



Republic of the Philippines  
Department of Agriculture  
Western Visayas  
Iloilo City


**ESTABLISHMENT OF SEED RESERVE  
WAREHOUSE/FACILITY (WITH OFFICE)**  
Brgy. Mansilingan, Bacolod City, Negros Occidental

**TECHNICAL SPECIFICATIONS**

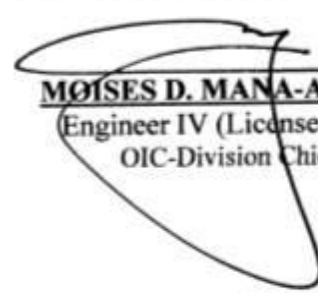
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## I. FACILITIES FOR THE ENGINEER

### A. A.1.1(8) PROVISION OF FIELD OFFICE FOR THE ENGINEER (Rental Basis)

#### A.1 REQUIREMENTS

##### 1. Office for the Engineer

The Contractor shall provide and maintain field offices, including all the necessary electricity, water, drainage and telephone services for the use of the Engineer.

The office shall have at least a minimum floor area of 48 square meters, including 1 bedroom, and toilet & bath. The office shall contain 1 piece 30 X 48 plastic table, 4 pieces Monoblock Chairs, Logbook, bond papers, markers and other supplies that should be provided by the contractor. The office shall be ready for occupancy for the duration of the Contract and its location shall subject to the approval of the Engineer.

The Contractor shall be responsible for the maintenance and protection of all facilities to be provided during the duration of the Contract.

#### A.2 MEASUREMENT AND PAYMENT

##### 1. Measurement

Lump-sum items shall be provided for the provision of:

- Office building for the Engineer including furnishings.

##### 2. Payment

The quantities determined as provided above shall be paid for at the appropriate contract price.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
A.1.1(7)	Construction of Field Office for the Engineers	Lump Sum

## II. OTHER GENERAL REQUIREMENTS

### A. B.3 PERMITS AND LICENSES

#### B.3.1 General Requirements

The concerned implementing office DA-RAED shall be responsible for securing all necessary permits and clearances related to the project, which shall include but not limited to building permits, occupancy permit, excavation permit, locational clearances and environmental compliance certificate, etc. Contractors All Risk Insurance & Third Party Liability and Workman's Compensation Insurance (CARI), and other insurances required by the Local Government Unit (LGU) among others, including payment of assessed fees as may be required by the LGU and/or Regulating Agencies before the implementation of the project. However, for projects implemented by DA-RAED but owned by other agencies/farmers associations and cooperatives, the owner shall secure all the necessary permits and clearances. ***This item includes taxes, permits and clearances which might be paid by the Contractor and reimbursed by the Employer or other GOP agencies***, except the following taxes included in unit prices:

- VAT,
- Import Duties and taxes,
- Corporate income tax, and
- Personal income taxes on Japanese employees.

### **B.3.2 Method of Measurement**

Permits and Clearances shall be measured by Lump sum.

### **B.3.3 Basis of Payment**

The accepted quantities, measured as provided in Section B.3.2, Method of Measurement, shall be paid for at the Contract Unit Price of the Pay Item listed below that is included in the Bill of Quantities. The unit price shall cover full compensation for all related services necessary to complete the Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
B.3	Permits and Licenses	Lump sum

## **B. B.5 PROJECT BILLBOARD & MARKER /SIGNBOARD/COA BILLBOARDS AND BARRICADES**

### **Description**

This Item shall consist of furnishing and installing project billboard in accordance with this Specification and details shown on the Plans, or as required by the Engineer. The item also includes installation of project marker as specified on plan.

The project billboard shall comply in all respects with the "COA Circular No. 2013-004" dated January 30, 2013. The information and publicity on projects of Government Agencies including Foreign Funded Projects are being guided by this Circular.

The project billboard will be erected as soon as the award has been made. It will be located at the beginning and at the end of the subproject throughout the project duration.

The size, materials and design to be used for the project signboard will specifically adhere to the General Guidelines No. 2.2.3 of the Circular while the content of the information shall conform to the General Guidelines No. 2.2.6 and the sample format shown in "Annex A" of the Circular.

### **Method of Measurement**

The quantities of project billboard shall be the lump sum of such signs of the size specified, including the necessary posts and supports erected and accepted.

### **Basis of Payment**

The quantities measured as determined in the Method of Measurement, shall be paid for at the contract unit price for the Pay Items shown in the Bid Schedule which price and payment shall be full compensation for furnishing and installing project billboard, for excavation, backfilling and construction of foundation blocks, and all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
B.5	Project Signboard / Signboard	Lump sum

**C. B.7(2) OCCUPATIONAL SAFETY AND HEALTH PROGRAM**

Section 6 (Personal Protective Equipment) of D. O. No. 13 guidelines states that "every employer shall, at his own expense, furnish his workers with protective equipment for eyes, face, hands and feet, lifeline, safety belt/harness, protective shields and barriers whenever necessary by reason of the hazardous work process or environment, chemical or radiological or other mechanical irritants of hazards capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical agent".

All Personal Protective Equipment and Devices shall be in accordance with the requirement of the Occupational Safety and Health Standards (OSHS) and should pass the test conducted and/or standards sets by the Occupational Safety and Health Center (OSHC). For General Construction Work the required Basic PPEs for all workers shall be Safety Helmet, Safety Gloves and Safety Shoes. Specialty PPEs shall be provided to workers in addition to or in lieu of the corresponding basic PPE as the work or activity requires.

Overall supervision, control and monitoring of the implementation of Construction Safety and Health Program for projects undertaken by administration/contracts shall be under the Bureau of Construction.

**Basis of Payment**

Method of Measurement shall be paid for at the contract unit price for the Pay Items shown in the Bid Schedule which price and payment shall be full compensation for the provision of Personal Protective Equipment (PPE) and Devices, Medicines, Medical Supplies and other incidentals necessary to complete the Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
B.7	Occupational Safety and Health Program	Month

**D. B.9 MOBILIZATION AND DEMOBILIZATION**

**Scope of Work**

This Section includes mobilization, demobilization, assembly, and disassembly of equipment/plants including incidentals necessary to complete the work.

**Measurement**

The Lump sum price shall provide for the mobilization and demobilization of all Contractor's plant/equipment and personnel to cover all costs for mobilization and demobilization, transportation, insurance during transportation, port fees, taxes, utilities, support staffs and all other incidentals.

The payment shall cover the dismantling of the work site by the Contractor, with removal of all the alterations, constructional plant and equipment, so that the site is restored to the state it was in before the installations, plant and equipment were placed there.

**Basis of Payment**

All costs associated with and necessary for compliance with this Specification shall be included in the Lump Sum price. No additional or separate payment will be made in this regard.

The DA-RAED may at any time withhold payment if (in the opinion of the Engineer) requirements of this Specification section are not provided.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
B.9	Mobilization / Demobilization	Lump Sum

### **III. SITE WORKS**

#### **1. SITE CLEARING & GRUBBING- ITEM 800(1) (Refer to Item 100, Part C of Volume II (Blue Book))**

##### **ITEM 100 – CLEARING AND GRUBBING**

###### **100.1 Description**

This item shall consist of clearing, grubbing, removing and disposing all vegetation and debris as designated in the Contract, except those objects that are designated to remain in place or are to be removed in consonance with other provisions of this Specification. The work shall also include the preservation from injury or defacement of all objects designated to remain.

###### **100.2 Construction Requirements**

###### **100.2.1 General**

The Engineer will establish the limits of work and designate all trees, shrubs, plants and other things to remain. The Contractor shall preserve all objects designated to remain.

Clearing shall extend one (1) meter beyond the toe of the fill slopes or beyond rounding of cut slopes as the case maybe for the entire length of the project unless otherwise shown on the plans or as directed by the Engineer and provided it is within the right of way limits of the project, with the exception of trees under the jurisdiction of the Forest Management Bureau (FMB).

###### **100.2.2 Clearing and Grubbing**

All surface objects and all trees, stumps, roots and other protruding obstructions, not designated to remain, shall be cleared and/or grubbed, including mowing as required, except as provided below:

(1) In areas covered by cogon/talahib, wild grass and other vegetation, top soil shall be cut to a maximum depth of 150 mm below the original ground surface or as designated by the Engineer, and disposed outside the clearing and grubbing limits as indicated in the typical roadway section.

If perishable material is burned, it shall be burned under the constant care of component watchmen at such times and in such a manner that the surrounding vegetation, other adjacent property, or anything designated to remain on the right of way will not be jeopardized. If permitted, burning shall be done in accordance with applicable laws, ordinances, and regulation.

Materials and debris which cannot be burned and perishable materials may be disposed off by methods and at locations approved by the Engineer, on or off the project. The disposal areas shall be seeded, fertilized and mulched at the Contractor's expense.

###### **100.3 Method of Measurement**

Measurement will be by one or more of the following alternate methods:

1. Area Basis. The work to be paid for shall be the number of hectares and fractions thereof acceptably cleared and grubbed within the limits indicated on the Plans or as may be adjusted in field staking by the Engineer. Areas not within the clearing and grubbing limits shown on the Plans or not staked for clearing and grubbing will not be measured for payment.

###### **100.4 Basis of Payment**

The accepted quantities, measured as prescribed in Section 100.3, shall be paid for at the Contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities, which price and payment shall be full compensation for furnishing all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

#### IV. EARTHWORKS

##### A. STRUCTURAL EXCAVATION (Common Soil)- ITEM 803(1)a (Refer to Item 103, Part C of Volume II (Blue Book))

#### ITEM 103 – STRUCTURE EXCAVATION

##### 103.1 Description

This Item shall consist of the necessary excavation for foundation of bridges, culverts, underdrains, and **other structures** not otherwise provided for in the Specifications. Except as otherwise provided for pipe culverts, the backfilling of completed structures and the disposal of all excavated surplus materials, shall be in accordance with these Specifications and in reasonably close conformity with the Plans or as established by the Engineer.

It shall also include the furnishing and placing of approved foundation fill material to replace unsuitable material encountered below the foundation elevation of structures. No allowance will be made for classification of different types of material encountered.

##### 103.2 Construction Requirements

###### 103.2.1 Clearing and Grubbing

Prior to starting excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Item 100, Clearing and Grubbing.

###### 103.2.2 Excavation

(1) General, all structures. The Contractor shall notify the Engineer sufficiently in advance of the beginning of any excavation so that cross-sectional elevations and measurements may be taken on the undisturbed ground. The natural ground adjacent to the structure shall not be disturbed without permission of the Engineer.

After each excavation is completed, the Contractor shall notify the Engineer to that effect and no footing, bedding material shall be placed until the Engineer has approved the depth of excavation and the character of the foundation material.

(2) Structures other than pipe culverts. All rock or other hard foundation materials shall be cleaned all loose materials, and cut to a firm surface, either level, stepped, or serrated as directed by the Engineer. All seams or crevices shall be cleaned and grouted. All loose and disintegrated rocks and thin strata shall be removed.

When the footing is to rest on material other than rock, excavation to final grade shall not be made until just before the footing is to be placed. When the foundation material is soft or mucky or otherwise unsuitable, as determined by the Engineer, the Contractor shall remove the unsuitable material and backfill with approved granular material. This foundation fill shall be placed and compacted in 150 mm (6 inches) layers up to the foundation elevation.

###### 103.2.3 Utilization of Excavated Materials

All excavated materials, so far as suitable, shall be utilized as backfill or embankment. The surplus materials shall be disposed off in such manner as not to obstruct the stream or otherwise impair the efficiency or appearance of the structure. No excavated materials shall be deposited at any time so as to endanger the partly finished structure.

###### 103.2.3 Backfill and Embankment for Structures Other Than Pipe Culverts

Excavated areas around structures shall be backfilled with free draining granular material approved by the Engineer and placed in horizontal layers not over 150 mm (6 inches) in thickness, to the level of the original ground surface. Each layer shall be moistened or dried as required and thoroughly compacted with mechanical tampers.

##### 103.3 Method of Measurement

###### 103.3.1 Structure Excavation

The volume of excavation to be paid for will be the number of cubic meters measured in original position of material acceptably excavated in conformity with the Plans or as directed by the Engineer, but in no case, except as noted, will any of the following volumes be included in the measurement for payment:

(1) Volume of water or other liquid resulting from construction operations and which can be pumped or drained away.

(2) The volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed ground.

(3) The volume of excavation for footings ordered at a depth more than 1.5 m (60 inches) below the lowest elevation for such footings shown on the original Contract Plans, unless the Bill of Quantities contains a pay

item for excavation ordered below the elevations shown on the Plans for individual footings.

### **103.3.3 Foundation Fill**

The volume of foundation fill to be paid for will be the number of cubic meters measures in final position of the special granular material actually provided and placed below the foundation elevation of structures as specified, complete in place and accepted.

### **103.3.5 Basis of Payment**

The accepted quantities, measured as prescribed in Section 103.3, shall be paid for at the contract unit price for each of the particular pay items listed below that is included in the Bill of Quantities. The payment shall constitute full compensation for the removal and disposal of excavated materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item, except as follows:

(1) Any excavation for footings ordered at a depth more than 1.5 m below the lowest elevation shown on the original Contract Plans will be paid for as provided in Part K, Measurement and Payment, unless a pay item for excavation ordered below Plan elevation appears in the Bill of Quantities.

(2) Concrete will be measured and paid for as provided under Item 405, Structural Concrete.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
103 (1)	Structure Excavation	Cubic Meter
103 (3)	Foundation Fill	Cubic Meter
103 (4)	Excavation ordered	Cubic Meter

**B. EMBANKMENT FROM STRUCTURAL EXCAVATION- ITEM 804(1)b (Refer to Item 104, Part C of Volume II (Blue Book))**

**C. EMBANKMENT COMMON BORROW- ITEM 804(1)a (Refer to Item 104, Part C of Volume II (Blue Book))**

## **ITEM 104 – EMBANKMENT**

### **104.1 Description**

This Item shall consist of the construction of embankment in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

### **104.2 Material Requirements**

Embankments shall be constructed of suitable materials, in consonance with the following definitions:

1. Suitable Material – Material which is acceptable in accordance with the Contract and which can be compacted in the manner specified in this Item. It can be common material or rock.

Selected Borrow, for topping – soil of such gradation that all particles will pass a sieve with 75 mm (3 inches) square openings and not more than 15 mass percent will pass the 0.075 mm (No. 200) sieve, as determined by AASHTO T 11.

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

### **104.3 Construction Requirements**

#### **104.3.1 General**

Prior to construction of embankment, all necessary clearing and grubbing in that area shall have been performed in conformity with Item 100, Clearing and Grubbing.

Embankments and backfills shall contain no muck, peat, sod, roots or other deleterious matter. Rocks, broken concrete or other solid, bulky materials shall not be placed in embankment areas where piling is to be placed or driven.

Where shown on the Plans or directed by the Engineer, the surface of the existing ground shall be compacted to a depth of 150 mm (6 inches) and to the specified requirements of this Item.

#### **104.3.2 Methods of Construction**

Where there is evidence of discrepancies on the actual elevations and that shown on the Plans, a preconstruction survey referred to the datum plane used in the approved Plan shall be undertaken by the Contractor under the control of the Engineer to serve as basis for the computation of the actual volume of the embankment materials.

Effective spreading equipment shall be used on each lift to obtain uniform thickness as determined in the trial section prior to compaction. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, or other methods satisfactory to the Engineer.

When excavated material contains more than 25 mass percent of rock larger than 150 mm in greatest diameter and cannot be placed in layers of the thickness prescribed without crushing, pulverizing or further breaking down the pieces resulting from excavation methods, such materials may be placed on the embankment in layers not exceeding in thickness the approximate average size of the larger rocks, but not greater than 600 mm (24 inches).

Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

#### **104.3.3 Compaction**

##### **Compaction Trials**

Before commencing the formation of embankments, the Contractor shall submit in writing to the Engineer for approval his proposals for the compaction of each type of fill material to be used in the works. The proposals shall include the relationship between the types of compaction equipment, and the number of passes required and the method of adjusting moisture content. Compaction trials with the main types of fill material to be used in the works shall be completed before work with the corresponding materials will be allowed to commence.

Throughout the periods when compaction of earthwork is in progress, the Contractor shall adhere to the compaction procedures found from compaction trials for each type of material being compacted, each type of compaction equipment employed and each degree of compaction specified.

##### **Earth**

The Contractor shall compact the material placed in all embankment layers and the material scarified to the designated depth below subgrade in cut sections, until a uniform density of not less than 95 mass percent of the maximum dry density determined by AASHTO T 99 Method C, is attained, at a moisture content determined by Engineer to be suitable for such density.

The Engineer shall during progress of the Work, make density tests of compacted material in accordance with AASHTO T 191, T 205, or other approved field density tests. If, by such tests, the Engineer determines that the specified density and moisture conditions have not been attained, the Contractor shall perform additional work as may be necessary to attain the specified conditions.

##### **Rock**

Density requirements will not apply to portions of embankments constructed of materials, which cannot be tested in accordance with approved methods.

Embankment materials classified as rock shall be deposited, spread and leveled the full width of the fill with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment.

#### **104.3.4 Protection of Structure**

If embankment can be deposited on one side only of abutments, wing walls, piers or culvert headwalls, care shall be taken that the area immediately adjacent to the structure is not compacted to the extent that it will cause overturning of, or excessive pressure against the structure. When embankment is to be placed on both sides of a concrete wall or box type structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure.

#### **104.4 Method of Measurement**



The quantity of embankment to be paid for shall be the volume of material compacted in place, accepted by the Engineer and formed with material obtained from any source.

Material from excavation per Item 103 which is used in embankment and accepted by the Engineer will be paid under Embankment and such payment will be deemed to include the cost of excavating, hauling, stockpiling and all other costs incidental to the work.

Material for Selected Borrow topping will be measured and paid for under the same conditions specified in the preceding paragraph.

#### **104.5 Basis of Payment**

The accepted quantities, measured as prescribed in Section 104.4, shall be paid for at the Contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities. The payment shall continue full compensation for placing and compacting all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
104 (2)	Selected, Borrow for topping, Case 1	Cubic Meter
104 (3)	Selected Borrow for topping, Case 2	Cubic Meter

## V. PLAIN & REINFORCED CONCRETE WORKS

- A. STRUCTURAL CONCRETE CLASS A, 28 DAYS – ITEM No. 900(1)c1
- B. REINFORCING STEEL (Deformed) GRADE 40 – ITEM No. 902(1)a
- C. REINFORCING STEEL (Deformed) GRADE 60 – ITEM No. 902(1)b

### ITEM 900 - REINFORCED CONCRETE

#### 900.1 Description

This Item shall consist of furnishing, placing and finishing concrete in buildings and related structures in accordance with this specification and conforming to the lines, grades, and dimension shown on the plans.

#### 900.2 Materials Requirements

##### 900.2.1 Portland Cement

This shall conform to the requirement of ITEM 700, Volume II (BlueBook), Hydraulic cement.

##### 900.2.2 Concrete Aggregates

Concrete aggregate shall conform to the requirements of subsection 311.2.2 and 311.2.3 under Item 311 of Volume II, (Blue Book)

##### 900.2.3 Water

Water used in mixing concrete shall conform to the requirement of subsection 311.2.4 under Item 311, Part E, of Volume II, (BlueBook).

##### 900.2.4 Metal Reinforcement

Reinforcing steel bars shall conform to the requirements of the following Specifications:

Deformed & Plain Billet Steel Bars for concrete Reinforcement	(ASTM A 615)
Bars for concrete Reinforcement	AASHTO M 31

If reinforcing bars are to be welded, these ASTM specifications shall be supplemented by requirements assuring satisfactory weldability.

Bar and rod mats for concrete reinforcement	ASTM A 187
Cold-Drawn Steel Wire for concrete reinforcement	(ASTM A 82) AASHTO M 32
Welded steel wire fabric for concrete reinforcement except that the weld shear strength requirement of those specification shall be extended to include a wire size differential up to and including six gages.	(ASTM A 185) AASHTO M55
Wire and Strands for pre-stressed concrete Used in making strands for post-tensioning shall be cold- drawn and either stress-relieved in the case of uncoated strands, or hot dip galvanized in the case of galvanized strands	ASTM A 416 ASTM A 421

High strength alloy steel bar for post- tensioning shall be proof stressed to 90 % of the granted tensile strength. After proof stressing, the bars shall conform to the following minimum properties:

Tensile strength fs'	1000 MPa
Yield strength (0.2 offset)	0.90 fs'
Elongation at rupture in 20 diameter	4 percent
Reduction of area at rupture	25 percent
Structural steel	ASTM A 36
Steel Pipe for concrete-filled	ASTM A 53 pipe columns
Cast-Iron Pipe for composite	ASTM A 377 columns

## 900.2.5

### 900.2.6 Storage of Materials

(Refer to Item 311.2.10)

## 900.3 Construction Requirements

Notations: The notations used in these regulations are defined as follows:  $f'_c$  = compressive strength of concrete

$F_{sp}$  = ratio of splitting tensile strength to square root of compressive strength.

### 900.3.1 Concrete Quality

All plans submitted for approval or used for any project shall clearly show the specified strength,  $f'_c$ , of concrete of the specified age for which each part of the structure was designed.

Concrete that will be exposed to sulfate containing or other chemically aggressive solutions shall be proportioned in accordance with "Recommended Practice for Selecting Proportions for Concrete (ACI 613)" and Recommended Practice for Selecting Proportions for Structural Lightweight Concrete (ACI 613A)."

### 900.3.2 Methods of Determining the Proportions of Concrete

TABLE 900.1 MAXIMUM PERMISSIBLE WATER-CEMENT RATIOS FOR CONCRETE (METHOD NO.1)

Specified compressive strength at 28 days, psi $f'_c$	Maximum permissible water-cement ratio			
	Non air-entrained concrete		Air-entrained concrete	
	U.S. gal. per 42.6 kg. bag of cement	Absolute ratio by weight	U.S. gal per 42.6 kg. bag of cement	Absolute ratio by weight
2500	7 ¼	0.642	6 ¼	0.554
3000	6 ½	0.576	5 ¼	0.465
3500	5 ¾	0.510	4 ½	0.399
4000	5	0.443	4	0.354

### 900.3.3 Concrete Proportions and Consistency

The proportions of aggregate to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the form and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface. The methods of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at any time during the work.

### 900.3.4 Sampling and Testing of Structural Concrete

As work progress, at least one (1) set of sample consisting of three (3) concrete cylinder test specimens, 150 x 300 mm shall be taken from each class of concrete placed each day, and each set to represent not more than 75 cu m of concrete.

### 900.3.5 Consistency

Concrete shall have a consistency such that it will be workable in the required position. It shall be such a consistency that it will flow around reinforcing steel but individual particles of the coarse aggregate when isolated shall show a coating or mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the equipment to properly placed it and not by the difficulty of mixing water shall be determined by the Engineer and shall not be varied without his consent. Concrete as dry as it is practical to place with the equipment specified shall be used.

### 900.3.6 Strength Test of Concrete

When strength is a basis for acceptance, each class of concrete shall be represented by at least five test (10 specimens). Two specimens shall be made for each test at a given age, and not less than one test shall be made for each 150 cu yd of structural concrete, but there shall be at least one test for each days concreting. The Building Official may require a reasonable number of additional tests during the progress of the work. Samples from which compression test specimens are molded shall be secured in accordance with ASTM C 172. Specimens made to check the adequacy of the proportions for strength of concrete or as a basis for acceptance of concrete shall be made and laboratory-cured in accordance with ASTM C 31. Additional test specimens cured entirely under field conditions may be required by the Building Official to check the adequacy of curing and protection of the concrete. Strength tests shall be made in accordance with ASTM C 39.

The age for strength tests shall be 28 days of, where specified, the earlier age at which the concrete is to receive its full load or maximum  $j$  stress. Additional test may be made at earlier ages to obtain advance information on the

adequacy of strength development where age-strength relationships have been established for the materials and proportions used.

To conform to the requirements of this Item:

1. For structures designed in accordance with the working stress design method of this chapter, the average of any five consecutive strength tests of the laboratory-cured specimens representing each class of concrete shall be equal on or greater than the specified strength,  $f_c'$ , and not more than 20 percent of the strength test shall have values less than that specified.

2. For structures designed in accordance with the ultimate strength design method of this chapter, and for pre-stressed structures the average of any three consecutive strength test of the laboratory, cured specimens representing each class of concrete shall be equal to or greater than the specified strength,  $f_c'$  and not more than 10 percent of the strength tests shall have values less than the specified strength.

When it appears that the laboratory-cured specimens will fail to conform to the requirements for strength, the Engineer shall have the right to order changes in the concrete sufficient to increase the strength to meet these requirements. The strengths of the specimens cured on the job are intended to indicate the adequacy of protection and curing of the concrete and may be used to determine when the forms may be stripped, shoring removed, or the structure placed in service.

#### **900.3.7 Splitting Tensile Test of Concrete**

To determine the splitting ratio,  $F_{sp}$ , for a particular aggregate, test of concrete shall be made as follows:

1. Twenty four (24) 15 cm. dia. by 30 cm long (6 in. dia. by 12 in. long) cylinders shall be made in accordance with ASTM C 192, twelve at a compressive strength level of approximately 210 kilograms per square centimeter (3000 psi) and twelve at approximately 280 kilograms per square centimeter (4000 psi) or 350 kilograms per square centimeter (5000 psi). After 7 days moist curing followed by 21 days drying at 23C (73F) and 50 percent relative humidity, eight of the test cylinders at each of the two strength levels shall be tested for splitting strength and four for compressive strength.

2. The splitting tensile strength shall be determine in accordance with ASTM C 496, and compressive strength in accordance with ASTM C 39.

The ratio,  $F_{sp}$ , of splitting tensile strength to the square root of compressive strength shall be obtained by using the average of all 16 splitting tensile test and all 8 compressive tests.

Minimum Strength, Concrete other than fill, shall have a minimum compressive strength at 28 days of 140 kilograms per square centimeter (2000 psi).

#### **900.3.8**

#### **900.3.9 Mixing and Delivery**

Mixing and delivery shall conform to the requirements of Item 405, Structural Concrete.

#### **900.4 Concrete Surface Finishing: General**

This shall be in accordance with Item 407, Concrete Structures.

#### **900.5 Curing Concrete (See subsection 407)**

#### **900.6 Acceptance of Concrete**

The strength of concrete shall be deemed acceptable if the average of 3 consecutive strength test results is equal to or exceed the specified strength and no individual test result falls below the specified strength by more than 15 %.

Concrete deemed to be not acceptable using the above criteria may be rejected unless contractor can provide evidence, by means of core tests, that the quality of concrete represented by the failed test result is acceptable in place. Three (3) cores shall be obtained from the affected area and cured and tested in accordance with AASHTO T24.

Concrete in the area represented by the cores will be deemed acceptable if the average of cores is equal to or at least 85 % and no sample core is less than 75 % of the specified strength otherwise it shall be rejected.

#### **900.7 Method of Measurement**

The quantity of concrete to be paid shall be the quantity shown in the Bid Schedule, unless changes in design are made in which case the quantity shown in the Bid Schedule will be adjusted by the amount of the change for the purpose of payment.

#### **900.8 Basis of Payment**

The accepted quantities of structural concrete completed in place will be paid for at the contract unit price for cubic meter as indicated on the Bid Schedule.

Pay Item and Description

Unit of measurement

Such prices and payment shall be full compensation for furnishing all materials, including metal, and rock backing; for all form and false work; for mixing, placing, furnishing, and curing the concrete; and for all labor, materials, equipment, tools and incidentals necessary to complete the item, except that reinforcing steel shall be paid for at the contract unit price per kilogram.

### **\*SUBTOPIC REFERENCES FOR ITEM 900**

#### **ITEM 700 (Part I of Volume II (Blue Book))**

#### **ITEM 700 – HYDRAULIC CEMENT**

##### **700.1 Portland Cement and Masonry Cement**

Cement shall conform to the requirements of the following cited Specifications for the type specified or permitted.

Type	Specifications
Portland Cement 150-74 (ASTM C 91)	AASHTO M 85 (ASTM C 150) Blended Cement AASHTO M

Unless otherwise permitted by the Engineer, the product of only one mill of any one brand and type of Portland Cement shall be used on the project.

The Contractor shall provide suitable means of storing and protecting the cement against dampness. Cement which, for any reason, has become partially set or which contains lumps of caked cement will be rejected. Cement salvaged from discarded or used bags shall not be used.

#### **ITEM 311.2.4 - WATER**

Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water which is drinkable may be used without test. Where the source of water is shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.

#### **ITEM 405 – STRUCTURAL CONCRETE**

##### **405.1 Description**

###### **405.1.1 Scope**

This Item shall consist of furnishing, bending, placing and finishing concrete in all structures except pavements in accordance with this Specification and conforming to the lines, grades, and dimensions shown on the Plans. Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, admixture when specified, and water mixed in the proportions specified or approved by the Engineer.

###### **405.1.2 Classes and Uses of Concrete**

Five classes of concrete are provided for in this Item, namely: A, B. Each class shall be used in that part of the structure as called for on the Plans.

The classes of concrete will generally be used as follows:

Class A – All superstructures and heavily reinforced substructures. The important parts of the structure included are slabs, beams, girders, columns, and reinforced footings.

Class B – Pedestals, unreinforced or with only a small amount of reinforcement.

##### **405.2 Material Requirements**

###### **405.2.1 Portland Cement**

It shall conform to all the requirements of ITEM 700.

###### **405.2.2 Fine Aggregate**

It shall conform to all the requirements of Subsection 311.2.2.

###### **405.2.3 Coarse Aggregate**

It shall conform all the requirements of Subsection 311.2.3 except that gradation shall conform to Table 405.1.

Table 405.1 – Grading Requirements for Coarse Aggregate

Sieve	Designation	Mass Percent Passing				
Standard Mm	Alternate US Standard	Class A	Class B	Class C	Class P	Class Seal
63	2-1/2"		100			
50	2"	100	95 – 100			
37.5	1-1/2"	95 – 100	-			100
25	1"	-	35 – 70		100	95 – 100
19.0	3/4"	35 – 70	-	100	95 – 100	-
12.5	1/2"	-	10 – 30	90 – 100	-	25 – 60
9.5	3/8"	10 – 30	-	40 – 70	20 – 55	-
4.75	No.4	0 - 5	0 - 5	0 – 15*	0 – 10*	0 – 10*

\* The measured cement content shall be within plus (+) or minus (-) 2 mass percent of the design cement content.

#### 405.2.4 Water

It shall conform to the requirements of Subsection 311.2.4

#### 405.2.5 Reinforcing Steel

It shall conform to the requirements of Item 710, Reinforcing Steel and Wire Rope.

#### 405.2.11 Storage of Cement and Aggregates

Storage of cement and aggregates shall conform to all the requirements of Subsection 311.2.10.

#### 405.3.2 Consistency

(Refer to Item 900.3.5)

#### 405.3.4 Mixing and Delivery

Concrete should be mixed at the site of construction. Mixing of concrete shall be in accordance with the appropriate requirements of AASHTO M 157.

For batch mixing at the site of construction, a batch mixer of an approved type shall be used. Mixer having a rated capacity of less than a one-bag batch shall not be used. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer except that an overload up to 10 percent above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided no spillage of concrete takes place. The batch shall be so charge into the drum that a portion of the water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 seconds. If timing starts, the instant the skip reaches its maximum raised position, 4 seconds shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his own expenses.

The timing device on stationary mixers shall be equipped with a bell or other suitable warning device adjusted to give a clearly audible signal each time the lock is released. In case of failure of the timing device, the Contractor will be permitted to continue operations while it is being repaired, provided he furnishes an approved timepiece equipped with minute and second hands. If the timing device is not placed in good working order within 24 hours, further use of the mixer will be prohibited until repairs are made.

Re-tempering concrete will not be permitted.

### ITEM 407- CONCRETE STRUCTURES

#### 407.1 Description

This Item shall consist of the general description of the materials, equipment, workmanship and construction requirements of concrete structures and the concrete portions of composite structures conforming to the alignment, grades, design, dimensions and details shown on the Plans and in accordance with the Specifications for piles, reinforcing steel, structural steel, structural concrete and other items which constitute the completed structure. The class of concrete to be used in the structure or part of the structure shall be as specified in Item 405, Structural Concrete.

## **407.2 Material Requirements**

### **1. Concrete and Concrete Ingredients**

Concrete and concrete materials shall conform to the requirements in Item 405, Structural Concrete. Unless otherwise shown on the Plans or specified in Special Provisions, concrete shall be of Class A.

### **2. Reinforcing Steel**

Reinforcing steel shall conform to the requirements in Item 404, Reinforcing Steel.

### **3. Structural Steel**

Structural steel shall conform to the requirements of corresponding materials in Item 403, Metal Structures.

### **4. Paints**

Paints shall conform to the requirements in Item 411, Paint.

## **407.2.1 Proportioning and Strength of Structural Concrete**

(Refer to Item 900.3.2)

## **407.2.2 Sampling and Testing**

(Refer to Item 900.3.2)

## **407.3 Construction and Requirements**

### **407.3.1 Handling and Placing Concrete: General**

Concrete shall not be placed until forms and reinforcing steel have been checked and approved by the Engineer.

If lean concrete is required in the Plan or as directed by the Engineer prior to placing of reinforcing steel bar, the lean concrete should have a minimum compressive strength of 13.8 MPa (2,000 psi)..

In preparation for the placing of concrete all sawdust, chips and other construction debris and extraneous matter shall be removed from inside the formwork, struts, stays and braces, serving temporarily to hold the forms in correct shape and alignment, pending the placing of concrete at their locations, shall be removed when the concrete placing has reached an elevation rendering their service unnecessary. These temporary members shall be entirely removed from the forms and not buried in the concrete.

No concrete shall be used which does not reach its final position in the forms within the time stipulated under "Time of Hauling and Placing Mixed Concrete".

Concrete shall be placed to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete to the forms shall be permitted only on written authorization of the Engineer. The Engineer shall reject the use of the equipment for concrete transportation that will allow segregation, loss of fine materials, or in any other way will have a deteriorating effect on the concrete quality.

When placing operations would involve dropping the concrete more than 1.5 m, concrete shall be conveyed through sheet metal or approved pipes. As far as practicable, the pipes shall be kept full of concrete during placing and their lower end shall be kept buried in the newly placed concrete. After initial set of the concrete, the forms shall not be jarred and no strain shall be placed on the ends of projecting reinforcement bars.

The concrete shall be placed as nearly as possible to its final position and the use of vibrators for moving of the mass of fresh concrete shall not be permitted.

### **407.3.2 Compaction of Concrete**

Concrete during and immediately after placing shall be thoroughly compacted. The concrete in walls, beams, columns and the like shall be placed in horizontal layers not more than 30 cm thick except as hereinafter provided. When less than a complete layer is placed in one operation, it shall be terminated in a vertical bulkhead. Each layer shall be placed and compacted before the preceding layer has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the layers. Each layer shall be compacted so as to avoid the formation of a construction joint with a preceding layer.

The compaction shall be done by hand compaction through rodding. By poking with 2m long, 16 mm dia rod at sharp corners and edges. The thickness of layers for rodding should be 15 to 20 cm.

### **407.3.7 Concrete Surface Finishing**

Surface finishing shall be classified as follows:

Class 3, Floated Finish

All concrete shall be given Class 3, Floated Finish and additionally any further finish as specified.

**407.3.8.** All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete.

#### Class 3, Concrete Floated Finish

After the concrete is compacted as specified in Subsection 407.3.2, Compaction of Concrete, the surface shall be carefully struck off with a strike board to conform to the cross-section and grade shown on the Plans. Proper allowance shall be made for camber if required. The strike board may be operated longitudinally or transversely and shall be moved forward with a combined longitudinal and transverse motion, the manipulation being such that neither is raised from the side forms during the process. A slight excess of concrete shall be kept in front of the cutting edge at all times.

After striking off and consolidating as specified above, the surface shall be made uniform by longitudinal or transverse floating or both. Longitudinal floating will be required except in places where this method is not feasible.

The transverse float shall be operated across the pavement by starting at the edge and slowly moving to the center and back again to the edge. The float shall then be moved forward one-half of each length and the above operation repeated. Care shall be taken to preserve the crown and cross-section of the pavement.

After the longitudinal floating has been completed and the excess water removed, but while the concrete is still plastic, the slab surface shall be tested for trueness with a straight-edge. For the purpose, the Contractor shall furnish and use an accurate 3m straight-edge swing handless 1m longer than one half the width of the slab.

The straight-edge shall be held in successive positions parallel to the road centerline and in contact with the surface and the whole area gone over from one side of the slab to the other as necessary advancement along the deck shall be in successive stages of not more than one-half the length of the straight-edge. Any depression found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. The straight-edge testing and refloating shall continue until the entire surface is found to be free from observable departure from the straight-edge and the slabs has the required grade and contour, until there are no deviations of more than 3mm under the 3m straight-edge.

When the concrete has hardened sufficiently, the surface shall be given a broom finish. The broom shall be an approved type. The strokes shall be square across the slabs from edge to edge, with adjacent strokes slightly overlapped, and shall be made by drawing the broom without tearing the concrete, but so as to produce regular corrugations not over 3 mm in depth. The surface as thus finished shall be free from porous spots, irregularities, depressions and small pockets or rough spots such as may be caused by accidental disturbing, during the final brooming of particles of coarse aggregate embedded near the surface.

#### **407.3.8 Curing Concrete**

All newly placed concrete shall be cured in accordance with this Specification, unless otherwise directed by the Engineer. The curing method shall be of the following:

##### **1. Waterproof Membrane Method**

The exposed finished surfaces of concrete shall be sprayed with water, using a nozzle that so atomizes the flow that a mist and not a spray is formed until the concrete has set, after which a curing membrane of waterproof paper or plastic sheeting shall be placed. The curing membrane shall remain in place for a period of not less than 72 hours.

Waterproof paper and plastic sheeting shall conform to the specification of AASHTO M 171.

The waterproof paper or plastic sheeting shall be formed into sheets of such width as to cover completely. Cement shall be batched and charged into the mixer so that it will not result in loss of cement due to the effect of wind, or in accumulation of cement on surface of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

#### **ITEM 311.2.2 FINE AGGREGATE**

It shall consist of natural sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of concrete without the approval of the Engineer.

It shall not contain more than three (3) mass percent of material passing the 0.075 mm (No. 200 sieve) by washing nor more than one (1) mass percent each of clay lumps or shale. The use of beach sand will not be allowed without the approval of the Engineer.



The fine aggregate shall be free from injurious amounts of organic impurities. If subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall be rejected. However, when tested for the effect of organic impurities of strength of mortar by AASHTO T 71, the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95 mass percent.

The fine aggregate shall be well-graded from coarse to fine and shall conform to Table 311.1

**Table 311.1 – Grading Requirements for Fine Aggregate**

Sieve Designation	Mass Percent Passing
9.5 mm (3/8 in)	100
4.75 mm (No. 4)	95 – 100
2.36 mm (No. 8)	-
1.18 mm (No. 16)	45 – 80
0.600 mm (No. 30)	-
0.300 mm (No. 50)	5 – 30
0.150 mm (No. 100)	0 – 10

### **ITEM 311.2.3 COARSE AGGREGATE**

It shall consist of crushed stone, gravel, blast furnace slag, or other approved inert materials of similar characteristics, or combinations thereof, having hard, strong, durable pieces and free from any adherent coatings.

It shall contain not more than one (1) mass percent of material passing the 0.075 mm (No. 200) sieve, not more than 0.25 mass percent of clay lumps, nor more than 3.5 mass percent of soft fragments.

Only one grading specification shall be used from any one source.

### **ITEM 710 REINFORCING STEEL AND WIRE ROPE**

#### **710.1 Reinforcing Steel**

Reinforcing steel shall conform to the requirements of the following Specifications:

Deformed Billet-Steel Bars for Concrete Reinforcement	-AASHTO M 31 (ASTM A 615)
Deformed Steel Wire for Concrete Reinforcement	-AASHTO M 225 (ASTM A 496)
Welded Steel Wire Fabric for Concrete Reinforcement	-AASHTO M 55 (ASTM A 185)
Cold-Drawn Steel Wire for Concrete Reinforcement	-AASHTO M 32 (ASTM A 82)
Fabricated Steel Bar or Rod Mats for Concrete Reinforcement	-AASHTO M 54 (ASTM A 184)

Bar reinforcement for concrete structures, except No. 2 bars shall be deformed in accordance with AASHTO M 42, M 31 and M 53 for Nos. 3 through 11.

Dowel and tie bars shall conform to the requirements of AASHTO M 31 or AASHTO M 42 except that rail steel shall not be used for tie bars that are to be bent and re-straightened during construction. Tie bars shall be deformed bars. Dowel bars shall be plain round bars. They shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the site of the work, a minimum of one half (1/2) the length of each dowel bar shall be painted with one coat of approved lead or tar paint.

The sleeves for dowel bars shall be metal of an approved design to cover 50 mm (2 inches), plus or minus 6.3 mm of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least 25 mm (1 inch) from the end of the dowel bar. Sleeves shall be of such design that they do not collapse during construction.

### **ITEM 311.2.8 CURING MATERIALS**

Curing materials shall conform to the following requirements as specified;

- a) Sheeting (film) materials- Polyethylene tarpaulins can be used.

### **ITEM 311.2.10 STORAGE OF CEMENT & AGGREGATE**

All cement shall be stored, immediately upon delivery at the Site, in weatherproof building which will protect the cement from dampness. The floor shall be raised from the ground. The buildings shall be placed in locations approved by the Engineer. Provisions for storage shall be ample, and the shipments of cement as received shall be separately stored in such a manner as to allow the earliest deliveries to be used first and to provide easy access for identification and inspection of each shipment. Storage buildings shall have capacity for storage of a sufficient

quantity of cement to allow sampling at least twelve (12) days before the cement is to be used. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. Stored cement shall meet the test requirements at any time after storage when the Engineer orders retest. At the time of use, all cement shall be free flowing and free of lumps.

The handling and storing of concrete aggregates shall be such as to prevent segregation or the inclusion of foreign materials. The Engineer may require that aggregates be stored on separate platforms at satisfactory locations.

In order to secure greater uniformity of concrete mix, the Engineer may require that the coarse aggregate be separated into two or more sizes. Different sizes of aggregate shall be stored in separate bins or in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

## **ITEM 404 REINFORCING STEEL**

### **404.1 Description**

This Item shall consist of furnishing, bending, fabricating and placing of steel reinforcement of the type, size, shape and grade required in accordance with this Specification and in conformity with the requirements shown on the Plans or as directed by the Engineer.

### **404.2 Material Requirements**

Reinforcing steel shall meet the requirements of item 710, Reinforcing Steel and Wire Rope.

### **4.4.3 Construction Requirements**

#### **404.3.1**

#### **404.3.2 Protection of Material**

Steel reinforcement shall be stored above the surface of the ground upon platforms, skids, or other supports and shall be protected as far as practicable from mechanical injury and surface deterioration caused by exposure to conditions producing rust. When placed in the work, reinforcement shall be free from dirt, detrimental rust, loose scale, paint, grease, oil, or other foreign materials. Reinforcement shall be free from injurious defects such as cracks and laminations. Rust, surface seams, surface irregularities or mill scale will not be cause for rejection, provided the minimum dimensions, cross sectional area and tensile properties of a hand wire brushed specimen meets the physical requirements for the size and grade of steel specified.

#### **404.3.3 Bending**

All reinforcing bars requiring bending shall be cold-bent to the shapes shown on the Plans or required by the Engineer. Bars shall be bent around a circular pin having the following diameters (D) in relation to the diameter of the bar (d):

Nominal diameter, d, mm	Pin diameter (D)
10 to 20	6d
25 to 28	8d
32 and greater	10d

Bends and hooks in stirrups or ties may be bent to the diameter of the principal bar enclosed therein.

#### **404.3.4 Placing and Fastening**

All steel reinforcement shall be accurately placed in the position shown on the Plans or required by the Engineer and firmly held there during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than 300mm in each directions, in which case, alternate intersections shall be tied. Ties shall be fastened on the inside.

Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports, so that it does not vary from the position indicated on the Plans by more than 6mm. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shapes and dimensions. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Unless otherwise shown on the Plans or required by the Engineer, the minimum distance between bars shall be 40mm. Reinforcement in any member shall be placed and then inspected and approved by the Engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal may be required. If fabric reinforcement is shipped in rolls, it shall be straightened before being placed. Bundled bars shall be tied together at not more than 1.8m intervals.

#### **404.3.5 Splicing**

All reinforcement shall be furnished in the full lengths indicated on the Plans. Splicing of bars, except where shown on the Plans, will not be permitted without the written approval of the Engineer. Splices shall be staggered as far as possible and with a minimum separation of not less than 40 bar diameters. Not more than one-third of the bars may be spliced in the same cross-section, except where shown on the Plans.

Unless otherwise shown on the Plans, bars shall be lapped a minimum distance of:

Splice Type	Grade 40 min. lap	Grade 60 min. lap	But not less than
Tension	24 bar dia	36 bar dia	300 mm
Compression	20 bar dia	24 bar dia	300 mm

In lapped splices, the bars shall be placed in contact and wired together. Lapped splices will not be permitted at locations where the concrete section is insufficient to provide minimum clear distance of one and one-third the maximum size of coarse aggregate between the splice and the nearest adjacent bar. Welding of reinforcing steel shall be done only if detailed on the Plans or if authorized by the Engineer in writing. Spiral reinforcement shall be spliced by lapping at least one and a half turns or by butt welding unless otherwise shown on the Plans.

#### **404.3.6 Lapping of Bar Mat**

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The overlap shall not be less than one mesh in width.

#### **404.4 Method of Measurement**

The quantity of reinforcing steel to be paid for will be the final quantity placed and accepted in the completed structure.

No allowance will be made for tie-wires, separators, wire chairs and other material used in fastening the reinforcing steel in place. If bars are substituted upon the Contractor's request and approved by the Engineer and as a result thereof more steel is used than specified, only the mass specified shall be measured for payment.

No measurement or payment will be made for splices added by the Contractor unless directed or approved by the Engineer.

When there is no item for reinforcing steel in the Bill of Quantities, costs will be considered as incidental to the other items in the Bill of Quantities.

#### **404.5 Basis of Payment**

The accepted quantity, measured as prescribed in Section 404.4, shall be paid for at the contract unit price for Reinforcing Steel which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
404	Reinforcing Steel	Kilogram

### **F. FORMWORKS AND FALSEWORKS ITEM 903(2)**

#### **ITEM 414 FORMS AND FALSEWORKS**

##### **414.1 Description**

This Item shall consist of designing, constructing and removing forms and falsework to temporarily support concrete, girders and other structural elements until the structure is completed to the point it can support itself.

##### **414.2 Material Requirements**

###### **414.2.1 Formwork**

The materials used for smooth form finish shall be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper or other acceptable materials capable of producing the desired finish for form-facing materials. Form-facing materials shall produce a smooth, uniform texture on the concrete. Form-facing materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of concrete surfaces shall not be permitted. No form-facing material shall be specified for rough form finish.

#### **414.2.1.1 Formwork accessories**

Formwork accessories that are partially or wholly embedded in concrete, including ties and hangers shall be commercially manufactured. The use of non-fabricated wire form ties shall not be permitted. Where indicated in the Contract, use form ties with integral water barrier plates in walls.

#### **414.2.1.2 Formwork release agents**

Commercially manufactured formwork release agents shall be used to prevent formwork absorption of moisture, prevent bond with concrete, and hot stain the concrete surfaces.

#### **414.2.2 Falsework**

The materials to be used in the falsework construction shall be of the quantity and quality necessary to withstand the stresses imposed; it may be timber or steel or a combination of both. The workmanship shall be of such quality that the falsework will support the loads imposed on it without excessive settlement or take-up beyond as shown on the falsework drawings.

#### **414.4 Method of Measurement**

When the Contract stipulates that payment will be made for forms and falsework on lump-sum basis, the pay item will include all materials and accessories needed in the work.

#### **414.5 Basis of Payment**

The accepted quantities measured as prescribed in subsection 414.4, shall be paid for at the Contract lump-sum price for Forms and Falsework which price and payment shall be full compensation for designing, constructing and removing forms and falsework, all materials and accessories needed and for furnishing all labor equipment tools and incidentals necessary to complete the item.

Payment will be made under:

Pay Item Number	Description	Unit Measurement
414	Forms and Falsework	Lump Sum

## **VI. MASONRY WORKS**

- A. CHB NON-LOAD BEARING (Including Reinforcing Steel)10 mm – ITEM No. 1046(2)a1**
- B. CEMENT FLLOR FINISH – ITEM No. 1021(6)**
- C. CEMENT PLASTER FINISH – ITEM No. 1027(1)**

### **ITEM 704 MASONRY UNITS**

#### **704.3 Concrete Masonry Blocks**

Concrete masonry blocks may be rectangular or segmented and, when specified, shall have ends shaped to provide interlock at vertical joints. Hollow blocks shall conform to the requirements of ASTM C 90, grade as specified. Dimensions and tolerances shall be as individually specified on the Plans.

### **ITEM 1027 CEMENT PLASTER FINISH**

#### **1027.1 Description**

This Item shall consist of furnishing all cement plaster materials, labor, tools and equipment required in undertaking cement plaster finish as shown on the Plans and in accordance with this Specification.

#### **1027.2 Material Requirements**

Manufactured materials shall be delivered in the manufacturer's original unbroken packages or containers which are labelled plainly with the manufacturer's name and trademark.

##### **1027.2.1 Cement**

Portland cement shall conform with the requirements as defined in Item 700, Hydraulic Cement.

##### **1027.2.3 Fine Aggregates**

Fine aggregates shall be clean, washed sharp river sand and free from dirt, clay, organic matter or other deleterious substances.

#### **1027.3 Construction Requirements**

##### **1027.3.1 Mixture**

a) Mortar mixture for brown coat shall be freshly prepared and uniformly mixed in the proportion by volume of one part Portland Cement, three (3) parts sand and one fourth (1/4) part hydrated lime.

b) Finish coat shall be pure Portland Cement properly graded conforming to the requirements of Item 700, Hydraulic Cement and mixed with water to approved consistency and plasticity.

##### **1027.3.2 Surface Preparation**

a) After removals of formworks reinforce concrete surfaces shall be roughened to improve adhesion of cement plaster.

b) Surfaces to receive cement plaster shall be cleaned of all projections, dust, loose particles, grease and bond breakers. Before any application of brown coat is commenced all surfaces that are to be plastered shall be wetted thoroughly with clean water to produce a uniformly moist condition.

##### **1027.3.3 Application**

a) Brown coat mortar mix shall be applied with sufficient pressure starting from the lower portion of the surface to fill the grooved and to prevent air pockets in the reinforced concrete/masonry work and avoid mortar mix drooping. The brown coat shall be lightly broomed/ or scratch before surface had properly set and allowed to cure.

b) Finish coat shall not be applied until after the brown coat has seasoned for seven days and corrective measures had been done by the Contractor on surfaces that are defective. Just before the application of the finish coat, the brown coat surface shall be evenly moistened with potable water. Finish coat shall be floated first to a true and even surface, then troweled in a manner that will force the mixture to penetrate into the brown coat. Surfaces applied with finish coat shall then be smooth with paper remove trowel marks, checks and blemishes. All cement plaster finish thickness shall be 12mm each side on walls, 25mm on each side of firewalls.

Cement plaster shall not be applied directly to:

- a) Concrete or masonry surface that had been coated with bituminous compound and,
- b) Surfaces that had been painted and previously plastered.

##### **1027.3.4 Workmanship**

Cement plaster finish shall be true to details and plumb. Finish surface shall have no visible junction marks where one (1) Day's work adjoins the other.

#### **1027.4 Method of Measurement**

All cement plaster finish shall be measured in square meters or part thereof for work actually completed in the building.

#### **1027.5 Basis of Payment**

The work quantified and determined as provided in the Bill of Quantities shall be paid for at the Contract Unit Price which price constitutes full compensation including labor, materials, tools and equipment and incidentals necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1027 (a)	Cement plaster finish	m <sup>2</sup>

### **VII. FABRICATED MATERIALS**

#### **A. DOORS & WINDOWS**

##### **INSTALLATION**

Frames shall be installed plumb, level, rigid and in true alignment as per the requirements. All frames shall be fastened to the adjacent structure so as to retain their position and stability. Where grouting is required in masonry installations, frames shall be braced or fastened in such a way that will prevent the pressure of the grout from deforming the frame members. Grout shall be mixed to provide a 4" (102mm) maximum slump consistency and hand troweled into place. Grout mixed to a thinner, "pumpable" consistency shall not be used. Excess water from thin consistency grout will cause premature rusting of steel frames and probable deformation or discoloration of certain wall constructions. Standard mortar protection in frames is not intended for thin consistency grout or drywall compound. Shimming shall be performed by the installer as needed to assure the proper clearances are achieved.

##### **CONFORMITY**

The doors/windows/ventilators selected in the sample shall be inspected for dimensions, tolerances, materials, fabrication, positioning of holes, fixing screws and lugs, finishing and glazing. Any door/window, ventilator not satisfying any or more of the requirements inspected by the Engineer shall be classified as defective thus leading to subsequent rejection. The lot having satisfied the above requirements shall be inspected for requirements of welded joints.

##### **Method of Measurement**

Doors and windows, fully equipped with fixing accessories and locking devices shall be measured in square meters based on actual in place installed as shown on the Plans accepted to the satisfaction of the Engineer.

##### **Basis of Payment**

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1042	Stainless Steel Door (w/ frame)	m <sup>2</sup>
1043	PVC Doors and Frames	m <sup>2</sup>
1007	Aluminum glass door	m <sup>2</sup>
1006(5)	Fire Rated Fire Steel Doors	m <sup>2</sup>
1008(1)a	Aluminum Glass Window (Sliding)	m <sup>2</sup>
1008(1)c	Aluminum Glass Window (Awning)	m <sup>2</sup>
1008(1)d	Aluminum Glass Window (Fixed)	m <sup>2</sup>

### **ITEM 1012- GLASS & GLAZING**

#### **1012.1 Description**

This Item shall consist of furnishing all glass and glazing materials, labor, tools, plant and requirement required in undertaking the proper installation as shown on the Plans and accordance with this Specification.

#### **1012.2 Materials Requirements**

All glass and glazing materials shall be delivered at jobsite with labels affixed indicating quality, make type and thickness. Each glass in glazed position shall resist a design pressure of 244 kilogram per square meter.

##### **Tempered or Toughened Glass**

Tempered glass is an extremely strong glass which is heat treated to a uniform temperature of approximately

650°C and rapidly cooled to induce compressive stresses of 770 kg/m<sup>2</sup> to 1462 kg/m<sup>2</sup> on the surfaces and edge compression of the order of 680 kg/m<sup>2</sup>. Tempered glass is not manufactured on float line. It is a separate process.

Tempered or toughened glass gains its added strength from the compressed surfaces. However, if a deep scratch or an impact penetrates the surface, the glass will break into a number of small particles. The heat treatment process for tempered glass requires that all fabrication be completed prior to toughening. Any attempt to cut, drill, grind or sand blast the glass after toughening may result in glass breakage. The heat treatment process does not change the light transmission and solar radiant heat properties of the glass.

#### **1012.2.3 Glazing materials for glass installation maybe:**

- a) Bulk compound such as:
  - a-1) Mastics that are elastic compounds and non-skinning compound.
  - a-2) Putties – shall be wood sash putty, or metal sash quality.
  - a-3) Sealant shall be chemically compatible with setting blocks, edge blocks and sealing tapes.
- b) Performed sealants such as:
  - b-1) Synthetic polymer shall be base sealants that is resilient or non-resilient type.
  - b-2) Performed gaskets shall be compression or structural type.
- c) Setting and Edge Blocks shall be made of lead or neoprene, chemical compatible with sealants.
- d) Accessories like glazing clip, shims spacer strips, etc. shall be made from non-corroding metal accessories.

#### **1012.2.4. Schedule of Glass and Mirrors**

Specifications of glass and glazing shall be indicated in the Plans.

**1012.2.4.3** Unless otherwise noted, clear glasses that are locally manufactured shall be used on steel windows.

- a) Use 3.1 mm (1/8") thick for areas exceeding .069 square meters.
- b) Use 4.7 mm (3/16") thick for areas exceeding .609 square meters.

**1012.2.4.4** All comfort rooms whether shown or not, the contractor shall provide and fit securely in place at the most convenient height above each lavatory 1 mirror, made from local glazing quality polished plate glass 6 mm thick with beveled edge and brass chromium plated frame 12 mm thick waterproof tan guile marine plywood backing, all in accordance with full size details. Sizes are as follows:

- a) Over single lavatories, 600 mm x 750 mm (24" x 30").
- b) For two lavatories, 1200 mm x 750 mm (48" x 30").
- c) For three lavatories, 1800 mm x 750 mm (72" x 30").

#### **1012.3 Construction Requirements**

Safety precaution and procedure shall be taken in determining the sizes and providing the required clearances by measuring the actual opening to receive the glass. Movable items shall be kept in closed and locked position until glazing compound has thoroughly set.

##### **1012.3.1 Installation**

**1012.3.1.1** All glass sheets shall be bedded, back puttied, secured in place and face puttied. Secure glass in aluminum frame with non-corrosive clips except where glazing beads are required. Apply putty in uniformly straight lines, with accurately formed bevels and clean-cut corners; remove excess putty from glass.

**1012.3.1.2** Set glass in hollow metal doors and in metal frames of interior partition in felt channel insets or added in putty to prevent any rattle; secure glass in wood doors and wooden frames with glazing stops; secure stops on doors with screws.

**1012.3.1.3** Glass breakage caused in executing the work or by faulty installation shall be replaced by the Contractor without extra cost.

**1012.3.1.4** Improperly set glass which does not fully meet requirements of its grade shall not be accepted and shall be replaced without extra cost.

**1012.3.1.5** The Contractor shall provide and install complete set ready for use, mirrors in all comfort rooms and elsewhere shown on the Plans. Size and location for each mirror shall be as indicated on the Plans.

##### **1012.3.2 Workmanship**

**1012.3.2.1** All glass shall be accurately cut to fit opening and set with equal bearing on the entire width of pane.

**1012.3.2.2** Putty shall be neatly run in straight lines parallel with inside of glazing rebate; corners shall be carefully made; all excess putty shall be removed and surface left clean.

**1012.3.2.3** Apply a thin layer of putty to rebate and set glass or putty, pressing until an even bed is secured; place spring wire or angle glazing clips and run face putty; remove excess putty shall be removed and surface left clean.

#### **1012.3.3 Cleaning**

Clean all glass on both sides after putty has been applied completely. Do not disturb edge of putty with scraper. At completion of work leave glass and glazing works free from cracks and rattles and clean on both sides.

#### **1012.3.4 Samples**

The Contractor shall submit for approval duplicate sample (150 mm x 250 mm) of each type of glass bearing manufacturer's label and a can of each type of putty.

#### **1012.4 Method of Measurement**

This item shall be measured by actual area of glass sheets installed respective of the quality type and thickness in square meters. The quantified unit of measurement shall be those accepted to the satisfaction of the Engineer.

#### **1012.5 Basis of Payment**

The quantities Item prescribed in sub-section 1012.4 shall be paid for the unit bid price which payment constitute full compensation for all glass and glazing materials and other facilities, labor and incidents necessary to complete this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1012 (3)a	Tempered glass doors	m <sup>2</sup>
1012 (4)a	Tempered glass windows	m <sup>2</sup>

### **B. CEILING (4.5mm metal frame, Fiber Cement Board)- ITEM 1003(1)a1**

#### **ITEM 1003- CARPENTRY & JOINERY WORKS**

##### **1003.1 Description**

The work under this Item shall consist of furnishing all required materials, fabricated woodwork, tools, equipment and labor and performing all operations necessary for the satisfactory completion of all carpentry and joinery works in strict accord with applicable drawings (ceiling, cabinetry, and drywall), details and these Specifications.

##### **1003.2 Material Requirements**

###### **1003.2.1 Lumber**

Lumber of the different species herein specified for the various parts of the structure shall be well seasoned, sawn straight, sundried or kiln dried and free from defects such as loose unsound knots, pitch pockets, sapwood, cracks and other imperfections impairing its strength, durability and appearance.

###### **1003.2.3 Plywood**

Plywood shall conform to the requirements of the Philippine Trade Standards 631-02. Thickness of a single layer laminae shall not be less than 2 mm. The laminae shall be superimposed in layers with grains crossing at right angles in successive layers to produce stiffness. The face veneers shall be rotary cut from select grade timber. The laminae and face veneers shall be bonded with water resistant resin glue, hot pressed and pressure treated.

Ordinary tanguile or red lauan plywood with good quality face veneers, 6 mm thick shall be used for double walling and ceiling not exposed to moisture; waterproof or marine plywood shall be used for ceiling exposed to moisture such as at toilets and eaves, and ceiling to be finished with acrytex.

###### **1003.2.5.2 Glue**

Glue shall be from water resistant resins, which, upon hardening, shall not dissolve nor lose its bond or holding power even when soaked with water for extended period.

###### **1003.2.5.3 Fasteners**

Nails, screw, belts and straps shall be provided and used where suitable for fixing carpentry and joinery works. All fasteners shall be brand new and of adequate size to ensure rigidity of connections.

- a. Nails of adequate size shall be steel wire, diamond-pointed, ribbed shank and bright finish.
- b. Screws of adequate size shall be cadmium or brass plated steel with slotted head.
- c. Lag screws of adequate size, for anchoring heavy timber framing in concrete or masonry, shall be



galvanized steel.

d. Bolts and nuts shall be of steel having a yield point of not less than 245 MPa. Bolts shall have square heads and provided with standard flat steel washers and hexagonal nuts. Threads shall conform to American coarse thread series. The threaded portion shall be long enough such that the nut can be tightened against the bolted members without any need for blocking. The bolt's threaded end shall be finished smooth for ease of engaging and turning of the nut.

e. Wrought iron straps or angles, when required in conjunction with bolts or lag screws to provide proper anchorage, shall be of the shape and size shown on the Plans.

### **1003.3 Construction Requirements**

#### **1003.3.1 Quality of Materials**

All materials to be incorporated in the carpentry and joinery works shall be of the quality specified under Section 2. Before incorporation in work, all materials shall have been inspected/accepted by the Engineer or his authorized representative.

#### **1003.3.2 Storage and Protection of Materials**

Lumber and other materials shall be protected from dampness during and after delivery at the site. Materials shall be delivered well in advance of actual need and in adequate quantity to preclude delay in the work. Lumber shall be piled in orderly stack at least 150 mm above ground and at sheltered place where it will be of least obstruction to the work.

#### **1003.3.3 Shop Drawings**

Shop drawings complete with essential dimensions and details of construction, as may be required by the Engineer in connection with carpentry and joinery work, shall be submitted for approval before proceeding with the work.

#### **1003.3.4 Rough Carpentry**

Rough carpentry covers partition (drywall).

a. Rough carpentry shall be done true to lines, levels and dimensions. It shall be squared, aligned, plumbed and well fitted at joints.

b. Fasteners, connectors and anchors of appropriate type and number shall be provided and fitted where necessary.

c. Woodworks in contact with concrete or masonry shall be treated with termite- proofing solution.

#### **1003.3.5 Finished Carpentry**

Finished carpentry covers works on flooring, ceiling boards, cabinets, fabricated woodwork.

a. Framing lumber shall be select grade, free from defects and where exposed in finished work, shall be selected for color and grain.

b. Joints of framing shall be tenoned, mortised or doweled where suitable, closely fitted and secured with water resistant resins glue. Exterior joints shall be mitered and interior angles coped.

c. Panels shall be fitted allow for contraction or expansion and insure that the panels remain in place without warping, splitting and opening of joints.

d. Plywood shall be specified under Section 1003.2.4.

e. Exposed edges of plywood or plywood for cabinets shall be provided with select grade hardwood strips, rabbetted as necessary, glued in place and secured with finishing nails. To prevent splitting, hardwood for trims shall be drilled before fastening with nails or screws.

f. Fabricated woodwork shall be done preferably at the shop. It shall be done true to details and profiles indicated on the Plans. Where set against concrete or masonry, woodwork shall be installed when curing is completed.

g. Exposed wood surfaces shall be free from disfiguring defects such as raised grains, stains, uneven planning, sanding, tool marks and scratches. Exposed surfaces shall be machine or hand sanded to an even smooth surface, ready for finish.

## **C. STAINLESS STEEL DA LOGO & LETTERING**

### **Description**

Stainless Steel Alloy 304. Furnished letters and hardware necessary to install cut metal letters shown on drawings and herein specified. Natural satin stroke sanded face, bead blasted return.

DA-Region 6 logo (40cm diameter) should conform to the standard design and color.

### **Installation**

Install signs level, plumb, and at the height indicated with sign surfaces free from distortion or other defects in appearance.

## **D. METAL RAILINGS**

### **ITEM 409- WELDED STRUCTURAL STEEL**

#### **409.1 Description**

This work shall consist of the joining of structural steel members with welds of the type, dimensions, and design shown on the Plans and in accordance with the Specifications.

It is the intent of this Specification to provide for work of a quality comparable to that required under the Standard Specifications for Welded Highway and Railway Bridges of the American Welding Society. In case of dispute or for situations not adequately provided for in this Specification, those designated Standard Specifications shall be considered as the final authority and shall govern except as amended by the Special Provisions. Welding of Structural Steel shall be done only when shown on the Plans or authorized in writing by the Engineer.

#### **409.2 Materials Requirements**

Steel base metal to be welded shall be open-hearth or electric furnace steel conforming to AASHTO M 183. All arc-welding electrodes shall conform to the requirements of American Welding Society Specifications. Filler material to be used in the repair or strengthening of old structures or for joining new parts to existing steel members, shall be adopted to the material to be welded and may depart from the foregoing requirements only if agreed by the Engineer.

#### **409.3.2 Welding**

##### **409.3.2.1 General**

Welding shall be performed by the metal-arc process, using the electrodes specified with either direct or alternating current.

Surfaces to be welded shall be smooth, uniform and free from fins, tears, and other defects which would adversely affect the quality of the weld. Edges of material shall be trimmed by machining, chipping, grinding, or machine gas-cutting to produce a satisfactory welding edge wherever such edge is thicker than: 13 mm for sheared edge of material; 16 mm for toes of angles or rolled shapes (other than wide flange sections); 25 mm for universal mill plate or edges of flange sections.

No operation or actual welding or gas-cutting shall be performed on a member while it is carrying live load stress or while subject to shock and vibration and from moving loads. Welding and gas-cutting shall cease in advance of the application of such loads.

##### **409.3.2.2 Welders**

All welding shall be done by approved competent and experienced and fully qualified welders.

##### **409.3.2.13 Inspection**

On completion of the welding work, inspection shall be carried out by an Inspector appointed by the Engineer.

#### **409.4 Measurement and Payment**

Unless otherwise provided in the Special Provisions, welded structural steel structures shall not be measured and paid for separately, but the cost thereof shall be considered as included in the contract price for other items.

## **VIII. FINISHING WORKS**

### **A. TILEWORKS – ITEM No. 1018**

### **B. REFLECTIVE INSULATION – ITEM No. 1038(1)**

### **C. ALUMINUM WALL CLADDING (Aluminum Composite Panel) – ITEM No. 1039**

## **TILE WORKS- ITEM 1018**

### **ITEM 1018 - CERAMIC TILES**

#### **1018.1 Description**

This Item shall consist of furnishing all ceramic tiles and cementitious materials, tools and equipment including labor required in undertaking the proper installation of walls and floor tiles as shown on the Plans and in accordance with this Specification.

#### **1018.2 Material Requirements**

**1018.2.1** Ceramic tiles and trims shall be made of clay, or a mixture of clay and other materials which is called the body of the tile. Tile bodies are classified by ASTM C 242 as to their degree of water absorption.

##### **1018.2.1.1 Glazed Tiles**

Glazed tiles shall have an impervious face of ceramic materials fused onto the body of the tiles. The glazed surface may be clear white or colored depending on the color scheme approved by the Engineer. Glazed tiles will only be used in toilet finishing (floor and wall) and kitchen counter.

##### **1018.2.1.2 Unglazed Tiles**

Unglazed tiles shall be hard dense tile of homogeneous composition. Its color and characteristics are determined by the materials used in the body, the method of manufacture and the thermal treatment. Unglazed tiles will only be used in mezzanine floor tiles, office workspace areas and backsplash.

##### **1018.2.1.3 Trims**

Trims are manufactured to match wall tile color, texture and to coordinate with it in dimension. These are shaped in various PVC trim units such as caps, bases, coves, bullnoses, corners, angles, etc. that are necessary for edging or making a transition between intersecting planes.

##### **1018.2.1.4 Accessories**

Accessories like some soap holders and shall be made wall mounted type with colors to reconcile with the color of the adjacent wall tiles.

##### **1018.2.1.5 Cement**

Cement shall be Portland conforming to the specification requirements defined in Item 700, Hydraulic Cement.

##### **1018.2.1.6 Sand**

Sand shall be well graded fine aggregate clean river sand, free from soluble salts and organic impurities.

#### **1018.3 Construction Requirements**

Tile work shall not start until roughing-ins for plumbing, electrical and other trades have been completed and tested. The work of all other trades shall be protected from damage.

##### **1018.3.1 Surface Preparation**

a) Mortar mix for scratch coat and setting bed shall consist of one part Portland cement 1/4 part lime and 3 parts sand by volume. Surface to receive tile must be level, true to elevation, dry, free from dirt, oil and other ointments. Allow at least seven days curing of scratch coat and setting bed. Installation work shall not be allowed to proceed until unsatisfactory conditions are corrected.

b) Bond coat shall be Portland cement paste.

**1018.3.1.1** Thoroughly dampen surfaces of masonry or concrete walls before scratch coat is applied.

**1018.3.1.2** On masonry or concrete surface first apply a thin coat with pressure, then bring it out sufficiently to compensate for the major irregularities of the surface to a thickness not less than 10 mm. at any point.

**1018.3.1.3** Evenly rate scratch coat to provide good mechanical key before the mortar mix has fully hardened.

### **1018.3.2 Installation Procedure**

Ceramic tiles shall be soaked in clean water prior to installation for a minimum of one hour.

#### **1018.3.2.1 Ceramic Glazed Wall Tiles**

- a) Determine and mark layout of ceramic tiles, joint location, position of trims and fixtures so as to minimize cut less than one-half tile in size.
- b) Thoroughly dampen surface of wall but do not saturate surface.
- c) Apply a bond coat mix with consistency of cream paste 1.5 mm thick to the wall surface or to the back of the tile to be laid.
- d) Lay the tiles true to profile then exert pressure and tamp tile surface before the bond coat mix has initially set.
- e) Continue with the next full tile to be laid and pressed firmly upon the setting bed tamped until flush and in place of the other tiles.
- f) Intersections and returns shall be formed accurately using the appropriate trims.
- g) All lines shall be kept straight and true to profiles, plumbed and internal corners rounded using the appropriate trims.

#### **1018.3.2.2 Floor Tiles**

- a) Before tile is applied the floor surface shall be tested for levelness or uniformity of slope by 'flooding it with water. Area where water ponds are filled or levelled, shall be retested before the setting bed is applied.
- b) Establish lines of borders and center of the walls at the fieldwork in both direction to permit the pattern to be laid with a minimum of cut tiles.
- c) Clean concrete subfloor then moisten but do not soak. Then sprinkle dry cement over the surface and spread the mortar on the setting bed.
- d) Apply and spread mortar mix for setting bed and tamp to assure good bond over the entire area to be laid with tile.
- e) Pitch floor to drain as shown on Plans or as directed by the Engineer
- f) Allow the setting bed to set sufficiently to be worked over then spread a bond coat over the surface and lay tile in accordance with Items 1018.3.2.1 a, b, c, d, e, f, g.

### **1018.3.3 Grouting and Pointing**

**1018.3.3.1** Tiles shall have laid in place for at least 24 hours before grouting of the joints is started. Grouting mortar shall be white Portland cement or blended with pigments to acquire the color appropriate for the ceramic tile.

**1018.3.3.2** Grouting mortar shall be applied over the tile by float or squeegee stroked diagonally across the joints. Remove excess mortar with a wet sponge stroked diagonally or in a circular motion after 12-15 minutes. Follow with a barely damp or dry sponge to remove remaining haze while smoothing all grouted joints.

#### **1018.3.3 Cleaning**

- a) Clean ceramic tile surfaces thoroughly as possible upon completion of grouting.
- b) Remove all grout haze, observing tile manufacturers recommendations as to use of acid or chemical cleaners.
- c) Rinse tile thoroughly with clean water before and after using chemical cleaners.
- d) Polish surface of tile with soft cloth.

#### **1018.3.4 Protection from Construction Dirt**

- a) Apply a protective coat of neutral cleanser solution diluted with water in the proportion of 1:4 or 1 liter cleanser concentrate to 1 gallon water.
- b) In addition, cover tile flooring with heavy-duty no staining construction paper, taped in place.
- c) Just before final acceptance of the work remove paper and rinse protective coat of neutral cleaner from tile surface. Do not let protective paper get torn or removed.

### **1018.4 Method of Measurement**

All works performed under this Item shall be measured in square meters for areas actually laid with ceramic tiles and accepted to the satisfaction of the Engineer.

### **1018.5 Basis of Payment**

Ceramic tile work determined and provided in the Bill of Bill of Quantities shall be paid for based at the unit bid price which price and payment constitute full compensation for furnishing all materials, tools, equipment and other incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1018.2.1.1	Glazed tiles and trims	m <sup>2</sup>
1018.2.1.2	Unglazed tiles	m <sup>2</sup>

## **ITEM NO. 1038 - REFLECTIVE INSULATION**

### **1038.1 Description**

This item shall consist of furnishing all thermal insulation materials of one or more low emittance surfaces bounding one or more enclosed air spaces, tools and equipment, plant including labor required in undertaking the proper installation complete as shown on the Plans and in accordance with this Specification.

### **1038.2 Material Requirements**

Reflective insulation materials shall consist of low emittance surface(s) with, or without, substrates and adhesives required to meet the specified thermal performance and physical properties.

Multiple layer reflective insulations shall be designed to attain the intended separation of layers in normal application. Such multiple layer insulation shall form an attachment flange suitable for stapling, or other means of attachment.

Insulation shall be furnished in dimensions to fit framing members, at spacings standard in the construction industry, or as specifically agreed upon between the producer and the buyer.

### **1038.2 Method of Measurement**

The work done under this Item shall be measured by actual area covered or installed with reflective insulation in square meters and accepted to the satisfaction of the Engineer/Architect.

### **1038.5 Basis of Payment**

The area of reflective insulation in square meters as provided in Section 1038.4 shall be paid for at the unit bid or contract unit price which payment shall constitute full compensation including labor, materials, tools and incidents necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit Measurement
1038	Reflective Insulation	Square meter

## ITEM 1039 – ALUMINUM WALL CLADDING (ALUMINUM COMPOSITE PANEL)

### 1039.1 Description

This Item covers aluminum cladding sheet as exterior and interior materials applied to the walls, columns and ceiling of a structure to protect from the effects of weather and for aesthetic purposes.

### 1039.2 Material Requirements

#### 1039.2.1 Aluminum and Aluminum Alloy

Aluminum and aluminum alloy shall be flat sheet, coiled sheet, and plate, in the alloys and tempers shown in Tables 2 and 3 of ASTM B 209M, and in the following finishes:

- i. Plate in all alloys and sheet in heat-treatable alloys: mill finish.
- ii. Sheet in non-heat-treatable alloys: mill finish, one-side bright mill finish, standard one-side bright finish, and standard two-sides bright finish.

Aluminum sheets shall be supplied without nail holes, and are normally applied horizontally (ceilings) and vertically (walls) in accordance with accepted practices.

#### 1039.2.2 Rivet

The rivet shall conform to the following requirements or as specified in the plans:

Length	18.0 mm
Shaft Diameter	5.0mm
Head Diameter	14.0 mm
Holes for Fixed Points	5.2mm
Holes for Sliding Points	8.5mm

#### 1039.2.3 General Quality

Unless otherwise specified, the material shall be supplied in the mill finish and shall be uniform as defined by the requirements of this Item and shall be commercially sound. Any requirement not so covered shall be subjected to evaluation and approval of the Engineer. Framing system shall be made of aluminum to prevent corrosion of the panels. Each sheet and plate shall be examined to determine conformance to this Specification with respect to general quality and identification marking.

#### 1039.2.4 Tensile Properties of Material

- *Limits* - The sheet and plate shall conform to the requirements for tensile properties as specified in Tables 2 and 3 of ASTM B 209 for non-heat-treatable and heat-treatable alloys, respectively.
- *Number of Samples* - One (1) sample shall be taken from each end of each parent coil, or parent plate, but no more than one sample per 1000 kg of sheet or 2000 kg of plate, or part thereof, in a lot shall be required.
- *Test Specimens* - Geometry of test specimens and the location in the product from which they are taken shall be as specified in ASTM Test Methods B 557M.
- *Test Methods* - The tension test shall be made in accordance with ASTM Test Methods B 557M

#### 1039.2.5 Bend Properties

- *Limits* - Sheet and plate shall be capable of being bent cold through an angle of 180 degrees around a pin having a diameter equal to  $N$  times the thickness of the sheet or plate without cracking, the value of  $N$  being as prescribed in Table 2 of ASTM B 209 for the different alloys, tempers, and thicknesses. The test need not be conducted unless specified on the purchase order.
- *Test Specimens* - When bend tests are made, the specimens for sheet shall be the full thickness of the material, approximately 20 mm in width, and when practical, at least 150 mm in length. Such specimens may be taken in any direction and their edges may be rounded to a radius of approximately 2 mm. For sheet less than 20 mm in width, the specimens should be the full width of the material.
- *Test Methods* - The bend tests shall be made in accordance with ASTM Test Method E 290 except as stated otherwise in 2.5 Test Specimens.

### 1039.3 Installation Requirements

Installation requirements shall be prepared by the Contractor and shall be approved by the Engineer.

### **1039.5 Method of Measurements**

The area to be paid for shall be the number of square meter of the facade and/or ceiling to be covered with aluminum cladding, placed and accepted as the completed work, measured from edge to edge.

### **1039.6 Basis of Payment**

The accepted number of square meter prescribed in Section 1039.5, Method of Measurement, shall be paid for at the contract unit price for aluminum cladding which payment shall be the full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete the work item.

Payment shall be made under:

Pay Item Number	Description	Unit Measurement
1039	Aluminum Wall Cladding (Aluminum Composite Panel)	Square meter

## IX. PAINTING WORKS

### A. PAINTING WORKS (MASONRY/CONCRETE)- ITEM 1032(1)a

### B. PAINTING WORKS (STEEL)- ITEM 1032(1)c

## ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

### 1032.1 Description

This Item shall consist of furnishing all paint materials, varnish and other related products, labor, tools, equipment and plant required in undertaking the proper application of painting, varnishing and related works indicated on the Plans and in accordance with this Specification.

### 1032.2 Material Requirements

#### 1032.2.1 Paint Materials

All types of paint material, varnish and other related product shall use the following approved and tested brand name: Boysen, Davies, Dutch Boy, Fuller O Brien, or any approved equal.

#### 1032.2.3 Concrete Neutralizer

Concrete neutralizer shall be first grade quality concentrate diluted with clean water and applied as surface conditioner of new interior and exterior walls thus improving paint adhesion and durability.

#### 1032.2.5 Patching Compound

Patching compound shall be water-based heavy paste type material to fill minor surface dents and imperfections.

#### 1032.2.9 Sanding Sealer

Sanding sealer shall be quick drying lacquer, formulated to provide quick dry, good holdout of succeeding coats, and containing sanding agents such as zinc stearate to allow dry sanding of sealer.

#### 1032.2.10 Glazing Putty

Glazing putty shall be alkyd-type product for filling minor surface unevenness.

#### 1032.2.11 Natural Wood Paste Filler

Wood paste filler shall be quality filler for filling and sealing open grain of interior wood. It shall produce a level finish for following coats of paint varnish/lacquer and other related products.

#### 1032.2.12 Schedule

Exterior		
paint	a) Plain cement plastered finish to be painted	-1 coat latex primer; 3 coats latex masonry
	b) Ferrous metal	-1 coat oil based primer; 3 coats oil based
Interior		
paint	a) Plain cement plastered finish to be painted	-1 coat latex primer; 3 coats latex masonry
	b) Ferrous metal	-1 coat oil based primer; 3 coats oil based
patch based paint	c) Woodwork painted	-1 coat wood primer; 3 coats of oil base paint
	d) Ceiling boards textured finish	-1 coat oil based paint allow to dry then surfaces unevenness; apply 3 coats of oil

### 1032.3 Construction Requirements

The Contractor prior to commencement of the painting, varnishing and related work shall examine the surfaces to be applied in order not to jeopardize the quality and appearances of the painting varnishing and related works.

#### 1032.3.1 Surface Preparation

All surfaces shall be in proper condition to receive the finish. Woodworks shall be hand- sanded smooth and dusted clean. All knotholes pitch pockets or sappy portions shall be sealed with natural wood filler. Nail holes, cracks or



defects shall be carefully puttied after the first coat, matching the color of paint.

Interior woodworks shall be sandpapered between coats. Cracks, holes or imperfections in plaster shall be filled with patching compound and smoothed off to match adjoining surfaces.

Concrete and masonry surfaces shall be coated with concrete neutralizer and allowed to dry before any painting primer coat is applied. When surface is dried apply first coating. Hairline cracks and unevenness shall be patched and sealed with approved putty or patching compound.

After all defects are corrected, apply the finish coats as specified on the Plans (color scheme approved). Metal shall be clean, dry and free from mill scale and rust. Remove all grease and oil from surfaces. Wash unprimed galvanized metal with etching solution and allow it to dry.

In addition the Contractor shall undertake the following:

1. Voids, cracks, nick etc. will be repaired with proper patching material and finished flushed with surrounding surfaces.
2. Marred or damaged shop coats on metal shall be spot primed with appropriate metal primer.
3. Painting and varnishing works shall not be commenced when it is too hot or cold.
4. Allow appropriate ventilation during application and drying period.
5. All hardware will be fitted and removed or protected prior to painting and varnishing works.

### **1032.3.2 Application**

Paints when applied by brush shall become non-fluid, thick enough to lay down as adequate film of wet paint. Brush marks shall flow out after application of paint.

Paints made for application by roller must be similar to brushing paint. It must be nonstick when thinned to spraying viscosity so that it will break up easily into droplets.

### **1032.3.3 Mixing and Thinning**

At the time of application paint shall show no sign of deterioration. Paint shall be thoroughly stirred, strained and kept at a uniform consistency during application. Paints of different manufacture shall not be mixed together. When thinning is necessary, this may be done immediately prior to application in accordance with the manufacturer's directions, but not in excess of 1 pint of suitable thinner per gallon of the paint.

### **1032.3.4 Storage**

All material to be used under this Item shall be stored in a single place to be designated by the Engineer and such place shall be kept neat and clean at all time. Necessary precaution to avoid fire must be observed by removing oily rags, waste, etc. at the end of daily work.

### **1032.3.5 Cleaning**

All cloths and cotton waste which constitute fire hazards shall be placed in metal containers or destroyed at the end of daily works. Upon completion of the work, all staging, scaffolding and paint containers shall be removed. Paint drips, oil, or stains on adjacent surfaces shall be removed and the entire job left clean and acceptable to the Engineer.

### **1032.3.6 Workmanship in General**

- a) All paints shall be evenly applied. Coats shall be of proper consistency and well brushed out to show a minimum of brush marks.
- b) All coats shall be thoroughly dry before the succeeding coat is applied.
- c) Where surfaces are not fully covered or cannot be satisfactorily finished in the number of coats specified such preparatory coats and subsequent coats as may be required shall be applied to attain the desired evenness of surface without extra cost to the owner.
- d) Where surface is not in proper condition to receive the coat, the Engineer shall be notified immediately. Work on the questioned portion(s) shall not start until clearance be proceed is ordered by the Engineer.
- e) Hardware, lighting fixture and other similar items shall be removed or 'protected during the painting varnishing and related work operations and re-installed after completion of the work.

### **1032.4 Method of Measurement**

The areas of concrete, wood and metal surfaces applied with varnish, paint and other related coating materials shall be measured in square meters as desired and accepted to the satisfaction of the Engineer.

### **1032.5 Basis of Payment**

The accepted work shall be paid at the unit bid price, which price and payment constitute full compensation for furnishing all materials, labor, equipment, tools and other incidental necessary to complete this Item.

Payment will made under:

Pay Item Number	Description	Unit of Measurement
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1032 (a)

Painting works

m<sup>2</sup>

## **X. ROOF AND ROOF FRAMING WORKS**

### **A. PRE-PAINTED METAL SHEETS LONG SPAN(above 0.427mm thick)- ITEM 1014(1)b2**

### **B. FABRICATED METAL ROOFING ACCESSORY – ITEM No. 1013(2)**

#### **ITEM 1014 – PRE-PAINTED METAL SHEETS**

##### **1014.1 Description**

This Item shall consist of furnishing all pre-painted metal sheet materials, tools and equipment, plant including labor required in undertaking the proper installation complete as shown on the Plans and in accordance with this Specification.

##### **1014.2 Material Requirements**

All pre-painted metal sheet and roofing accessories shall be oven baked painted true to profiles indicated on the Plans.

##### **1014.2.1 Pre-Painted Roofing Sheets**

Pre-painted roofing sheets shall be fabricated from cold rolled galvanized iron sheets specially tempered steel for extra strength and durability. It shall conform to the material requirements defined in PNS 67:1985. Profile section in identifying the architectural molded rib to be used are as follows: Regular corrugated, Quad-rib, Tri-wave, Rib-wide, twin-rib, etc. Desired color shall be subject to the approval of the Architect/Engineer.

**1014.2.2** Valleys, Flashings Hip and Ridge roll shall be fabricated from gauge 24 (.600 mm thick) cold-rolled plain galvanized iron sheets specially tempered steel.

**1014.2.3** Fastening hardware shall be of galvanized iron straps and rivets. G.I. straps are of .500 mm thick x 16 mm wide x 267 mm long (gauge 26 x 5/8" x 10-1/2") and standard rivets.

**1014.2.4** Base metal thickness shall correspond to the following gauge designation available locally as follows:

a)	Base Metal Thickness	Designated Gauges
	.400 mm thick	Gauge 28
	.500 mm thick	Gauge 26
	.600 mm thick	Gauge 24
	.800 mm thick	Gauge 22
b)	Protective Coatings	<u>Thickness</u>
1.	Zinc	34.4 microns (244 gm/m2)
2.	Paint coatings	
	Top coat	15.20 microns
	Bottom coat	6.8 microns
c)	Overall thickness with protective coats	
d)	.400 mm	.428-451 mm
	.500 mm	.532-551 mm
	.600 mm	.638-651 mm
e)	Length of roofing sheets - available in cut to length long span length up to 18.29 meters	
f)	Special length and thickness are available by arrangements.	

##### **1014.3 Construction Requirements**

Before any installation work will commence, the Contractor shall ascertain that the top faces of the purlins are in proper alignment. Correct the alignment as necessary in order to have the top faces of the purlins on an even plane.

##### **1014.3.1 Handling/Lifting/Positioning of Sheets**

Sheets shall be handled carefully to prevent damage to the paint coating. Lift all sheets or sheet packs on to the roof frame with the overlapping down-turned edge facing towards the side of the roof where installation will commence, otherwise sheets will have to be turned end-to-end during installation.

##### **1014.3.2 Installation Procedure**

**1014.3.2.1** Start roofing installation by placing the first sheet in position with the downturned edge in line with other building elements and fastened to supports as recommended.

**1014.3.2.2** Place the downturned edge of the next sheet over the edge of the first sheet, to provide side lap and

hold the side lap firmly in place. Continue the same procedure for subsequent sheets until the whole roofing area is covered (Adopt installation procedure provided in the instruction manual for each type of Architectural molded rib profile section).

#### **1014.3.3 Valleys, Flashing ridge and Hip rolls**

Valleys, flashing ridge and hip rolls shall be fastened where indicated on the Plans by self-tapping screws or galvanized iron straps and rivets.

#### **1014.3.4 End Laps**

In case handling or transport consideration requires using two or more end lapped sheets to provide full-length coverage for the roof run, install each line of sheets from bottom to top or from eave line to apex of roof framing. Provide 150 mm minimum end lap.

#### **1014.3.5 Anchorage/Fastening**

**1014.3.5.1** Pre-painted steel roofing sheets shall be fastened to purlins with standard length G.I. straps and rivets.

**1014.3.5.2** For steel frame up to 4.5 mm thick use self drilling screw No. 12 by 35 mm long hexagonal head with neoprene washer.

**1014.3.5.3** For steel support up to 5 mm thick or more use thread cutting screw No. 12 by 40 mm long hexagonal head with neoprene washer.

**1014.3.5.4** Side lap fastener use self drilling screw NO.10 by 16 mm long hexagonal head with neoprene washer.

**1014.3.5.5** Valley fastened to steel, use self-drilling wood screw No. 12 by 25 mm long hexagonal head with neoprene washer.

**1014.3.5.6** Valleys fastened to steel supports use self drilling screws, hexagonal head with neoprene washer. Drill size is 5 mm diameter.

#### **1014.3.6 Cutting of Sheets**

**1014.3.6.1** In cutting pre painted steel roofing sheets and accessories to place the exposed color side down. Cutting shall be carried out on the ground and not over the top of other painted roofing product.

**1014.3.6.2** Power cutting or drilling to be done or carried out on pre-painted products already installed or laid in position, the area around holes or cuts shall be masked to shield the paint from hot fillings.

#### **1014.3.7 Storage and Protection**

Pre-painted steel roofing products and accessories should be delivered to the jobsite in strapped bundles and shall be neatly stacked in the ground and if left in the open, it shall be protected by covering the stack materials with loose tarpaulin.

#### **1014.4 Method of Measurement**

The work done under this Item shall be measured by actual area covered or installed with pre-painted steel roofing and/or walling in square meters and accepted to the satisfaction of the Engineer/Architect.

#### **1014.5 Basis of Payment**

The area of pre-painted steel roofing and/or walling in square meters as provided in Section 1014 shall be paid for at the unit bid or contract unit price which payment shall constitute full compensation including labor, materials, tools and incidents necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1014 (a)	Pre painted metal sheets	m <sup>2</sup>

- C. **STRUCTURAL STEEL- ITEM No. 1047(2)a**
- D. **STRUCTURAL STEEL, PURLINS – ITEM No, 1047(2)b**

## **ITEM 403      STRUCTURAL STEEL**

### **403.1    Description**

This work shall consist of steel structures and the steel structure portions of composite structures, constructed in reasonably close conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

The work will include the furnishing, fabricating, hauling, erecting, welding and painting of structural metals called for in the Special Provision or shown on the Plans. Structural metals will include structural steel, rivet, welding, special and alloy steels, steel forgings and castings and iron castings. This work will also include any incidental metal construction not otherwise provided for, all in accordance with these Specifications, Plans and Special Provisions.

### **403.2    Material Requirements**

Materials shall meet the requirements of Item 712, Structural Metal; Item 409, Welded Structural Steel, and Item 409, Welded Structural Steel; and Item 709, Paints.

### **403.3    Construction Requirements**

#### **403.3.1      Inspection**

The Contractor shall give the Engineer at least fifteen (15) days notice prior to the beginning of work at the mill or shop, so that the required inspection may be made. The term “mill” means any rolling mill, shop or foundry where material for the work is to be manufactured or fabricated. No material shall be rolled or fabricated until said inspection has been provided.

The Contractor shall furnish the Engineer with copies of the certified mill reports of the structural steel, preferably before but not later than the delivery of the steel to the job site.

The Contractor shall furnish all facilities for inspection and the Engineer shall be allowed free access to the mill or shop and premises at all times. The Contractor shall furnish, without charge, all labor, machinery, material and tools necessary to prepare test specimens.

Inspection at the mill or shop is intended as a means of facilitating the work and avoiding errors and it is expressly understood that it will not relieve the Contractor from any responsibility for imperfect material or workmanship and the necessity for replacing same. The acceptance of any material or finished member at the mill or shop by the Engineer shall not preclude their subsequent rejection if found defective before final acceptance of the work. Inspection of welding will be in accordance with the provision of Section 5 of the “Standard Code for Arc and Gas Welding in Building Construction” of the American Welding Society.

#### **403.3.2 Stock Material Control**

When so specified in the Contract, stock material shall be segregated into classes designated as “identified” or “unidentified”. Materials which can be positively identified as having been rolled from a given heat for which certified mill test can be produced. Unidentified material shall include all other general stock materials. When it is proposed to use unidentified material, the Engineer shall be notified of such intention at least fifteen (15) days in advance of commencing fabrication to permit sampling and testing. When so indicated or directed, the Contractor shall select such material as he wishes to use from stock, and place it in such position that it will be accessible for inspection and sampling. The Contractor shall select identified material from as few heat numbers as possible, and furnish the certified mill test reports on each of such heat numbers. Two samples shall be taken from each heat number as directed, one for a tension test and one for a bend test.

In the case of unidentified stock, the Engineer may, at his discretion, select any number of random test specimens.

Each bin from which rivets or bolts are taken shall subject to random test. Five rivets or bolts may be selected by the Engineer from each bin for test purposes.

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

### 403.3.3 Fabrication

These Specifications apply to riveted, bolted and welded construction. The Contractor may, however, with approval of the Engineer, substitute high tensile strength steel bolts equivalent to the rivets in any connection.

Workmanship and finish shall be in accordance with the best general practice. Portions of the work exposed to view shall be finished neatly. Shearing, flame cutting, and chipping shall be done carefully and accurately.

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

Rolled material before being laid off or worked must be straight. If straightening is necessary, it shall be done by methods that will not injure the metal. Sharp kinks and bends will be cause for rejection of the material.

Preparation of material shall be in accordance with AWS (American Welding Society) D 1.1, paragraph 3.2 as modified by AASHTO Standard Specification for Welding of Structural Steel Highway Bridges.

### 403.3.4 Finishing and Shaping

Finished members shall be true to line and free from twists, bends and open joints.

#### 1. Edge Planing

Sheared edges of plates more than 15.9 mm in thickness and carrying calculated stresses shall be planed to a depth of 6.3 mm. Re-entrant cuts shall be filleted before cutting.

#### 2. Facing of Bearing Surfaces

The surface finish of bearing and based plates and other bearing surfaces that are to come in contact with each other or with concrete shall meet the American National Standards Institute surface roughness requirements as defined in ANSI B-46.1-47, Surface Roughness Waviness and Lay, Part I:

Steel slabs	ANSI 2,000
Heavy plates in contact in shoes to Be welded	ANSI 1,000
Milled ends of compression members, stiffeners and fillers	ANSI 500
Bridge rollers and rockers	ANSI 250
Pins and pin holes	ANSI 125
Sliding bearings	ANSI 125

#### 3. Abutting Joints

Abutting joints in compression members and girders flanges and in tension members where so specified on the drawings, shall be faced and brought to an even bearing. Where joints are not faced, the opening shall not exceed 6.3 mm.

#### 4. End Connection Angles

Floor beams, stringers and girders having end connection angles shall be built to plan length back to back of connection angles with a permissible tolerance of 0 mm to minus 1.6 mm. If end connections are faced, the finished thickness of the angles shall not be less than that shown on the detail drawings, but in no case less than 9.5 mm.

#### 5. Lacing Bars

The ends of lacing bars shall be neatly rounded unless another form is required.

#### 6. Fabrication of Members

Unless otherwise shown on the Plans, steel plates for main members and splice plates for flanges and main tension members, not secondary members, shall be cut and fabricated so that the primary direction of rolling is parallel to the direction of the main tensile and/or compressive stresses. Fabricated members shall be true to line and free from twists, bends and open joints.

#### 7. Tests

When full size tests of fabricated structural members are required by the Contract, the Plans or Specifications will statethe number and nature of the tests, the results to be attained and the measurements of strength, deformation or other performances that are to be made. The Contractor will provide suitable facilities, material, supervision and labor necessary for making and recording the tests. The members tested in accordance with the Contract will be paid for in accordance with Subsection 403.3.5.1. The cost of testing, including equipment handling, supervision labor and incidentals for making the test shall be included in the contract price for the fabrication or fabrication and erection of structural steel, whichever is the applicable item in the Contract, unless

otherwise specified.

#### **403.3.6 Fastener Holes (Rivets and Bolts)**

All holes for rivets or bolts shall be either punched or drilled. Material forming parts or a member composed of not more than five thickness of metal may be punched 1.6 mm larger than the nominal diameter of the rivets or bolts whenever the thickness of the material is not greater than 19 mm for structural steel, 15.9 mm for high-strength steel or 12.7 mm for quenched and tempered alloy steel, unless subpunching and reaming is required for field connections.

When there are more than five thicknesses or when any of the main material is thicker than 19 mm for structural steel, 15.9 mm for high-strength steel, or 12.7 mm for quenched and tempered alloy steel, all holes shall either be sub drilled or drilled full size.

When required for field connections, all holes shall either be subpunched or subdrilled (subdrilled if thickness limitation governs) 4.8 mm smaller and, after assembling, reamed 1.6 mm larger or drilled full size 1.6 mm larger than the nominal diameter of the rivets or bolts.

When permitted by design criteria, enlarged or slotted holes are allowed with high-strength bolts. For punched holes, the diameter of the die shall not exceed the diameter of the punch by more than 1.6 mm. If any holes must be enlarged to admit the fasteners, they shall be reamed. Holes shall be clean cut, without torn or ragged edges. Poor matching of holes will be cause for rejection.

Reamed holes shall be cylindrical, perpendicular to the member, and not more than 1.6 mm larger than the nominal diameter of the fasteners. Where practicable, reamers shall be directed by mechanical means. Drilled holes shall be 1.6 mm larger than the nominal diameter of the fasteners. Burrs on the outside surfaces shall be removed. Poor matching of holes will be cause for rejection. Reaming and drilling shall be done with twist drills. If required by the Engineer, assembled parts shall be taken apart for removal of burrs caused by drilling. Connecting parts requiring reamed or drilled holes shall be assembled and securely held while being reamed or drilled and shall be match marked before disassembling.

Unless otherwise specified, holes for all field connections and field splices of main truss or arch members, continuous beams, towers (each face), bents, plate girders and rigid frames shall be sub-punched (or sub-drilled if sub-drilling is required) and subsequently reamed while assembled in the shop in accordance with Subsection 403.3.7.

All holes for floor-beam and stringer field end connections shall be sub-punched and reamed to a steel template reamed while being assembled.

Reaming or drilling full size of field connection through templates shall be done after templates have been located with the utmost care as to position and angle and firmly bolted in place. Templates used for the reaming of matching members, or of the opposite faces of one member, shall be exact duplicated. Templates for connections which duplicate shall be so accurately located that like members are duplicates and require no match marking.

If additional sub-punching and reaming is required, it will be specified in the Special Provisions or on the Plans.

Alternately, for any field connection or splice designated above in lieu of sub-sized holes and reaming while assembled, or drilling holes full-size while assembled, the Contractor shall have the option to drill bolt holes full-size in unassembled pieces and/or connections including templates for use with matching sub-sized and reamed holes means of suitable numerically-controlled (N/C) drilling equipment subject to the specific provisions contained in this Subsection.

If N/C drilling equipment is used, the Engineer, unless otherwise stated in the Special Provisions or on the Plans, may require the Contractor, by means of check assemblies to demonstrate that this drilling procedure consistently produces holes and connections meeting the requirements of conventional procedures.

The Contractor shall submit to the Engineer for approval a detailed outline of the procedures that he proposes to follow in accomplishing the work from initial drilling through check assembly, if required, to include the specific members of the structure that may be N/C drilled, the sizes of the holes, the location of common index and other reference points, composition of check assemblies and all other pertinent information.

Holes drilled by N/C drilling equipment shall be drilled to appropriate size either through individual pieces, or any combination of pieces held tightly together.

All holes punched full size, sub-punched or sub-drilled shall be so accurately punched that after assembling

(before any reaming is done), a cylindrical pin 3.2 mm smaller in diameter than the nominal size of the punched hole may be entered perpendicular to the face of the member, without drifting, in at least 75 percent of the contiguous holes in the same plane. If the requirement is not fulfilled, the badly punched pieces will be rejected. If any hole will not pass a pin 4.8 mm smaller in diameter than the nominal size of the punched holes, this will cause for rejection.

When holes are reamed or drilled, 85 percent of the holes in any continuous group shall, after reaming or drilling, show no offset greater than 0.8 mm between adjacent thickness of metal.

All steel templates shall have hardened steel bushings in holes accurately dimensioned from the centerlines if the connections as inscribed on the template. The centerlines shall be used in locating accurately the template from the milled or scribed ends of the members.

#### **403.3.7 Shop Assembly**

##### **1. Fitting for Riveting and Bolting**

Surfaces of metal in contact shall be cleaned before assembling. The parts of a member shall be assembled, well pinned and firmly drawn together with bolts before reaming or riveting is commenced. Assembled pieces shall be taken apart, if necessary, for the removal of burrs and shavings produced by the reaming operation. The member shall be free from twists, bends and other deformation. Preparatory to the shop riveting of full-sized punched material, the rivet holes, if necessary, shall be spear-reamed for the admission of the rivets. The reamed holes shall not be more than 1.6 mm larger than the nominal diameter of the rivets.

End connection angles, and similar parts shall be carefully adjusted to correct positions and bolted, clamped, or otherwise firmly in place until riveted. Parts not completely riveted in the shop shall be secured by bolts, in so far as practicable, to prevent damage in shipment and handling.

##### **2. Shop Assembling**

The field connections of main members of trusses, continuous beam spans, and rigid frames shall be assembled in the shop with milled ends of compression members in full bearing, and then shall have their sub-size holes reamed to specified size while the connections are assembled. Assembly shall be "Full Truss Assembly" unless "Progressive Chord Assembly" or "Special Complete Structure Assembly" is specified in the Special Provisions or on the Plans.

Check assemblies with Numerically-Controlled Drilled Fields Connections shall be in accordance with the provision of 2 (f) of this Subsection.

Each assembly, including camber, alignment, accuracy of holes and fit of milled joints, shall be approved by the Engineer before reaming is commenced or before an N/C drilled check assembly is dismantled.

The fabricator shall furnish the Engineer a camber diagram showing the camber at each panel point in the cases of trusses or arch ribs and at the location of field splices and fractions of span length (0.25 points minimum, 0.10 points maximum) in case of continuous beam and girders or rigid frames. When the shop assembly is Full Truss or Girder Assembly or Special Complete Structure Assembly, the camber diagram shall show the camber measured in assembly. When any of the other methods of shop assembly is used, the camber diagram shall show calculated camber.

Methods of assembly shall be described below:

a. Full of Truss or Girders Assembly shall consist of assembling all members of each truss, arch rib, bent, tower face, continuous beam line, plate girder or rigid frame at one time.

b. Progressive Truss Assembly shall consist of assembling initially for each truss, continuous beam line, or rigid frame all members in at least three continuous shop sections or panels but not less than the number of panels associated with three continuous chord lengths (i.e., length between field splices) and not less than 45.72 m in case of structures longer than 45.72 m. At least one shop section or panel or as many panels as are associated with a chord length shall be added at the advancing end of the assembly before any member is removed from the rearward end so that the assembled portion of the structure is never less than that specified above.

c. Full Chord Assembly shall consist of assembling with geometric angles at the joints, the full length of each chord or each truss or open spandrel arch, or each leg of each bent or tower, then reaming their field connection holes while the members are assembled; and reaming the web member connections to steel templates set at geometric (not cambered) angular relation to the chord lines. Field connection holes in web members shall be reamed to steel templates. At least one end of each web member shall be milled or shall be scribed normal to the longitudinal axis of the member and the templates of both ends of the member shall be accurately located from one of the milled ends or scribed line.



d. Progressive Chord Assembly shall consist of assembling contiguous chord members in the manner specified for Full Chord Assembly, and in the number and length specified for Progressive Truss or Girder Assembly.

e. Special Complete Structure Assembly shall consist of assembling the entire structure, including the floor system. (This procedure is ordinarily needed only for complicated structures such as those having curved girders, or extreme skew in combination with severe grade or camber). The assembly including camber, alignment, accuracy of holes and fit of milled joints shall be approved by the Engineer before reaming is commenced.

A Contractor shall furnish the Engineer a camber diagram showing the camber at each panel point of each truss, arch rib, continuous beam line, plate girder or rigid frame. When shop assembly is Full Truss or Girder Assembly or Special Complete Structure Assembly, the camber diagram shall show the camber measured in assembly. When any of the other methods of shop assembly is used, the camber diagram shall show calculated camber.

f. Check Assemblies with Numerically-Controlled Drilled Field Connections. A check assembly shall be required for each major structural type of each project, unless otherwise designated on the Plans or in the Special Provisions, and shall consist of at least three contiguous shop sections or, in a truss, all members in at least three contiguous panels but not less than the number of panels associated with three contiguous chord lengths (i.e., length between field splices). Check assemblies should be based on the proposed order erection, joints in bearings, special complex points, and similar considerations. Such special points could be the portals of skewed trusses, etc.

Use of either geometric angles (giving theoretically zero secondary stresses under deadload conditions after erection) or cambered angles (giving theoretically zero secondary stresses under no-load conditions) should be designated on the Plans or in the Special Provisions.

The check assemblies shall be preferably be the first such sections of each major structural type to be fabricated. No matchmaking and no shop assemblies other than the check assemblies shall be required.

If the check assembly fails in some specific manner to demonstrate that the required accuracy is being obtained, further check assemblies may be required by the Engineer for which there shall be no additional cost to the contracting authority.

#### **403.3.8 Rivets and Riveting**

The size of rivets called for on the Plans shall be the size before heating. Rivet heads shall be of standard shape, unless otherwise specified, and of uniform size for the same diameter of rivet. They shall be full, neatly made, concentric with the rivets holes, and in full contact with the surface of the member. Sufficient rivets for field connections shall be furnished to rivet the entire structure with an ample surplus to replace all rivets burned, lost or cut out.

Rivets shall be heated uniformly to a "light cherry red color" and shall be driven while hot. Any rivet whose point is heated more than the remainder shall not be driven. When a rivet is ready for driving, it shall be free from slag, scale and other adhering matter. Any rivet which is sealed excessively, will be rejected.

All rivets that are loose, burned, badly formed, or otherwise defective shall be removed and replaced with satisfactory rivets. Any rivet whose head is defective in size or whose head is driven off center will be considered defective and shall be removed. Stitch rivets that are loosened by driving of adjacent rivets shall be removed and replaced with satisfactory rivets. Caulking, recapping, or double gunning of rivets heads will not be permitted.

Shop rivets shall be driven by direct-acting rivet machines when practicable. Approved beveled rivet sets shall be used for forming rivet heads on sloping surfaces. When the use of a direct-acting rivet machine is not practicable, pneumatic hammers of approved size shall be used. Pneumatic bucking tools will be required when the size and length of the rivets warrant their use. Rivets may be driven cold provided their diameter is not over 9.5 mm.

#### **403.3.9 Bolted Connections, Unfurnished, Turned and Ribbed Bolts**

##### **1. General**

Bolts under this Subsection shall conform to "Specifications for Carbon Steel Externally and Internally Threaded Standard Fasteners", ASTM A 307. Specifications for high strength bolts are covered under Subsection 403.3.10.

Bolts shall be unfinished, turned or an approved form of ribbed bolts with hexagonal nuts and heads except that ribbed bolts shall have button heads. Bolted connections shall be used only as indicated by the Plans or Special Provisions. Bolts not tightened to the proof loads shall have single self-locking nuts or double nuts. Bevel washers shall be used where bearing faces have a slope or more than 1:20 with respect to a plane normal to the

bolt axis. Bolts shall be of such length that will extend entirely through their nuts but not more than 6.3 mm beyond them.

Bolts shall be driven accurately into the holes without damage to the threads. A snap shall be used to prevent damage to the heads. The heads and nuts shall be drawn tight against the work with the full effort of a man using a suitable wrench, not less than 381 mm long for bolts of nominal diameter 19 mm and over. Heads of bolts shall be tapped with a hammer while the nuts are being tightened.

**2. Unfinished Bolts**

Unfinished bolts shall be furnished unless other types are specified. The number of bolts furnished shall be 5 percent more than the actual number shown on the Plans for each size and length.

**3. Turned Bolts**

The surface of the body of turned bolts shall meet the ANSI roughness rating value of 125. Heads and nuts shall be hexagonal with standard dimensions for bolts of the nominal size specified or the next larger nominal size. Diameter of threads shall be equal to the body of the bolt or the nominal diameter of the bolt specified. Holes for turned bolts shall be carefully reamed with bolts furnished to provide for a light driving fit. Threads shall be entirely outside of the holes. A washer shall be provided under the nut.

**4. Ribbed Bolts**

The body of ribbed shall be of an approved form with continuous longitudinal ribs. The diameter of the body measured on a circle through the points of the ribs shall be 1.98 mm greater than the nominal diameter specified for the bolts.

Ribbed bolts shall be furnished with round heads conforming to ANSI B 18.5 unless otherwise specified. Nuts shall be hexagonal, either recessed or with a washer of suitable thickness. Ribbed bolts shall make a driving fit with the holes. The hardness of the ribs shall be such that the ribs do not mash down enough to permit the bolts to turn in the holes during tightening. If for any reason, the bolt twists before drawing tight, the holes shall be carefully reamed and an oversized bolt used as a replacement. The Contractor shall provide and supply himself with oversize bolts and nuts for this replacement in an amount not less than ten percent (10%) of the number of ribbed bolts specified.

**403.3.11 Welding**

Welding shall be done in accordance with the best modern practice and the applicable requirements at AWS D1.1 except as modified by AASHTO "Standard Specifications for Welding of Structural Steel Highway Bridges".

**403.1.2 Erection**

**1. General**

The Contractor shall provide the falsework and all tools, machinery and appliances, including drift pins and fitting-up bolts, necessary for the expeditious handling of the work and shall erect the metal work, remove the temporary construction, and do all work necessary to complete the structure as required by the Contract and in accordance with the Plans and these Specifications.

If shown on the Plans or in the Special Provisions, the Contractor shall dismantle the old structure on the bridge site in accordance with Item 101, Removal of Structures and Obstructions.

**403.3.13 Handling and Storing Materials**

Materials to be stored shall be placed on skids above the ground. It shall be kept clean and properly drained. Girders and beams shall be placed upright and shored. Long members, such as columns and chords, shall be supported on skids placed near enough together to prevent injury from deflection. If the Contract is for erection only, the Contractor shall check the material turned over to him against the shipping lists and report promptly in writing any shortage or damage discovered. He shall be responsible for the loss of any material while in his care, or for any damage caused to it after being received by him.

**403.3.15 Method and Equipment**

Before starting the work of erection, the Contractor shall inform the Engineer fully as to the method of erection he proposes to follow, and the amount and character of equipment he proposes to use, which shall be subject to the approval of the Engineer. The approval of the Engineer shall not be considered as relieving the Contractor of the responsibility for the safety of his method or equipment or from carrying out the work in full accordance with the Plans and Specifications. No work shall be done until such approval by the Engineer has been obtained.

**403.3.17 Assembling Steel**

The parts shall be accurately assembled as shown on the working drawings and any match marks shall be followed. The material shall be carefully handled so that no parts will be bent, broken or otherwise damaged.

Hammering which will injure or distort the members shall not be done. Bearing surfaces and surfaces to be in permanent contact shall be cleaned before the members are assembled. Unless erected by the cantilever methods, truss spans shall be erected on blocking so placed as to give the trusses proper camber. The blocking shall be left in place until the tension chord splices are fully connected with permanent fasteners and all other truss connections pinned and erection bolted. Splices of butt joints of compression members, that are milled to bear and of railing shall not be permanently fastened until the spans have been swung, except that such permanent fastening may be accomplished for the truss members at any time that joint holes are fair. Splices and field connections shall have one-half of the holes filled with erection bolts and cylindrical erection pins (half bolts and half pins) before placing permanent fasteners. Splices and connections carrying traffic during erection shall have three-fourths of the holes so filled, unless otherwise permitted by the Engineer.

Fitting-up bolts shall be of the same nominal diameter as the permanent fasteners and cylindrical erection pins will be 1.6 mm larger.

#### **403.3.22 System of Paint**

The paint system to be applied shall comply with Item 1032- Paints

#### **403.3.24 Clean-up**

Upon completion and before final acceptance, the Contractor shall remove all falsework. Falsework piling down to at least 609.6 mm below the finished ground line, excavated or unused materials, rubbish and temporary buildings. He shall replace or renew any fences damaged and restored in an acceptable manner all property, both public and private, which may have been damaged during the prosecution of the work and shall leave the work site and adjacent highway in a neat and presentable condition, satisfactory to the Engineer. The Contractor before final acceptance shall remove all excavated material or falsework placed in the stream channel during construction.

### **403.4 Method of Measurement**

#### **403.4.1 Unit Basis**

The quantity of structural steel to be paid for shall be the number of kilos complete in place and accepted. For the purpose of measurement for payment components fabricated from metals listed in (1) below, such as casting, alloy steels, steel plates, anchor bolts and nuts, shoes, rockers, rollers, pins and nuts, expansion dams, roadway drains and souppers, welds metal, bolts embedded in concrete, cradles and brackets, posts, conduits and ducts, and structural shapes for expansion joints and pier protection will be considered as structural steel.

Unless otherwise provided, the mass of metal paid for shall be computed and based upon the following mass:

#### **1. Unit Density kg/m<sup>3</sup>**

Steel, cast or rolled, including alloy copper bearing and stainless	7849
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#### **2. Shapes, Plates Railing and Flooring**

The mass of steel shapes and plates shall be computed on the basis of their nominal mass and dimensions as shown on the approved shop drawings, deducting for copes, cuts and open holes, exclusive of rivets holes. The mass of all plates shall be computed on the basis of nominal dimensions with no additional for overrun.

The mass of railing shall be included as structural steel unless the Bill of Quantities contains as pay item for bridge railing under Item 401, Railings.

The mass of steel grid flooring shall be computed separately.

#### **3. Miscellaneous**

The mass of erection bolts, shop and field paint, galvanizing the boxes, crates and other containers used for shipping, together with sills, struts, and rods used for supporting members during the transportation, bridge hardware as defined in Subsection 402.2.2 excluding steel plates and bearings, connectors used for joining timber members, nails, spikes and bolts, except anchor bolts will be excluded.

#### **4. Other Items**

The quantities of other Contract Items which enter into the completed and accepted structure shall be measured for payment in the manner prescribed for the Items involved.

#### **403.4.2 Lump Sum Basis**

Lump sum will be the basis of payment unless noted otherwise in the bidding documents. No measurements of quantities will be made except as provided in Subsection 403.5.1 (4).

#### **403.5.4 Payment as Reinforcing Steel**

When the Bill of Quantities does not contain a pay item for structural steel, the quantities of metal drains,

scuppers, conduits, ducts and structural shapes for expansion joints and pier protection, measured as provided above will be paid for as Reinforcing Steel under Item 404.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
403 (1)	Structural Steel, furnished, fabricated and erected	kilogram
403 (2)	Structural Steel, furnished, fabricated and erected	kilogram
403 (3)	Structural Steel, furnished, fabricated	kilogram
403 (4)	Structural Steel, furnished, fabricated	kilogram
403 (5)	Structural Steel erected	kilogram
403 (6)	Structural Steel erected	kilogram
403 (7)	Structural Steel, furnished, fabricated and erected	kilogram

Where separate payment is to be made for certain metals or for certain particular components, other than under the general provision for structural steel, designation of those particular cases shall be inserted in the spaces provided in the pay names for Item 403 (2), 403 (4) or 403 (6), as the case may be.

## **XI. ELECTRICAL WORKS**

- A. CONDUITS, BOXES AND FITTINGS (Conduit Works/Conduit Rough-ins) – ITEM No. 1100(10)**
- B. WIRES AND WIRING DEVICES – ITEM No. 1101(33)**
- C. PANELBOARD WITH MAIN AND BRANCH BREAKERS – ITEM No. 1101(1)**
- D. LIGHTING FIXTURES – ITEM No. 1101(1)**

### **ITEM 1100 - CONDUITS, BOXES & FITTINGS**

#### **1100.1 Description**

This Item shall consist of the furnishing and installation of the complete conduit work consisting of electrical conduits; conduit boxes such as junction boxes, pull boxes, utility boxes, octagonal and square boxes; conduit fittings such as couplings, locknuts and bushings and other electrical materials needed to complete the conduit roughing-in work of this project. This Item of Works also include tapping or electrical connection from the main line/post nearest to the project location for operation of the said structure, necessary permits and licenses for application of end user to the electric cooperative was included in Item B.3

#### **1100.2 Material Requirements**

All materials shall be brand new and shall be of the approved type meeting all the requirements of the Philippine Electrical Code and bearing the Philippine Standard Agency (PSA) mark.

##### **Conduits**

Conduits shall be standard rigid steel, zinc coated or galvanized. Intermediate metal conduit may be used if shown or specified on the approved Plans. PVC conduit if required shall be Schedule 40. Enamel coated steel conduits and conduits with rough inner surfaces are not acceptable.

##### **Conduit Boxes**

All conduit boxes shall be Code gauge steel and galvanized. Outlet boxes shall be galvanized pressed steel of standard make. In general, outlet boxes shall be at least 100 mm square or octagonal, 53 mm deep and 16 mm minimum gauge.

##### **Conduit Fittings**

All conduit fittings such as locknuts and bushings shall be galvanized of standard make.

#### **1100.3 Construction Requirements**

All works throughout shall be executed in the best practice in a workmanlike manner by qualified and experienced electricians under the immediate supervision of a duly licensed Electrical Engineer.

##### **Conduits**

Conduits should be cut square with a hacksaw and reamed. No bending of pipes shall be made, instead, use of fittings should be observed. Conduits which have been crushed, deformed or flattened shall not be installed. No running thread shall be allowed. Conduit runs crossing construction joints of the building shall be provided with standard expansion fittings of the approved type.

No conduits shall be used in any system smaller than 12 mm diameter electric trade size nor shall have more than four (4) 90-degree bends in any run and where necessary, pull boxes shall be provided.

All ends of conduits which are left empty in cabinets and conduit boxes shall be plugged approved pipe caps so as to prevent the entrance of white ants and dirt within the conduit system. Pull wires shall be inserted in the empty ducts before they are closed with pipe caps and shall be left therein for future use.

On exposed work, all pipes and outlet boxes shall be secured by means of galvanized metal clamps which shall be held in place by means of machine screws. When running over concrete surfaces, the screws shall be held in place by means of expansion sleeves for big pipes and rolled lead sheet for small pipes. All pipes shall be run at right angles to and parallel with the surrounding walls. No diagonal run shall be allowed and all bends and offsets shall be avoided as much as possible. Conduits shall be supported at 1,500 mm intervals maximum. All conduit materials should be UPVC.

##### **Conduit Boxes & Fittings**

Provide conduit boxes for pulling and splicing wires and outlet boxes for installation of wiring devices. As a rule, provide junction boxes or pull boxes in all runs greater than 30 meters in length, for horizontal runs. For other lengths, provide boxes as required for splices or pulling. Pull boxes shall be installed in inconspicuous but accessible locations. Support boxes independently of conduits entering by means of bolts, red hangers or other suitable means.

Conduit boxes shall be installed plumb and securely fastened. They shall be set flush with the surface of the structure in which they are installed where conduits are run concealed.

All convenience and wall switch outlet boxes for concealed conduit work shall be deep, rectangular flush type boxes. Four-inch octagonal flush type boxes shall be used for all ceiling light outlets and shall be of the deep type where

three or more conduits connect to a single box. All conduits shall be fitted with approved standard UPVC bushing and locknuts where they enter cabinets and conduit boxes.

Junction and pull boxes of UPVC shall be provided as indicated or as required to facilitate the pulling of wires and cables.

#### 1100.4 Method of Measurement

The work under this Item shall be measured either by lengths, pieces, pairs, lot and set actually placed and installed as shown on the approved Plans.

#### 1100.5 Basis of Payment

All works performed and measured and as provided for in the Bill of Quantities shall be paid for at the Unit Bid or Contract Unit Price which payment shall constitute full compensation including labor, materials, tools and incidentals necessary to complete this Item.

Pay Item Number	Description	Unit of Measurement
(1)	RSC Conduit Pipe - mm dia., with couplings	length
(2)	Locknut & Bushings	pairs
(3)	Condulet type	pieces
(4)	Conduit pipe elbow	pieces
(5)	Connector	pieces
(6)	Conduit clamp	pieces
(7)	PVC adapter	pieces
(8)	G.I Wire G.A # 14	kilos
(9)	Hacksaw Blade	pieces
(10)	PVC Tape 19 mm dia x 18 mm	rolls
(11)	Rubber Tape 19 mm dia x 227g	rolls
(12)	PVC Solvent Cement @ 400 cc	cans
(13)	PVC End Ball	pieces
(14)	Octagonal junction boxes	pieces
(15)	Utility Boxes	pieces
(16)	Metal Pull Box	pieces
(17)	Square Box	pieces
(18)	Telephone Cabinet	set
(20)	Read Lead Point	lot
(21)	Wetherhead with type "F" condulet	pieces
(22)	Grounding Rod copperweld 20 mm dia x 3 m	length
(24)	Anchor Rod-mm dia	pieces
(25)	Anchor Log-mm dia	pieces
(26)	Powerload Studs with nuts	pieces

#### 1100.6 General Specifications

The work to be done under this division of specifications consists of the fabrication, furnishing, delivery and installation, complete in all details of the electrical work, at the subject premises and all work material's incidental to the proper completion of the installation, except those portions of the work which are expressly stated to be done by other fields. All works shall be done in accordance with the rules and regulations and with the specifications.

#### 1100.7 Specifications on:

##### 1. Lighting fixtures and lamp

All lighting fixtures and lamps are as specified and listed on lighting fixture schedule. For fluorescent lamp, it shall be 40-watt rapid start cool-white. All fluorescent ballast shall be 240 volt, high power factor, of good quality materials and approved by the Bureau of Product Standards (BPS).

##### 2. Material Requirements

All materials to be used shall conform to the BPS specification.

##### 3. Construction Requirements

All grounding system installation shall be executed in accordance with the approved plans. Grounding system shall include building perimeter ground wires, ground rods, clamps, connectors, ground wells and ground wire taps as shown in the approved design.

#### 1100.8 Auxiliary Systems

All auxiliary systems such as telephone system installations shall be done in accordance with the approved

design. All materials to be used shall conform to the Bureau of Product Standards (BPS) specifications.

#### **1100.9 Important requirement regarding supervision of the work and submission of certificate of completion.**

All wiring installation herein shall be done under the direct supervision of a licensed Electrical Engineer at the expense of the Contractor. The contractor shall submit the certificate of completion duly approved by the owner's representative.

#### **1100.10 Test and guarantee**

Upon completion of the electrical construction work, the contractor shall provide all test equipment and personnel and to submit written copies of all test results.

The contractor shall guarantee the electrical installation are done and in accordance with the approved plans and specifications. The contractor shall guarantee that the electrical systems are free from all grounds and from all defective workmanship and materials and will remain so for a period of one year from date and acceptance of works. The Contractor at his own expense shall remedy any defect.

### **ITEM 1101 - WIRES AND WIRING DEVICES**

#### **1101.1 Description**

This Item shall consist of the furnishing and installation of all wires and wiring devices consisting of electric wires and cables, wall switches, convenience receptacles, heavy-duty receptacles and other devices shown on the approved Plans but not mentioned in these specifications.

#### **1101.2 Material Requirements**

Wires and cables shall be of the approved type meeting all the requirements of the Philippine Electrical Code and bearing the PSA mark. Unless specified or indicated otherwise, all power and lighting conductors shall be insulated for 600 volts.

All wires shall be copper, soft drawn and annealed, smooth and of cylindrical form and shall be centrally located inside the insulation.

All wiring devices shall be standard products of reputable electrical manufacturers. Wall switches shall be rated at least 1 OA, 250 volts and shall be spring operated, flush, tumbler type. Duplex convenience receptacles shall be rated at least 15A, 250 volts, flush, parallel slots.

Single heavy duty receptacles shall be rated at least 20A, 250 volts. 3-wire, flush, polarized type.

#### **1101.3 Construction Requirements**

Conductors or wires shall not be drawn in conduits until after the cement piaster is dry and the conduits are thoroughly cleaned and free from dirt and moisture. In drawing wires into conduits, sufficient slack shall be allowed to permit easy connections for fixtures, switches, receptacles and other wiring devices without the use of additional splices.

All conductors of convenience outlets and lighting branch circuit home runs shall be wired with a minimum of 3.5 mm in size. Circuit home runs to panel boards shall not be smaller than 3.5 mm but all home runs to panel board more than 30 meters shall not be smaller than 5.5 mm. No conductor shall be less than 2 mm in size.

All wires of 14mm and larger in size shall be connected to panels and apparatus by means of approved type lugs or connectors of the solder less type, sufficiently large enough to enclose all strands of the conductors and securely fastened. They shall not loosen under vibration or normal strain.

All joints, taps and splices on wires larger than 14 mm shall be made of suitable solder less connectors of the approved type and size. They shall be taped with rubber and PVC tapes providing insulation not less than that of the conductors.

No splices or joints shall be permitted in either feeder or branch conductors except within outlet boxes or accessible junction boxes or pull boxes. All joints in branch circuit wiring shall be made mechanically and electrically secured by approved splicing devices and taped with rubber and PVC tapes in a manner, which will make their insulation as that of the conductor.

All wall switches and receptacles shall be fitted with standard Bakelite face plate covers. Device plates for flush mounting shall be installed with all four edges in continuous contact with finished wall surfaces without the use of coiled wire or similar devices. Plaster fillings will not be permitted. Plates installed in wet locations shall be gasketed. When more than one switch or device is indicated in a single location, gang plate shall be used.

#### **1101.4 Method of Measurement**

The work under this Item shall be measured either by meters, rolls, pieces, and set, actually placed and installed as shown on the Plans.

#### **1101.5 Basis of Payment**

All work performed and measured and as provided for in this Bid of Quantities shall be paid for at the Unit Bid or Contract Unit Price which payment shall constitute full compensation including labor, materials, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
(1)	Electric Wire	meter of rolls
(2)	Single pole tumbler switch	pieces
(3)	Two-gang tumbler switch	pieces
(4)	Three-gang tumbler switch	pieces
(6)	Duplex Convenience receptacles	set
(7)	Heavy Duty Convenience receptacles	set
(8)	Standard Telephone outlet bakelite cover w/ 9.52 center hole	pieces
(9)	Window type air conditioning outlet 3-prong polarized type	pieces
(10)	Bare copper wire	meters
(11)	Grounding clamps for electric wires	pieces
(12)	Messenger wire	meters
(13)	Guy wire	meters

## **ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS**

### **1102.1 Description**

This Item shall consist of the furnishing and installation of the power load center unit substation or low voltage switchgear and distribution panel boards at the location shown or the approved Plans complete with transformer, circuit breakers, cabinets and all accessories, completely wired and ready for service.

### **1102.2 Material Requirements**

All materials shall be brand new and shall be of the approved type. It shall conform to the requirements of the Philippine Electrical Code and shall bear the Philippine Standard Agency (PSA) mark.

#### **Low-Voltage Switchboard Section**

The low-voltage switchboard shall be standard modular-unitized units, metal-built, dead front, and safety type construction and shall consist of the following:

##### **(a) Switchboard Housing**

The housing shall be heavy gauge steel sheet, dead front type, gray enamel finish complete with frame supports, steel bracings, steel sheet panel boards, removable rear plates, copper bus bars, and all other necessary accessories to insure sufficient mechanical strength and safety. It shall be provided with grounding bolts and clamps.

##### **(b) Secondary Metering Section**

The secondary metering section shall consist of one (1) ammeter, AC, indicating type; one (1) voltmeter, AC, indicating type, one (1) ammeter transfer switch for 3-phase; one (1) voltmeter transfer switch for 3phase; and current transformers of suitable rating and capacity.

The above-mentioned instruments shall be installed in one compartment above the main breaker and shall be complete with all necessary accessories completely wired, ready for use.

##### **(c) Main Circuit Breaker**

The main circuit breaker shall be draw-out type, manually or electrically operated as required with ratings and capacity as shown on the approved Plans.

The main breaker shall include insulated control switch if electrically operated, manual trip button, magnetic tripping devices, adjustable time over current protection and instantaneous short circuit trip and all necessary accessories to insure safe and efficient operation.

##### **(d) Feeder Circuit Breakers**

There shall be as many feeder breakers as are shown on the single line diagram or schematic riser diagram and schedule of loads and computations on the plans. The circuit breakers shall be draw out or molded case as required. The circuit breakers shall each have sufficient interrupting capacity and shall be manually operated complete with trip devices and all necessary accessories to insure safe and efficient operation. The number, ratings, capacities of the feeder branch circuit breakers shall be as shown on the approved Plans.

Circuit breakers shall each be of the indicating type, providing "ON" - "OFF" and "TRIP" positions of the operating handles and shall each be provided with nameplate for branch circuit designation. The circuit breaker shall be so designed that an overload or short on one pole automatically causes all poles to open.



### Low-Voltage Switchgear

(For projects requiring 'low-voltage switchgear only').

The Contractor shall furnish and install low-voltage switchgear at the location shown on the plans. It shall be metal-clad, dead front, free standing, safety type construction and shall have copper bus bars of sufficient size, braced to resist allowable root mean square (RMS) symmetrical short circuit stresses, and all necessary accessories. The low-voltage switchgear shall consist of the switchgear housing, secondary metering, main breaker and feeder branch circuit breakers and all necessary accessories completely wired, ready for service.

### Grounding System:

All non-current carrying metallic parts like conduits, cabinets and equipment frames shall be properly grounded in accordance with the Philippine Electrical Code, latest edition. The size of the ground rods and ground wires shall be as shown on the approved Plans. The ground resistance shall not be more than 5 ohms.

### Panel boards and Cabinets

Panel boards shall conform to the schedule of panel boards as shown on the approved Plans with respect to supply characteristics, rating of main lugs or main circuit breaker, number and ratings and capacities of branch circuit breakers.

Panel boards shall consist of a factory completed dead front assembly mounted in an enclosing flush type cabinet consisting of code gauge galvanized sheet steel box with trim and door. Each door shall be provided with catch lock and two(2) keys. Panel boards shall be provided with - directories and shall be printed to indicate load served by each circuit.

Panel board cabinets and trims shall be suitable for the type of mounting shown on the approved Plans. The inside and outside of panel board cabinets and trims shall be factory painted with one rust proofing primer coat and two finish shop coats of pearl gray enamel paint.

Main and branch circuit breakers for panel boards shall have the rating, capacity and number of poles as shown on the approved Plans. Breakers shall be thermal magnetic type. Multiple breaker shall be of the common trip type having a single operating handle. For 50-ampere breaker or less, it may consist of single-pole breaker permanently assembled at the factory into a multi-pole unit.

## 1102.3 Construction Requirements

The Contractor shall install the Power Load Center Unit Substation or Low-Voltage Switchgear and Panel boards at the locations shown on the approved Plans. Standard panels and cabinets shall be used and assembled on the job. All panels shall be of dead front construction furnished with trims for flush or surface mounting as required.

## 1102.4 Method of Measurement

The work under this Item shall be measured either by set and pieces actually placed and installed as shown on the approved Plans.

## 1102.5 Basis of Payment

All works performed and measured and as provided for in the Bill of Quantities shall be paid for at the Unit Bid or Contract Unit Price which payment shall constitute full compensation including labor, materials, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
(1)	Panel board (Circuit Breaker Type)	set
(2)	Panelboard (Safety Switch Type)	set
(3)	Low-Voltage Switchgear (LVS) complete with metering devices and accessories	set
(4)	Power Fuses	pieces
(5)	Lightning Arresters	pieces
(6)	Air Break Switch	set
(7)	Enclosed ACB NEMA Type I	set
(8)	Enclosed ACB NEMA Type 3R	set
(9)	Automatic Transfer Switch	set
(11)	Motor Controller	set

## **ITEM 1103 – LIGHTING & ELECTRICAL FIXTURES (including accessories)**

### **1103.1 Description**

This item shall consist of the furnishing and installation of the Lighting Fixtures and other electrical fixtures as specified in plan to be complete and ready for service. In this item of work air conditioning unit was included in estimates and to be provided by the contractor based on the approval of the engineer.

### **1103.2 Material Requirements**

All materials shall be brand new and shall be of the approved type. It shall conform with the requirements of the Philippine Standard and shall bear the Philippine Standard Agency (PSA) mark.

### **1103.3 Construction Requirements**

The Contactor shall furnish and install the Lighting Fixtures and Lamps at the location shown on the approved Plans.

### **1103.4 Method of Measurement**

## **XII. PLUMBING AND SANITARY WORKS**

### **A. PLUMBING WORKS -ITEM No. 1002**

#### **ITEM 1002-PLUMBING**

##### **1002.1 Description**

This Item shall consist of furnishing all materials, tools, equipment and fixtures required as shown on the Plans for the satisfactory performance of the entire plumbing system including installation in accordance with the latest edition of the National Plumbing Code, and this Specification.

##### **1002.2 Material Requirements**

All piping materials, fixtures and appliances fitting accessories whether specifically mentioned or not but necessary to complete this Item shall be furnished and installed.

##### **1002.2.2 WATER SUPPLY Pipes and Fittings**

- a. Pipes and Fittings shall be uPVC Pipe, Series 1000.
- b. Valves for water supply shall be stainless steel with threaded end. All valves shall be gate valves unless otherwise specified.
- c. Unions of 50mm in diameter and smaller shall be galvanized iron.
- d. Water meter where required to be furnished by the Contractor shall be of the type tested and approved by MWSS.

##### **1002.2.3 Approved Alternate Pipes and Fittings**

Pipes and fittings for sanitary and potable water lines as approved alternate shall be Un-plasticized Polyvinyl Chloride Pipes and Fittings (UPVC).

Fittings shall be molded type and designed for solvent cement joint connection for water lines and rubber O-ring seal joint for sanitary lines.

##### **1002.2.4 Septic Vault**

The septic vault shall be provided as shown on the Plans including all pipe vents and fittings. The various construction materials such as concrete masonry work shall conform to the corresponding Items of these Specifications. Inlet and outlet pipes shall conform to the latest edition of the National Plumbing Code.

##### **1002.2.5 Plumbing Fixtures and Fittings**

All fittings and trimmings for fixtures shall be chromium-plated and polished brass unless otherwise approved. Exposed traps and supply pipes for fixtures shall be connected to the roughing in, piping system at the wall unless otherwise indicated on the Plans. Built-in fixtures shall be watertight with provision of water supply and drainage outlet, fittings and trap seal. Unless otherwise specified, all plumbing fixtures shall be made of vitreous china complete with fittings.

a. Water closet shall be vitreous china, free standing toilet combination, round front bottom outlet symphonic wash down bowl with extended rear self and closed coupled tank with cover complete with fittings and mounting accessories. Model make and color shall be submitted for approval prior to delivery at jobsite by the Engineer.

b. Lavatory shall be vitreous china, wall-hung with rear overflow and cast-in soap dishes, pocket hanger with integral china brackets, complete with twin faucets, supply pipes, P-trap and mounting accessories. Where indicated on the Plans to be counter top model make and color shall be approved by the Engineer.

c. Urinal shall be china vitreous, wall-hung wash-out urinal with extended shields and integral flush spreader, concealed wall-hanger pockets, 19mm top spud complete with fitting and mounting accessories. Model make and color shall be approved by the Engineer.

##### **1002.2.6 Bathroom and Toilet Accessories**

- a. Grab bars (fixed and flip up) shall be made of tubular stainless steel pipe provided with safety grip and mounting flange.
- b. Floor drains shall be made of stainless steel beehive type, measuring 100mm x 100mm, and provided with detachable stainless strainer, expanded metal lath type.
- c. Toilet paper holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent fixture and facing tiles.
- d. Soap holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent tile works.
- e. Faucet(s) shall be made of stainless steel for interior use.
- g. Hose-bibb(s) shall be made of bronze cast finish.

##### **1002.2.7 Special Plumbing Fixtures**

a. Kitchen sink shall be made of stainless steel self-rimming, single compartment complete with supply fittings, strainer traps, single control lever and other accessories.

- b. Grease traps shall be made of cast bronze with detachable cover and mounting accessories.

### **1002.2.9 Fire Protection System**

a. Fire extinguisher shall be portable, suitable for Class A, B, C fires, mounted inside cabinet. Cabinet shall be full flush mounting door with aluminum trim for glass plate, frame and box shall be made of gauge 14 galvanized iron sheet with white interior and red exterior baked enamel finish over primer. Cabinet to be wall mounted and size to be able to accommodate the defined components.

**1002.2.10** Built-in appliances such as urinal trough, lavatory and slope sink shall be made as indicated on the Plans, exposed surfaces to be tiled with fitting accessories required as practiced in this specialty trade.

### **1002.3 Construction Requirement**

The Contractor before any installation work starts shall carefully examine the Plans and shall investigate actual structural and finishing work condition affecting all his work. Where actual condition necessitates a rearrangement of the approved pipe layout, the Contractor shall prepare Plan(s) of the proposed pipe layout for approval by the Engineer.

#### **1002.3.1 Installation of Soil, Waste, Drain and Vent Pipes**

- a. Horizontal lines shall be supported by well secured length heavy strap hangers. Vertical pipe lines shall be secured strongly by hooks to the building frame and a suitable brackets or chairs shall be provided at the floor from which they start.
- b. All main vertical soil and waste stacks shall be extended full size to and above the roof line to act as vents, except otherwise indicated on the Plans.
- c. Vent pipes in roof spaces shall run as close as possible to underside of roof with horizontal piping pitched down to stacks without forming traps. Vertical vent pipes may be connected into one main vent riser above the highest vented fixtures.
- d. Where an end or circuit vent pipe from any fixtures is connected to a vent line serving other fixtures, the connections shall be at least 1.20 m above the floor on which the fixtures are located.
- e. All changes in pipe sizes on soil and waste lines shall be made with reducing fittings or recessed reducers. All changes in directions shall be made by appropriate use of 45 degree wyes, half 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 waste closets. Where it becomes necessary to use short radius fittings in other locations the approval of the Engineer shall be obtained prior to installation of the same.
- f. Cleanouts on floors shall be cast uPVC caulked into cast hub and fitted with uPVC screw plug flush with floor. Cleanouts for threaded pipes shall be installed at the foot of soil, waste and drain stacks and on each building drain outside the building.
- g. Vent pipe shall be flashed and made watertight.
- h. Each fixtures and place of equipment requiring connection to the drainage system except fixtures with continuous waste shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible. Traps installed on threaded pipe shall be recessed drainage pattern.

#### **1002.3.2 Water Pipes, Fittings and Connections.**

All water piping inside the building and underground, 100 mm. diameter and smaller shall be uPVC pipes

- a. The water piping shall be extended to all fixtures, outlets, and equipment from the gate valves installed in the branch near the riser.
- b. Ends of pipes and outlets shall be capped or plugged and left ready for future connections.
- c. Mains and Branches
1. All pipes shall be cut accurately to measurements and shall be worked into place without springing or forcing. Care shall be taken so as not to weaken the structural portions of the building.
  2. All piping above the ground shall be run parallel with the lines of the building unless otherwise indicated on the Plans.
  3. All service pipes, valves and fittings shall be kept at sufficient distance from other work to permit finished covering not less than 12.5mm from such work or from finished covering on the different service.
  4. No water piping shall be buried in floors, unless specifically indicated on the Plans and approved by the Engineer.
  5. Changes in pipes shall be made with reducing fittings.
- d. Drain Cocks  
Pipe drain indicated on the drawings shall consist of 12 mm globe valve with renewable disc and installed at low points on the cold water piping so that all piping shall slope 100 mm in 30.5 m.
- e. Threaded Pipe Joints  
All pipes shall be reamed before threading. All screw joints shall be made with graphite and oil or with an approved graphite compound applied to make threads only. Threads shall be full cut and not more than three threads on the pipe shall remain exposed.
- f. Expansion and Contraction of Pipes  
Accessible contraction-expansion joints shall be made whenever necessary. Horizontal runs of pipe over 15m

in length shall be anchored to the wall to the supporting structure about midway on the run to force expansion and contraction equally toward the ends or as shown on the Plans.

#### **1002.3.3 Fixtures, Equipment and Fastenings**

- a. All fixtures and equipment shall be supported and fastened in a safe and satisfactory workmanship as practiced.
- b. All fixtures, where required to be wall mounted on concrete or concrete hollow block wall, fasten with brass expansion bolts. Expansion bolts shall be 6 mm diameter with 20 mm threads to 25 mm into solid concrete, fitted with loose tubing or sleeves of proper length to acquire extreme rigidity.
- c. Inserts shall be securely anchored and properly flushed into the walls. Inserts shall be concealed and rigid.
- d. Bolts and nuts shall be horizontal and exposed. It shall be provided with washers and chromium plate finish.

#### **1002.3.4 Pipe Hangers, Inserts and Supports**

- a. Chains, straps perforated turnbuckles or other approved means of adjustment except the turnbuckles may be omitted for hangers on sailor waste lines or individual toilet rooms to maintain stacks when spaced does not permit.
- b. Trapeze hangers may be used in lieu of separate hangers on pipe running parallel to and close to each other.
- c. Inserts shall be cast steel and shall be of type to receive a machine bolt or nut after installation. Insert may be permitted adjustment of the bolts in one horizontal direction and shall be installed before pouring of concrete.

#### **1002.3.6 Protection and Cleaning**

- a. During installation of fixtures and accessories and until final acceptance, protect items with strippable plastic or other approved means to maintain fixtures in perfect conditions.
- b. All exposed metal surfaces shall be polished clean and rigid of grease, dirt or other foreign materials upon completion.
- c. Upon completion, thoroughly clean all fixtures and accessories to leave the work in polished condition.

#### **1002.3.7 Inspection, Warranty Test and Disinfection**

All pipes, fittings, traps, fixtures, appurtenances and equipment of the plumbing and drainage system shall be inspected and approved by the Engineer to insure compliance with all requirements of all Codes and Regulations referred to in this Specification.

##### **1002.3.7.1 Drainage System Test**

- a. The entire drainage and venting system shall have all necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent above ceiling.
- b. The system shall hold this water for a full 30 minutes during which time there shall be no drop greater than 102 mm.
- c. Where only a portion of the system is to be tested, the test shall be conducted in the same manner as described for the entire system except that a vertical stack 3.00 m highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure or water pump may be used to supply the required pressure.
- d. If and when the Engineer decides that an additional test is needed, such as an air to smoke test on the drainage system, the Contractor shall perform such test without any additional cost.

##### **1002.3.7.2 Water Test on System**

- a. Upon completion of the roughing-in and before connecting fixtures the entire cold water piping system shall be tested at a hydrostatic pressure 1 1/2 times the expected working pressure in the system during operation and remained tight and leak-proofed.
- b. Where piping system is to be concealed the piping system shall be separately in manner similar to that described for the entire system and in the presence of the Engineer or his duly designated representative.

##### **1002.3.7.3 Defective Work**

- a. All defective materials replaced and tested will be repeated until satisfactory performance is attained.
- b. Any material replaced for the satisfactory performance of the system made shall be at the expense of the Contractor.
- c. Caulking of screwed joints or holes will not be permitted.

##### **1002.3.7.3 Disinfection**

- a. The entire water distribution system shall be thoroughly flushed and treated with chlorine before it is operated for public use.
- b. Disinfection materials shall be liquid chlorine or hypochlorite and shall be introduced in a manner approved as practiced or approved by the Engineer into the water distribution system.
- c. After a contact period of not less than sixteen hours, the heavily chlorinated water shall be flushed from the system with potable water.
- d. Valves for the water distribution system shall be opened and closed several times during the 16 hours chlorination treatment is done.

#### **1002.3.8 As-Built Drawings**

Upon completion of the work, the Contractor shall submit two sets of prints with all as- built changes shown on

the drawings in a neat workmanship manner. Such prints shall show changes or actual installation and conditions of the plumbing system in comparison with the original drawings.

#### **1002.4 Method of Measurement**

The work done under this Item shall be quantified per length and/or number of units as provided in the Bill of Quantities, tested and accepted to the satisfaction of the Engineer.

#### **1002.5 Basis of Payment**

The quantified items, installed in place shall be the basis for payment based from the unit bid price for which prices and payments shall constitute full compensation including labor, materials and incidentals necessary to complete this Item.

Payment shall be made:

Pay Item Number	Description	Unit of Measurement
	uPVC Pipes (blue)	meter
1002(c)	Plumbing Fixtures	set

#### **B. SEPTIC VAULT- ITEM 1001(11)**

Refer to ITEM 1002.2.4

Concrete Requirements (Refer to MASONRY WORKS- ITEM 704)

**REFERENCES:**

- STANDARD SPECIFICATIONS FOR PUBLIC WORKS STRUCTURES VOLUME III (Buildings, Ports and Harbors, Flood Control and Drainage Structures and Water Supply Systems)
- DPWH Standard Specifications for Public Works and Highways, 2004 Edition: Volume II, Highways, Bridges and Airports.
- DPWH DO No. 56, Series of 2005
- Standardized Pay Items of Work For Construction of Infrastructure Projects Volume II & III