to exterior lighting
- f. Panelboards and enclosed circuit breakers
- g. Interior lighting and power wiring and raceway system
- h. Standby generator system including 4.16kV feeders to switchboards, exhaust piping, radiator ducting, fuel supply piping, 2-hour day tanks, fuel pumps and 72-hour capacity above ground diesel fuel storage tanks
- i. Grounding system
- J. Painting of electrical works and equipment
- k. Complete testing and commissioning of electrical systems and equipment

TEMPORARY LIGHT AND POWER

The Contractor shall make all arrangements and pay for the provisions of the necessary electrical power of the type and capacity required for the performance of the work of all trades engaged in the construction of the building.

CODES, INSPECTION, PERMITS AND FEES

All work under this contract shall be installed in accordance with the latest requirements of the Philippine National building Code, Philippine Electrical Code (PEC), Regulations of Cagayan De Oro City and the Local Power Company.

All necessary permits and electrical fees required for this work shall be obtained by and at the expense of the Contractor. The contractor shall furnish the Engineers and the Owner final certificate of electrical inspection and approval from the proper government authorities after completion of the work. The Contractor shall prepare all as-built plan and all forms and documents required by the approving authorities.

Power service application including drawings for the work shall be obtained by and at the expense of the Contractor. The Contractor shall comply with all requirements of the utility company regarding service applications.

Approval of Plans:

Approval from authorities of all plans for construction shall be secured by the Contractor.

SUBMITTALS:

Obtain Owner's approval before procurement, fabrication, or delivery of items to the jobsite. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, and place of manufacturer, catalog model or number, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable industry, and technical society publication references and other information necessary to establish contract compliance of each item to be furnished. Substitutions for materials, devices and equipment other than those specified shall be accepted only when specified brand names are not available.

Shop Drawings:

Shop drawings shall meet the following requirements. Drawings shall be a minimum of 215 mm by 280 mm in size, except as specified otherwise. Drawings shall include wiring diagrams and installation details of equipment indicating proposed location, layout and arrangement, accessories, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.

Manufacturer's Data:

Submittals for each manufactured item shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.

Publication Compliance:

Where equipment or materials are specified to conform to industry and technical society publications of organizations such as International Electro technical Commission (IEC), American National Standards Institute (ANSI), American Society for Testing and Materials (ASTM), and Underwriters Laboratories Inc. (UL), submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publication.

Certified Test Reports:

Furnish as specified or as required per standards requirements.

Certificates of Compliance:

Submit manufacturer's certifications as required on products, materials, finish, and equipment indicated in the technical sections. Certifications shall be documents prepared specifically for this contract. Preprinted certifications and copies of previously submitted documents will not be acceptable. The manufacturer's certifications shall name the appropriate products, equipment, or materials and the publication specified as controlling the quality of that item. Certification shall not contain statements to imply that the item does not meet requirements specified, such as "as good as", "achieve the same end use and results as materials formulated in accordance with the referenced publications", or "equal or exceed the service and performance of the specified material." Certifications shall simply state that the item conforms to the requirements specified. Certificates shall be printed on the manufacturer's letterhead and shall be signed by the manufacturer's official authorized to sign certificates of compliance.

RECORD DRAWINGS:

The Contractor shall, during the progress of the work, keep a record of all deviations of the actual installation from that shown on the contract drawings.

Electronic Copies:

The Engineer will furnish the Contractor at cost a complete set of electronic copies of drawings, or the Contractor may, at his discretion, prepare a new set of electronic files indicating the work as actually installed. A copy and at least three (3) hard copies of these electronic files, indicating such changes and revisions, shall be submitted to the Engineer.

As-Built Drawings:

Upon completion of the work, the Contractor shall submit two (2) copies of the as-built drawings, indicating the work as actually and finally installed, including new information not originally shown in contract drawings, to the Engineer for approval as to conformance with the design concepts and compliance with pertinent code provisions. After such approval, the Contractor shall submit the as-built drawings electronic files and originals and one (1) set of prints to the Owner. Approval of the as-built drawings by the Project Manager shall be a requirement for final acceptance of the completed works and for final payment.

OPERATION AND MAINTENANCE MANUAL:

Submit as required for systems and equipment indicated in the technical sections. Furnish three copies, bound in hardback binders or an approved equivalent. Furnish one complete manual prior to performance of systems or equipment test, and furnish the remaining manuals prior to contract completion. Inscribe the following identification on the cover: the words "OPERATION AND MAINTENANCE MANUAL," the name and location of the system, equipment, building, name of Contractor, and Contract number. Include in the manual the names, addresses, and telephone numbers of each subcontractor installing the system or equipment and the local representatives for the system or equipment. Include a table of contents and assemble the manual to conform to the table of contents, with the tab sheets placed before instructions covering the subject. The instructions shall be legible and easily read, with large sheets of drawings folded in. The manual shall include:

- a. Internal and interconnecting wiring and control diagrams with data to explain detailed operation and control of the system or equipment
- b. A control sequence describing startup, operation, and shutdown
- c. Description of the function of each principal item of equipment
- d. Installation and maintenance instructions
- e. Safety precautions
- f. Diagrams and illustrations
- g. Testing methods
- h. Performance data
- i. Parts List. The list shall indicate sources of supply, recommended spare parts, and name of servicing organization
- j. Appendix: List qualified permanent servicing organizations for support of the equipment, including addresses and certified qualifications

POSTED OPERATING INSTRUCTIONS

Furnish approved operating instructions for system and equipment indicated in the technical sections for use by operation and maintenance personnel. The operating instructions shall include wiring diagrams, controls diagrams, and control sequence for each principal system and equipment. Print or engrave operating instructions and frame under glass or in approved laminated plastic. Post instructions as directed. Attach or post operating instructions adjacent to each principal system and equipment including startup, proper adjustment, operating, lubrication, shutdown, safety precautions procedure in the event of equipment failure, and other items of instruction as recommended by the manufacturer of each system or equipment.

DELIVERY AND STORAGE:

Handle, store, and protect equipment and materials in accordance with the manufacturer's recommendations. Replace damaged or defective items with new items.

CATALOGED PRODUCTS/SERVICE AVAILABILITY:

Materials and equipment shall be current products by manufacturers regularly engaged in the production of such products. Products shall have been in satisfactory commercial or industrial use for two years prior to bid opening. The two-year period shall include applications of equipment and materials under similar circumstances and of similar size. The two-year period shall be satisfactorily completed by a product for sale on the commercial market through advertisements, manufacturers' catalog, or brochures. Products having less than a two-year field service record will be acceptable if a certified record of satisfactory field operation for not less than 6000 hours, exclusive of the manufacturers' factory or laboratory tests, is furnished. The equipment items shall be supported by service organizations which are reasonably convenient to the equipment installation in order to render satisfactory service to the equipment on a regular and emergency basis during the warranty period of the contract.

MANUFACTURER'S RECOMMENDATIONS:

Where installation procedures or any part thereof are required to be in accordance with manufacturer's recommendations, furnish printed copies of the recommendations prior to installation. Installation of the item shall not proceed until recommendations are received. Failure to furnish recommendations shall be cause for rejection of the equipment or material.

ELECTRICAL CHARACTERISTICS:

Electrical characteristics for this project are 4.16kV and 400Y/230 volts, 3-phase, 4-wire 60 Hz.

ELECTRICAL REQUIREMENTS:

Provide power wiring and conduit under Item, "Interior Wiring Systems." Power wiring and conduit shall conform to the requirements of Item, "Interior Wiring Systems."

GUARANTEE:

The Contractor shall guarantee that the Electrical Works are free from defective workmanship and materials and will remain so for a period of one year from date of acceptance of the work. Any defects appearing within the said period shall be remedied by the Contractor at his own expense.

The Contractor shall indemnify and save harmless the Owner and the Engineers from and against all liability for injuries or disabilities to persons or damage to property occasioned by any act or omissions of the Contractor or any of his Subcontractors, including any and all expenses, legal or otherwise which may be incurred by the Owner or the Engineers, in the defense of any claim, action or suit.

2. PRODUCTS

NAMEPLATES: Provide laminated plastic nameplates for each enclosed circuit breaker, equipment enclosure, switch, and device. Each nameplate inscription shall identify the function and, when applicable, the position. Nameplates shall be melamine plastic, 3 mm thick, white with black center core. Surface shall be matte finish. Corners shall be square.

Accurately align lettering and engrave into the black core. Minimum size of nameplates shall be 50mm by 150mm. Lettering shall be a minimum of 25mm high normal block style.

EQUIPMENT AND MATERIAL:

Equipment and material should be based on acceptable brands or manufacturers as indicated below. Any substitution or use of equivalent brands other than those listed shall be subject to the approval of the Engineers. The list of the acceptable brands or manufacturers indicates compliance of the equipment and materials listed to the project specifications. Final approval and selection of specific equipment and materials shall comply with items and other specifications sections.

<u>Equipment/Material</u>	<u>Acceptable Brand/Manufacturer</u>
1. Insulated Conductors	L.S, American Wire, Phelps Dodge
2. Plastic Conduit	Neltex, Emerald
3. Receptacles & Device Plate	National or equivalent
4. Light Switches	National
5. Panel board/ Circuit Breaker	LS, Schneider Siemens, Fuji, ABB
6. Disconnect Switches	Schneider, Siemens

- | | |
|--------------------------------------|-----------------------------|
| 7. Conduit and Fittings | |
| a. Rigid Steel or Intermediate Metal | Panasonic or equivalent |
| b. Flexible Metal Conduit | Panasonic and Pusan |
| c. Polyvinyl Chloride (PVC) | Neltex, Emerald |
| 8. Insulated Conductors | American Wire, Phelps Dodge |
| 9. Outlet and Junction Boxes | Steel City, Timco |
| 10. Motor Starter | LS, Schneider, Siemens, ABB |
| 11. Fluorescent lamp & Ballast | Philips, Osram |

3. EXECUTION

NAMEPLATE MOUNTING: Provide number, location, and letter designation of nameplates as indicated. Fasten nameplates to the device with a minimum of two sheet-metal screws or two rivets.

PAINTING OF EQUIPMENT:

Factory Applied:

1. Electrical equipment shall have factory applied painting systems which shall, as a minimum, meet the requirements of NEMA ICS 6 corrosion-resistance test. Baked enamel paint or powder coat finish on epoxy primer are also acceptable.

Field Applied:

2. Paint electrical equipment as required to match finish or to meet safety criteria.

ITEM 17 : UNDERGROUND ELECTRICAL WORK

1. GENERAL

"Electrical General Requirements," applies to this section with additions and modifications specified herein.

SUBMITTALS: Submit the following information for approval

- a. Catalog Data / Or Shop Drawings:
 - Conduits
 - Wires/ Cables
 - Cable Lubricant
 - Ground Rods

2. PRODUCTS

MATERIALS AND EQUIPMENT: Materials and equipment shall conform to the respective specifications and standards and to the specifications herein. Electrical ratings shall be as indicated.

CONDUITS:

Intermediate Metal Conduit (UL 1242): Hot-dip galvanized, threaded type. Conduit shall be Panasonic, Smarttube or approved equal.

Rigid Plastic Conduit: UL 651, Schedule 40 PVC, Neltex, Emerald, Atlanta.

Fittings and Outlet Boxes:

Metal Fittings and Outlet Boxes: UL 514 A & B. Fittings and outlet boxes for use with steel and plastic conduit, rigid or flexible shall be cast-metal with gasketed closures.

PVC Fittings: UL 651.

Tape: UL 510. Plastic insulating tape shall be capable of performing in a continuous temperature environment of 80 degrees C.

Power Wire and Cable:

Wire and Cable Conductor Sizes: Wire and Cable conductor sizes are designated in square millimeter area unless millimeter diameter is indicated. Use 3.5 square mm minimum sized conductors, unless otherwise noted. Conductors shall be copper. Provide conductor identification within each enclosure where a tap, a splice or a termination is made. Wires shall be as manufactured by American Wire, Phelps Dodge, LS or approved equal.