Republic of the Philippines
PROVINCE OF LA UNION
City of San Fernando

Procurement of INFRASTRUCTURE PROJECT

Construction of Tanquigan Elementary School Water System, City of San Fernando, La Union

INFRA-24-00-RA-058

April 29, 2024

TABLE OF CONTENTS

Glossary of Terms, Abbreviations, and Acronyms

ABC – Approved Budget for the Contract.

ARCC – Allowable Range of Contract Cost.

BAC – Bids and Awards Committee.

Bid – A signed offer or proposal to undertake a contract submitted by a bidder in response to and in consonance with the requirements of the bidding documents. Also referred to as *Proposal* and *Tender*. (2016 revised IRR, Section 5[c])

Bidder – Refers to a contractor, manufacturer, supplier, distributor and/or consultant who submits a bid in response to the requirements of the Bidding Documents. (2016 revised IRR, Section 5[d])

Bidding Documents – The documents issued by the Procuring Entity as the bases for bids, furnishing all information necessary for a prospective bidder to prepare a bid for the Goods, Infrastructure Projects, and/or Consulting Services required by the Procuring Entity. (2016 revised IRR, Section 5[e])

BIR – Bureau of Internal Revenue.

BSP – Bangko Sentral ng Pilipinas.

CDA – Cooperative Development Authority.

Consulting Services – Refer to services for Infrastructure Projects and other types of projects or activities of the GOP requiring adequate external technical and professional expertise that are beyond the capability and/or capacity of the GOP to undertake such as, but not limited to: (i) advisory and review services; (ii) pre-investment or feasibility studies; (iii) design; (iv) construction supervision; (v) management and related services; and (vi) other technical services or special studies. (2016 revised IRR, Section 5[i])

Contract – Refers to the agreement entered into between the Procuring Entity and the Supplier or Manufacturer or Distributor or Service Provider for procurement of Goods and Services; Contractor for Procurement of Infrastructure Projects; or Consultant or Consulting Firm for Procurement of Consulting Services; as the case may be, as recorded in the Contract Form signed by the parties, including all attachments and appendices thereto and all documents incorporated by reference therein.

Contractor – is a natural or juridical entity whose proposal was accepted by the Procuring Entity and to whom the Contract to execute the Work was awarded. Contractor as used in these Bidding Documents may likewise refer to a supplier, distributor, manufacturer, or consultant.

CPI – Consumer Price Index.

DOLE – Department of Labor and Employment.

DTI – Department of Trade and Industry.

Foreign-funded Procurement or Foreign-Assisted Project – Refers to procurement whose funding source is from a foreign government, foreign or international financing institution as specified in the Treaty or International or Executive Agreement. (2016 revised IRR, Section 5[b]).

GFI – Government Financial Institution.

GOCC – Government-owned and/or –controlled corporation.

Goods – Refer to all items, supplies, materials and general support services, except Consulting Services and Infrastructure Projects, which may be needed in the transaction of public businesses or in the pursuit of any government undertaking, project or activity, whether in the nature of equipment, furniture, stationery, materials for construction, or personal property of any kind, including non-personal or contractual services such as the repair and maintenance of equipment and furniture, as well as trucking, hauling, janitorial, security, and related or analogous services, as well as procurement of materials and supplies provided by the Procuring Entity for such services. The term "related" or "analogous services" shall include, but is not limited to, lease or purchase of office space, media advertisements, health maintenance services, and other services essential to the operation of the Procuring Entity. (2016 revised IRR, Section 5[r])

GOP – Government of the Philippines.

Infrastructure Projects – Include the construction, improvement, rehabilitation, demolition, repair, restoration or maintenance of roads and bridges, railways, airports, seaports, communication facilities, civil works components of information technology projects, irrigation, flood control and drainage, water supply, sanitation, sewerage and solid waste management systems, shore protection, energy/power and electrification facilities, national buildings, school buildings, hospital buildings, and other related construction projects of the government. Also referred to as *civil works or works*. (2016 revised IRR, Section 5[u])

LGUs – Local Government Units.

NFCC – Net Financial Contracting Capacity.

NGA – National Government Agency.

PCAB – Philippine Contractors Accreditation Board.

PhilGEPS - Philippine Government Electronic Procurement System.

Procurement Project – refers to a specific or identified procurement covering goods, infrastructure project or consulting services. A Procurement Project shall be described, detailed, and scheduled in the Project Procurement Management Plan prepared by the agency which shall be consolidated in the procuring entity's Annual Procurement Plan. (GPPB Circular No. 06-2019 dated 17 July 2019)

PSA – Philippine Statistics Authority.

SEC – Securities and Exchange Commission.

SLCC – Single Largest Completed Contract.

UN – United Nations.

Section I. Invitation to Bid

Republic of the Philippines
PROVINCE OF LA UNION
City of San Fernando

Invitation to Bid for the *Construction of Tanquigan Elementary School Water System, City of San Fernando, La union*

1. The ***Provincial Government of La Union***, through the ***RA8240-Tobacco Excise Tax Funds*** intends to apply the sum of ***₱1,500,000.00*** being the Approved Budget for the Contract (ABC) to payments under the contract for ***Construction of Tanquigan Elementary School Water System, City of San Fernando, La union / INFRA-24-00-RA-058.*** Bids received in excess of the ABC shall be automatically rejected at bid opening.

2. The ***Provincial Government of La Union*** now invites bids for the above Procurement Project. Completion of the Works is required ***30 calendar days***. Bidders should have completed a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II (Instructions to Bidders).

3. Bidding will be conducted through open competitive bidding procedures using non-discretionary "*pass/fail*" criterion as specified in the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.

4. Interested bidders may obtain further information from ***Provincial Government of La Union*** and inspect the Bidding Documents at the address given below from ***Monday to Friday at 8:00 AM to 5;00 PM***.

5. A complete set of Bidding Documents may be acquired by interested bidders on ***April 29 - May 21, 2024*** from given address and website/s below upon payment of the applicable fee for the Bidding Documents, pursuant to the latest Guidelines issued by the GPPB, in the amount of ***P5,000.00***. The Procuring Entity shall allow the bidder to present its proof of payment for the fees in person, by facsimile, or through electronic means.

6. The ***Provincial Government of La Union*** will hold a Pre-Bid Conference on ***May 7, 2024*** at the ***BAC Conference Room, Provincial Capitol, San Fernando City, La Union*** which shall be open to prospective bidders.

7. Bids must be duly received by the BAC Secretariat through manual submission at the office address as indicated below. Late bids shall not be accepted.

8. All bids must be accompanied by a bid security in any of the acceptable forms and in the amount stated in **ITB** Clause 16.

9. Bid opening shall be on ***May 21, 2024*** at the given address below ***BAC Conference Room, Provincial Capitol, San Fernando City, La Union.*** Bids will be opened in the presence of the bidders' representatives who choose to attend the activity.

10. The ***Provincial Government of La Union*** reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with Sections 35.6 and 41 of the 2016 revised Implementing Rules and Regulations (IRR) of RA No. 9184, without thereby incurring any liability to the affected bidder or bidders.

11. For further information, please refer to:

    PGLU-BAC Secretariat
    BAC Conference Room
    Provincial Capitol, Brgy. II
    City of San Fernando, Province of La Union
    Email Add: pglu_bacsu@launion.gov.ph
    Telefax No. (072) 242-5550 Loc. 249
    www.launion.gov.ph

12. You may visit the following websites:

    For downloading of Bidding Documents: *https://launion.gov.ph/infrastructure-3/*

April 29, 2024

SGD.

RESSIE A. ESTRELLA
Chairperson, Bids and Awards Committee (BAC)

Section II. Instructions to Bidders

1. Scope of Bid

The Procuring Entity, ***Provincial Government of La Union*** invites Bids for the **Construction of Tanquigan Elementary School Water System, City of San Fernando, La Union** with Project Identification Number ***INFRA-24-00-RA-058.***

The Procurement Project (referred to herein as "Project") is for the construction of Works, as described in Section VI (Specifications).

2. Funding Information

2.1. The GOP through the source of funding as indicated below for ***RA8240-Tobacco Excise Tax Funds*** in the amount of ***₱1,500,000.00***.

2.2. The source of funding is LGUs, the Annual or Supplemental Budget, as approved by the Sanggunian.

3. Bidding Requirements

The Bidding for the Project shall be governed by all the provisions of RA No. 9184 and its 2016 revised IRR, including its Generic Procurement Manual and associated policies, rules and regulations as the primary source thereof, while the herein clauses shall serve as the secondary source thereof.

Any amendments made to the IRR and other GPPB issuances shall be applicable only to the ongoing posting, advertisement, or invitation to bid by the BAC through the issuance of a supplemental or bid bulletin.

The Bidder, by the act of submitting its Bid, shall be deemed to have inspected the site, determined the general characteristics of the contracted Works and the conditions for this Project, such as the location and the nature of the work; (b) climatic conditions; (c) transportation facilities; (c) nature and condition of the terrain, geological conditions at the site communication facilities, requirements, location and availability of construction aggregates and other materials, labor, water, electric power and access roads; and (d) other factors that may affect the cost, duration and execution or implementation of the contract, project, or work and examine all instructions, forms, terms, and project requirements in the Bidding Documents.

4. Corrupt, Fraudulent, Collusive, Coercive, and Obstructive Practices

The Procuring Entity, as well as the Bidders and Contractors, shall observe the highest standard of ethics during the procurement and execution of the contract. They or through an agent shall not engage in corrupt, fraudulent, collusive, coercive, and obstructive practices defined under Annex "I" of the 2016 revised IRR of RA No. 9184 or other integrity violations in competing for the Project.

5. Eligible Bidders

5.1. Only Bids of Bidders found to be legally, technically, and financially capable will be evaluated.

5.2. The Bidder must have an experience of having completed a Single Largest Completed Contract (SLCC) that is similar to this Project, equivalent to at least fifty percent (50%) of the ABC adjusted, if necessary, by the Bidder to current prices using the PSA's CPI, except under conditions provided for in Section 23.4.2.4 of the 2016 revised IRR of RA No. 9184.

A contract is considered to be "similar" to the contract to be bid if it has the major categories of work stated in the **BDS**.

5.3. For Foreign-funded Procurement, the Procuring Entity and the foreign government/foreign or international financing institution may agree on another track record requirement, as specified in the Bidding Document prepared for this purpose.

5.4. The Bidders shall comply with the eligibility criteria under Section 23.4.2 of the 2016 IRR of RA No. 9184.

6. Origin of Associated Goods

There is no restriction on the origin of Goods other than those prohibited by a decision of the UN Security Council taken under Chapter VII of the Charter of the UN.

7. Subcontracts

7.1. The Bidder may subcontract portions of the Project to the extent allowed by the Procuring Entity as stated herein, but in no case more than fifty percent (50%) of the Project.

The Procuring Entity has prescribed that:

a. Subcontracting is not allowed.

8. Pre-Bid Conference

The Procuring Entity will hold a pre-bid conference for this Project on the specified date and time and either at its physical address *BAC Conference Room, Provincial Capitol, San Fernando City, La Union* as indicated in paragraph 6 of the **IB.**

9. Clarification and Amendment of Bidding Documents

Prospective bidders may request for clarification on and/or interpretation of any part of the Bidding Documents. Such requests must be in writing and received by the Procuring Entity, either at its given address or through electronic mail indicated in the

IB, at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

10. Documents Comprising the Bid: Eligibility and Technical Components

10.1. The first envelope shall contain the eligibility and technical documents of the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.

10.2. If the eligibility requirements or statements, the bids, and all other documents for submission to the BAC are in foreign language other than English, it must be accompanied by a translation in English, which shall be authenticated by the appropriate Philippine foreign service establishment, post, or the equivalent office having jurisdiction over the foreign bidder's affairs in the Philippines. For Contracting Parties to the Apostille Convention, only the translated documents shall be authenticated through an apostille pursuant to GPPB Resolution No. 13-2019 dated 23 May 2019. The English translation shall govern, for purposes of interpretation of the bid.

10.3. In case of joint ventures, a special PCAB License, and registration for the type and cost of the contract for this Project, shall be required. Any additional type of Contractor license or permit shall be indicated in the **BDS**.

10.4. A List of Contractor's key personnel (e.g., Project Manager, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.

10.5. A List of Contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership, certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be, must meet the minimum requirements for the contract set in the **BDS**.

11. Documents Comprising the Bid: Financial Component

11.1. The second bid envelope shall contain the financial documents for the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.

11.2. Any bid exceeding the ABC indicated in paragraph 1 of the **IB** shall not be accepted.

11.3. For Foreign-funded procurement, a ceiling may be applied to bid prices provided the conditions are met under Section 31.2 of the 2016 revised IRR of RA No. 9184.

12. Alternative Bids

Bidders shall submit offers that comply with the requirements of the Bidding Documents, including the basic technical design as indicated in the drawings and specifications. Unless there is a value engineering clause in the **BDS**, alternative Bids shall not be accepted.

13. Bid Prices

All bid prices for the given scope of work in the Project as awarded shall be considered as fixed prices, and therefore not subject to price escalation during contract implementation, except under extraordinary circumstances as determined by the NEDA and approved by the GPPB pursuant to the revised Guidelines for Contract Price Escalation guidelines.

14. Bid and Payment Currencies

14.1. Bid prices may be quoted in the local currency or tradeable currency accepted by the BSP at the discretion of the Bidder. However, for purposes of bid evaluation, Bids denominated in foreign currencies shall be converted to Philippine currency based on the exchange rate as published in the BSP reference rate bulletin on the day of the bid opening.

14.2. Payment of the contract price shall be made in Philippine Pesos.

15. Bid Security

15.1. The Bidder shall submit a Bid Securing Declaration or any form of Bid Security in the amount indicated in the **BDS**, which shall be not less than the percentage of the ABC in accordance with the schedule in the **BDS**.

15.2. The Bid and bid security shall be valid until *September 18, 2024.* Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

16. Sealing and Marking of Bids

Each Bidder shall submit one copy of the first and second components of its Bid.

The Procuring Entity may request additional hard copies and/or electronic copies of the Bid. However, failure of the Bidders to comply with the said request shall not be a ground for disqualification.

If the Procuring Entity allows the submission of bids through online submission to the given website or any other electronic means, the Bidder shall submit an electronic copy of its Bid, which must be digitally signed. An electronic copy that cannot be opened or is corrupted shall be considered non-responsive and, thus, automatically disqualified.

17. Deadline for Submission of Bids

The Bidders shall submit on the specified date and time and either at its physical address or through online submission as indicated in paragraph 7 of the **IB.**

18. Opening and Preliminary Examination of Bids

18.1. The BAC shall open the Bids in public at the time, on the date, and at the place specified in paragraph 9 of the **IB**. The Bidders' representatives who are present shall sign a register evidencing their attendance. In case videoconferencing, webcasting or other similar technologies will be used, attendance of participants shall likewise be recorded by the BAC Secretariat.

In case the Bids cannot be opened as scheduled due to justifiable reasons, the rescheduling requirements under Section 29 of the 2016 revised IRR of RA No. 9184 shall prevail.

18.2. The preliminary examination of Bids shall be governed by Section 30 of the 2016 revised IRR of RA No. 9184.

19. Detailed Evaluation and Comparison of Bids

19.1. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all Bids rated "*passed*" using non-discretionary pass/fail criteria. The BAC shall consider the conditions in the evaluation of Bids under Section 32.2 of 2016 revised IRR of RA No. 9184.

19.2. If the Project allows partial bids, all Bids and combinations of Bids as indicated in the **BDS** shall be received by the same deadline and opened and evaluated simultaneously so as to determine the Bid or combination of Bids offering the lowest calculated cost to the Procuring Entity. Bid Security as required by **ITB** Clause 16 shall be submitted for each contract (lot) separately.

19.3. In all cases, the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184 must be sufficient for the total of the ABCs for all the lots participated in by the prospective Bidder.

20. Post Qualification

Within a non-extendible period of five (5) calendar days from receipt by the Bidder of the notice from the BAC that it submitted the Lowest Calculated Bid, the Bidder shall submit its latest income and business tax returns filed and paid through the BIR Electronic Filing and Payment System (eFPS), and other appropriate licenses and permits required by law and stated in the **BDS**.

21. Signing of the Contract

The documents required in Section 37.2 of the 2016 revised IRR of RA No. 9184 shall form part of the Contract. Additional Contract documents are indicated in the **BDS**.

Section III. Bid Data Sheet

Bid Data Sheet

ITB Clause	
5.2	For this purpose, contracts similar to the Project refer to contracts which have the same major categories of work, which shall be: *Building Construction*
7.1	*n/a*
10.3	*n/a*
10.4	The key personnel must meet the required minimum years of experience set below: <u>Key Personnel</u> — <u>General Experience</u> — <u>Relevant Experience</u> 1. Project Engineer — 5 years — 3 years 2. Materials Engineer — 3 years — 3 years
10.5	The minimum major equipment requirements are the following: <u>Equipment</u> — <u>Capacity</u> — <u>Number of Units</u> Water Truck — 1 Concrete Vibrator — 1 Dump Truck — 1 Backhoe — 1 Concrete Saw, Blade Ø 14" (7.5 Hp) — 1 Bar Cutter, Single Phase — 1 One Bagger Mixer — 1
12	*n/a*
15.1	The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts: a. The amount of not less than ***₱30,000.00***, if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit; b. The amount of not less than ***₱75,000.00*** if bid security is in Surety Bond.
19.2	Partial bid is not allowed. The infrastructure project is packaged in a single lot and the lot shall not be divided into sub-lots for the purpose of bidding, evaluation, and contract award.
20	*None*
21	Additional contract documents relevant to the Project: 1. Construction Schedule and S-curve, 2. Manpower Schedule, 3. Construction Methods, 4. Equipment Utilization Schedule, and 5. Construction safety and health program approved by the DOLE

Section IV. General Conditions of Contract

1. Scope of Contract

This Contract shall include all such items, although not specifically mentioned, that can be reasonably inferred as being required for its completion as if such items were expressly mentioned herein. All the provisions of RA No. 9184 and its 2016 revised IRR, including the Generic Procurement Manual, and associated issuances, constitute the primary source for the terms and conditions of the Contract, and thus, applicable in contract implementation. Herein clauses shall serve as the secondary source for the terms and conditions of the Contract.

This is without prejudice to Sections 74.1 and 74.2 of the 2016 revised IRR of RA No. 9184 allowing the GPPB to amend the IRR, which shall be applied to all procurement activities, the advertisement, posting, or invitation of which were issued after the effectivity of the said amendment.

2. Sectional Completion of Works

If sectional completion is specified in the **Special Conditions of Contract (SCC)**, references in the Conditions of Contract to the Works, the Completion Date, and the Intended Completion Date shall apply to any Section of the Works (other than references to the Completion Date and Intended Completion Date for the whole of the Works).

3. Possession of Site

3.1 The Procuring Entity shall give possession of all or parts of the Site to the Contractor based on the schedule of delivery indicated in the **SCC,** which corresponds to the execution of the Works. If the Contractor suffers delay or incurs cost from failure on the part of the Procuring Entity to give possession in accordance with the terms of this clause, the Procuring Entity's Representative shall give the Contractor a Contract Time Extension and certify such sum as fair to cover the cost incurred, which sum shall be paid by Procuring Entity.

3.2 If possession of a portion is not given by the above date, the Procuring Entity will be deemed to have delayed the start of the relevant activities. The resulting adjustments in contract time to address such delay may be addressed through contract extension provided under Annex "E" of the 2016 revised IRR of RA No. 9184.

4. The Contractor's Obligations

The Contractor shall employ the key personnel named in the Schedule of Key Personnel indicating their designation, in accordance with **ITB** Clause 10.3 and specified in the **BDS**, to carry out the supervision of the Works.

The Procuring Entity will approve any proposed replacement of key personnel only if their relevant qualifications and abilities are equal to or better than those of the personnel listed in the Schedule.

5. Performance Security

5.1. Within ten (10) calendar days from receipt of the Notice of Award from the Procuring Entity but in no case later than the signing of the contract by both parties, the successful Bidder shall furnish the performance security in any of the forms prescribed in Section 39 of the 2016 revised IRR.

5.2. The Contractor, by entering into the Contract with the Procuring Entity, acknowledges the right of the Procuring Entity to institute action pursuant to RA No. 3688 against any subcontractor be they an individual, firm, partnership, corporation, or association supplying the Contractor with labor, materials and/or equipment for the performance of this Contract.

6. Site Investigation Reports

The Contractor, in preparing the Bid, shall rely on any Site Investigation Reports referred to in the **SCC** supplemented by any information obtained by the Contractor.

7. Warranty

7.1. In case the Contractor fails to undertake the repair works under Section 62.2.2 of the 2016 revised IRR, the Procuring Entity shall forfeit its performance security, subject its property(ies) to attachment or garnishment proceedings, and perpetually disqualify it from participating in any public bidding. All payables of the GOP in his favor shall be offset to recover the costs.

7.2. The warranty against Structural Defects/Failures, except that occasioned-on force majeure, shall cover the period from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity. Specific duration of the warranty is found in the **SCC**.

8. Liability of the Contractor

Subject to additional provisions, if any, set forth in the **SCC**, the Contractor's liability under this Contract shall be as provided by the laws of the Republic of the Philippines.

If the Contractor is a joint venture, all partners to the joint venture shall be jointly and severally liable to the Procuring Entity.

9. Termination for Other Causes

Contract termination shall be initiated in case it is determined *prima facie* by the Procuring Entity that the Contractor has engaged, before, or during the implementation of the contract, in unlawful deeds and behaviors relative to contract acquisition and implementation, such as, but not limited to corrupt, fraudulent, collusive, coercive, and obstructive practices as stated in **ITB** Clause 4.

10. Dayworks

Subject to the guidelines on Variation Order in Annex "E" of the 2016 revised IRR of RA No. 9184, and if applicable as indicated in the **SCC**, the Dayworks rates in the Contractor's Bid shall be used for small additional amounts of work only when the Procuring Entity's Representative has given written instructions in advance for additional work to be paid for in that way.

11. Program of Work

11.1. The Contractor shall submit to the Procuring Entity's Representative for approval the said Program of Work showing the general methods, arrangements, order, and timing for all the activities in the Works. The submissions of the Program of Work are indicated in the **SCC.**

11.2. The Contractor shall submit to the Procuring Entity's Representative for approval an updated Program of Work at intervals no longer than the period stated in the **SCC.** If the Contractor does not submit an updated Program of Work within this period, the Procuring Entity's Representative may withhold the amount stated in the **SCC** from the next payment certificate and continue to withhold this amount until the next payment after the date on which the overdue Program of Work has been submitted.

12. Instructions, Inspections and Audits

The Contractor shall permit the GOP or the Procuring Entity to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors of the GOP or the Procuring Entity, as may be required.

13. Advance Payment

The Procuring Entity shall, upon a written request of the Contractor which shall be submitted as a Contract document, make an advance payment to the Contractor in an amount not exceeding fifteen percent (15%) of the total contract price, to be made in lump sum, or at the most two installments according to a schedule specified in the **SCC**, subject to the requirements in Annex "E" of the 2016 revised IRR of RA No. 9184.

14. Progress Payments

The Contractor may submit a request for payment for Work accomplished. Such requests for payment shall be verified and certified by the Procuring Entity's Representative/Project Engineer. Except as otherwise stipulated in the **SCC**, materials and equipment delivered on the site but not completely put in place shall not be included for payment.

15. Operating and Maintenance Manuals

15.1. If required, the Contractor will provide “as built” Drawings and/or operating and maintenance manuals as specified in the **SCC.**

15.2. If the Contractor does not provide the Drawings and/or manuals by the dates stated above, or they do not receive the Procuring Entity’s Representative’s approval, the Procuring Entity’s Representative may withhold the amount stated in the **SCC** from payments due to the Contractor.

Section V. Special Conditions of Contract

Special Conditions of Contract

GCC Clause	
2	*n/a*
3.1	Within 10 calendar days after receipt of the Notice to Proceed (NTP)
6	The site investigation reports are: ***Certificate of Site Inspection***
7.2	*Fifteen (15) years*
10	No dayworks are applicable to the contract.
11.1	The Contractor shall submit the Program of Work to the Procuring Entity's Representative within 15 days of delivery of the Notice of Award.
11.2	The amount to be withheld for late submission of an updated Program of Work is P10,000.00.
13	The amount of the advance payment is 15% of the total contract price.
14	Materials and equipment delivered on the site but not completely put in place shall be included for payment.
15.1	The date by which operating and maintenance manuals are required is ***July 3, 2024*** The date by which "as built" drawings are required is ***July 18, 2024***.
15.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is ***P20,000.00***.

Section VI. Specifications

B.5 – PROJECT BILLBOARD /SIGNBOARD

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 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.

Material Requirements

Tarpaulin

The design and format of the tarpaulin shall have the following specifications:

Color : White

Size : 8 ft. x 8 ft.

Resolution : 70 dpi

Font : Helvetica

Font Size of Main Information : 3 inches

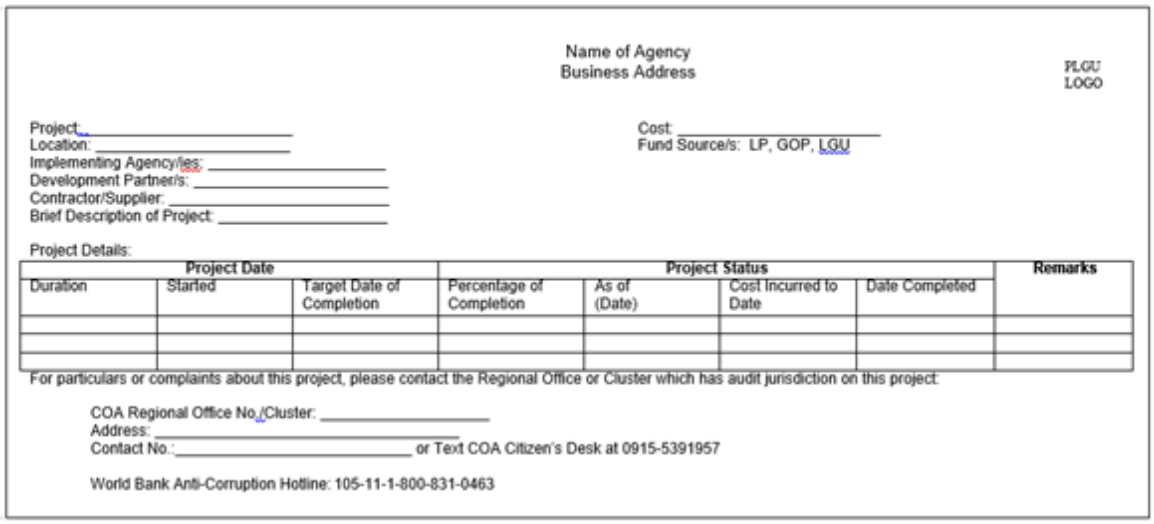
Font Size of Sub-Information : 1 inch

Font Color : Black

Suitable Frame: Rigid wood frame with post; and

Posting: Outside display at the project location after award has been made.

ANNEX 14
PROJECT BILLBOARD



Name of Agency
Business Address

PLGU
LOGO

Project: _____
Location: _____
Implementing Agency/ies: _____
Development Partner/s: _____
Contractor/Supplier: _____
Brief Description of Project: _____

Cost: _____
Fund Source/s: LP, GOP, LGU

Project Details:

Project Date			Project Status				Remarks
Duration	Started	Target Date of Completion	Percentage of Completion	As of (Date)	Cost Incurred to Date	Date Completed	

For particulars or complaints about this project, please contact the Regional Office or Cluster which has audit jurisdiction on this project:

COA Regional Office No./Cluster: _____
Address: _____
Contact No.: _____ or Text COA Citizen's Desk at 0915-5391957

World Bank Anti-Corruption Hotline: 105-11-1-800-831-0463

The information shall contain but not limited to i.) logo of the funding agencies, ii.) the name of implementing agencies, iii.) name of contractor, iv.) subproject's title, location, cost and description, v.) project details to include duration, date started, target date of completion and project status, and vi.) COA and WB Anti-corruption Hotline.

The display/and or affixture of the picture, image, motto, logo, color motif, initials or other symbol or graphic representation associated with the top leadership of the project proponent or implementing agency/unit/office, on project billboard, is considered unnecessary. (General Guidelines No. 2.2.6)

Post and Frame

Posts and frames/braces shall be made from good lumber with a 2X3 and 2x2 inches size respectively and shall be well-seasoned, straight and free of injurious defects. The frame will be covered with 2 pieces ¼ inch thick marine plywood where the tarpaulin will be attached.

Concrete Foundation Blocks

The concrete for the foundation blocks shall be Class A in accordance with Item 405, Structural Concrete and shall be of the size shown on the Plans.

Construction Requirements

Excavation and Backfilling

Holes shall be excavated to the required depth to the bottom of the concrete foundation as shown on the Plans.

The space around the post shall be backfilled to the ground line with approved material in layers not exceeding 100 mm and each layer shall be moistened and thoroughly compacted. Surplus excavated material shall be disposed of by the Contractor as directed by the Engineer.

Erection of Posts

The posts shall be erected vertically in position inside the formwork of the foundation block prior to the placing of the concrete and shall be adequately supported by bracing to prevent movement of the post during the placing and setting of concrete. The posts shall be located at the positions shown on the Plans.

Tarpaulin Installation

Tarpaulin shall be installed in accordance with the details shown on the Plans. The frame should be covered with the marine plywood before the tarpaulin is attached.

Method of Measurement

The quantities of project billboard shall be in pieces 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 No.	Description	Unit of Measurement
B.5	Project Billboard	Each

B.7 - OCCUPATIONAL SAFETY AND HEALTH PROGRAM

B.7.1 Description

This Item covers the implementation of construction safety in all stages of project procurement (design, estimate, construction and maintenance), requirements, provisions, and instructions for the guidance of the Engineer.

B.7.2 Construction safety and Health Program (CSHP)

Every construction project shall have suitable and approved Construction Safety and Health Program (CSHP) as required in all projects regardless of amount, funding source and mode of implementation which shall comply with the minimum safety and health requirements as specified in the Occupational Safety and Health Standards.

The required CHSP shall include but not limited to the following:

1. Composition of the Safety and Health personnel responsible for the implementation of CSHP.
2. Specific safety policies which shall be undertaken in the construction site, including frequency of and persons responsible for conducting toolbox and gang meetings.
3. Penalties and sanction for violation of the CSHP.
4. Frequency, content and persons responsible for orienting, instructing and training all workers at the site with regard to the CHSP which they operate.
5. The manner of disposing waste arising from the construction

B.7.3 Construction Safety and Health Personnel

At the start of the project, the Contractor shall have an established construction safety and health committee composed of the following personnel:

1. Project Manager/Project Engineer

The Contractor must provide for a full time Project Manager/Project Engineer, who is tasked to observe, monitor and supervise if the enforcement of CSHP was being followed strictly and correctly.

2. Safety Engineer/Officer

The General Contractor must provide for a full time Officer, who shall be assigned as the General Construction Safety and Health Officer to oversee and enforce full time the overall management of the Construction Safety and Health Program (CSHP). Furthermore, deployment of part-time or full-time safety man depending on the number of workers shall be complied in accordance with Rule 1033 of the Occupational Safety and Health Standards (OSHS) and applicable provisions under Section 7.0, Safety Personnel of Department of Labor and Employment (DOLE) D.O. 13, Series of 1998.

3. Health Personnel

The Contractor's health personnel may be full time or part time certified first-aider, registered nurse, physician and dentist depending on the total number of workers conforms with Section 8.0, Emergency Occupational Health Personnel and Facilities or DOLE D.O. 13, Series of 1998.

4. Safety Practitioner

The Contractor must provide a full time or part time Safety Practitioner, who shall initiate and supervise safety and health training for employees.

B.7.4 Supervision, Control and Monitoring

Overall supervision, control and monitoring of the implementation of CSHP for projects undertaken by administration/contracts shall be under the implementing office.

B.7.5 Construction Safety and Health Training

The Construction Safety and Health seminar (COSH) shall be a 40 hrs. training course as prescribed by the DOLE-Bureau of Working Conditions (BWC). All safety personnel involved in a construction project shall be required to complete such basic training course.

The Contractor shall provide continuing construction safety and health training to all technical personnel under his organization. Continuing training shall be a minimum of 16 h per year for every full-time safety personnel.

B.7.6 Construction Safety and Health Reports

The Contractor shall be required to submit a monthly construction safety and health report to the Department of Labor and Employment (DOLE) Regional Office concerned. The report shall include a monthly summary of all safety and health committee meeting agreements, a summary of all accident investigations/reports and periodic hazards assessment with the corresponding remedial measures/action for each hazard.

In case of any dangerous occurrence or major accident resulting in death or permanent total disability, the concerned employer shall initially notify the DOLE Regional Office within 24 hours from occurrence. After the conduct of investigation by the concerned construction safety and health officer, the employer shall report all permanent total disabilities to DOLE Regional Office on or before the 20th of the month following the date of occurrence of accident using the DOLE Employer's Work Accident Illness Report.

B.7.7 Personnel Protective Equipment (PPE) and Devices

The Contractor shall 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 PPE and Devices shall be in accordance with the requirements of the Occupation Safety and Health Standards (OSHS) and should pass the test conducted and/or standards set 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. Workers within the construction project site shall be required to wear the necessary PPE at all times. Moreover, all other persons who are either authorized or allowed to be at a construction site shall also wear appropriate PPEs.

Construction workers who are working from unguarded surfaces 6 m or more above water or ground, temporary or permanent floor platform, scaffold or where they are exposed to the possibility of falls hazardous to life or limb, must be provided with safety harnesses and life lines.

B.7.8 Signages and Barricades

Construction Safety Signages and Barricades shall be provided as a precaution and to advice the workers and the general public of the hazards existing in the worksite. Signages shall be posted in prominent positions at strategic location and as far as practicable, be in the language understandable to most of the workers employed. For road projects, it shall be in accordance with the DPWH Road Works Safety Manual.

B.7.9 Facilities

The Contractor shall provide the following welfare facilities in order to ensure humane working conditions:

1. Adequate supply of safe drinking water;

2. Adequate sanitary and washing facilities;

3. Suitable living accommodation of workers and as may be applicable for their families; and

4. Separate sanitary, washing and sleeping facilities for men and women workers.

The services of a full-time registered nurse, a full-time physician, a dentist and an infirmary or emergency hospital with one (1) bed capacity when the number of employees exceed three hundred (300). In addition, there should be one (1) bed capacity for every one hundred (100) employees in excess of three hundred (300).

B.7.10 Costing

The cost for the implementation of construction safety and health shall be integrated to the overall project cost under the prescribed pay item. In consideration of the cost involved of providing the necessary safety equipment and manpower for an effective implementation of safety in the workplace, the following shall be used as a guide:

1. Personal Protective Equipment (PPE)

The PPEs shall be provided by the Contractor, and its cost shall be duly quantified and made part of the overall cost of Item B.7, Occupational Safety and Health. The use of PPEs shall conform to Section B.7.7 Personal Protective Equipment and Devices.

2. Clinical Materials and Equipment

Clinical material and equipment such as medicines, beds and linens, other related accessories shall be to the account of the Contractors implementing the project and shall be in accordance with the Rule 1960, Occupational Health Services of OSHS.

3. Signages and Barricades

The quantities and cost of signages and barricades necessary for a specific item of work shall be quantified and made part of that particular pay item of work. For general signages and barricades not included in specific pay item of work but necessary for promoting safety in and around the construction site, the quantities and cost shall be a separate pay item and included in the overall cost of Item B.7, Occupational Safety and Health.

4. Facilities

Facilities such as portable toilets, waste disposal, sanitary and washing facilities, convenient dwelling and office, adequate lighting, and other facilities related to construction safety and health shall be in accordance with OSH Standards and previously approved guidelines of the Department and shall be quantified and the cost thereof be made a separate pay item under "Facilities for the Engineers" and "Other General Requirements" as required in the DPWH Standard Specifications.

5. Salaries

Labor cost for the medical and safety personnel actually assigned in the field shall be included in the overall cost of Item B.7, Occupational Safety and Health. Manpower cost shall be established based on the cost of labor in the area. Duration of employment shall be based on project duration of the particular project.

6. Safety and Health Training

Cost associated for the provision of basic and continuing construction safety and health training to all safety and technical personnel shall be made part of the indirect/overhead cost of the project.

B.7.11 Safety on Construction during Heavy Equipment Operation

In relation to heavy equipment operation in all construction sites, the following are required in the different phases of the project.

1. Pre-Construction

The Contractor must ensure that appropriate certification is obtained from DOLE duly accredited organizations for the following:

a. All heavy equipment operators assigned at the project site must be tested and certified in accordance with a standard trade test prescribed by Technical Education and Skills Development Authority (TESDA) in coordination with its accredited organization.

b. All heavy equipment must be tested and certified in accordance with the standards prepared by DOLE or its recognized organization prior to commissioning of said equipment.

2. During Construction

The Contractor must ensure that the following conditions are met or complied with:

a. For mobilization or transport of heavy equipment, load restrictions, height and width clearances as imposed by Department for all roads and bridges to be utilized during transport. Moreover, only duly certified operators are allowed to load and unload heavy equipment to low-bed trailer.

b. During erection and set-up of heavy equipment, existing hazards must be avoided. Standard checklist of steps and procedures must be observed. List of necessary equipment, tools and materials must be available and properly utilized.

c. In the interest of accident prevention, duly certified mechanics and operators shall conduct daily routine inspection of all heavy equipment deployed at the site in accordance with standards set by TESDA in coordination with the Association of Construction Equipment Lessors (ASCEL, Inc.). During routine inspection all equipment which do not comply with the minimum safety standards for equipment certification shall be immediately removed from the work site for restoration or repair until they meet said standards or requirements. The Contractor and the equipment owner shall maintain a separate logbook for data on maintenance, repair, tests and inspections for each heavy equipment. Such logbook shall be used as a necessary reference during the conduct of equipment inspection.

3. Post Operation and Post Construction

The procedures for dismantling and demobilization of heavy equipment shall follow the same requirements as listed under provisions of mobilization or transport of heavy equipment and erection and set-up of heavy equipment.

B.7.12 Violations and Penalties

The Contractor if found violating safety rules and regulations shall be meted sanctions depending on the gravity of offense. The amount corresponding to non-compliance shall be deducted from the contractor's billing.

***The following shall be the minimum requirements for the approval of a Construction Safety and Health Program (CSHP) under the* Department of Labor and Employment (DOLE) Department Order No. 13, Series 1998.**

1.1 Company Safety and Health Policy. The following shall apply:

A Company Safety Policy which shall serve as the general guiding principles in the implementation of safety and health on site duly signed by the highest company official or his duly authorized representative who has the over---all control of project execution and should include the contractor's general policy towards occupational safety, worker's welfare and health, and environment.

A Safety policy, which shall include the commitment that the contractor shall comply with DOLE minimum safety requirements, including reporting requirements of the Occupational Health and Safety Standards (OSHS), and other relevant DOLE issuances. These may include, but are not limited to the following:

a. Registration (Rule 1020 and DO 18---02)
b. Report of Safety Committee Organization (Rule 1040)
c. Notification of Accidents and Occupational Illnesses (Rule 1050)
d. Annual Work Accident/Illness Exposure Data Report (Rule 1050)
e. Application for installation of mechanical/electrical equipment for construction of structure for industrial use (Rule 1070 and 1160)
f. Annual Medical Report (Rule 1960)

1.2 Specific Construction Safety and Health Program shall contain the tendering agency's requirements in addition to the minimum requirements under the appropriate sections of D.O. No. 13 whenever deemed as applicable.

1.3 Composition of Construction Safety and Health Committee.

A structure and membership of the construction safety and health committee which shall be consistent with the minimum requirements of Section 11 of D.O. 13, series of 1998.

***1.4 Safety and Health Personnel*.** The following shall apply:

a. All appointed first---aiders shall be duly trained and certified by the Philippine National Red Cross and shall possess a Certificate of Basic First Aid Training Course (Standard) with a valid PNRC ID Card.
b. All appointed Safety Officers shall have completed the 40---hour BWC prescribed safety and health course as required by Rule 1030 of the OSHS, as amended by D.O. 16. All full---time safety personnel shall be accredited by the BWC pursuant to D.O. 16.

c. All physicians and nurses assigned at the project site shall have completed the Bureau prescribed course on occupational safety and health course, pursuant to Rule 1960 of the OSHS.

1.5 Specific duties and responsibilities of the Safety Officer. The following shall apply:

a. Specific duties and responsibilities shall comply with the outlined duties and responsibilities in Rule 1047 of the OSHS; and

b. Procedure on the required performance of the assigned duties and responsibilities of safety officers in the construction site.

1.6 Applicable In---plant Safety and Health Promotion and Continuing Information Dissemination. The following shall apply:

a. Detailed information dissemination or advisories to the new employees prior to on---site assignment, e.g. conduct of safety orientation, company's health and safety policies, hazards related to the job safety measures, safe work procedures.

b. Detailed programs on continuing education such as trainings and seminars, if any, that shall be given to employees, e.g. BOSH, refresher course, first aid training, refresher course toolbox meeting, construction safety training for site safety officers, 80---hour advance safety course prescribe.

c. Arrangements for conveying information on safety and health IEC materials e.g. Posters/komics/flyers, safety signages, handbooks/manuals, bulletin boards

d. Arrangements for setting up sub---committees on safety and health, where necessary.

e. Schedule of safety related activities, e.g. toolbox meeting, health and safety committee meeting

1.7 Accident and incident investigation, recording, and reporting. The following shall apply:

a. All accidents or incidences shall be investigated and recorded.

b. All work related accidents resulting to disabling injuries and dangerous occurrences as defined in OSH Standards (Rule 1050) shall be reported.

c. Responsible or duly authorized officer for accident or incident investigation recording and reporting who are either the employer/owner/project manager/safety officer

d. Accident Report shall contain the minimum information as required in DOLE/BWC/OHSD/IP---6.

e. Shall notify the appropriate DOLE Regional within 24 hours in case of fatal accidents. An accident investigation shall be conducted by the Regional Office within forty eight (48) hours after receipt of initial report of the employer.

1.8 Provisions for the protection of the general public within the vicinity of the company premises during construction and demolition. The following shall apply:

a. Measures in order to ensure the safety of the general public shall be pursuant to Rule 11 of the National Building Code---Implementing Rules and Regulations: Protection of Pedestrians During Construction or Demolition

b. Appropriate provisions and rules of OSHS

--- Rule 1412.09: Protection of the Public

--- Rule 1412.12: Protection against collapse of Structure

--- Rule 1412.16: Traffic Control

--- Rule 1413: Excavation

--- Rule 1417: Demolition

--- Rule 1060: Premises of Establishments

--- D.O. 13, Section 9: Construction Safety Signs

--- Other relevant provisions of OSHS.

***1.9 General safety within construction premises*.** The following shall apply:

The provisions for danger signs, barricades, and safety instructions for workers, employees, public, and visitors such as, housekeeping; walkway surfaces; means of access i.e. stairs, ramps, floor openings, elevated walkways, runways and platforms; and, light.

1.10 Environmental Control (Rule 1070 of the Standards). The following shall apply:

a. Monitoring and control of hazardous noise, vibration and air---borne contaminants such as gases, fumes, mists and vapors.

b. Provisions to comply with minimum requirements for lighting, ventilation and air movement.

1.11 Guarding of hazardous machinery (Rule 1200 of the Standards). The following shall apply:

a. Provisions for installation/design of built---in machine guards.

b. Provisions for built---in safety in case of machine failure.

c. Provisions for guarding of exposed walkways, access---ways, working platforms.

1.12 Provisions for and use of Personal Protective Equipment (PPE) --- (Rule 1080 of the Standards). The following shall apply:

a. Appropriate types and duly tested PPEs to be issued to workers after the required training on their use.

b. Provisions for maintenance, inspection and replacement of PPEs.

c. In all cases the basic PPE commonly required for all types of construction projects are hard hats, safety shoes and working gloves. Other PPEs shall be required depending on the type of work and hazards.

1.13 Handling of Hazardous Substances – (Rule 1090 of the Standards). The following shall apply:

Provision for identification, safe handling, storage, transport and disposal of hazardous substances and emergency procedure in accordance with Material Safety Data Sheet (MSDS) in cases of accidents.

1.14 General materials handling and storage procedures. – (Rule 1150 of the Standards). The following shall apply:

--- Safe use of mechanical materials handling equipment

--- Secured and safe storage facilities

--- Regular housekeeping as necessary so as not to constitute and/orresent hazards

--- Clearly marked clearance limits

--- Proper area guarding of storage facilities

1.15 Installation, use and dismantling of hoist and elevators.---Rule 1415.10 Testing and Examination of Lifting Appliance, Rule 1220 Elevators and Related Equipment. The following shall apply:

a. Provisions to ensure safe installation, use and dismantling of hoist and elevator;

b. Periodic inspection of hoists and elevators.

1.16 Testing and inspection of electrical and mechanical facilities and equipment. The following Rules of the Occupational Safety and Health Standards shall apply: **Rule Coverage**

a. Rule 1160 --- Boiler

b. Rule 1170 --- Unfired Pressure Vessels

c. Rule 1210 --- Electrical Safety

d. Rule 1220 --- Elevators and Related Equipment

e. Rule 1410 --- Construction Safety

f. Rule 1415.10 – Training and Examination of Lifting Appliance

1.17 Workers skills and certification. The following shall apply:

a. Provisions to ensure that workers are qualified to perform the work safely.

b. Provisions to ensure that only qualified operators are authorized to use and operate electrical and mechanical equipment.

1.18 Provisions for emergency transportation facilities for workers. The following shall apply:

Rule 1963.02 of the Occupational Safety and Health Standards – Emergency Medical and Dental Services

1.19 Fire Protection Facilities and Equipment. The following rule shall apply:

a. Fire protection facilities and equipment as required under Rule 1940 of the OSHS

b. Proposed structure and membership of fire brigade

c. Provision for training on emergency preparedness

1.20 First aid and health care medicines, equipment and facilities.

a. Identification of the proposed first aid and health care facilities that the employer shall provide satisfying the minimum requirements of OSHS.

b. Identification of the medical and health supplies, such as medicines and equipment to be provided.

c. In all cases, the provision of first aid medicines and emergency treatment shall be mandatory.

d. In the absence of the required on site health care facilities, the employer shall attach a copy of a written contract with a recognized emergency health provider as required under the OSHS.

1.21 Workers Welfare Facilities. The following shall apply:

a. Provisions for toilet and sanitary facilities

b. Proposed bathing, washing, facilities

c. Proposed facilities for supplying food and eating meals

d. Proposed facilities for supplying potable water for drinking and for washing

e. Proposed facilities for locker rooms, storing and changing of clothes for workers.

1.22 Proposed Hours of Work and Rest and Rest Breaks. The following shall apply:

a. Work schedules, working hours, shifting schedules

b. Frequency and length of meals and breaks

c. Schedule of rest periods

1.23 Waste Disposal. The following shall apply:

a. Proposed method of clearing and disposal of waste.

b. Provisions for permits and clearance where require in disposal of hazardous wastes.

1.24 Disaster and Emergency Preparedness Contingency

1.25 Safety Program . The Safety Programs shall contain the following:

a. Standard work procedures.

b. Job hazard analysis for the following activities as applicable to the project.

c. Other hazardous work, not outline herein but will be performed during project execution must also be included.

The activities may consist of any number of the following, depending on the nature of the project, vis---à---vis exposure to hazards:

a. Site Clearing

b. Excavations

c. Erection and dismantling of scaffolds and other temporary working platforms
d. Temporary electrical connections/installations
e. Use of scaffolds and other temporary working platforms
f. Working at unprotected elevated working platforms or surfaces
g. Work over water
h. Use of power tools and equipment
i. Gas and electric welding and cutting operations
j. Working in confined spaces
k. Use of internal combustion engines
l. Handling hazardous and/or toxic chemical substances
m. Use of hand tools
n. Working with pressurized equipment
o. Working in hot or cold environments
p. Handling, storage, usage and disposal of explosives
q. Use of mechanized lifting appliances for movement of materials
r. Use of construction heavy equipment
s. Demolition

The hazard analysis shall contain the following:

a. Identification of possible hazards for a particular activity.
b. Identification of any company permits or clearances needed prior to the performance of the activity together with the name of person/s who is authorized to issue such permit or clearance.
c. Identification of the proposed improvement in work standard procedures that shall be followed during implementation of a particular activity.
d. Company inspection procedures to ensure safety during the execution of a particular activity.
e. Identification of emergency procedures in case of accidents or any untoward incident while performing a particular activity.

1.26 **Company Penalties/Sanctions for Violation/s of the Provision/s of Safety and Health Program –** The appropriate penalties or sanctions for violation of company rules and regulations or those stipulated in the CHSP and the observance of due process.

2. Personal Protective Equipment by Type of Project

2.1 General Building Construction Project (GBC). The following classifications shall apply:

Classification: Air Navigation Facilities, Power Transmission & Distribution, Building and Housing, Communication facilities, Sewerage, water treatment plants and Site/Land development.

2.2 General Engineering Construction Project. The following classifications shall apply:

Classifications: Roads and Airports (Horizontal structure), bridges, irrigation system, flood control and drainages, dams, tunneling, ports and harbor, water supply

2.3 Specialty Construction Project. The following classifications shall apply:

Classifications: Electrical work, mechanical work, plumbing and sanitary work, air conditioning or refrigeration, water proofing work, painting work, communication facilities, foundation or piling work, structural steel work, concrete pre---cast, elevator or escalator, well drilling work, navigational equipment and instrument installation, electromechanical work, metal roofing and siding installation, structural demolition and landscaping.

3. Safety Personnel and Skilled Worker. The following shall apply: 3.1 **Minimum Required Safety Personnel.** The following shall apply:

a. The General Constructor shall provide for a full time officer, who shall be assigned as the general construction safety and health officer to oversee full time the overall management of the Construction Safety and Health Program.

b. The General Constructor shall provide for additional Construction Safety and Health Officer/s in accordance with the requirements for Safety Officer of D.O. 16, s. 2001, depending of the total number of personnel assigned to the construction project site.

c. The General Constructor shall provide for one (1) Construction Safety and Health Officer for every ten (10) units of heavy equipment assigned to the project site.

d. Each construction contractors/subcontractors shall provide for the required number of safety officers in accordance with the requirements of D.O. 16 series 2001.

3.2 Qualification and Training of Safety and Health Personnel and Skilled Workers. The following shall apply:

a. Training of OSH Personnel shall be pursuant to D.O. 16 series of 2001 and its Procedural Guidelines.

b. Worker Skills Certification for the critical operations/occupations shall be pursuant to D.O. 13 and D.O. 19 as well as the TESDA requirements on worker competency.

4. Construction Heavy Equipment. The following shall apply:

4.1 Accreditation of Organization for Testing of Construction Heavy Equipment shall be pursuant to D.O. No. 16 and its Implementing Guidelines and Procedural Guidelines on Accreditation and Performance Audit of Testing Organization for Construction Heavy Equipment.

4.2 Conduct of Inspection and Test of Construction Heavy Equipment shall be pursuant to Sec. 10 of D.O. No. 13 and its Procedural Guidelines. The following shall apply:

a. Procedural Guidelines on Accreditation and Performance Audit of Testing Organization for Construction Heavy Equipment

b. Standard Checklist for Testing and Inspection of Construction Heavy Equipment.

c. Inspection Procedures for DOLE Inspectors

4.3 TESDA Certification Requirements for Operators. Certification for Operators shall be in accordance with the requirements of TESDA on worker competency.

4.4 Monitoring and Evaluation of CHE Test/Inspection conducted shall be pursuant to the Procedural Guidelines on Accreditation and Performance Audit of Testing Organization for Construction Heavy Equipment.

5. Signages and Barricades. The following shall apply:

Construction Safety Signages shall be provided as a precaution and to advise the workers and the general public of the hazards existing in the worksite.

5.1 Signage Procedures: The signages shall be:

a. Posted in prominent positions and at strategic locations.

b. As far as practicable, be in the language understandable to most of the workers employed in the site.

c. For non---raised floor areas, the attached yellow CAUTION sign shall be used when using yellow CAUTION tape.

d. For non---raised floor areas , the attached red DANGER sign shall be used when using the red DANGER tape.

e. Placed in designated areas at four (4) feet from ground level, if there are no other more practicable height placement.

f. Regularly inspected and maintained in good condition to achieve its purpose. Signages that are damaged; illegible or that no longer apply as to purpose, site or language, shall be removed or be replaced by the safety officer when needed.

g. Removed after the hazard is completely eliminated. If upon work completion the hazard is still present, the signage shall remain in place.

h. Designed and constructed following the Overall Dimensions of Safety Signs Formula as required by the OSHS

i. Specific with the type of hazard and should indicate the name of the contaminant/ substance involved (for chemical hazards), and the type of PPE or respiratory equipment to be worn.

5.2 Posting of Signages shall include, but not limited to the following places:

a. Areas where there are risks of falling objects.

b. Areas where there are risks of falling, slipping, tripping among workers and the public

c. Prior to entry in project sites, locations and its perimeter.

d. Where there is mandatory requirement on the usage of PPEs.

e. Areas where explosives and flammable substances are used or stored

f. Approaches to working areas where danger from toxic or irritant airborne contaminants/ substances may exist,

g. All places where contact with or proximity to electrical facility/equipment can cause danger

h. All places where workers may come in contact with dangerous moving parts of machinery or equipment

i. Locations of fire alarms and fire---fighting equipment

j. Locations for instructions on the proper usage of specific construction equipment, tools.

5.3 Barricading Procedures: The following shall apply:

a. The contractor shall provide all necessary barricades, safety tapes, safety cones or safety lines as required in isolating or protecting an unsafe work area from other workers, pedestrians or vehicular traffic.

b. Barricades shall completely enclose the hazardous area and effectively limit unintentional or casual entry.

c. Barricades shall be three (3) feet vertical height from the ground, when no other more practical height specification is available.

d. Barricades shall be maintained in good condition to achieve its purpose.

e. Barricades that are damaged; faded or that no longer apply as to purpose, site or meaning, shall be removed or shall be replaced by the safety officer.

f. Barricade tape shall not be used on the floor as this presents a slipping hazard of its own.

g. In addition to using the proper warning tape, the contractor shall use the appropriate safety signage when barricading an area.

h. All barricades shall be removed after the hazard is completely eliminated.

i. Upon work completion, if the hazard is still present, the barricade shall remain in place.

5.4 Installation of barricades shall include, but not limited to the following worksites conditions:

a. hazardous areas

b. trip hazard

c. robotic movement

d. energized electrical works

e. overhead suspended load test

f. critical high pressure test

g. chemical introduction

h. fall exposure

i. Emergency Response Zone

j. Unsafe condition zone

k. Danger zone

l. Confined and enclosed space

6. Construction Safety and Health Committee. The following shall apply:

6.1 Composition

a. Project Manager or his representative as chairperson ex---officio

b. General Construction Safety and Health Officer

c. Construction Safety and Health Officers

d. Safety representatives (SAFETY OFFICER) from each subcontractor.

If DOLE's minimum requirements based on the number of workers of the contractor requires only a part time safety officer, the safety officer need not be an accredited safety practitioner or consultant.

e. Doctors, nurses and other health personnel pursuant to the requirements stated in Rule 1042 of the OSHS

f. Workers' representatives

If there are no contractor's sub---contractors or the constructor is a subcontractor, the safety and health committee shall be in accordance with the requirements of Rule 1040 of the Occupational Safety and Health Standards.

6.2 Duties and responsibilities

a. The Project Manager or his representative shall act as the Chairperson of the committee.

b. The committee shall conduct safety meetings at least once a month.

c. The persons constituting the Safety and Health Committee shall, as far as practicable, be at the construction site whenever construction work is being undertaken.

d. The committee shall continually plan and develop accident prevention programs.

e. The committee shall review reports of inspection, accident investigation and monitor implementation of the safety program.

f. The committee shall provide necessary assistance to government authorities authorized to conduct inspection in the proper conduct of their activities

g. The committee shall initiate and supervise safety trainings for its employees

h. The committee shall conduct safety inspection at least once a month, and shall conduct investigation of work accidents and shall submit a regular report to DOLE.

i. The committee shall initiate and supervise the conduct of daily brief safety meetings or toolbox meetings.

j. The committee shall prepare and submit to DOLE, reports on said committee meetings.

k. The committee shall develop a disaster contingency plan and organize such emergency service units as may be necessary to handle disaster situations.

7. Construction Safety and Health Reports. The following shall apply:

7. 1 The Construction Safety and Health Report shall include:

a. Monthly summary of all safety and health committee meetings

b. Summary of all accident investigations /reports

c. Corrective/Preventive measures/action for each hazard

d. Periodic hazards assessment with corresponding remedial measures for new hazards

e. Safety promotions and trainings conducted/attended

***7.2 Submission of Reports*.** The following shall apply:

a. All general constructors shall be required to submit a monthly construction safety and health report to the BWC copy furnished the DOLE Regional Office concerned.

b. In case of any dangerous occurrence or major accident resulting in death or permanent total disability, the concerned employer shall notify the appropriate DOLE Regional Office within twenty---four (24) hours from occurrence.

c. After the conduct of investigation by the concerned construction safety and health officer, the employer shall report all disabling injuries to the DOLE Regional Office on or before the 20th of the month following the date of occurrence of accident using the DOLE/BWC/HSD---IP---6 form.

8. Cost of Construction Safety and Health Program. The following shall apply:

8.1 The total cost of implementing a Construction Safety and Health Program shall be mandatory and shall be made an integral part of the project's construction cost as a separate pay item, duly quantified and reflected in the Project's Tender Documents and likewise reflected in the Project's Construction Contract Documents.

8.2 The cost of the following PPEs: helmet, eye goggles, safety shoes, working gloves, rain coats, dust mask, ear muffs, rubber boots, and other similar PPE's shall be indicated/enumerated per cost, per worker, foreman, leadman, jackhammer operator, carpenter, electrician, mason, steelman, painter, mechanic, welder, plumber, heavy equipment operator, physician/inspector, and other such personnel.

8.3 The PPEs shall be sufficient in number for all workers particularly where simultaneous construction activities/operations in different areas are being undertaken.

8.4 The cost of the minimum required inventory of medicines, supplies and equipment as indicated in "Attachment C" of the OHS Standards shall be included.

8.5 The safety personnel manpower cost salaries/wages, benefits shall be included.

8.6 Cost of safety promotions/activities, training conducted and salaries of safety and health personnel, medical personnel employed or engaged by constructor

9. Safety and Health Information. The following shall apply:

9.1 Workers shall be adequately and suitably:

a. Informed of potential safety and health hazards to which they may be exposed at their workplace.

b. Instructed and trained on the measures available for the prevention, control and protection against those hazards.

9.2 Every worker shall receive instruction and training regarding general safety and health common to construction sites which shall include, but not limited to the following:

a. The basic rights and duties of the workers at the construction site.

b. The means of access and egress, both during normal work and in emergency situations.

c. The measures for good housekeeping.

d. The location and proper use of welfare and first---aid facilities.

e. The proper care and use of the items or personal protective equipment and protective clothing provided the workers.

f. The general measures for personal hygiene and health protection.

g. The fire precautions to be taken.

h. The action to be taken in case of any emergency.

i. The requirements of relevant health and safety rules and regulations.

9.3 ***The instruction, training and information materials provided shall be given in a language or dialect understood by the worker.***

Written, oral, visual and participative approaches shall be used to ensure that the worker has understood and assimilated the information.

9.4 Each supervisor or any person e.g. foreman, lead man, gangboss, and other similar personnel shall conduct daily tool box or similar meetings prior to the start of the operations for the day to discuss with the workers and to anticipate safety and health problems related.

9.5 No person shall be deployed in a construction site unless he has undergone a safety and health awareness seminar conducted by safety professionals or accredited organizations or other institutions recognized by DOLE.

9.*6 Specialized instruction and training shall be provided to the following:*

a. Drivers and operators of lifting appliances, transport, earth---moving and materials---handling equipment and machinery; or any equipment of specialized or dangerous nature.

b. Workers engaged in the erection or dismantling of scaffolds.

c. Workers engaged in excavations at least one (1) meter deep or deep enough to cause danger, shafts, earthworks, underground works or tunnels.

d. Workers handling explosives or engaged in blasting operations.

e. Workers engaged in pile---driving.

f. Workers in compressed air cofferdams and caissons.

g. Workers engaged in the erection of prefabricated parts of steel structural frames and tall chimneys, and in concrete work, form work and other such type of work.

h. Workers handling hazardous substances and materials.

i. Workers as signalers and riggers.

j. Other types of workers as may be categorized by TESDA

10. Welfare Facilities. The following shall apply:

The employer shall provide the following welfare facilities in order to ensure humane working conditions:

10.1 Adequate supply of safe drinking water:

a. If the water is used in common drinking areas, it shall be stored in closed containers from which the water is dispensed through taps or cocks. Such containers shall be cleaned and disinfected at regular intervals but not exceeding fifteen (15) days.

b. Notices shall be posted conspicuously in locations where there is water supply that is not for drinking purposes

10.2 Adequate sanitary and washing facilities:

a. Adequate facilities for changing and for the storage and drying of work clothes.

b. Adequate accommodation facilities for taking meals and for shelter.

c. Adequate washing facilities regardless of sex for every 25 employees up to the first 100 and an additional of one (1) facility for every 40 additional workers.

d. Suitable living accommodation for workers and as may be applicable for their families, such as separate sanitary, washing and sleeping facilities for men and women workers.

10.3 Adequate and suitable toilet and bath facilities for both male and female workers at the following ratio:

a. Where the number of female workers exceeds 100, one (1) and bath facilities for every 20 female workers up to the first 100 and one (1) toilet and bath facilities for every 30 additional female workers.

b. Where the number of male workers exceeds 100 and sufficient urinals have been provided, one (1) toilet and bath facilities for every 25 sales up to the first 100 and one (1) more for every 40 additional male workers.

c. Every toilet shall be provided with enclosure, partitioned off so as to provide/ensure privacy. If feasible, shall have a proper door and fastenings, so doors shall be tight fitting and self---closing.

d. Urinals shall be placed or screened so as not to be visible from other parts of the site, or other workers.

e. Rest rooms shall be so arranged so as to be conveniently accessible to the workers and shall be kept clean and orderly at all times.

f. Adequate hand---washing facilities shall be so provided within or adjacent to the toilet facilities

g. In cases where persons of both sexes are employed, toilet and bath facilities for each sex shall be situated or partitioned so that the interior will not be visible even when the door of any facility is opened from any place where persons of the other sex have to work or pass.

h. If toilet and bath facilities for one sex adjoin those for the other sex, the approaches shall be separate, and toilet and bath facilities for each sex shall be properly indicated.

11. Compliance to the DPWH DO 30 Series 2021 Revised Construction Safety Guidelines for the Implementation of Infrastructure projects During the COVID-19 Public Health Crisis

12. Compliance to the provisions in the PRDP Supplemental Guidelines on Community and Occupational Safety and Health (COSH) during the Implementation of PRDP subprojects amidst the COVID-19 Public Health Crisis dated June 10, 2020.

I. Background

The coronavirus disease (COVID-19) is an infectious disease caused by a new strain of coronavirus and was unknown before the outbreak began in Wuhan, China, in December 2019. On January 30, 2020, the Department of Health (DOH) reported the first case of COVID-19 in the Philippines and on March 07, the first local transmission of COVID-19 was confirmed. Proclamation No. 922, s. 2020 declaring a "State of Public Health Emergency throughout the Philippines" was issued and signed on July 7, 2020.

The World Health Organization (WHO) declared COVID-19 a pandemic on March 11, 2020 since the virus had inflicted more than 150,000 people including 6,000 deaths all over the world. Following the declaration of COVID-19 as a pandemic, President Rodrigo Duterte announced on March 12, 2020 the "community quarantine" in Metro Manila but on March 16, 2020 President Duterte declared a Luzon-wide "enhanced community quarantine" (ECQ) through Presidential Proclamation No. 929, s. 2020 “Declaring a State of calamity throughout the Philippines due to Corona Virus Disease 2019”.

Pursuant to the above Presidential Declaration, the Inter-agency Task Force (IATF) for the Management of Emerging Infectious Diseases Omnibus Guidelines on the Implementation of the Community Quarantine in the Philippines, this Supplemental Guidelines on Community and Occupational Safety and Health (COSH) is issued in addition to the existing COSH standards employed in the implementation of the Project adhering to the Safeguards Policies of the World Bank as well as the new policy issuances, protocols and standards of the Philippine Government in ensuring public safety and health amidst COVID-19.

II. Objectives of the Guidelines

This guideline shall facilitate the implementation of PRDP into transitioning to the “new normal” amidst the COVID-19 Public health crisis, supplemental to the existing COSH guidelines under the PRDP Integrated Environmental and Social Safeguards Framework

(IESSF) of 25 October 2018 and the policy objectives of the RA 11058 An Act Strengthening Compliance with Occupational Safety and Health Standards and providing penalties for violations thereof of August 17, 2018. It strengthens the protection of the rights of workers to a safe and healthy working environment as well as the protection of the community especially the vulnerable population, ensuring non-discrimination and social inclusion during the time of the COVID-19 pandemic.

III. General Guidelines

The Supplemental COSH Guidelines shall primarily adopt and harmonize the following issuances of the Philippine Government in the implementation of PRDP covering the Infrastructures and Enterprises subprojects and all other PRDP activities.

1. Department of Public Works and Highways (DPWH) Revised Construction Safety Guidelines for the Implementation Infrastructure Projects during COVID-19 Public health crisis, repealing Department Order No. 35 Series of 2020 issued per Department Order No. 39 Series of 2020;

2. Joint Department of Trade and Industry (DTI) and Department of Labor and Employment (DOLE) Interim Guidelines on Workplace Prevention and Control of COVID-19 issued April 30, 2020;

3. Department of Health (DOH) Interim Guidelines on the Return-to-Work issued per Memorandum No. 2020-0220 dated May 11, 2020;

4. Department of Interior and Local Government (DILG) Amended Guide to Action Against the 2019 Novel Coronavirus Acute Respiratory Diseases issued per Memorandum Circular No. 2020-023 dated 06 February 2020;

5. Department of Agriculture (DA) Guidelines on Food Safety for the Philippine Agricultural and Fishery Sectors during COVID-19 Pandemic issued per Memorandum Circular No. 15 Series of 2020 dated May 13, 2020.

Under the "new normal", the Minimum Health Protocols and Standards set by the Department of Health (i.e. regular handwashing, observing cough etiquette, wearing of face masks, taking of body temperature, regular disinfecting, reducing contact and physical distancing) shall be applicable to all PRDP funded Infrastructure and Enterprise subprojects, and other relevant PRDP activities. Such activities are, but not limited to, consultations, trainings, technical coaching, meetings, technical reviews, procurement activities, validation s, appraisal reviews, monitoring, supervision, grievance investigation & resolution, and all other activities that involve interaction. PRDP shall adopt mixed or blended methodologies in the conduct of such activities that conform to health and safety policies, protocols and procedures stipulated in the above-mentioned issuances and guidelines.

As stakeholder engagement is important and critical in all project implementation phases, the Project has crafted a separate Consultation Guideline amidst the COVID-19 Public health crisis to ensure the continuous meaningful consultations despite the community quarantine

limitations. This will serve as reference into transitioning to the "new normal" for the implementation of PRDP subprojects (Annex A).

As measures in the prevention and control of COVID-19 incur costs, the PRDP recommends to adhere with DOLE Labor Guidelines on the cost of COVID-19 prevention and control measures issued per Labor Advisory No. 18 series of 2020.

As stipulated in Section 2 of the Labor Advisory, the costs associated to COVID-19 measures shall be charged to the employers and principals of the service contract and no direct or indirect costs shall be charged to the workers.

As these costs have not been part of the PRDP subprojects' feasibility study and business plan, the cost associated to the implementation of the required mitigation and control measures shall be shouldered by the: 1) Proponent LGU, as principal of the service contract for I-BUILD Infrastructure subprojects; and 2) Enterprise Proponent Groups, as business owner and employer of the workers in I-REAP Enterprise subprojects. However, due to funding limitations of the LGUs brought about by the pandemic and of the Proponent Groups, cost-sharing is advised. The LGUs may work out cost-sharing with the winning Contractors for the I-BUILD subprojects and with the Proponent Groups for the I-REAP subprojects to ensure that all subprojects are compliant to the health protocols and standards required for the resumption of operations of both the infrastructures and enterprise subprojects.

As we are continually learning from this unprecedented pandemic crisis, subproject proponents are reminded to regularly check recent issuances of the National government (DOH, DPWH, DOLE, DTI, DILG, etc.) and consult with/seek further advice from the concerned PRDP offices (RPCO, PSO and NPCO) for any further developments that may arise.

IV. Specific Guidelines for Construction of I–BUILD and I-REAP Infrastructure subprojects

In ensuring community, occupational safety and health during construction amidst the COVID-19 Public health crisis, supplemental guidelines on a) Prior deployment for construction; and b) During construction were harmonized in reference with the PRDP Integrated Environmental and Social Safeguards Framework (IESSF) based on the following international and local guidelines:

a. DPWH Department Order No. 39 Series of 2020 on Revised Construction Safety Guidelines for the Implementation Infrastructure Projects during COVID-19 Public health crisis, repealing Department Order No. 35 Series of 2020;

b. Joint DTI and DOLE Interim Guidelines on Workplace Prevention and Control of COVID-19 issued April 30, 2020;

c. DOH Memorandum No. 2020-0220 dated May 11, 2020 on Interim Guidelines on the Return-to-Work;

d. DILG Memorandum Circular No. 2020-023 dated 06 February 2020 on Amended Guide to Action Against the 2019 Novel Coronavirus Acute Respiratory Diseases;

e. International Labour Organization's (ILO) on Prevention and Mitigation of COVID-19 at Work: Action Checklist.

A. Prior deployment for construction

A.1. The LGU, and Contractor/Sub–Contractor/Suppliers shall:

. Establish regular communication and coordination among each other for any relevant COVID-19 information;

. b) Strengthen the Grievance Redress Mechanism to ensure that there is an open, active, and easily accessible communication platform for workers to channel their questions and concerns especially regarding COVID-19.

. c) Incorporate in the Environmental and Social Management Plan (ESMP) the management's commitment and responsibilities on the reduction and risk of exposure to the virus and transmission of COVID-19 at the workplace through prioritizing safety and health of workers and their surrounding communities;

. d) Assess and review occupational safety and health hazards of all construction works and develop strategic measures and possible changes in the construction methodologies on managing the potential risks and its impacts through incorporation of DOH minimum health protocols and standards, and other relevant guidelines.

A.2. The LGU shall:

. a) Screen and issue construction quarantine pass (QP) to the individual qualified personnel of the contractors clearly stating the identification, designation, nature of work, validity and destination, if necessary;

. b) Advise the Barangay Council of the start/resumption of construction works with adherence to DOH and IATF guidelines;

. c) Facilitate the inclusion of necessary information on the impacts and mitigation measures of the construction in the IEC campaigns through Barangay Council.

A.3. The Barangay Council through its Barangay Health Emergency Response Team (BHERT) shall:

a) Include in the IEC campaign for the community the necessary information on the impacts and mitigation measures relevant to the construction;

b) Inform the Contractor on the existing ordinances or plans of the Barangay on containment and control and prevention measures especially in terms of public health and sanitation through its waste management, cleaning and disinfection, isolation procedures, among others;

c) Inform the community on the start/resumption of the construction with special considerations on vulnerable groups such as women, children, elderly, Indigenous Peoples/Indigenous Cultural Communities (IP/ICCs), People with Disabilities (PWD), and immuno- compromised people through several mechanisms. Refer to Annex A - Consultation Guidelines amidst COVID-19 Public Health Crisis.

A.4. The Contractor/Sub – Contractor/Suppliers shall:

a) Not allow any person below twenty-one (21) years old, those who are sixty (60) years old and above, those with immune deficiencies, comorbidities, or other health risks, and pregnant women, including those who reside with the aforementioned, to be part of the workforce for construction projects except as may be allowed under the Revised Omnibus Guidelines issued by the IATF;

b) Undergo its employees fourteen (14) days quarantine prior to deployment, especially for the migrant workers coming from another barangay/municipality; or in the alternative, the employee may undergo any available Food and Drug Administration (FDA) - approved COVID-19 test, as may be prescribed by the DOH, and be retested as the need arises. In this regard, consultation with medical doctors (duly accredited by DOH, if possible) prior to the conduct of COVID-19 test shall be made. Further, COVID-19 test procedures and return-to-work policies of the contractors should comply with DOH Circular No. 2020- 0160 dated 31 March 2020, Department Memorandum No. 2020-0220 dated 11 June 6020, and other pertinent issuances of the DOH on the matter;

c) Ensure that the subproject is in compliance with DOLE DO. NO. 13 series of 1998, and the DTI and DOLE Interim Guidelines on Workplace Prevention and Control of COVID-19. Provide personnel and workers face mask and/or shield, soap, sanitizer, disinfectant, and continuous supply of vitamins particularly vitamin C, other over – the counter medicines, quarantine facilities, and oxygen tanks for emergency purposes;

d) Provide for the personnel/workers the necessary welfare facilities and amenities (i.e. employees' quarters board and lodging, adequate toilet and baths for both men and women, communal kitchens, etc.) while ensuring compliance to social distancing, proper hygiene, etc.;

e) Provide disinfection facilities in the respective project sites in compliance with pertinent DOH and IATF Guidelines, to be place at strategic locations to ensure the safety and welfare of all personnel;

f) Conduct proper information dissemination through the Safety Officer to increase awareness and knowledge of the workforce regarding COVID-19 construction protocols, guidelines, and management/mitigation measures on top of the existing construction safety practices through orientation, training, and installation of IEC materials and other notices for workers' safety;

g) Submit personal records of all personnel, especially for those migrant workers who would be coming from different barangay/municipalities, to proponent LGU and Barangay Council through its BHERT for necessary for contact tracing, assistance and monitoring. It shall be resubmitted and updated monthly, or as the need arises (Annex B – PRDP Worker's Log Format);

h) Prioritize engaging workers coming from the community or close proximity of the construction site. Should there be workers coming from another barangay/municipality, adhere with the proponent PLGU/MLGU and BHERT on the relevant guidelines for migrating workers;

i) Ensure non-discrimination of workers through developing and communicating a clear policy

of non-discrimination to reduce stigma so that employees feel safe reporting illness of themselves or within their families;

j) Maintain and disclose rights and workers benefits, such as the following:

Access to essential health care and other basic social services;

All workers shall be appropriately informed by the employer about all types of hazards in the workplace and be provided access to training, education, and orientation on chemical safety, electrical safety, mechanical safety, ergonomics and other hazards and risks (DOLE - DO. 198 series of 2018, Section 5);

iii. Worker has the right of refusal to work without threat or reprisal from the employer if, as determined by DOLE, an imminent danger situation exists. (DOLE - DO. 198 series of 2018, Section 6);

iv. No cost related or incidental to COVID-19 prevention and control measures shall be charged directly or indirectly to the workers (Labor Advisory No.18 series of 2020, Section 2);

v. Health hospital benefits, sickness benefits under the SSS and employee's compensation benefits under PD 626 (EC Law). In the event that the worker is not qualified to avail of the benefits under SSS or Phil Health due to the employer, the employer will shoulder all the medical expenses until full recovery (Labor Advisory No. 04 series of 2020);

k) Incorporate COVID-19 Health and Emergency Response Protocols and COVID-19 hotlines of designated hospitals and emergency medical centers in the existing Emergency response procedures or contingency plans established and Hotlines posted.

During Construction

B.1. The LGU shall:

a) Assist to the Barangay Council and Contractors in the management of COVID-19 concerns that may arise during construction and potentially impact the community;

b) Monitor the implementation of the supplemental guidelines through the Project's regular monitoring procedures and activities with the Resident Engineer as lead for the proponent LGU. The report on monitoring of compliance to these guidelines shall be submitted monthly to the PPMIU/MPMIU Head.

B.2. The Barangay Council through its Barangay Health Emergency Response Team (BHERT) shall:

a) Inform the Contractors on the status of the daily health monitoring in the community;

b) Remind the community and workers to reduce direct contact and adhere to physical distancing during construction;

c) Encourage other modes of uptake such as text messaging, call, e-mail, and social media in lodging community concerns and feedback through Grievance Redress Mechanism.

B.3. The Contractor/Sub – Contractor/Suppliers shall:

a) Conduct an inventory of works for the construction sequencing to be followed and undertake to uphold the required physical distancing. Barangay Council shall be informed of the revised construction sequencing or daily construction works;

b) Reduce direct personnel contact to adhere with physical distancing through clustered and staggered deployment of employees within the construction sites for easier contact tracing;

c) Make work breaks staggered; and during breaks, workers shall stay in the quarters or established welfare facilities rather than along the streets or nearby public space;

d) Prohibit smoking in public spaces especially while construction is on- going. It shall only be allowed only to designated smoking area and after construction work;

e) House all employees in their respective quarters for the entire duration of the project covered by the Community Quarantine. In case there is a need to leave the said quarters during the project duration, "Prior to Deployment" procedures shall be conducted at every instance of re-entry;

f) Ensure availability of adequate food, potable drinking water, disinfectants, and hand soaps to its in-house personnel;

g) Assist workers to manage any emerging psychosocial risks, new forms of work arrangements and in the promotion and maintenance of healthy lifestyles including diet, rest and sleep, exercise and social contacts with friends and family;

h) Designate workers in charge of the regular cleaning and disinfection of the premises and construction materials;

i) Regularly maintain good housekeeping which includes daily cleaning and disinfection of all construction facilities such as Field Office, employees' quarters, and other common area;

j) Promote culture of regular cleaning and disinfection among workers and within the premises of construction through reminders in tool box meeting and posting of relevant IEC materials;

k) Observe proper disposal of COVID-19 related PPE (e.g. face masks) by setting up a distinct bin labelled as special wastes and adhering to BHERT waste management collection protocols. Any face masks that could potentially be reused should be cut into pieces as a safety measure to avoid reuse;

l) Remind workers, during the conduct of regular tool box meetings, on the relevant construction protocols and prevention measures on the specific daily or weekly work tasks;

m) Conduct daily monitoring of the pre-and post-work health conditions of workers, including, but not limited to, temperature, health, and exposure monitoring, as preventive measures. Personnel with manifestation or symptoms relative to COVID-19 shall be immediately isolated and quarantined for fourteen (14) days and if necessary, brought to the nearest DOH COVID-19 treatment facility under strict confidentiality and privacy. Proper protocols in accordance with DTI and DOLE Interim Guidelines on Work Place Prevention and Control of COVID-19 shall likewise be strictly observed. Daily health monitoring report shall be endorsed to the proponent PLGU/MLGU and BHERT (Annex C - PRDP Daily COVID -19 Surveillance Fill-Up/Checklist Form);

n) Ensure that Project Engineers and Safety Officer assigned at the site shall strictly monitor work activities. Said Safety Officer shall conduct daily monitoring in strict compliance with DOLE D.vO. No. 13, Series of 1998 and the DTI and DOLE Interim Guidelines on Workplace Prevention and Control of COVID-19 with regard to the wearing of additional Personal Protective Equipment (PPE) required such as, but not limited to, face masks, safety glasses/goggles, face shields, and long sleeve T-shirts, and other measures to contain the spread of COVID-19 in the workplace, as provided in these guidelines.

o) Discourage sharing of construction and office equipment. However, if necessary, the shared equipment must be disinfected in between transfers amongst personnel;

p) Ensure that all materials and equipment delivery and disposal shall be conducted by a specific team of personnel on an isolated loading/unloading zone while limiting contact with the delivery/disposal personnel. All materials and/or equipment entering the construction site shall be duly disinfected, as possible;

q) Restrict the entrance/visit of non-essential personnel, visitors, and the general public in the construction site, employees' quarters, and field offices. Otherwise, all personnel entering the construction site premises on a temporary basis (e.g. delivery truck drivers, inspectors, etc.) shall be properly logged and checked for symptoms;

r) Strictly prohibit gatherings, liquors, and/or merry – making within the construction site premises;

s) Provide transport service for off-site employees' quarters. The transport service shall be disinfected before and after use, and social distancing shall likewise be observed therein at all times in accordance with DOTr guidelines;

t) Regularly clean and disinfect the vehicles and materials. During construction transport and delivery services, workers' shall reduce direct contact with clients. If contact with clients are necessary, drivers should ensure minimum safety protocols. All records on transport and delivery services (i.e. location of delivery, driver in charge, and client contact information) shall be submitted to the proponent PLGU/MLGU and BHERT as reference for contract tracing and other necessary assistance;

u) Keep errands to be conducted outside the construction site premises at a minimum. Number of personnel running errands shall be limited and shall properly be disinfected and closely monitored for symptoms within fourteen (14) days upon re-entry.

V. Specific Guidelines for I-REAP Enterprise and I-BUILD Other infrastructure Operations

This guideline primarily used as references the ***Joint DTI and DOLE interim guidelines on workplace prevention and control of COVID-19 issued April 30, 2020 and the Department of Health Memorandum No. 2020-0220 dated May 11, 2020 with subject Interim Guidelines on the Return-to-Work.*** These issuances were harmonized with PRDP's Integrated Environmental and Social Safeguards Framework (as of October 25, 2018) to come up with the COSH guidelines as follow:

A. Workplace Safety and Health

A.1. Increase physical and mental resilience

The Enterprise Management with the assistance from the proponent PLGU/MLGU shall assist workers in maintaining and increasing their physical and mental resilience such as:

1. Emphasize to workers everyday actions to stay healthy such as eating nutritious food and observing a healthy diet, drinking plenty of fluids, having adequate rest and at least eight (8) hours sleep, exercising regularly;

2. Provide free medicine and vitamins, if feasible;

3. Explore new forms of work arrangement beneficial to the health of the workers; and

4. Manage emerging psychosocial risks by providing referral for workers needing counseling or presenting with mental health concerns and facilitating continued social contacts with family and friends.

A.2.Reducing transmission of COVID-19

1. *The Enterprise Management shall assign a "Workplace Coordinator for COVID-19 concerns*".

1.1. He/She may also be the existing Safety Officer if applicable to the Enterprise.

1.2. The Workplace Coordinator for COVID-19 shall be in-charge of ensuring the guidelines stated herein are implemented accordingly together with the supervision of the Enterprise Management.

1.3. The proponent PLGU/MLGU shall provide assistance to ensure that the assigned Coordinator for COVID-19 receives the proper training.

2. *Prior Entrance in buildings and workplaces*

2.1. All employers and workers shall:

i. Wear face masks at all times and remove the same only when eating/drinking. Employers shall provide the appropriate face masks for workers. Should cloth masks be used, the washable type shall be worn but additional filter material such as tissue papers inside the masks may be added;

ii. Accomplish daily the health symptoms questionnaire and submit to the guard or designated safety officer prior to entry;

iii. Have their temperature checked and recorded in the health symptoms questionnaire. (Annex D – Health Checklist) For any personnel with temperature > 37.50 C, even after a 5-minute rest, or if their response in the questionnaire needs further evaluation by the Workplace Coordinator, the person shall be isolated in an area identified by the Enterprise and not allowed to enter the premises. The isolation area should be well ventilated and must be disinfected frequently. Workplace Coordinator assigned to assess the workers held in the isolation area shall be provided the appropriate medical grade PPE by the establishment which shall include but not limited to, face masks,

goggles/face shields, and/or gloves; and

iv. Spray alcohol/sanitizers to both hands; and provide disinfectant foot baths at the entrance if practicable.

2.2. Equipment or vehicle entering the hub operational area must go through a disinfection process; and

2.3. If there will be a long queue outside the office or store premises, roving officers should instill physical distancing of one meter.

3. Inside the workplace

3.1. All work areas and frequently handled objects such as door knobs and handles, shall be cleaned and disinfected regularly, at least once every two (2) hours;

3.2. All washrooms and toilets shall have sufficient clean water and soap, workers are encouraged to wash their hands frequently and avoid touching their eyes, nose and mouth;

3.3. Sanitizers shall be made available in corridors, conference areas, elevators, stairways and areas where workers pass;

3.4. Workers, whether in office workstations or in operations area, shall always practice physical distancing meaning at the minimum one (1) meter radius space (side, back and front) between workers;

3.5. Eating in communal areas is discouraged. It is best to eat in individual work area and all wastes shall be disposed properly. If eating in individual work areas is not possible, the employer shall ensure that physical distancing is maintained in dining areas with one worker per table and 1- meter distance per worker. It is discouraged that workers engage in conversation with masks off during meal times. Tables and chairs shall be cleaned or disinfected after every use of the area, and before as well as at the end of the work day; and

3.6. Canteens and kitchens should be cleaned and disinfected regularly.

A.3. Minimize contact rate

1. Alternative work arrangements, such as working-hour shifts, work from home (WFH), where feasible and on rotation basis;

2. Prolonged face-to-face interaction between workers and with clients are discouraged and masks shall be worn at all times and not removed. Meetings needing physical presence shall be kept to a minimum number of participants and with short duration. Videoconferencing shall be utilized for lengthy discussions among workers;

3. Office tables should be arranged in order to maintain proper physical distancing. Barriers may be provided between tables;

4. Workstation layout should be designed to allow for unidirectional movement in aisles, corridors or walkways;

5. To maintain physical distancing, number of people inside an enclosed space such as a room, store or hall shall be limited;

6. Use of stairs should be encouraged subject to physical distancing requirements. If more than 2 stairways are accessible, one stairway may be used exclusively for going up and another for going down;

7. Online system shall be highly encouraged to be utilized for clients needing assistance from offices including the use of videoconferencing; and

8. Roving officers (i.e. Manager, Supervisor, and Workplace Coordinator) shall always ensure physical distancing and observance of minimum health protocols.

A.4. On Reducing the risk of infection from COVID-19

1. In the event that a worker is suspected as having COVID-19:

1.1. The worker shall immediately proceed to the isolation area designated in the workplace and never remove his/her mask;

1.2. Workplace Coordinator attending to the workers should wear appropriate PPE and if needed should require the transport of the affected worker to the nearest hospital. Company protocols for transport for suspect COVID-19 cases and for PCR testing, should be in place including providing for ambulance conduction. For the micro and small enterprises, they may seek help from the Barangay or the Municipal Government. Hospitals will report to the DOH for COVID-19 suspect; and

1.3. Decontamination of workplace

i. Workplace shall be decontaminated with appropriate disinfectant (e.g. chlorine bleaching solution and 1:100 phenol-based disinfectant);

ii. After decontamination of the work area, work can resume after twenty-four (24) hours; and

iii. Workers present in the work area with the suspect COVID-19 worker shall go on fourteen (14) days home quarantine with specific instructions from the Workplace Coordinator on monitoring of symptoms and possible next steps. If suspect COVID-19 worker has negative result, co-workers may be allowed to report back to work.

2. In the event that a worker is sick or has fever but is not suspected to have COVID-19 (ex., urinary infection, wound infection or any diseases not related to lungs or respiratory tract) the employer must advise the worker to take prudent measures to limit the spread of communicable diseases, as follows:

2.1. Stay at home and keep away from work or crowds;

2.2. Take adequate rest and take plenty of fluids;

2.3. Practice personal hygiene to prevent spread of disease; and

2.4. Seek appropriate medical care if there is persistent fever, when difficulty of breathing has started, or when he/she becomes weak.

B. Duties of Employers and Workers B.1. Employer (Enterprise Management) shall:

1. Provide the necessary Enterprise policies/operating manuals to adapt to the "new normal" brought about by the COVID-19 pandemic in consultation with workers. Advocacy and IEC programs should be taken from DOH, WHO and reliable sources of information on COVID-19. Polices may be informed by the risk identification and mitigation process and can include the following (as adopted from COVID-19 Info-Sheet on Preventing and Managing related Environmental, Social, Health and Safety (ESHS) risks):

i. Prevention procedures covering basic hygiene, cleaning and

ii. Policies and procedures on how to determine and manage

iii. Updated working condition policies as appropriate;

iv. Stakeholder engagement procedures where operations or

2. Conduct training to guide workers for the transition to the "new normal" and provide proper visual reminders/IEC materials for safety policies posted strategically around the workplace to ensure workers are well informed and improve compliance;

3. Coordinate with concerned LGU and government agencies to provide the necessary capacity building activities relevant to COVID-19 health protocols, guidelines, and management/mitigation measures to prepare and equip farmers, fisherfolks, farmworkers and other units who will operate and maintain the facilities;

4. Ensure non-discrimination of workers: It is recommended to develop and communicate a clear policy of non-discrimination to reduce stigma so that employees feel safe reporting illness of themselves or within their families. All policies and procedures should be clearly communicated alongside contact information and access to a grievance mechanism should employees have questions or concerns;

5. Strengthen the Grievance Redress Mechanism to ensure that there is an open, active, and easily accessible communication platform for workers to channel their questions and concerns especially regarding COVID-19;

6. Establish clear and regular communication about preventive measures and precautions to workers and, where applicable, contractors, the supply chain, customers, and the wider community;

7. Adhere to the following provisions stated in RA 11058 Sections 5 & 6; Workers' Right to Know and Workers' Right to Refuse Unsafe Work:

i. All workers shall be appropriately informed by the employer about all types of hazards in the

workplace and be provided access to training, education, and orientation on chemical safety, electrical safety, mechanical safety, ergonomics and other hazards and risks;

ii. The worker has the right of refusal to work without threat or

8. Put in place policies and mechanisms in particular for the inclusion and protection of the vulnerable population such as women, older persons, those with underlying health conditions, persons with disabilities and Indigenous Peoples;

9. Provide resources and materials needed to keep the workers healthy and the workplace safe, e.g., masks, soap, sanitizer, disinfectant, PPE, including COVID-19 testing kits. For micro and small enterprises that proponent LGU shall provide assistance to the PG especially in accessing COVID-19 testing kits;

10. Observe proper disposal of COVID-19 related PPE (e.g. face masks, face shields, gloves, etc.) by setting up a distinct bin labelled as special wastes and adhering to BHERT waste management collection protocols. Any face masks that could potentially be reused should be cut into pieces as a safety measure to avoid reuse;

11.Enhance health insurance provision for workers, aside from the mandatory Philhealth, and establish appropriate sick leave policies to accommodate the COVID-19 situation;

12.Establish referral network for employees who will develop symptoms;

13.Where feasible, provide shuttle services and/or decent accommodation on near-site location to lessen travel and people movement;

14.Adhere to and regularly check recent issuances of the National government and consult with/seek further advice from the concerned PRDP offices (RPCO, PSO and NPCO) for any further developments that may arise. It is to be recognized that certain enterprises, depending on the nature of the enterprise (i.e. food processing, non-food processing, crop production, animal raising, aquaculture), may require other additional mitigation measures. For Food processing and production related enterprises, we may refer to:

i. COVID-19 and Food Safety: Guidance for food businesses: Food and Agriculture Organization (FAO) and World Health Organization (WHO) dated April 7, 2020; and

ii. Department of Agriculture (DA) Guidelines on Food Safety for the Philippine Agricultural and Fishery Sectors during COVID-19 Pandemic issued per Memorandum Circular No. 15 Series of 2020 dated May 13, 2020;

15.Provide the DOLE through its Regional Office and/or Barangay Council through its BERTH, copy furnished DOH, the LGU and PRDP, monthly reporting of illness, diseases and injuries utilizing the DOLE Work Accident/Illness Report Form (WAIR), attached as Annex E;

16. Incorporate COVID-19 Health and Emergency Response Protocols and COVID-19 hotlines of designated hospitals and emergency medical centers in the existing Emergency response procedures or contingency plans established and Hotlines posted;

17. Ensure that Enterprise Manager and Workplace Coordinator shall strictly monitor operation activities. Said Workplace Coordinator shall conduct daily monitoring in strict compliance with DOLE D.O. No. 13, Series of 1998 and the DTI and DOLE Interim Guidelines on Workplace Prevention and Control of COVID-19 and other supplemental measures, as provided in these guidelines.

B.2. LGU shall:

1. Extend technical and financial support to the enterprise operations in complying with the implementation of these guidelines;

2. Monitor the implementation of the supplemental guidelines through the Project's regular monitoring procedures and activities. The report on monitoring of compliance to these guidelines shall be submitted monthly to the PPMIU/MPMIU Head.

Mode of Measurement

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.

Basis of Payment

Payment shall be made on a proportional basis, calculated by multiplying the percentage rate of physical progress to the total lump sum amount every progress billing.

Payment will be made under:

Pay Item No.	Description	Unit of Measurement
B.7	**Occupational Health and Safety**	**Lump Sum**

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. Paint required for cut or scarred surface of trees or shrubs selected for retention shall be an approved asphaltum base paint prepared especially for tree surgery.

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) Removal of undisturbed stumps and roots and nonperishable solid objects with a minimum depth of one (1) meter below subgrade or slope of embankment will not be required.

(2) In areas outside of the grading limits of cut and embankment areas, stumps and nonperishable solid objects shall be cut off not more than 150 mm (6 inches) above the ground line or low water level.

(3) In areas to be rounded at the top of cut slopes, stumps shall be cut off flush with or below the surface of the final slope line.

(4) Grubbing of pits, channel changes and ditches will be required only to the depth necessitated by the proposed excavation within such areas.

(5) In areas covered by cogon/talahib, wild grass and other vegetations, 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.

Except in areas to be excavated, stump holes and other holes from which obstructions are removed shall be backfilled with suitable material and compacted to the required density.

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.

The Contractor shall use high intensity burning procedures, (i.e., incinerators, high stacking or pit and ditch burning with forced air supplements) that produce intense burning with little or no visible smoke emission during the burning process. At the conclusion of each burning session, the fire shall be completely extinguished so that no smoldering debris remains.

In the event that the Contractor is directed by the Engineer not to start burning operations or to suspend such operations because of hazardous weather conditions, material to be burned which interferes with subsequent construction operations shall be moved by the Contractor to temporary locations clear of construction operations and later, if directed by the Engineer, shall be placed on a designated spot and burned.

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. If disposal is by burying, the debris shall be placed in layers with the material so disturbed to avoid nesting. Each layer shall be covered or mixed with earth material by the land-fill method to fill all voids. The top layer of material buried shall be covered with at least 300 mm (12 inches) of earth or other approved material and shall be graded, shaped and compacted to present a pleasing appearance. If the disposal location is off the project, the Contractor shall make all necessary arrangements with property owners in writing for obtaining suitable disposal locations which are outside the limits of view from the project. The cost involved shall be included in the unit bid price. A copy of such agreement shall be furnished to the Engineer. The disposal areas shall be seeded, fertilized and mulched at the Contractor's expense.

Woody material may be disposed off by chipping. The wood chips may be used for mulch, slope erosion control or may be uniformly spread over selected areas as directed by the Engineer. Wood chips used as mulch for slope erosion control shall have a maximum thickness of 12 mm (1/2 inch) and faces not exceeding 3900 mm^2 (6 square inches) on any individual surface area. Wood chips not designated for use under other sections shall be spread over the designated areas in layers not to exceed 75 mm (3 inches) loose thickness. Diseased trees shall be buried or disposed off as directed by the Engineer.

All merchantable timber in the clearing area which has not been removed from the right of way prior to the beginning of construction, shall become the property of the Contractor, unless otherwise provided.

Low hanging branches and unsound or unsightly branches on trees or shrubs designated to remain shall be trimmed as directed. Branches of trees extending over the roadbed shall be trimmed to give a clear height of 6 m (20 feet) above the roadbed surface. All trimming shall be done by skilled workmen and in accordance with good tree surgery practices.

Timber cut inside the area staked for clearing shall be felled within the area to be cleared.

100.2.3 Individual Removal of Trees or Stumps

Individual trees or stumps designated by the Engineer for removal and located in areas other than those established for clearing and grubbing and roadside cleanup shall be removed and disposed off as specified under Subsection 100.2.2 except trees removed shall be cut as nearly flush with the ground as practicable without removing stumps.

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.
2. Lump-Sum Basis. When the Bill of Quantities contains a Clearing and Grubbing lump-sum item, no measurement of area will be made for such item.
3. Individual Unit Basis (Selective Clearing). The diameter of trees will be measured at a height of 1.4 m (54 inches) above the ground. Trees less than 150 mm (6 inches) in diameter will not be measured for payment.

When Bill of Quantities indicates measurement of trees by individual unit basis, the units will be designated and measured in accordance with the following schedule of sizes:

Diameter at height of 1.4 m	Pay Item Designation
Over 150 mm to 900 mm	Small
Over 900 mm	Large

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.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
100 (1)	Clearing and Grubbing	Hectare
100 (3)	Individual Removal of Trees, Small	Each

ITEM 801 – REMOVAL OF STRUCTURES AND OBSTRUCTIONS

801.1 Description

This Item shall consist of the removal wholly or in part, and satisfactory disposal of all buildings, fences, structures, old pavements, abandoned pipe lines, and any other obstructions which are not designated or permitted to remain, except for the obstructions to be removed and disposed off under other items in the Contract. It shall also include the salvaging of designated materials and backfilling the resulting trenches, holes, and pits.

801.2 Construction Requirements

801.2.1 General

The Contractor shall perform the work described above, within and adjacent to the roadway, on Government land or easement, as shown on the Plans or as directed by the Engineer. All designated salvable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported, and shall be stored by the Contractor at specified places on the project or as otherwise shown in the Special Provisions. Perishable material shall be handled as designated in Subsection 100.2.2 Nonperishable material may be disposed off outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners are to be furnished to the Engineer. Basements or cavities left by the structure removal shall be filled with acceptable material to the level of the surrounding ground and, if within the prism of construction, shall be compacted to the required density.

801.2.2 Removal of Existing Bridges, Culverts, and other Drainage Structures

All existing bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic. The removal of existing culverts within embankment areas will be required only as necessary for the installation of new structures. Abandoned culverts shall be broken down, crushed and sealed or plugged. All retrieved culvert for future use as determined by the Engineer shall be carefully removed and all precautions shall be employed to avoid breakage or structural damage to any of its part. All sections of structures removed which are not designated for stockpiling or re-laying shall become the property of the Government and be removed from the project or disposed off in a manner approved by the Engineer.

Unless otherwise directed, the substructures of existing structures shall be removed down to the natural stream bottom and those parts outside of the stream shall be removed down to at least 300 mm (12 inches) below natural ground surface. Where such portions of existing structures lie wholly or in part within the limits for a new structure, they shall be removed as necessary to accommodate the construction of the proposed structure.

Steel bridges and wood bridges when specified to be salvaged shall be carefully dismantled without damaged. Steel members shall be match marked unless such match marking is waived by the Engineer. All salvaged material shall be stored as specified in Subsection 801.2.1.

Structures designated to become the property of the Contractor shall be removed from the right-of-way.

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work, unless otherwise provided in the Special Provisions.

801.2.3 Removal of Pipes Other than Pipe Culverts

Unless otherwise provided, all pipes shall be carefully removed and every precaution taken to avoid breakage or damaged. Pipes to be relaid shall be removed and stored when necessary so that there will be no loss of damage before re-laying. The Contractor shall replace sections lost from storage or damage by negligence, at his own expense.

801.2.4 Removal of Existing Pavement, Sidewalks, Curbs, etc.

All concrete pavement, base course, sidewalks, curbs, gutters, etc., designated for removal, shall be:

(1) Broken into pieces and used for riprap on the project, or

(2) Broken into pieces, the size of which shall not exceed 300 mm (12 inches) in any dimension and stockpiled at designated locations on the project for use by the Government, or

(3) Otherwise demolished and disposed off as directed by the Engineer. When specified, ballast, gravel, bituminous materials or other surfacing or pavement materials shall be removed and stockpiled as required in Subsection 801.2.1, otherwise such materials shall be disposed off as directed.

There will be no separate payment for excavating for removal of structures and obstructions or for backfilling and compacting the remaining cavity.

801.3 Method of Measurement

When the Contract stipulates that payment will be made for removal of obstructions on lump-sum basis, the pay item will include all structures and obstructions encountered within the roadway. Where the contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the Contract.

Whenever the Bill of Quantities does not contain an item for any aforementioned removals, the work will not be paid for directly, but will be considered as a subsidiary obligation of the Contractor under other Contract Items.

801.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 801.3, shall be paid for at the Contract unit price or lump sum price bid 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 removing and disposing of obstructions, including materials, labor, equipments, tools and incidentals necessary to complete the work prescribed in this Item. The price shall also include backfilling, salvage of materials removed, their custody, preservation, storage on the right-of-way and disposal as provided herein.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
801 (1)	Removal of Structures and Obstruction	Lump Sum

ITEM 803 - STRUCTURE EXCAVATION

803.1 Description

This Item shall consist of the necessary excavation for foundation of buildings, 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 the Plans and this Specification.

This Item shall include necessary diversion of live streams, dewatering, pumping, draining, sheeting, bracing, and the necessary construction of cribs and cofferdams, and furnishing the materials therefore, and the subsequent removal of cribs and cofferdams and the placing of all necessary backfill.

It shall also include the furnishing and placing of approved foundation fil material to replace unsuitable material encountered below the foundation elevation of structures.

No allowance shall be made for classification of different types of material encountered.

803.2 Construction Requirements

803.2.1 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 800, Clearing and Grubbing.

803.2.2 Excavation

1. General, All Structures

The Contractor shall notify the Engineer sufficiently in advance at 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.

Trenches or foundation pits for structures or structure footings shall be excavated to the lines and grades or elevations shown on the Plans or as staked by the Engineer. They shall be of sufficient size to permit the placing of structures or structure footings of the full width and length shown. The elevations of the bottoms of footings, as shown on the Plans, shall be considered as approximate only and the Engineer may order, in writing, such changes in dimensions or elevations of footings as may be deemed necessary, to secure a satisfactory foundation.

Boulders, logs, and other objectionable materials encountered in excavation shall be removed.

After each excavation is completed, the Contractor shall notify the Engineer to that effect and no footing, bedding material or pipe culvert 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 of 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 layers up to the foundation elevation.

When foundation piles are used, the excavation of each pit shall be completed before the piles are driven and any placing of foundation fill shall be done after the piles are driven. After the driving is completed, all loose and displaced materials shall be removed, leaving a smooth, solid bed to receive the footing.

3. Pipe Culverts

The width of the pipe trench shall be sufficient to permit satisfactory jointing of the pipe and thorough tamping of the bedding material under and around the pipe.

Where rock, hardpan, or other unyielding material is encountered, it shall be removed below the foundation grade for a depth of at least 300 mm or 4 mm for each 100 mm of fill over the top of pipe, whichever is greater, but not to exceed three-quarters of the vertical inside diameter of the pipe. The width of the excavation shall be at least 300 mm greater than the horizontal outside diameter of the pipe. The excavation below grade shall be backfilled with selected fine compressible material, such as silty clay or loam, and lightly compacted in layers not over 150 mm in uncompacted depth to form a uniform but yielding foundation.

Where a firm foundation is not encountered at the grade established, due to soft, spongy, or other unstable soil, such unstable soil under the pipe and for a width of at least one diameter on each side of the pipe shall be removed to the depth directed by the Engineer and replaced with approved granular foundation fill material properly compacted to provide adequate support for the pipe, unless other special construction methods are called for on the Plans.

The foundation surface shall provide a firm foundation of uniform density throughout the length of the culvert and, if directed by the Engineer, shall be cambered in the direction parallel to the pipe centerline.

Where pipe culverts are to be placed in trenches excavated in embankments, the excavation of each trench shall be performed after the embankment has been constructed to a plane parallel to the proposed profile grade and to such height above the bottom of the pipe as shown on the Plans or directed by the Engineer.

803.2.3 Utilization of Excavated Materials

All excavated materials, so far as suitable, shall be utilized as backfill or embankment. The surplus materials shall be disposed of 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.

803.2.4 Cofferdam

Suitable and practically watertight cofferdams shall be used wherever water bearing strata are encountered above the elevation of the excavation. If requested, the Contractor shall submit drawings showing his proposed method of cofferdam construction, as directed by the Engineer.

Cofferdams or cribs for foundation construction shall in general, be carried well below the bottoms of the footings and shall be well braced and as nearly watertight as practicable. In general, the interior dimensions of cofferdams shall be such as to give sufficient clearance for

the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.

When conditions are encountered which, as determined by the Engineer, render it impracticable to dewater the foundation before placing the footing, the Engineer may require the construction of a concrete foundation seal of such dimensions as he may consider necessary, and of such thickness as to resist any possible uplift. The concrete for such seal shall be placed as shown on the Plans or directed by the Engineer. The foundation shall then be dewatered and the footing placed. When weighted cribs are employed and the mass is utilized to overcome partially the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire mass of the crib to the foundation seal. When a foundation seal is placed under water, the cofferdams shall be vented or ported at low water level as directed.

Cofferdams shall be constructed so as to protect green concrete against damage from sudden rising of the stream and to prevent damage to the foundation by erosion. No timber or bracing shall be left in cofferdams or cribs in such a way as to extend into substructure masonry, without written permission from the Engineer.

Any pumping that may be permitted from the interior of any foundation enclosure shall be done in such a manner as to preclude the possibility of any portion of the concrete material being carried away. Any pumping required during the placing of concrete, or for a period of at least 24 h thereafter, shall be done from a suitable sump located outside the concrete forms. Pumping to dewater a sealed cofferdam shall not commence until the seal has set sufficiently to withstand the hydrostatic pressure.

Unless otherwise provided, cofferdams or cribs, with all sheeting and bracing involved therewith, shall be removed by the Contractor after the completion of the substructure. Removal shall be effected in such manner as not to disturb or mar finished masonry.

803.2.5 Preservation of Channe

Unless otherwise permitted, no excavation shall be made outside of caissons, cribs, cofferdams, or sheet piling, and the natural stream bed adjacent to structure shall not be disturbed without permission from the Engineer. If any excavation or dredging is made at the side of the structure before caissons, cribs, or cofferdams are sunk in place, the Contractor shall, after the foundation base is in place, backfill all such excavations to the original ground surface or stream bed with material satisfactory to the Engineer.

803.2.6 Trimming Works

The excavation shall conform to the lines, grades, cross sections and dimensions shown on the Plans. The Engineer shall order the removal of any soft spots, debris or organic material exposed when excavated areas shall have been trimmed to finished formation levels. Subgrade in earth shall be trimmed cut to an even surface free of loose material and compact as specified by the Engineer to the density prescribed in in the Plans.

803.2.6.1 Trimming and Finishing of Surfaces

Unless otherwise specified, all areas within the limits of clearing and outside the limits of earthworks shall be graded to an even surface. Ridges shall be trimmed and depressions shall

be filled as necessary to produce a surface which will drain freely and is suitable for the operation of tractor mounted mowers. Batters in cut and fill shall be trimmed to shapes shown on drawings. Cut and fill batters shall be trimmed as specified in the Plans.

803.3 Method of Measurement

803.3.1 Structure Excavation

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

1. The volume outside of vertical planes 450 mm outside of and parallel to the neat lines of footings and the inside walls of pipe and pipe-arch culverts at their widest horizontal dimensions.

2. The volume of excavation for culvert and sections outside the vertical plane for culverts stipulated in (1) above.

3. The volume outside of neat lines of underdrains as shown on the Plans, andoutside the limits of foundation fill as ordered by the Engineer.

4. The volume included within the staked limits of the excavation, contiguous channel changes, ditches, and the like, for which payment is otherwise provided in the Specification.

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

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

7. The volume of any material rehandled, except that where the Plans indicate or the Engineer directs the excavation after embankment has been placed and except that when installation of pipe culverts by the imperfect trench method specified in Subsection 1718.3.7, Imperfect Trench of Item 1718, Pipe Culverts and Storm Drains is required, the volume of material re excavated as directed will be included.

8. The volume of excavation for footings ordered at a depth more than 1.5 m 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.

803.3.2 Shoring, Cribbing, and Related Work

Shoring, cribbing and related work whenever included as a pay item in Bill of Quantities shall be paid for at the lump sum bid price. This work shall include furnishing, constructing, maintaining, and removing any and all shoring, cribbing, cofferdams, caissons, bracing, sheeting, water control, and other operations necessary for the acceptable completion of excavation included in the work of this Subsection, to a depth of 1.5 m below the lowest elevation shown on the Plans for each separable foundation structure.

803.3.3 Trimming Works

Trimming shall include all activities associated with the excavation of any material, the haulage of material, and trimming of batters that conform to the lines, grades, cross sections and dimensions shown on the Plans.

803.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 803.3, Method of Measurement 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 shall be paid for as provided in the Part K of Volume I Requirements and Conditions of Contract, 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 900, Structural Concrete. The quantity of structural concrete to be paid for shall be the final quantity placed and accepted in the completed structure. No deduction shall be made for the volume occupied by pipe less than 100 mm in diameter or by reinforcing steel, anchors, conduits, weep holes or expansion joint materials.

3. Any excavation or borrow excavation required in excess of the quantity excavated for structures shall be measured and paid for as provided under Item 802, Excavation.

4. Shoring, cribbing, and related work required for excavation ordered more than 1.5 m below Plan elevation shall be paid for in accordance with Part K.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
803(1)a	Structure Excavation (Common Soil)	Cubic Meter

ITEM 804- EMBANKMENT

804.1 Description

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

804.2 Material Requirements

804.2.1 Suitable Material

Embankments shall be constructed of suitable materials and materials meeting with the following requirements:

1. Selected Borrow - soil of such gradation that all particles will pass a sieve with 75 mm square openings and not more than 15 mass percent will pass the 0.075 mm (No. 200) sieve, as determined by AASHTO T 11, Standard Method of Test for Materials Finer Than 75-µm (No. 200) Sieve in Mineral Aggregates by Washing. The material shall have a plasticity index of not more than six (6) as determined by AASHTO T 90, Standard Method of Test for Determining the Plastic Limit and Plasticity Index of Soils and a liquid limit of not more than 30 as determined by AASHTO T 89, Standard Method of Test for Determining the Liquid Limit of Soils.

2. Gravel fill shall consist of crushed, partially crushed, or naturally occurring granular material. The abrasion loss as determined by AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine shall not exceed 40 mass percent.

The gravel fill material grading requirements shall conform to Table 804.1.

Table 804.1 Grading Requirements

Sieve Designation		Mass Percent Passing
Standard, mm	Alternate US Standard	Grading A
63.5	2 ½”	100
50	2”	65-100
25	1”	50-85
4.75	No. 4	26-44
0.425	No. 40	16 max
0.075	No. 200	9 max

3. Rock fill material shall be hard, sound and durable material, free from seams, cracks, and other defects tending to destroy its resistance to weather. Specific gravity of rock fill materials shall be above 2.40.

804.2.2. Unsuitable Material

Materials that are not acceptable for use are the following

1. Organic soils such as peat and muck.

2. Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.

3. Soils with a natural water content exceeding 100%.

4. Soils with very low natural density, 800 kg/m³ or lower.

5. Materials containing detrimental quantities of organic materials, such as grass, roots, sewerage, and other materials that cannot be properly compacted as determined by the Engineer.

804.3 Construction Requirements

804.3.1 General

Prior to placing of embankment materials, all necessary clearing and grubbing in that area shall have been performed in conformity with Item 800, Clearing and Grubbing.

Embankment construction shall consist of constructing embankments, including preparation of the areas upon which they are to be placed; the construction of dikes within or adjacent to any structures; the placing and compacting of approved material within areas where unsuitable material has been removed: and the placing and compacting of embankment material in holes, pits, and other depressions within the area.

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 and to the specified requirements of this Item.

Where provided on the Plans and Bill of Quantities the top portions of the roadbed in both cuts and embankments, as indicated, shall consist of selected borrow for topping from excavations.

804.3.2 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.

When embankment is to be placed and compacted on hillsides, or when new embankment is to be compacted against existing embankments, or when embankment is built 1/2 of the width at a time, the existing slopes that are steeper than 3:1 when measured at right angles to the roadway shall be continuously benched over those areas as the work is brought up in layers. Benching will be subject to the Engineer's approval and shall be of sufficient width to permit operation of placement and compaction equipment. Each horizontal cut shall begin at the intersection of the original ground and the vertical sides of the previous cuts. Material thus excavated shall be placed and compacted along with the embankment material in accordance with the procedure described in this Section

Unless shown otherwise on the Plans or Special Provisions, where an embankment of less than 1.2 m below subgrade is to be made, all sod and vegetable matter shall be removed from the surface upon which the embankment is to be placed, and the cleared surfaced shall be completely broken up by plowing, scarifying, or steeping to a minimum depth of 150 mm except as provided in Subsection 802.2.2, Conservation of Topsoil. This area shall then be compacted as provided in Subsection 804.3.3, Compaction. Sod not required to be removed shall be thoroughly disc harrowed or scarified before construction of embankment. Wherever a compacted embankment containing granular materials lies within 900 mm of the subgrade, such old embankment shall be scarified to a depth of at least 150 mm whenever directed by the Engineer. This scarified material shall then be compacted as provided in Subsection 804.3.3, Compaction.

When shoulder excavation is specified, the shoulders shall be excavated to the depth and width shown on the Plans. The shoulder material shall be removed without disturbing the adjacent existing base course material, and all excess excavated materials shall be disposed of as provided in Subsection 802.2.3, Utilization of Excavated Materials. If necessary, the areas shall be compacted before being backfilled.

Embankment of earth material shall be placed in horizontal layers not exceeding 200 mm, loose measurement, and shall be compacted as specified before the next layer is placed. However, thicker layer maybe placed if vibratory roller with high compacting effort is used provided that density requirement is attained and as approved by the Engineer. Trial section to this effect must be conducted and approved by the Engineer. 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, blading, discing, or other methods satisfactory to the Engineer.

Where embankment is to be constructed across low swampy ground that will not support the mass of trucks or other hauling equipment, the lower part of She fill may be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the auling equipment while placing subsequent layers. Fill material shall be placed in a way it effectively displaces unsuitable material from within unstable area of the proposed embankment.

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.

Even though the thickness of layers is limited as provided above, the placing of individual rocks and boulders greater than 600 mm in diameter shall be permitted provided that when placed, they do not exceed 1,200 mm in height and provided they are carefully distributed, with the interstices filled with finer material to form a dense and compact mass.

Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. Lifts of material containing more than 25 mass percent of rock larger than 150 mm in greatest dimensions shall not be constructed above an elevation 300 mm below the finished subgrade. The balance of the embankment shall be composed of suitable material smoothed and placed in layers not exceeding 200 mm in loose thickness and compacted as specified for embankments.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until compaction complies with the requirements of Subsection 804.3.3, Compaction.

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.

804.3.3 Compaction

1. 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, the number of passes required and the method of adjusting moisture content. The Contractor shall carry out full scale compaction trials on areas not less than 10 m wide and 50 m long as required by the Engineer and using his proposed procedures o such amendments thereto as may be found necessary satisfy the Engineer that all the specified requirements regarding compaction can be consistently achieved. The compaction equipment shall be equivalent or higher than the required capacity prescribed in the Contract. Compaction trials with the main types of fill material to be used in the works shall be completed before work with the corresponding materials shall be allowed to commence. When embankment dimension is less than 10 m wide and 50 m long, the Engineer may waive the construction of compaction trials.

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.

2. 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, Standard Method of Test for Moisture Density Relations of Soils Using a 2.5 kg Rammer and a 305 mm Drop - 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, Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method, AASHTO T 205, Soil- Field density test sets: Balloon density apparatus or other approved field density tests, including the use of properly calibrated nuclear testing devices. 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.

At least one group of three (3) in-situ density tests shall be carried out for each 500 m² of each layer of compacted fill.

3. Gravel Fil

Gravel fill shall be constructed below the original ground elevation. The maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner. Gravel fill shall be in accordance with the approved Plan and conform to the applicable requirements of earth embankment.

4. Broken Concrete

Pieces of concrete not exceeding 20 cm in diameter can be mixed if approved by the Engineer. Any exposed rebar on broken concrete pieces shall be cut and disposed of properly.

5. Rock

Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with approved methods Embankment materials containing rocks 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. In addition, one of the rollers, vibrators, or compactors shall compact the embankment full width with a minimum of three (3) complete passes for each layer of embankment.

804.3.4 Protection of Embankment During Construction

During the construction, the in-placed embankments shall be maintained in such condition that it will be well drained at all times. Side ditches or gutters emptying from cuts to embankments or otherwise shall be so constructed as to avoid damage to embankments by erosion.

804.3.5 Protection of Structure

If embankment can be deposited on one (1) side of adjoining structure, care shall be taken that the area adjacent to the structure shall not be compacted to the extent that it will cause damages against the structure.

When embankment is to be placed on both sides of a concrete structure, operations shall be so conducted that the embankment is always at approximately the same elevation on both sides of the structure unless otherwise specified in the Plans.

Embankment shall not be placed in areas where the materials will be submerged in water. The area shall be pumped dry and any mud or loose material shall be removed.

804.3.6 Rounding and Warping Slopes

Rounding except in solid rock, the tops and bottoms of all slopes, including the slopes of drainage ditches, shall be rounded as indicated on the Plans. A layer of earth overlaying rock shall be rounded above the rock as done in earth slopes.

Warping adjustments in slopes shall be made to avoid injury in standing trees or marring of weathered rock, or to harmonize with existing landscape features, and the transition to such adjusted slopes shall be gradual. At intersections of cuts and fills, slopes shall be adjusted and warped to flow into each other or into the natural ground surfaces without noticeable break.

804.3.7 Finishing Roadbed and Slopes

After the roadbed has been substantially completed, the full width shall be conditioned by removing any soft or other unstable material that will not compact properly or serve the intended purpose. The resulting areas and all other low sections, holes or depressions shall be brought to grade with suitable elected material. Scarifying, blading, dragging, rolling, or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the grades and cross-sections shown on the Plans or as staked by the Engineer.

All earth slopes shall be left with roughened surfaces but shall be reasonably uniform, without any noticeable break, and in reasonably close conformity with the Plans or other surfaces indicated on the Plans or as staked by the Engineer, with no variations there from readily discernible as viewed from the road.

804.3.8 Serrated Slopes

Cut slopes in rippable material (soft rock) having slope ratios between 0.75:1 and 2:1 shall be constructed so that the final slope line shall consist of a series of small horizontal steps. The step rise and tread dimensions shall be shown on the Plans. No scaling shall be performed on the stepped slopes except for removal of large rocks which will obviously be a safety hazard if they fall into the ditch line or roadway.

804.3.9 Earth Berms

When called for in the Contract, permanent earth berms shall be constructed of well graded materials with no rocks having a maximum diameter greater than 25% the height of the berm. When local material is not acceptable, acceptable material shall be imported, as directed by the Engineer.

Compacted Berm

Compacted berm construction shall consist of moistening or drying and placing material as necessary in locations shown on the drawings or as established by the Engineer. Material shall contain no roots, sod, or other deleterious materials Contractor shall take precaution to prevent material from escaping over the embankment slope. Shoulder surface beneath berm will be roughened to provide a bond between the berm and shoulder when completed. The Contractor shall compact the material placed until at least 95 mass percent of the maximum density is obtained as determined by AASHTO T 99, Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg Ramme and a 305 mm Drop - Method C. The cross-section

of the finished compacted berm shall reasonably conform to the typical cross-section as shown on the Plans.

Uncompacted Berm

Uncompacted berm construction shall consist of drying, if necessary and placing material in locations shown on the Plans or as established by the Engineer. Material shall contain no roots, sod or other deleterious materials. Contractor shall take precautions to prevent material from escaping over the embankment slope.

804.3.10 Visual Inspection

Prior to final acceptance, the inspector shall visually inspect the entire section of the compacted embankment. If visual inspection shows that the course is not uniform or that the test values may not be representative of the entire section additional tests may be performed and deficiencies shall be corrected by the Contractor. Deficiencies identified by visual inspection, such as laminations dimensional deficiencies, soft areas, etc. shall be corrected before the section will be accepted. The section must be accepted prior to the placement of the next lift.

804.3.11 Dust Control

Adequate dust control must be maintained by the Contractor at all times during the earth-moving operations. Dust shall be controlled exclusively through the use of water unless otherwise indicated in the Contract documents or authorized by the Engineer.

804.3.12 Stockpiling

The Contractor shall not place stockpiles at locations where they are subject to erosion. The Contractor shall maintain erosion and drainage control near all stockpiles to the satisfaction of the Engineer and shall ensure that surface drainage does not adversely affect adjacent lands, watercourses or future reclamation sites.

Stockpiles shall not be situated at locations or by methods that will interfere or cause damage to any utilities such as power lines, telephone lines, pipelines, and underground utilities, among others.

Sites shall be cleared to the required dimensions. Topsoil and subsoil shall be separately excavated to the full depth or 300 mm, whichever is greater, and stockpiled separately.

Stockpiles shall not be situated within 30 m of a watercourse or permanent structure or within 4 m of adjacent property boundary unless otherwise permitted in writing by the property owner.

804.4 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 an approved source.

The volume of embankment materials can be calculated using cross-sectional end area method or by the prismoidal formula method with the assistance of computer aided design program.

Material from excavation per Item 802, Excavation 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.

804.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 804.4, Method of Measurement 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 shall be made under:

Pay Item Number	Description	Unit Of Measurement
804(1)a	Embankment from Roadway/Structure Excavation (Common soil)	Cubic Meter
804(4)	Gravel Fill	Cubic Meter

ITEM 900-STRUCTURAL CONCRETE

900.1 Description

900.1.1 Scope

This Item shall consist of furnishing, placing and finishing concrete in buildings and related structures, flood control and drainage, ports, and water supply structures in accordance with this Specification and conforming to the lines, grades, and dimension shown on the Plans.

900.1.2 Classes and Uses of Concrete

Five classes of concrete are provided for in this Item, namely: A, B, C, P and Seal. 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 substructures which include the important parts such as slabs, beams, girders, columns, arch ribs, box culverts, abutments, retaining walls, shear walls, pedestal and footings.

Class B - Pier shafts, pipe bedding, slab on fill, gravity walls (unreinforced or with only a small amount of reinforcement), and other miscellaneous concrete structures.

Class C - Thin reinforced sections, railings, precast R.C. piles and cribbing and for filler in steel grid floors.

Class P- Prestressed concrete structures and members.

Seal - Concrete deposited in water

900.2 Material Requirement

900.2.1 Portland Cement

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

Table 900.1 Types of Cement

Type	Specification
Portland Cement	AASHTO M 85, Standard Specification for Portland Cement (ASTM C150, Standard Specification For Portland Cement)

Blended Hydraulic Cements	AASHTO M 240, Standard Specification for Portland Cement (ASTM C595, Standard Specification For Blended Hydraulic Cement)
Masonry Cement	ASTM C91, Standard Specification For Masonry Cement

900.2.2 Concrete Aggregates

Concrete aggregates shall conform to ASTM C33M, Standard Specification for Concrete Aggregates, and lightweight concrete aggregates shall conform to ASTM C330M, Standard Specification for Lightweight Aggregates except that aggregates failing to meet these specifications, but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used under Method 2 of Subsection 900.3.2, Methods of Determining the Proportions of Concrete, when authorized by the Engineer in writing.

Except as permitted elsewhere in this Subsection, the maximum size of the aggregate shall be or not larger than 1/5 of the narrowest dimensions between sides of forms of the member for which the concrete is to be used nor larger than 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars or pre-tensioning strands.

900.2.2.1 Fine Aggregates

Fine aggregates shall consist of natural and crushed sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles. Fine aggregates 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 written 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 written approval of the Engineer.

If the fine aggregate is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate and ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate, the weighted loss shall not exceed ten (10) mass percent.

Fine aggregates 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 on strength of mortar by AASHTO T 71, Standard Method of Test for Organic Impurities in Fine Aggregate on Strength of Mortar (ASTM C87, Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar) the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95%.

The fine aggregate shall be well-graded and shall conform to Table 900.2.

Table 900.2 Grading Requirements for Fine Aggregate

Sieve Designation	Mass Percent Passing
9.50	100
4.75	95-100
2.36	-
1.18	45-80
0.60	-
0.30	5-30
0.15	0-10

900.2.2.2 Coarse Aggregates

Coarse Aggregates 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 no more than one (1) mass percent of material passing the 0.075 mm comment sieve, not more than 0.25 mass percent of clay lumps, nor more than 3.5 mass percent of soft fragments.

If the coarse aggregate is subjected to five (5) cycles of the sodium sulfate soundness test in accordance with AASHTO T 104, Soundness of Aggregate by Use of Sodium Sulfate or Magnesium Sulfate and ASTM C88, Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate, the weighted loss shall not exceed 12 mass percent.

Coarse Aggregates shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse

Aggregate by Abrasion and Impact in the Los Angeles Machine (ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine).

If the slag is used, its density shall not be less than 1,120 kg/m³.

Gradation shall conform to Table 900.3.

Table 900.3 Grading Requirements for Coarse Aggregate

Sieve Designation (mm)	Mass Percent Passing				
	Class A	**Class B**	**Class C**	**Class P**	**Class Seal**
63.00					
50.00	100	100			
37.50	95-100	-			100
25.00	-	35-70		100	95-100
19.00	35-70	-	100	-	-
12.50	-	10-30	90-100	-	25-60
9.50	10-30	-	40-70	20-55	-
4.75	0-5	0-5	0-15	0-10	0-10

900.2.2.3 Aggregate Tests

Samples of the fine and coarse aggregates to be used shall be selected by the Engineer for tests at least 30 days before the actual concreting operations shat begin. It shall be the responsibility

of the Contractor to designate the source or sources of aggregates to give the Engineer sufficient time to obtain the necessary samples and submit them for testing.

No aggregates shall be used unless official advice has been received that it has satisfactorily passed all tests, at which time written authority by the Engineer shall be given for its use.

900.2.3 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.

If it contains quantities of substance that discolor it or make it smell or taste unusual or objectionable, or cause suspicion, it shall not be used unless service records of concrete made with it (or other information) indicated that it is not deleterious to the quality, shall be subject to the acceptance criteria as shown in Table 900.4 and Table 900.5 or as designated by the Engineer.

Table 900.4 Acceptance Criteria for Water Supply

Physical Property	Limit
Compressive strength, min. % control at 7 days	90
Time of Setting deviation from control, h:min[A]	From 1:100 earlier to 1:30 later

Table 900.5 Chemical Limitation for Water

Chemical Property	Limits (parts per million, ppm), max	Test Method

A. Chloride as $Cl^{(-1)}$ 1. Prestressed concrete 2. Other reinforced concrete in moist environment or containing aluminum embedments or dissimilar metals or with stay in place	500 1000	ASTM C114 ASTM C114
B. Sulfate as SO_4	3000	ASTM C114
C. Alkalies as (NA_2O + 0.658 K_2O)	600	ASTM C114
D. Total Solids by Mass	50000	ASTM C1603

Non-potable water will be tested in accordance with, and shall meet the suggested requirements of ASTM C1602M, Standard Specification for Mixing sen Water Used in the Production of Hydraulic Cement Concrete.

900.2.4 Metal Reinforcement

Reinforcing steel bars shall conform to the requirements of Subsection 902.2, Material Requirements of Item 902, Reinforcing Steel.

900.2.5 Admixtures

Air-entraining admixtures, if used, shall conform to ASTM C260M, Standard Specification for Air Entraining Admixtures for Concrete. Air-entraining admixture shall conform to the requirements of AASHTO M 154, Standard Method of Test for Time of Setting of Hydraulic Cement Paste by Gillmore Needles.

Chemical Admixtures, if used, shall conform to the requirements of ASTM C494M, Standard Specification for Chemical Admixtures for Concrete or AASHTO M 194, Standard Specification for Chemical Admixtures for Concrete.

Fly Ash, if specified or permitted as a mineral admixture and not exceeding 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.

Chemical Admixture/s may be added to the concrete mix to produce some desired modifications to the properties of concrete if necessary, but not as partial replacement of

cement. If specified, monofilament polypropylene synthetic fibrin fibers, which are used as admixture to prevent the formation of temperature/shrinkage cracks and increase impact resistance of concrete slabs shall be applied in the dosage rate recommended by its manufacturer.

900.2.6 Storage of Cement and Aggregates

All cement shall be stored immediately upon delivery at the site in a 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 12 days before the cement is to be used. For a storage period of less than 60 days, stack the bags no higher than 14 layers, and for longer periods, no higher than seven (7) layers. As an additional precaution the oldest cement shall be used first. 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 retest is ordered by the Engineer. 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 (2) 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.

900.2.7 Curing Materials

Curing materials shall conform to the following requirements as specified;

1. Burlap cloth - AASHTO M 182, Standard Specification for Burlap Cloth Made from Jute or Kenaf and Cotton Mats

2. Liquid membrane forming compounds - ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

3. Sheeting (film) materials - AASHTO M 171, Standard Specification for Sheet Materials for Curing Concrete

900.2.8 Expansion Joint Materials

Expansion joint materials shall be:

1. Preformed Sponge Rubber and Cork, conforming to AASHTO M 153, Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction (ASTM D1752, Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion Joint Fillers for Concrete Paving and Structural Construction)

2. Hot-Poured Elastic Type, conforming to ASTM D6690, Standard Specification for Joint and Crack Sealants, Hot-Applied, for Concrete and Asphalt Pavement.

3. Preformed Fillers, conforming to AASHTO M 213, Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types), ASTM D994M, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type)

900.3 Construction Requirements

The notation used in these regulations is defined as follows:

fc' = compressive strength of concrete

900.3.1 Concrete Quality

All Plans submitted for approval or used for any project shall clearly show the specified strength, fc', 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 (AC 613A)."

900.3.2 Methods of Determining the Proportions of Concrete

The determination of the proportions of cement, aggregate, and water to attain the required strengths shall be made by one of the following methods:

Method 1. Without preliminary test

Where preliminary test data on the materials to be used in the concrete have not been obtained, the water-cement ratio for a given strength of concrete shall not exceed the values shown in Table 900.6. When strengths in excess of 27.58 MPa are required or when lightweight aggregates or admixtures (other than those exclusively for the purpose of air entraining) are used, the required water-cement ratio shall be determined in accordance with Method 2.

Method 2. For combination of materials previously evaluated or to be established by trial mixtures.

Water-cement ratios for strengths greater than that shown in Table 900.6 may be used provided that the relationship between strength and water-cement ratio for the materials to be used has been previously established by reliable test data and the resulting concrete satisfies the requirements of concrete quality.

Where previous data are not available. Concrete trial mixtures having proportions and consistency suitable for the work shall be made using at least three (3) different water cement ratios (or cement content in the case of lightweight aggregates) which will produce a range of strengths encompassing those required for the work. For each water-cement ratio (or cement content) at least three (3) specimens for each age to be tested shall be made, cured and tested for strength in accordance with ASTM C39M, Standard Test Method for Compressive Strength

of Cylindrical Concrete Specimen and ASTM C192, Standard Practice for Making & Curing Concrete Test Specimens in the Laboratory.

The strength test shall be made at 7, 14 and 28 days at which the concrete is to receive load, as indicated on the Plans. A graph shall be established showing the relationship between water-cement ratio (or cement content) and compressive strength. The maximum permissible water-cement ratio for the concrete to be used in the structure shall be that shown by the curve to produce an average strength to satisfy the requirements of the strength test of concrete

Where different materials are to be used for different portions of the work, each combination shall be evaluated separately.

Table 900.6 Maximum Permissible Water-Cement Ratios for Concrete (Method No. 1)

Specified compressive strength at 28 days, MPa	Maximum Permissible water-Cement ratio			
	Non-air-entrained		Air-entrained concrete	
	Liters per 40 kg bag of cement	Absolute ratio by weight	Liters per 40 kg bag of cement	Absolute ratio by weight
17.24	25.77	0.642	22.22	0.554
20.70	23.11	0.576	18.66	0.465
24.13	20.44	0.510	15.99	0.399
27.58	17.77	0.443	14.22	0.354

900.3.3 Concrete Proportions and Consistency

The proportions of aggregates 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 progresses, at least one (1) sample consisting of three (3) concrete cylinder test specimens, 150 mm x 300 mm, shall be taken from each 75 m³ of each class of concrete or fraction thereof placed each day.

Samples from which compression test specimens are molded shall be secured in accordance with ASTM C172M, Standard Practice for Sampling Freshly Mixe Concrete. 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 C31M, Standard Practice for Making and Curing Concrete Test Specimen in the Field. Additional test specimens cured entirely under field conditions may required by the Engineer to check the adequacy of curing and protection of the concrete. Strength tests shall be made in accordance with ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen.

Compliance with the requirements of this Subsection shall be determined in accordance with the following standard methods of AASHTO:

Sampling of fresh concrete :	AASHTO R 60, Standard Practice for Sampling Freshly Mixed Concrete
Weight per cubic meter : And air content (gravi- Metric) of concrete	AASHTO T 121M, Standard Method of Test for Density (unit weight), Yield, and Air Consent (Gravimetric) of Concrete
Slump of Portland : Cement Concrete	AASHTO T 119M, Standard Method Of Test For Slump of Hydraulic Cement Concrete

Test for strength shall be made in accordance with the Following:

Making and curing of concrete compressive specimen in the field	AASHTO T 23, Standard Method of test for Making and Curing Concrete Test Specimens in the Field (ASTM C31, Standard Practice for Making and Curing Concrete Test Specimens in The Field)

Compressive strength of molded concrete cylinders	AASHTO T 22, Standard Method of test for Test Method for Compressive Strength of Cylindrical Concrete Specimens (ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens)

900.3.5 Proportioning and Strength of Structural Concrete

The concrete materials shall be proportioned in accordance with the requirements for each class of concrete as specified in Table 900.7, using the absolute volume method as outlined in the American Concrete Institute (ACI) Standard 211.1, Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete. Other methods of proportioning may be employed in the mix design with prior approval of the Engineer. A change in the source of materials during the progress of work shall necessitate a new mix design.

The strength requirements for each class of concrete shall be as specified in Table 900.7.

Table 900.7 Composition and Strength of Concrete for Use in Structures

Class of Concrete	**Minimum Cement Content per m^3 40kg/(bag**)**	**Maximum Water/Cement Ratio** **Kg/kg**	**Consistency Range in Slump** **mm**	**Designated Size of Coarse Aggregate** **Square opening Std. mm**	**Minimum Compressive Strength of 150mm x 300mm Concrete Cylinder Specimen at 28 days, MN/m^2**
A	364 (9.1 bags)	0.53	50-100	37.50-4.75	20.7
B	320 (8 bags)	0.58	50-100	50.00-4.75	16.5
C	380 (9.5 bags)	0.55	50-100	12.50-4.75	20.7
P	440 (11 bags)	0.49	100 max.	19.00-4.75	37.7

Seal	380 (9.5 bags)	0.58	100-200	25.00-4.75	20.7

900.3.6 Consistency

Concrete shall have a consistency such that it will be workable in the required position and will flow around the reinforcing steel but individual particles of the coarse aggregates, when isolated, shall show a coating of mortar containing its proportionate amount of sand. The consistency of concrete shall be gauged by the ability of the equipment to properly place it and not by the difficulty in mixing and transporting concrete mix. The quantity of mixing water, which 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.

900.3.7 Strength Test of Concrete

As basis of acceptance, strength test shall generally be made with the frequency of not less than one (1) test [three (3) specimens] for each 75 m^3. Each test shall be made from a separate batch. One each day concrete is delivered, at least one (1) strength test shall be made for each class of concrete.

The age for strength tests shall be 28 days or, when specified in the Plan, the earlier age at which the concrete is to receive its full load or maximum 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.

For structures designed in accordance with the ultimate strength design method, and for prestressed structures the average of any three (3) consecutive strength test of the laboratory cured specimens representing each class of concrete shall be equal to or greater than the specified compressive strength, fc' and not more than 10% of the strength tests shall have values less than the specified strength.

When the laboratory-cured specimens failed to conform to the requirements for strength, the Engineer shall have the right to order changes in the concrete sufficient to requirements. If the cured specimen had attained the intended minimum strength requirement, the removal of forms and falseworks may take place and shall conform to the requirements of Item 903, Formworks and Falseworks. When in the opinion of the Engineer, the strengths of the job-cured specimens may not likely be achieved, the Contractor may be required to improve the procedures for protecting and curing the concrete specimen, or when test of field-cured cylinders indicate deficiencies in protection and curing, the Engineer may require test in accordance with ASTM C42M, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete or order load tests as outlined in the load tests of structures for that portion of the structure where the questionable concrete has been placed.

900.3.8 Batching

Measuring and batching of materials shall be done at a batching plant.

1. Portland Cement

Either sacked or bulk cement may be used. No fraction of a sack of cement shall be used in a batch of concrete unless the cement is weighed. All bulk cement shall be weighed on an approved weighing device. The bulk cement weighing hopper shall be properly sealed and vented to preclude dusting operation. The discharge chute shall not be suspended from the weighing hopper and shall be so arranged that cement will neither be lodged in it nor leak from it.

Accuracy of batching shall be within plus (+) or minus (-) one (1) mass percent.

2. Water

Water may be measured either by volume or by weight. The accuracy of measuring the water shall be within a range of error of not more than 1%.

3.Aggregates

Stockpiling of aggregates shall be in accordance with Subsection 900.2.6, Storage of Cement and Aggregate. All aggregates whether produced or handled by hydraulic methods or washed, shall be stockpiled or binned for draining for at least 12 hours prior to batching. Shipment requiring more than 12 hours will be accepted as adequate binning only if the car bodies permit free drainage. If the aggregates contain high or non-uniform moisture content, storage or stockpile period in excess of 12 h may be required by the Engineer.

Batching shall be conducted as to result in a two (2) mass percent maximum tolerance for the required materials.

4. Bins and Scales

The batching plant shall include separate bins for bulk cement, fine aggregate and for each size of coarse aggregate, a weighing hopper, and scales capable of determining accurately the mass of each component of the batch.

Scales shall be accurate to 0.5% throughout the range used.

5. Batching

When batches are hauled to the mixer, bulk cement shall be transported either in waterproof compartments or between the fine and coarse aggregate. When cement is placed in contact with moist aggregates, batches will be rejected unless mixed within one and 1.5 h of such contact. Sacked cement may be transported on top of the aggregates.

Batches shall be delivered to the mixer separate and intact. Each batch shall be dumped cleanly into the mixer without loss, and, when more than one (1) batch is carried on the truck, without spilling of material from one (1) batch compartment into another.

6. Admixtures

The Contractor shall follow an approved procedure for adding the specified amount of admixture to each batch and will be responsible for its uniform operation during the progress of the work. He shall provide separate scales for the admixtures which are to be proportioned by weight, and accurate measures for those to be proportioned by volume. Admixtures shall be measured into the mixer with an accuracy of plus or minus 3%.

The use of Calcium Chloride ($CaCl_2$) as an admixture will not be permitted.

900.3.9 Mixing and Delivery

Concrete may be mixed at the construction site, at a central point or by a combination of central point and truck mixing or by a combination of central point mixing and truck agitating. Mixing and delivery of concrete shall be in accordance with the appropriate requirements of AASHTO M 157, Standard Specification for Ready-Mixed Concrete except as modified in the following paragraphs of this Subsection, for truck mixing or a combination of central point and truck mixing or truck agitating. Delivery of concrete shall be regulated so that placing is at a continuous rate unless delayed by the placing operations. The intervals between deliveries of batches shall not be so great as to allow the concrete in place to harden partially, and in no case, shall such an interval exceed 30 min.

Volumetric measurement shall be used only if by weight batching plant is located more than 1 h travel from the project site. Concrete mixing, by chute is allowed provided that a weighing scales for determining the batch weight will be used.

For batch mixing at the construction site or at a central point, 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% 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 s 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 s for mixers having a capacity of 1.5 m^3 or less. For mixers having a capacity greater than 1.5 m^3, the mixing time shall not be less than 90 s. If timing starts, the instant skip reaches its maximum raised position, 4 s 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 of by the Contractor at his own expense.

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 h, further use of the mixer will be prohibited until repairs are made. Retempering concrete will not be permitted. Admixtures for increasing the workability, for retarding the set, or for accelerating the set or improving the pumping characteristics of the concrete will be permitted only when specifically provided for in the Contract, or authorized in writing by the Engineer.

Mixing Concrete: General

All concrete batching plant prior to use shall be accredited by the DPWH-Bureau of Research and Standards.

1. Mixing Concrete at Site

Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer. The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn 20 mm or more below the original height of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

When bulk cement is used and volume of the batch is 0.5 m^3 or more, the scale and weigh hopper for Portland cement shall be separated and distinct from the aggregate hopper or hoppers. The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall also be interlocked against opening when the amount of cement in the hopper is underweight by more than one (1) mass percent or overweight by more than three (3) mass percent of the amount specified.

When the aggregate contains more water than the quantity necessary to produce a saturated surface dry condition, representative samples shall be taken and the moisture content determined for each kind of aggregate.

The batch shall be so charged into the mixer that some water will enter in advance of cement and aggregate. All water shall be in the drum by the end of the first quarter of the specified mixing time.

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 of surface of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

The entire content of a batch mixer shall be removed from the drum before materials for a succeeding batch are placed therein. The materials composing a batch except water shall be deposited simultaneously into the mixer.

All concrete shall be mixed for a period of not less than 90 s after all materials, including water, are in the mixer. During the period of mixing, the mixer shall operate at the speed for which it has been designed.

Mixers shall be operated with an automatic timing device that can be locked by the Engineer. The time device and discharge mechanics shall be so interlocked that during normal operation no part of the batch will be charged until the specified mixing time has elapsed

The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand, and water to coat inside of the drum without reducing the required mortar content of the mix. When mixing is to cease for a period of 1 hour or more, the mixer shall be thoroughly cleaned.

2. Mixing Concrete at Central Plant

Mixing at central plant shall conform to the requirements for mixing concrete at site.

3. Mixing Concrete in Truck

Truck mixers, unless otherwise authorized by the Engineer, shall be of the 3) ma revolving drum type, water-tight, and so constructed that the concrete can be mixed to insure a uniform distribution of materials throughout the mass. All solid materials for the concrete shall be accurately measured and charged into the drum at the proportioning plant. Except as subsequently provided, the truck mixer shall be equipped with a device by which the quantity of water added can be readily verified. The mixing water may be added directly to the batch, in which case a tank is not required. Truck mixers may be required to be provided with a means of which the mixing time can be readily verified by the Engineer.

The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacturer and stamped in metal on the mixer. Truck mixing, shall, unless otherwise directed be continued for not less than 100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

Mixing shall begin within 30 min after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface wet aggregate and when the temperature is above 32 °C, this limit shall be reduced to 15 min. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the judgement of the Engineer, the aggregate is sufficiently free from moisture, so that there will be no harmful effects on the cement.

When a truck mixer is used for transportation, the mixing time specified herein at a stationary mixer may be reduced to 30 s and the mixing completed in a truck mixer. The mixing time in the truck mixer shall be as specified for truck mixing.

4. Transporting and Delivery of Mixed Concrete

Mixed concrete may only be transported to the delivery point in truck agitators or truck mixers operating at the speed designated by the manufacturers of the equipment as agitating speed, or in non-agitating hauling equipment, provided the consistency and workability of the mixed concrete upon discharge at the delivery point is suitable point for adequate placement and consolidation in place.

Truck agitators shall be loaded not to exceed the manufacturer's guaranteed capacity. They shall maintain the mixed concrete in a thoroughly mixed and uniform mass during hauling.

No additional mixing water shall be incorporated into the concrete during hauling or after arrival at the delivery point.

The rate of discharge of mixed concrete from truck mixers or agitators shall be controlled by the speed of rotation of the drum in the discharge direction with the discharge gate fully open.

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within 1 h, or before 250 revolutions of the drum or blades, whichever comes first, after the introduction of the cement to the aggregates. Under conditions contributing to quick stiffening of the concrete or when the temperature of the concrete is 30°C, or above, a time less than 1 h will be required.

The maximum temperature of concrete produced with heated aggregates, heated water, or both, shall at no time during its production or transportation exceed 32°C.

The Contractor shall have sufficient plant capacity and transportation apparatus to insure continuous delivery at the rate required. The rate of delivery of concrete during concreting operations shall be such as to provide for the proper handling, placing and finishing of the concrete. The rate shall be such that the interval between batches shall not exceed 20 min. The methods of delivering and handling the concrete shall be such as that will facilitate placing of the minimum handling.

900.3.10 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.

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 so as 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.

Open troughs and chutes shall be of metal lined; where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths tha reverse the direction of movement to avoid segregation.

All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

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.

900.3.10.1 Placing Concrete by Pneumatic Means

The equipment shall be so arranged that vibration will not damage freshly placed concrete. The capacity of equipment shall be 0.30 to 1.00 m^3.

Where concrete is conveyed and placed by pneumatic means, the equipment shall be suitable in kind and adequate in capacity for the work. The machine shall be located as close as practicable to the work. The discharge lines shall be horizontal or inclined upwards from the machine. The discharge end of the line shall not be more than 3 m from the point of deposit.

At the conclusion of placing the concrete, the entire equipment shall be thoroughly cleaned.

900.3.10.2 Placing of Concrete by Pumping

The equipment shall be so arranged that vibration will not damage freshly placed concrete. The discharge capacity of the equipment shall be 1.5 to 10.0 m^3/h. The minimum pressure capacity of the equipment shall be 0.60 MPa.

Where concrete is conveyed and placed by mechanically applied pressure the equipment shall be suitable in kind and adequate in capacity for the work. The operation of the pump shall be such that a continuous stream of concrete without air pockets is produced. When pumping is completed, the concrete remaining in the pipeline, if it is to be used, shall be ejected in such a manner that there will be no contamination of the concrete or separation of the ingredients. After this operation, the entire equipment shall be thoroughly cleaned.

900.3.10.3 Placing Concrete in Water

Concrete deposited in water shall be Class Seal concrete with a minimum cement content of 380 kg/m^3 of concrete. The slump of the concrete shall be maintained between 4 and 8 cm, whichever is called for in the Bill of Quantities. To prevent segregation, concrete shall be carefully placed in a compact mass, in its final position, by means of a tremie, a bottom-dump bucket, or other approved means, and shall not be disturbed after being placed.

A tremie shall consist of a tube having a diameter of not less than 250 mm constructed in sections having flanged couplings fitted with gaskets with a hopper at the top. The tremie shall be supported so as to permit free movement of the discharge and over the entire top surface of the work and so as to permit rapid lowering when necessary to retard or stop the flow of concrete. The discharge end shall be closed at the start of work so as to prevent water entering the tube and shall be completely submerged in concrete at all times. The tremie tube shall be kept full to the bottom of the hopper. When a batch is dumped into the hopper, the flow of concrete shall be induced by lightly raising the discharge end, but always keeping it in the placed concrete. The flow shall be continuous until the work is completed.

When the concrete is placed with a bottom-dump bucket, the top of the bucket shall be open. The bottom doors shall open freely downward and outward when tripped. The buckets shall be completely filled and slowly lowered to avoid backwash. It shall not be dumped until it rests on the surface upon which the concrete is to be deposited and when discharged shall be withdrawn slowly until well above the concrete.

900.3.11 Consolidation of Concrete

The consolidation method should be compatible with the concrete mixture, placing conditions, and degree of air removal desired. When concrete comes down the chute and flows into forms

it carries entrapped air. The entrapped air shall be removed to prevent voids in concrete. Poorly consolidated concrete will be weak, porous and poorly bonded to the reinforcement.

Poured concrete shall be immediately and thoroughly consolidated. 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 consolidated before the Each layer shall be preceding layer has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the layers. consolidated so as to avoid the formation of a construction joint with a preceding layer.

The consolidation shall be done by mechanical vibration. The concrete shall be vibrated internally unless special authorization of other methods is given or is provided herein. The intensity of vibration shall be such as to visibly affect a mass of concrete with a 3 cm slump over a radius of at least 50 cm. A sufficient number of vibrator shall be provided to properly consolidate each batch immediately after it is placed in the forms. Vibrators shall be manipulated so as to thoroughly work the concrete around the reinforcement and embedded fixtures and into the corners and angles of the forms and shall be applied at the point of placing and in the area of freely placed concrete. The vibrators shall be inserted into and withdrawn from the concrete slowly. The diameter of the steel tube called poker depends on the spacing between the reinforcing bars in the form-work. In no case shall the vibrator be operated longer than 15 s in any one location. The vibration shall be of sufficient duration and intensity to consolidate the concrete thoroughly but shall not be continued so as to cause segregation and at any one point to the extent that localized areas of grout are formed. Application of vibrators shall be at points uniformly spaced, and not farther apart than twice the radius over which the vibration is visibly effective. Vibration shall not be applied directly or thru the reinforcement to sections or layers of concrete that have hardened to the degree that the concrete ceases to be plastic under vibration. It shall not be used to make concrete flow in the forms over distances so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms of troughs or chutes.

900.3.12 Concrete Surface Finishing: General

900.3.12.1 Float Finish

Surface shall be consolidated with power-driven floats or by hand floating. Surfaces shall be left uniform, smooth and granular texture.

Float finish shall be applied to the surfaces indicated, to surfaces to receive trowel finish, and to floor and slab surfaces to be covered with fluid-applied or sheet waterproofing, built-up or membrane roofing, or sand-bed terrazzo.

900.3.12.2 Trowel Finish

After applying float finish, trowel shall be applied first then concrete shall be consolidated by hand or power-driven trowel. Continue troweling passes and restraigthen until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coating or floor coverings.

900.3.12.3 Concrete Rubbed Finish

After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Allow the concrete to cure before the final rubbing with a fine carborundum stone and water. The concrete shall be kept damp while rubbing. This rubbing shall be continued until the entire surface is of smooth texture and uniform color.

After the final rubbing is completed and the surface has dried, it should be rubbed with burlap to remove loose powder and shall be left free from all unsound patches, paste, powder and objectionable marks. Surface coating of cementitious material which adds thickness to the original surface is not acceptable.

900.3.13 Curing Concrete

900.3.12.1

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

1. Water Method

The concrete shall be kept continuously wet by the application of water for a minimum period of 7 days after the concrete has been placed. The entire surface of the concrete shall be kept damp by applying water with an atomizing nozzle. Cotton mats, rugs, carpets, or earth or sand blankets may be used to retain the moisture. At the expiration of the curing period the concrete surface shall be cleared of the curing medium.

2. Curing Compound

Surfaces exposed to the air may be cured by the application of an impervious membrane if approved by the Engineer.

The membrane forming compound used shall be practically colorless liquid. The use of any membrane-forming compound that will alter the natural color of the concrete or impart a slippery surface to any wearing surface shall be prohibited. The compound shall be applied with a pressure spray in such a manner as to cover the entire concrete surface with a uniform film and shall be of such character that it will harden within 30 min after application. The amount of compound applied shall be ample to seal the surface of the concrete thoroughly. Power-operated spraying equipment shall be equipped with an operational pressure gauge and means of controlling the pressure.

The curing compound shall be applied to the concrete following the surface finishing operation immediately after the moisture sheen begins to disappear from the surface, but before any drying shrinkage or craze cracks begin to appear. In the event of any delay, in the application of the curing compound, which results in any drying or cracking of the surface, application of water with an atomizing nozzle as specified under "Water Method", shall be started immediately and shall be continued until the application of the compound is resumed or started, however, the compound shall not be applied over any resulting free-standing water. Should the film of compound be damaged from any cause before the expiration of 7 days after the concrete is placed in the case of structures, the damaged portion shall be repaired immediately with additional compound.

Curing compound shall not be diluted or altered in any manner after manufacture. At the time of use, the compound shall be in a thoroughly mixed condition. If the compound has not been

used within 120 days after the date of manufacture, the Engineer may require additional testing before the use to determine compliance to requirements.

An anti-setting agent or a combination of anti-setting agents shall be incorporated in the curing compound to prevent caking.

The curing compound shall be packaged in clean barrels or steel containers or shall be supplied from a suitable storage tank located on the site. Storage tank shall have a permanent system designed to completely redisperse any settled material without introducing air or any other foreign substance. Containers shall be well-sealed with ring seals and lug type crimp lids. The linings of the containers shall be of a character that will resist the solvent of the curing compound. Each container shall be labeled with a manufacturer's name, specification number, batch number, capacity and date of manufacture, and shall have label warning concerning flammability. The label shall also warn that the curing compound shall be well-stirred before use. When the curing compound is shipped in tanks or tank trunks, a shipping invoice and Material Safety Data Sheet (MSDS) shall accompany each load. The invoice and MSDS shall contain the same information as that required herein for container labels.

Curing compound may be sampled by the Engineer at the source of supply and/or on the site.

3. Waterproof Membrane Metho

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 h.

Waterproof paper and plastic sheeting shall conform to the specification of AASHTO M 171, Standard Specification for Sheet Materials for Curing Concrete.

The waterproof paper or plastic sheeting shall be formed into sheets of such width as to cover completely the entire concrete surface.

All joints in the sheets shall be securely fastened together in such a manner asto provide a waterproof joint. The joint seams shall have a minimum lap of 100 mm.

The sheets shall be securely weighed down by placing a bank of earth materials on the edges of the sheets or by other means satisfactory to the Engineer.

Should any portion of the sheets be broken or damaged within 72 h after being placed, the broken or damaged portions shall be immediately repaired with new sheets properly fastened in place.

Sections of membrane which have lost their waterproof qualities or have been damaged to such an extent as to render them unfit for curing the concrete shall not be used

4. Forms-in-Place Method

Formed surfaces of concrete may be cured by retaining the form-in-place. The forms shall remain in place for a minimum period of 7 days after the concrete has been placed, except that for members over 50 cm in least dimensions, the forms shall remain in place for a minimum period of 5 days. Wooden forms shall be kept wet by watering during the curing period.

5. Steam Curing Method

Steam curing for pre-cast members shall conform to the following provisions:

a. After placement of the concrete, members shall be held for a minimum 4 h pre-steaming period.

b. To prevent moisture loss on exposed surfaces during the pre-steaming period, members shall be covered immediately after casting or the exposed surface shall be kept wet by fog spray or wet blankets.

c. Enclosures for steam curing shall allow free circulation of steam about the member and shall be constructed to contain the live steam with a minimum moisture loss. The use of tarpaulins or similar flexible covers will be permitted, provided they are kept in good condition and secured in such a manner to prevent the loss of steam and moisture.

d. Steam at jets shall be low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 20°C per hour. The curing temperature throughout the enclosure shall not exceed 65 °C and shall be maintained at a constant level for a sufficient time necessary to develop the required compressive strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature of the enclosure will be the same as that of the concrete.

e. Temperature recording devices that will provide an accurate continuous permanent record of the curing temperature shall be provided. A minimum of one (1) temperature recording device per 50 m of continuous bed length will be required for checking temperature.

f. Curing of pre-cast concrete will be considered completed after the termination of the steam curing cycle.

900.3.13.2

The application for curing method shall be one or more of the following:

1. Curing Cast-In-Situ Concrete

All newly placed concrete for cast-in-situ structures, shall either be cured by the water method, the forms-in-place method, or as permitted herein, by the curing compound method, all in accordance with the requirements of Subsection 900.3.13, Curing Concrete.

The curing compound method may be used on concrete surfaces which are to be buried under ground and surfaces where only Ordinary Surface Finish is to be applied and on which a uniform color is not required, and which will not be visible from public view.

When deemed necessary by the Engineer during periods of hot weather, water shall be applied to concrete surface being cured by the curing compound method or by the forms-in-place method until the Engineer determine that a cooling effect is no longer required.

2. Curing Pre-Cast Concrete (except piles)

Pre-cast concrete members shall be cured for not less than 7 days by the water method, Subsection 900.3.13 (1), Water Method or by steam curing, Subsection 900.3.13 (5), Steam Curing Method.

3. Curing Pre-cast Concrete Piles

All newly placed concrete for pre-cast concrete piles, conventionally reinforced or prestressed shall be cured by the "Water Method" as described in Subsection 900.3.11, Curing Concrete, except that the concrete shall be kept under moisture for at least 14 days. At the option of the Contractor, steam curing may be used in which case the steam curing provisions of Subsection 900.3.13(5), Steam Curing Method shall apply except that the concrete shall be kept wet for at least 7 days including the holding and steaming period.

900.3.14 Acceptance of Concrete

The strength of concrete shall be deemed acceptable if the average of three (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 the 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 T 24, Standard Method of Test for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete (ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete. 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.

900.4 Method of Measurement

The quantity of concrete to be paid shall be the number of cubic meters placed and accepted in the completed structure. No deduction will be made for the volume occupied by the pipe less than 101 mm outside diameter nor for reinforcing steel, anchors, weephole(s) or expansion materials.

900.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 900.4, Method of Measurement shall be paid for at the Contract Unit Price for each of pay item listed below that is included in the Bill of Quantities of structural concrete and/or reinforced concrete completed in place will be paid for at the contract unit price for cubic meter as indicated on the Bid Schedul

Payment shall be made under:

Pay Item Number	Description	Unit of Measurements

900(1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter

ITEM 902- REINFORCING STEEL

902.1 Description

This Item shall consist of furnishing, cutting, bending, fabricating, welding, and placing of steel reinforcement with or without epoxy coating of the type, size, shape and grade required in accordance with this Specification and in conformity with the requirements shown on the Plans.

902.2 Material Requirements

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

Table 902.1 Reinforcing Steel Bars Requirements

Type of Reinforcing Steel	Specification
Deformed Billet Steel Bars for Concrete Reinforcement	AASHTO M 31M, Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
	ASTM A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
	PNS 49, Philippine National Standard, Steel Bars for Concrete Reinforcement - Specification

Deformed Steel Wire for Concrete Reinforcement	AASHTO M 336M, Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement (ASTM A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete)
Welded Steel Wire Fabric for Concrete Reinforcement	ASTM A1064M Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete
Cold-Drawn Steel Wire for Concrete Reinforcement	AASHTO M 336M, Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement (ASTM A1064M, Standard Specification for Carbon-Stee Wire and Welded Wire Reinforcement, Plain and Deformed for Concrete)
Fabricated Steel Bar or Rod Mats for Concrete Reinforcement	AASHTO M 54M, Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement (ASTM A184M, Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement)
Welded Deformed Steel Wire Fabric of Concrete Reinforcement	AASHTO M 336M, Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement (ASTM 1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete)
Plastic Coated Dowel Bars	AASHTO M 254M, Standard Specification for Corrosion Resistant Coated Dowel Bars Type A

Low Alloy Steel Deformed Bars for Concrete Reinforcement	ASTM A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
Deformed Rail - Steel and Plain Bars for Concrete Reinforcement	ASTM A996M, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

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

Dowel and tie bars shall conform to the requirements of AASHTO M 31 (ASTM A615)/PNS 49 except that rail steel shall not be used for tie bars that are to be bent and restraightened 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 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, 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 from the end of the dowel bar. Sleeves shall be of such design that they do not collapse during construction.

Plastic coated dowel bar conforming to AASHTO M 254M may be used.

902.2.1 Wire Rope or Wire Cable

The wire rope or wire cable shall conform to the requirements of AASHTO M 30, Standard Specification for Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail for the specified diameter and strength class.

902.2.2 Prestressing Reinforcing Steel

Prestressing reinforcing steel shall conform to the requirements of the following Specifications:

High-tensile wire	AASHTO M 204M, Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete ASTM A421M, Standard Specification for Stress-Relieved Steel Wire for Prestressed Concrete
High-tensile wire	AASHTO M 203 M, Standard Specification strand or rope for Steel Strand, Uncoated Seven-Wire for Concrete

Reinforcement ASTM A416M, Standard Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concrete

High-tensile-strength alloy bars shall be cold stretched to a minimum of 895.7 MPa. The resultant physical properties shall be as follows:

Table 902.2 Resultant Physical Properties of High Tensile Strength Alloy Bars

Physical Property	Requirement
Minimum ultimate tensile strength	1000 MPa followed by stress relieving
Minimum yield strength, measured by the 0.7% extension under load method	895.7 MPa
Minimum modulus of Elasticity	25000000
Minimum elongation in 20 bar diameters after rupture	4%
Diameters tolerance	0.254 mm. to 0.762 mm.

If shown on the Plans, Type 270 k strand shall be used, conforming to AASHTO M 203M

Where strands are to be used for post-tensioning, the same shall be cold-drawn and either stress-relieved in the case of uncoated strands, or hot-dip galvanized in the case of galvanized strands.

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

Table 902.3 Minimum Requirements for High Strength Alloy Steel Bar for Post-Tensioning

Property	Requirement

Tensile Strength fs’	1000 MPa
Yield Strength (0.2 offset)	0.90 fs’
Elongation at Rupture in 20 diameter	4%
Reduction of Area at Rupture	25%

902.2.3 Epoxy Coated Reinforcing Steel Bars

Epoxy coated reinforcing steel bars shall be applied with protective epoxy coating by the electrostatic spray method to strengthen the concrete and protect against corrosive conditions that will be exposed to the aggressive elements.

Epoxy coated reinforcing steel bars shall conform to ASTM A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Steel Bars for steel bars coated in straight condition and then bent, and ASTM A934M, Standard Specification for Epoxy-Coated Prefabricated Steel Bars for steel bars that are bent prior to coating.

The powder coating shall be of organic composition except for the pigment which may be inorganic if used.

The following kinds of reinforcing steel bars are allowed to be applied with epoxy coating.

Table 902.4 Kinds of Reinforcing Steel Bars are allowed to be applied with epoxy coating

Reinforcing Steel	Standard Designation
Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement	ASTM A615/AASHTO M 31
Low Alloy Steel Deformed and Plain Bars for Concrete Reinforcement	ASTM A706

Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement	ASTM A996/AASHTO M 322

902.2.3.1 Surface Preparation

The surface of the steel reinforcing bars to be coated shall be cleaned by abrasive blast cleaning to a near white metal. It is recommended that reinforcing steel bars and blast media be checked for contamination by any foreign materials and oil impurities prior to use. Blast media found to be salt contaminated should be rejected. Reinforcing steel bars and blast media found to be contaminated shall be rejected or washed cleaned prior to heating thru the use of methods suitable to remove the contamination.

Manufacturers shall be permitted to use a chemical wash or blast-cleaned steel reinforcing bar surface, or both, to enhance coating adhesion. This pretreatment shall be applied after abrasive cleaning and before epoxy coating, in accordance with the written application instructions specified by the pretreatment manufacturer.

902.2.3.2 Coating Application

If pretreatment is used in the preparation of the surface, the powder coating shall be applied to the cleaned and pretreated steel reinforcing bar surface as soon as possible after surface treatments have been completed, and before visible oxidation of the surface occurs as discernible to a person with normal or corrected vision. In no case shall application of the coating be delayed more than 3 hours after cleaning.

The fusion-bonded epoxy powder coating shall be applied in accordance with the written recommendations of the manufacturer of the powder coating for initial surface temperature range and post application curing requirements. During continuous operations, the temperature of the surface immediately prior to coating shall be measured using infrared guns or temperature indicating crayons, or both, at least once every 30 minutes. The powder coating shall be applied by electrostatic spray or other suitable method.

902.2.3.3 Curing

Following powder application, the coating is allowed to cure at approximately 30 seconds during which time it hardens to a solid. In some plants, the curing is often followed by an air or water quench that quickly reduces the bar temperature to facilitate handling.

902.2.3.4 Requirements for Epoxy-Coated Reinforcing Steel Bars

1. Coating Thickness

For acceptance purpose, at least 90% of all recorded thickness measurements of the coating after curing shall be 175 um to 300 µm. Thickness measurements below 125 µm shall be

considered cause for rejection. The upper thickness limit does not apply to repaired areas of damaged coating.

A single recorded coated reinforcing steel bar thickness measurement is the average of three (3) individual gauge readings obtained between four (4) consecutive deformations. A minimum of five (5) recorded measurements shall be obtained approximately evenly spaced along each side of the test bar (a minimum of ten (10) recorded measurements per bar).

The coating thickness shall be measured on the body of a straight length of reinforcing steel bar between the deformations.

2. Coating Continuity

Holiday checks to determine the acceptability of the reinforcing steel bars prior to shipment shall be made at the manufacturer's plant with a 67.5 V, 80,000 2, wet-sponge type direct-current holiday detector or equivalent method.

On average, there shall not be more than three (3) holidays per meter on a coated steel reinforcing bar. The average applies to the full production length of a bar.

A wetting agent shall be used as per applicable requirements of Test Method of ASTM G62, Standard Test Methods for Holiday Detection in Pipeline Coatings in the inspection for holidays on the coated steel reinforcing bars.

3. Coating Flexibility

a. The coating flexibility shall be evaluated by bending production coated reinforcing steel bars at a uniform rate around a mandrel of specified size within a maximum specified time as prescribed in the applicable requirements of bend test requirements of ASTM A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars. The two (2) longitudinal ribs shall be placed in a plane perpendicular to the mandrel radius. The test specimen shall be between 20° C and 30° C.

b. No cracking or disbonding of the coating shall be visible to the unaided eye on the outside radius of the bent bar. Evidence of cracking or disbanding of the coating shall be considered cause for rejection of the coated reinforcing steel bars represented by the bend test sample.

c. Fracture or partial failure of the reinforcing steel bar, or cracking or disbonding caused by imperfections in the bar surface visible after performing the bend test shall not be considered a flexibility failure of the coating, but shall require testing two (2) additional specimens. These two (2) specimens shall then meet the requirements of (b).

d. The requirements for coated reinforcing steel bars shall be met at the manufacturer's plant prior to shipment.

902.3 Construction Requirements

902.3.1 Order Lists

Before materials are ordered, all order lists and bending diagrams shall be furnished by the Contractor, for approval of the Engineer. The approval of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Any expense incident to the revisions of materials furnished in accordance with such lists and diagrams to make them comply with the Plans shall be borne by the Contractor..

902.3.2 Protection of Material

1. Steel Reinforcement

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.

2. Epoxy-Coated Reinforcing Steel Bars

a. Epoxy coated steel stored at the site shall be placed on timber sills suitably spaced so that no steel shall be laid upon or come in contact with the ground and elevated sufficiently to prevent sags in the bundles and from workers walking on the steel.

b. If rainy or exceptionally humid weather occurs or is anticipated, bars shall be stored under cover immediately upon delivery to site. Epoxy bars shall be covered with polyethylene or other materials to prevent exposure to direct sunlight.

c. Reinforcement steel bars shall be handled and stored in manner to prevent damage to bars or the epoxy coating.

d. Coated reinforcing steel bars, whether individual bars or bundles of bars of both, shall be covered with opaque polyethylene sheeting or other suitable opaque protective material. For stacked bundles, the protective covering shall be draped around the perimeter of the stack. The covering shall be secured adequately, and allow for air circulation around the bars to minimize condensation under the covering.

e. All systems for handling the epoxy coated bars shall have padded contact areas to eliminate damage

f. All bundling bands shall be padded or suitable banding shall be used to prevent damage to the coating. All bundles of coated reinforcing steel bars shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge to prevent bar to bar abrasion from sags in the bundles of coated reinforcing steel bars.

902.3.3 Bending

All reinforcing bars requiring bending shall be cold-bent to the shapes shown on the Plans. Bars shall be bent around a circular pin having the following diameters (D) in relation to the nominal diameter of the bar (d) as shown in Table 902.5.

Table 902.5 Pin Diameter for Bending Bars

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.

902.3.4 Placing and Fastening

All steel reinforcement shall be accurately placed in the position shown on the Plans 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 300 mm in each direction, 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 6 mm. 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 orbrick, metal pipe and wooden blocks shall not be permitted. Unless otherwise shown on the Plans or as required by the Engineer, the minimum distance between bars shall be 40 mm. Reinforcement in any member shall be placed and then inspected and approved by the Engineer before the placing of concrete begins. Concrete reinforcement placed in violation of this provision shall be rejected and removal shall be required unless otherwise structural integrity of the structure was proved adequate by the Contractor in writing and approved by the Engineer. If fabric reinforcement is shipped in rolls, it shall be straightened before being placed. Bundled bars shall be tied together at not more than 1.80 m intervals.

902.3.5 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.

Bars shall be lapped in accordance to Table 902.6.

Table 902.6 Bars Minimum Lap Distance

Splice Type	Grade 280 (40)	Grade 420 (60)	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 1 1/3 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. Spiral reinforcement shall be spliced by lapping at least 1 ½ turns or by butt welding unless otherwise shown on the Plans. Splicing shall conform to the following requirements unless otherwise shown on the Plans.

1. Lap splices shall not be permitted for bars larger than 36 mm diam.

2. For contact lap splices, minimum clear spacing between the contact lap splice and adjacent splices or bars shall be in accordance with the requirements below.

a. For parallel non-prestresed reinforcement in a horizontal layer, clear spacing shall be at least the greatest of 50 mm, nominal diameter of bar (db) and (4/3) nominal maximum size of coarse aggregates (dagg).

3. For non-contact splices in flexural members, the transverse center-to-center spacing of spliced bars shall not exceed the lesser of one-fifth the required lap splice length and 150 mm.

4. Lap splices of bundled bars shall be in accordance with the requirements below.

a. Lap splices of bars in the bundle shall be based on the lap splice length required for the individual bars within the bundle.
b. Individual bar splices within a bundle shall not overlap.
c. Entire bundles shall not be lap spliced.

902.3.6 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 (1) mesh in width.

902.3.7 Welding

Welding of reinforcing steel bars shall conform to American Welding Society, AWS D1.4M, Structural Welding Code - Reinforcing Steel.

For steel bars conforming to ASTM A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement the bars can be welded without preheating.

Steel bars conforming to ASTM A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement shall be preheated to 260°C.

After completion of welding on epoxy-coated bars, the damaged areas shall be repaired using patch materials conforming to ASTM A47M, Standard Specification for Ferritic Malleable Iron Castings.

902.4 Method of Measurement

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

902.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 902.4, Method of Measurement shall be paid for at the Contract Unit Price for reinforcing stee 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 shall be made under:

Pay Item Number	Description	Unit of measurement
902 (1) a1	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 903- FORMWORKS AND FALSEWORKS

903.1 Description

This Item covers the furnishing, fabrication, installation, erection, and removal of forms and falseworks for cast-in-place concrete.

903.2 Material Requirements

Forms shall be constructed with metal or timber. For timber forms, it is important that the moisture content of the timber that will be used to make the formwork in between 15% to 20%. Low moisture content means the timber is very dry thus it can absorb moisture from the wet concrete resulting to swelling and bulging of timber and weak hardened concrete. Use of tough resin as wood coating is the treatment used to overcome the moisture problem in timber formworks though painting the wood with varnish is an alternative cheaper treatment. Forms for surfaces which will be exposed to view when construction is completed shall be prefabricated plywood panel forms, job-built plywood forms, or forms that are lined with plywood or fiber board.

For metal forms, it is important that the metal used as sheating should be free from rust and nonreactive to concrete or concrete containing calcium oxide. Plywood or lined forms will not be required for surfaces which are normally submerged or not ordinarily exposed to view. Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not restricted to plywood or lined forms, and may be used as backing for form linings. Forms are required above all extended footings.

903.3 Construction Requirements

903.3.1 General

Forms shall be furnished, fabricated, installed, erected, and removed as specified herein and shall be of a type, size, shape, quality and strength to produce hardened concrete having the shape, lines and dimensions indicated on the drawings. The forms shall be true to line and grade in accordance with the tolerances as specified for cast-in-place concrete and shall be mortar tight and sufficiently rigid to resist deflection during concrete placement. The surfaces of forms shall be smooth and free from irregularities, dents, sags, and holes that would deface the finished surfaces.

The minimum thickness used for metal forms shall be 2.5 mm or 3 mm thickor of such thickness that the forms remain true to shape. For timber formworks plywood is used for sheating with a minimum thickness of 18 mm to 25 mm though the thickness of the plywood to be used will depend on the pressure that the wet concrete will put on the formwork. The design of formwork will specify the thickness of the plywood that will be incorporated in the project. All tie bars with bolts used in fastening forms should be countersunk to a depth similar to the required concrete covering and patched with cement mortar. The use of approved internal steel ties or steel or plastic spacers shall be permitted The fabricated spacer blocks shall have an embedded No. 16 G.I. Tie Wire with sufficient length to be attached to the reinforcing steel bars to hold the spacers in place after closure of forms and during pouring. Structural steel tubes used as support for forms shall have a minimum wall thickness of 4 mm.

The design and construction of the formworks and falseworks shall be the responsibility of the Contractor and for approval of the Engineer. The Contractor shall employ competent professional engineering services to design forms to be approved by the Engineer and supervise the erection of all formworks needed for the completion of the project. All materials to be incorporated to the site shall be inspected and approved by the Engineer.

903.3.2 Fabrication and Erection

Formworks to be used shall conform to ACI 347 Guide to Formwork for Concrete. Forms shall be substantial and sufficiently tight to prevent leakage of mortar. Forms shall be braced or tied to maintain the desired position, shape, and alignment during and after concrete placement. Walers, studs, internal ties, and other form supports shall be sized and spaced so that proper working stresses are not exceeded. Joints in forms shall be bolted tightly and shall bear on solid construction. Forms shall be constructed so they can be removed without hammering, wedging, or prying against the concrete. Form ties shall be approved by the Engineer and shall be of the snap cone or she-bolt with cone type. The spacing of form ties shall be designed to withstand concrete pressures without bulging, spreading, or lifting of the forms. The forms shall produce finished surfaces that are free from off-sets, ridges, waves, and concave of convex areas.

Forms to be reused shall be thoroughly cleaned and repaired. Split, frayed, delaminated, or otherwise damaged forms shall not be used. All form panels shall be placed in a neat, symmetrical pattern with level and continuous horizontal joints. The Contractor shall place special attention on mating forms to previously placed walls so as to minimize steps or rough transitions. Form panels shall be of the largest practical size to minimize joints and to improve rigidity which is to be designed by the formworks engineer of the Contractor. For engineered wood, available panels sizes of 1.20 m x 2.70 m and 3.00 m x 2.40 m can be ordered. Beams and slabs supported by concrete columns shall be formed in a way that the column forms can be removed without disturbing the supports of the beams or slabs.

Wherever the top of a wall will be exposed to weathering, the forms on at least one side shall not extend above the top of the wall and shall be brought to true line and grade. At other locations, forms for concrete which is to be finished to a specified elevation, slope, or contour, shall be brought to a true line and grade, or a wooden guide strip shall be provided at the proper location on the forms so that the top surface can be finished with a screed or template. At horizontal construction joints in walls, the forms on one side shall not extend more than 7 m above the joints.

When necessary, temporary openings shall be provided at the bottom of column and wall forms and at other points in order to facilitate cleaning and inspection prior to concrete placement. Unless otherwise shown on the drawings, all salient corners and edges of beams, columns, walls, slabs, and curbs shall be provided with a 25 mm x 25 mm chamfer formed by a wood or metal chamfer strip.

Forms for exposed surfaces and all steel forms shall be coated with non-staining form release agent which shall be applied just prior to placement of steel reinforcement. After coating with industrial lubricants such as form oil, any surplus form release coating on the form surface shall be removed. Wood forms for unexposed surfaces may be thoroughly wetted with water in lieu of coating with industrial lubricant immediately before concrete placement, except in freezing weather form release coating shall be used. Should misalignment of forms or screeds, excessive deflection of forms, or displacement of reinforcement occur during concrete placement, immediate corrective measure shall be taken to ensure acceptable lines and surface to required

dimensions and cross sections. If any forms bulge or show excessive deflection, in the opinion of the Engineer, the concrete shall be removed and the forms shall be rebuilt and strengthened.

903.3.2.1 Foundations for Formwork

Proper foundations on ground, such as mudsills, spread footings, or pile footings should be provided. If soil under mudsills is or may become incapable d supporting superimposed loads without appreciable settlement, it should be stabilized or other means of support should be provided.

903.3.3 Safety

Forms must be strong and sound (made of good quality and durable materials in order to carry the full load and side pressure from freshly placed concrete To ensure that forms are safe, correctly designed and strong enough for the expected load, Occupational Safety and Health Administration (OSHA) regulations under Section 1926.703 Safety and Health Regulations for Construction, American Concrete Institute 347 (ACI 347) - Guide to Formwork recommendations under Section 3.1 Safety Precautions in Construction and Section 3.2 Construction Practices and Workmanship, and local code requirements for formwork should be followed.

903.3.4 Delivery, Storage, Maintenance and Handling

Any formwork with steel components should be stored in a dry place. Avoid direct sunlight on timber forms. Store form materials and accessories above ground with a minimum height of 100 mm on framework or blocking without twist or bend, and shall be covered with a suitable waterproof of covering providing adequate air circulation and free from dirt. Store and handle form coating to prevent contamination in accordance with manufacturer's recommendation. For maintenance of the forms, use stiff brush and clean water for the cleaning of forms. Use scrapers only as a last resort for maintenance purposes. Keep forms well-oiled to prevent delamination of plywood or rusting of steel and always oil the edges.

903.3.5 Removal of Forms

Forms, falseworks and centering shall not be removed or disturbed until the concrete has attained sufficient strength to safely support all dead and live loads, or until the concrete has attained the minimum percentage of specified design strength listed in the Table below. Shoring beneath beams or slabs shall be left in place and reinforced as necessary to carry any construction equipment or materials placed thereon.

No forms shall be removed without the approval of the Engineer. In general and under normal conditions, the Engineer will approve removal of forms after the following time has elapsed:

Description of Structural Member	Period of time (days)	Minimum % of Deign Strength
Walls, column and vertical sides of beams	1-2	70%

Beam soffits (steel formwork props/shoring left under)	7	80%
Soffits of slab (steel formwork props/shoring left under)	7	70%
Removal of sheet formwork props/shoring to slab: Soffits of slab, for slabs spanning up to 4.5 m.	7	70%
Removal of sheet formwork props/shoring to slab: Soffits of slab, for slabs spanning over to 4.5 m.	14	70%
Removal of sheet formwork props/shoring to beams and arches: Centering under girders, beam frames and arches spanning up to 6.0 m	14	80%
Removal of sheet formwork props/shoring to beams and arches: Centering under girders, beam frames and arches spanning over to 6.0 m	21	80%

Order and method of removing formwork:

1. Shuttering forming the vertical faces of walls, beams and columns sides shall be removed first as they bear no load but only retain the concrete.

2. Shuttering forming soffit of slabs shall be removed next.

3. Shuttering forming soffit of beams, girders or other heavily loaded shuttering shall be removed in the end.

Care shall be taken into consideration during form removal to avoid surface gouging, corner or edge breakage, or other damage to the concrete. Immediately after form removal, any damaged or imperfect work shall be repaired as specified by the Engineer.

903.3.5.1 Removal of Forms for Special Structures

In continuous structures, support should not be released in any span until the first and second adjoining spans on each side have reached the specified strength. For prestressed concrete construction, pre-tensioning and post tensioning of strands, cables or rods can be done with or without side forms of the member in place. Bottom forms and supporting shores or falsework should remain in place until the member is capable of supporting its dead load and anticipated construction loads, as well as any formwork carried by the member Side forms that remain in place during the transfer of pre-stressing force should be designed to allow for vertical and

horizontal movements of the cast member during the prestressing operation. In I cases, the deflections of members due to pre-stressing force and the elastic deformation of forms or falsework should be considered in the design and removal of the forms. For reasons of safety, when using post-tensioned, cast-in-place elevated slabs, the Contractor should be careful to ensure that supporting shores do not fall out due to lifting of the slab during tensioning. For large structures where the dead load of the member remains on the formwork during pre-stressing, displacement of the dead load toward end supports should be considered in the design of the forms and shoring, including sills or other foundation support.

For concrete structures with direct or indirect contact with sea water, sea water or brackish water shall not come in direct contact with concrete prior to the age in days indicated in the Table shown below.

Requirements for the Removal of Formwork for Concrete in Contact with Sea Water or Brackish Water	
Water Salinity (ppm dissolved salts) (Parts per million or mg/L of dissolved salts)	**Days to Elapse prior to Salt Water Contact (days)**
0-10000	Normal curing
10000-20000	15
20000-30000	25
Over 30000	30

903.3.6 Quality Control and Inspection

Materials and components used for formworks shall be examined for damage or excessive deterioration before use. Reuse of forms shall be allowed only if found suitable after necessary repairs. In case of timber forms, the inspection shall not only cover physical damages but also signs of attacks by decay, rot or insect attack or the development of splits. Reuse of job-built forms shall be permitted only when specifically approved by the Engineer.

The Engineer shall inspect the completed formwork, before carrying out any work, including fixing of reinforcing support.

903.4 Method of Measurement

Forms installed for the cast-in-place concrete in accordance to shop drawings and design calculations shall be measured in square meters or when the contract stipulates that the payment for formworks and falseworks will be on lump sum basis, the Pay Item will include all materials and components used for furnishing, fabrication, installation, erection and removal of forms. The quantity to be paid for shall be the square meters of formwork used and accepted by the Engineer or the lump sum bid price in the Contract.

903.5 Basis of Payment

The quantity measured as prescribed above shall be paid for at the Contract Unit Price or lump sum price bid for the pay item listed below that is included in the Bill of Quantities. This unit price shall cover full compensation for all materials, labor, tools, equipment, and related services necessary for the design, construction and removal of formwork and falsework. Properly supported members as required until the concrete is cured, set and hardened is also part of the Contract Unit Price.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903(1)	Formworks and Falseworks	Lump Sum

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 and fire protection system including installation in accordance with the latest edition of the Revised National Plumbing Code, Uniform Plumbing Code of the Philippines, The Fire Code of the Philippines, The National Building 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.

1002.2.1 Cast Iron Soil Pipes and Fittings

1. Pipes and fitting materials shall comply with the Specification requirements, whenever applicable, defined in ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings. The material description and standards of manufacture are herein described.

a. Cast Iron - the casting shall be made of gray iron which shall be sound, free from cracks, sand holes and blow holes. They shall be uniformly low hardness that permits drilling and cutting by ordinary methods. Pipes and fittings shall be true to pattern and of compact closed grained structure.

b. Quality of Iron - the iron shall be made by the cupola, air furnace, electric furnace or other processes which shall be checked by regular chemical and physical control test. The resultant shall be gray iron of good quality.

c. Manufacture - the pipes shall be made with hub and spigot ends or hub ends only. All hubs for pipes and fittings shall be provided with held lead grooves and all spigot ends shall be made with beads or plain if machine cast centrifugally. Plugs shall be wrought or cast, machined to the dimensions required and shall be free from defects.

d. Freedom from Defects-pipes and fittings shall be true, smooth and cylindrical, their inner and outer surfaces being as nearly concentric as practicable. They shall be in all aspects, sound and good casting free from laps, pin holes or other imperfections and shall be neatly dressed and carefully fettled. The ends shall be finished reasonably square to their axes.

2. Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of the soil or waste or at right angles thereto and, except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

Clean-outs shall be made of heavy cast brass ferrule with counter sunk screw cover same diameter as the pipe except that they shall not be larger than 100 mm diameter.

Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or by extending flush with paving with approved materials and shall be adequately protected.

3. Caulking lead shall be of molten type peg lead conforming to specification requirements defined in ASTM B29, Standard Specification for Refined Lead.

4. Oakum shall be twisted or braided hemp or abaca fibers slightly impregnated with oil.

1002.2.2 Water Supply Pipes and Fittings

1. Pipes shall be galvanized iron pipe schedule 40 conforming to specification requirements defined in ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless with threaded connection. Under roads where necessary shall suitably protected as shown on the Plans.

Fittings shall be malleable iron Type II, galvanized iron conforming to specification requirements defined in ASTM A338, Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 345°C.

Water pipe and fittings with a lead content which exceeds 8% shall be prohibited in piping systems used to convey potable water.

Where required for large diameter pipes (315 mm up to 800 mm) with elastomeric rubber sealed ring, the Oriented Polyvinyl Chloride (PVC-0) Class 500 shall be in accordance with the applicable requirements defined in ISO 16422:2014, Pipes and Joints Made of Oriented Unplasticized Polyviny Chloride (PVC-0) for the Conveyance of Water under Pressure or Unplasticized ISO 1452:2009, Plastics Piping Systems for Water Supply and for Buried and Above-Ground Drainage and Sewerage Under Pressure - Poly(Vinyl Chloride) (PVC-U).

2. Valves

Valves for water supply shall be bronze body with threaded ends rated 21 kg/cm². All valves shall be gate valves unless otherwise specified. Gate valves shall have solid wedge body and discs conforming to specification requirements defined in ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings. Globe valves shall have plug type discs with ferrule threaded ends and bronze body.

Valves up to and including 51 mm in size shall be brass or other approved materials. Sizes exceeding 51 mm shall be permitted to have cast-iron or brass bodies.

3. Water Meter

Water meter when required to be furnished by the Contractor shall be of the type tested and approved by Metropolitan Waterworks and Sewerage System (MWSS) or Local Water Utilities Authority (LWUA) or any agency/ (ies) accredited by both.

1002.2.3 Approved Alternate Pipes and Fittings

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

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series) and PNS 65: 1993, Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply. Fittings shall be molded type and designed for solvent cement joint connection for water lines and rubber O-ring seal joint for sanitary lines.

All materials shall bear Philippine Standards (PS) mark for locally manufactured and Import Commodity Clearance (ICC) marks duly issued by Bureau of Philippine Standards (BPS) for imported materials.

1002.2.3.1 Unplasticized Polyvinyl Chloride (uPVC) - Potable Water

1. Pipes and fittings for water lines and pressure lines shall conform to PNS 65: 1993: Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.

2. Pipes and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).

3. Maximum levels of toxic substances shall conform to Table 3 of PNS 65: - Unplasticized Polyvinyl Chloride (UPVC) Pipes for Potable Water Supply.

4. Pipes and fittings for water lines, sizes 20 mm to 63 mm shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.

5. Pipes and fittings for pressure lines, sizes 63 mm and larger shall be designed for manually-installed or machine-installed fixed seal gasket type jointing connection. Gaskets is to be made of Ethylene Propylene Diene Monomer (EPDM) rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced embedded in EPDM rubber gasket.

1002.2.3.2 Unplasticized Polyvinyl Chloride (Sanitary and Sewer Line) Non-Potable Water

1. Pipes and fittings for sanitary lines shall conform to PNS 1950, Plastic piping systems for soil and waste discharge (Low & High temp.) inside buildings - Unplasticized Polyvinyl Chloride (PVC-U), conforming to specification requirements defined in ASTM D2729, Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings for pipes, and ASTM D3311, Standard Specification for Drain, Waste, and Vent (DWV) Plastic Fittings Patterns for fittings.

2. Pipes and fittings for sewer lines shall conform to Standard Dimension Ratio (SDR) 34 conforming to specification requirements defined in ISO 4435, Plastics Piping Systems for Non-Pressure Underground Drainage and Sewerage - Unplasticized Polyvinyl Chloride (UPVC).

3. Pipes and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass.

4. Pipes and fittings for sanitary and sewer lines, sizes 57 mm and larger shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems and/or machine-installed seal gasket type jointing connection. Gaskets is to be made of Engineered Natural Rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced NBR (Nitrile Butadiene Rubber).

1002.2.3.3 Chlorinated Polyvinyl Chloride (CPVC)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in ASTM 2846 (CTS) SDR 11, Standard Specification for Chlorinated Polyvinyl Chloride (CPVC) Plastic Hot and Cold Water Distribution Systems, with the use of one-step CPVC solvent cement in jointing method.

Pipes and fittings shall be Heavy Metal-Free (HMF) as validated through Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES) method.

1002.2.3.4 High-Density Polyethylene (HDPE) Pipe

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in PNS-ISO 4427, Polyethylene (PE) Pipes and Fittings for Water Supply.

1002.2.3.5 Polypropylene Random/ Copolymer (PPR/PPR-C)

Pipes and fittings for hot and cold water line shall be designed conforming t specification requirements defined in DIN 8077- Polypropylene (PP) Pipes- PP H, PP-B, PP-R, PP-RCT-Dimensions and DIN 8078 - Polypropylene (PP) Pipes PP-H, PP-B, PP-R, PP-RCT - General Quality Requirements and Testing for pipes and DIN 19560/16962 - Pipes and Fittings made of Polypropylene (PP) for hot water resistant waste and soil discharge systems inside buildings/Pipe Joint assemblies and fittings for types 1 and 2 polypropylene (PP) pressure pipes; tees and branches produced by segment inserts and necking for butt welding; dimensions for fittings or ISO 15874- Plastic Piping Systems for Hot and Cold Water Installations-Polypropylene (PP).

100.2.2.3.6 Ductile Iron

Ductile Iron shall be designed conforming to specification requirements defined in ASTM A536:2014 Standard Specification for Ductile Iron Castings, ASTM A746, Standard Specification for Ductile Iron Gravity Sewer Pipe and ASTM A377, Standard Index of Specifications for Ductile-Iron Pressure Pipe.

1002.2.4 Septic Tank

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

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.

1. Water closet shall be vitreous china, free standing toilet combination, round front bottom outlet siphonic washdown 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 or unless otherwise specified on the Plans.

2. Plastic toilet bowl shall be a high quality polypropylene virgin material composition, complete with integrated parts and other accessories or unless otherwise specified on the Plans.

3. 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.

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

1002.2.5.1 Prohibited Fixtures

Water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge shall be prohibited. Any water closet that might permit siphonage of the contents of the bowl back into the tank shall be prohibited. Drinking fountains shall not be installed in public toilet rooms.

Trough urinals and urinals with an invisible seal shall be prohibited. Non-water urinals are exception.

1002.2.6 Bathroom and Toilet Accessories

1. Shower head and fitting shall be movable, cone type with escutcheon arm complete with stainless steel shower valve and control lever, all exposed surface to be chromium finish.

2. Grab bars shall be made of tubular stainless steel pipe provided with safety grip and mounting flange.

3. Floor drains shall be made of stainless steel beehive type, measuring mm by 100 mm, and provided with detachable stainless strainer, expanded metal lath type.

4. Toilet paper holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent fixture and facing tiles.

5. Soap holder shall be vitreous china wall mounted. Color shall reconcile with the adjacent tile works.

6. Faucet(s) shall be made of stainless steel for interior use. 7. Hose-bib(s) shall be made of bronze cast finish.

1002.2.7 Special Plumbing Fixtures

1. Kitchen sink shall be made of stainless steel self-rimming, single compartment complete with supply fittings, strainer traps, dual control lever and other accessories or plastic made of a high quality polypropylene virgin material composition, with stainless steel strainer, lock-nut, rubber gasket and flexible connector unless otherwise specified on the Plans.

2. Laboratory sink shall be made of cast iron metal with white porcelain finish with single compartment, flat rim ledge, 762 mm x 533 mm complete with supply fittings, strainer, trap and other accessories.

3. Scrub-up sink shall be made of cast iron metal with white porcelain finish measuring 610 mm x 610 mm complete with supply fittings, strainer, trap and wall mounting accessories.

4. X-ray developing tank shall be made of cast iron white porcelain finish with three (3) compartment x-ray processing, drain plug, open standing drain, 19 mm IPS inlet spud complete with stand and mounting accessories.

5. Squat bowl(s) shall vitreous china, wash down squat bowl with integral foot treads, pail flush type or plastic made of a high quality polypropylene virgin material composition, complete with P-Trap fitting and its rubber gasket. Color, make and type to be approved by the Engineer.

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

1002.2.8 Roof Drains, Downspout, Overflow Pipe and Steel Grating

The Contractor shall provide, fir and/or install necessary drains with strainers, where shown on the Plans. Each drain with strainer shall fit the size of the corresponding downspout (or roof leader) over which it is to be installed and in conformity with the following schedule:

1. Scupper drains (for balconies, parapet) shall be made of bronze base with flashing. Flange threaded outlet and convex with integral flashing clamp bolted to flange.

2. Roof drains shall be made of bronze base semi-dome with large free area, flashing clamp and integral gravel stopper. To be used at roof decks, canopies, gutters, and elsewhere indicated on the Plans.

3. Downspouts when encased in concrete, unless otherwise shown on the Plans shall be polyvinyl chloride (PVC). Whether indicated or specified to be cast iron or galvanized iron the same shall meet the specification requirement as herein described.

4. Overflow pipes shall be made of galvanized iron pipe measuring at least 13 mm diameter and spaced 200 mm on center.

5. Steel grating shall be made of wrought iron metals of design on shop drawings approved and surfaces to be located with shop finish.

1002.2.9 Fire Protection System

Firestop materials shall be installed in accordance with Uniform Plumbing Code of the Philippines, the National Building Code of the Philippines, Fire Code of the Philippines and the manufacturer's instructions.

1. Fire hose cabinets shall be locally available consisting of 38 mm diameter valve hose rack with nipple 30 mm rubber lined hose cable with standing pressure of 4,268 kg/cm², nozzle 38 mm diameter brass, chromium plated. Wet standpipes shall be located so that all portions of the buildings are within 6 m of a nozzle attached to 22 m of hose.

2. Fire standpipe system shall consist of risers and hose valves. Pipe shall be extra strong black iron. Valves to be high grade cast bronze mounted withstanding pressure of 79.40 kg/cm², working pressure as indicated on the Plans.

3. 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.

4. Yard hydrant where shown on the Plans shall match the integrated Fire Department requirements. Outlet shall be single 63 mm diameter gate valves with chain connected caps.

5. Pipes and fittings for fire sprinkler piping system as approved alternate shall be made out of high grade Chlorinated Polyvinyl Chloride (CPVC) materials conforming to specification requirements defined in ASTM F442 for pipes and ASTM F437, F438, F439 or F1970 for fittings.

6. For Steel pipe and fittings shall conforming to specification requirements defined in ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless, ASTM A135 Standard Specification for Electric-Resistance-Welded Steel Pipe and ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

7.Fire pumps where shown on the approved Plans shall conform to the Integrated Fire Department requirements, wherein the Fire Pump Motor shall be electric-driven and the overall system shall include an integrated Jockey Pump, Controller, and all the necessary accessories.

1002.2.10 Built-in Appliances

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

1002.3 Construction Requirements

The Contractor before any installation work is started 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. For approved alternate pipes and fittings, installation work shall conform to the approved Plans or manufacturer's recommendation.

1002.3.1 Installation of Soil, Waste, Drain and Vent Pipes

1. All cast iron soil and drainage pipes shall be pitch 6 mm per 300 mm but in no case flatter than 3 mm per 300 mm.

2. Horizontal lines shall be supported by well secured length heavy strap hangers. Vertical 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.

3. 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

4. Vent pipes in roof spaces shall be 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.

5. 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.

6. Horizontal waste line receiving the discharge from two or more fixtures shall be provided with end vents unless separate venting of fixtures is noted on the Plans.

7. 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 degrees 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.

8. All joints of cast iron pipes in bell and spigot shall be firmly packed with oakum or hemp and caulked with peg lead at least 25 mm deep.

9. Cleanouts at the bottom of each soil stack, waste stack, interior downspout and where else indicated shall be the same size as the pipe up to and including 102 mm, 152 mm, for larger pipes.

10. Cleanouts on floors shall be cast iron ferrule caulked into cast hub and fitted with cast brass 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.

11. Vent pipe shall be flashed and made watertight at the roof with ferrule lead sheet. Flashing shall be turned down into pipes.

12. 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.

13. Overhead horizontal runs of pipes shall be hung with adjustable wrought it on pipe hanger spaced not over 3.04 m apart except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart and located near a hub.

1002.3.2 Water Pipes, Fittings and Connections.

All water piping inside the building and underground, 100 mm diameter and smaller shall be galvanized iron threaded pipe with malleable iron fittings, PVC-U, HDPE, PPR and ductile iron.

1. The water piping shall be extended to all fixtures, outlets, and equipment

from the gate valves installed in the branch near the riser.

2. The cold water system shall be installed with a fall towards a main shutoff valve and drain. Ends of pipes and outlets shall be capped or plugged and left ready for future connections.

3. Mains and Branches

a. 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.

b. All piping above the ground shall be run parallel with the lines of the building unless otherwise indicated on the Plans.

c. All service pipes, valves and fittings shall be kept at sufficient distance from other work to permit finished covering not less than 12.5 mm from such work or from finished covering on the different service.

d. No water piping shall be buried in floors, unless specifically indicated on the plans and approved by the Engineer.

e. Changes in pipes shall be made with reducing fittings.

4. 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.

5. 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 (3) threads on the pipe shall remain exposed.

6. Expansion and Contraction Pipes

Accessible contraction-expansion joints shall be made whenever necessary. Horizontal runs of pipe over 15 m 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.

7. Pipe Standpipe System

Fire standpipe system shall consist of risers and valve. Pipe shall be extra strong black iron. Valves to be underwriter's approval high grade cast bronze mounted.

8. Valves and Hose Bibs

a. Valves shall be provided on all supplied fixture as herein specified.

b. The cold water connections to the domestic hot water heater shall be provided with gate valves and the return circulation connection shall have a gate and a check valve.

c. All connection to domestic hot water heaters shall be equipped with unions between valve and tanks. d. Valve shall not be installed with its stem below the horizontal. All valves shall be gate valves unless otherwise indicated on the Plans.

e. Valves up to and including 50 mm diameter shall be threaded ends, rough bodies and finished trimmings, except those on chromium plated brass pipe.

f. Valves 63 mm in diameter and larger shall have iron bodies, brass mounted and shall have either screws or flange ends.

g. Hose bibs shall be made of brass with 12.5 inlet threads, hexagon shoulders and 19 mm male.

1002.3.3 Fixtures, Equipment and Fastenings

All fixtures and equipment shall be supported and fastened in a safe and satisfactory workmanship as practiced.

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.

Inserts shall be securely anchored and properly flushed into the walls. Inserts shall be concealed and rigid.

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

1. Pipe hangers shall be wrought iron or malleable iron pipe spaced not more than 3 mm apart for horizontal runs or pipe, except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart located near the hub.

2. Chains, straps perforated turn-bucklers or other approved means of adjustment except the turn-buckles may be omitted for hangers on soil or waste lines or individual toilet rooms to maintain stacks when spaced does not permit.

3. Trapeze hangers may be used in lieu of separate hangers on pipe running parallel to and close to each other.

4. 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

5. Wrought iron clamps or collars to support vertical runs of pipe shall be spaced not more than 6 mm apart for as indicated on the Plans.

1002.3.5 Plates and Flashing

1. Plates to cover exposed pipes passing through floor finished walls or ceiling shall be fitted with chromium plated cast brass plates or chromium plated cast iron or steel plates on ferrous pipes.

2. Plates shall be large enough to cover and close the hole around the area where pipes pass. It shall be properly installed to insure permanence.

3. Roof areas penetrated by vent pipes shall be rendered watertight by lead sheet flashing and counter flashing. It shall extend at least 150 mm above the pipe and 300 mm along the roof.

1002.3.6 Protection and Cleaning

1. 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.

2. All exposed metal surfaces shall be cleaned and polished upon completion.

3. 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 approved by the Engineer and inspected both by the Engineer and the Contractor's duly designated representative (Licensed Master Plumber or Sanitary Engineer) to insure compliance with all requirements of all Codes and Regulations referred to in this Specification.

1002.3.7.1 Drainage System Test

1. 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 the roof.

2. The system shall hold this water for a full 30 min during which time there shall be no drop greater than 102 mm.

3. Where only a portion of the system is to be tested, the test shall be conducted in the same manner as described to the entire system except that a vertical ack 3 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.

4. 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

1. Upon completion of the rough-in and before connecting fixtures the entire cold water piping system shall be tested at a hydrostatic pressure 1 ½ times the expected working pressure in the system during operation and remained tight and leak-proofed.

2. 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 presence of the Engineer or his duly designated representative.

3. The water test shall be applied to the drainage and vent systems either in its entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 3 m head of water. In testing successive sections at least the upper 3 m height of the preceding section previously tested shall be tested again so that no joint or pipe in the building (except the uppermost 3 m of the system) shall have been submitted to a test of not less than 3 m head of water. The water shall be kept in pipe system or in the portion under test, for at least 15 min before inspection starts. The system shall be tight at all joints.

1002.3.7.3 Defective Work

1. The entire water distribution system shall be thoroughly flushed and treated with chlorine before it is operated for public use.

2. 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.

3. After a contact period of not less than 16 h, the heavenly chlorinated water shall be flushed from the system with potable water.

4. Valves for the water distribution system shall be opened and closed several times during the 16 h chlorination treatment is done.

1002.3.8 As-Built Drawings

Upon completion of the work, the Contractor shall submit two (2) 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. Plumbing Fixtures shall be measured by set, piece, square meter and/or lump sum.

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
1002 (4)	Plumbing Fixtures	Lump Sum
1002(24)	Cold Water Line	Lump Sum

ITEM 1003 - CARPENTRY AND 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 accordance with the Plans and this Specification.

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. Jambs, transoms, mullions, headers, sills, frames, and wood base shall be air dried and well-seasoned for at least 2 months before use.

1003.2.1.1 Grades of Lumber and Usage

1. Stress grade is seasoned, close-grained and high-quality lumber of the specified specie free from defects and suitable for sustaining heavy loads. Stress grade lumber shall be used for wooden structural member subject to heavy loads, and for sub-floor framing embedded or in contact with concrete or masonry.

2. Select grade lumber of the specified specie is generally of high quality, of good appearance, without imperfections, and suitable for use without waste due to defects and suitable also for natural finish.

3. Select grade lumber shall be used for flooring, sidings, facia and base boards, trims, mouldings, millwork, railings, stairs, cabinet work, shelvings, doors windows and frames of openings.

4. Common grade lumber has minimum tight medium knot not larger than 25 mm in diameter, with minimal imperfections, without sapwood, without decay, insect holes, and suitable for use with some waste due to minor defects and suitable also for paint finish.

5. Common grade lumber shall be used for light framework for wall partitions, ceiling joist and nailer

1003.2.1.2 Lumber Species and Usage

Unless otherwise specified on the Plans, the following lumber species shall be used as indicated:

1. Yacal (stress grade) for structural member such as post, girders, girts, sleepers door and window frames set or in contact with concrete or masonry.

2. Guijo (select grade) for door and window frames set in wooden framework, for stairs, for roof framing supporting ceramic or cement tiles, for floor joists and other wooden structural parts.

3. Apitong (common grade) for roof framing supporting light roofing materials such as galvanized iron, aluminum, for wall framing, ceiling joists, hangers and nailers.

4. Tanguile (select grade) for door and windows, facia and base boards, trims, mouldings, millwork, railings, stairs, cabinet work, shelvings, flooring siding, celling joist, studs, roof framing and nailers.

5. Narra (select grade) for stair railings, flooring boards, wall panels base boards, trims, mouldings, cabinet work, millwork, doors and windows when indicated as such in the Plans.

6. Dao (selected grade) for stair railings, flooring boards, wall panels base boards, trims, mouldings, cabinet work, millwork, doors and windows when indicated as such on the Plans.

1003.2.1.3 Moisture Content

Except otherwise specified, lumber shall be sun-dried, or kiln-dried. At time of installation, the maximum moisture content, expressed as a percentage of the oven-dry wood, shall be as follows:

Rough Carpentry and Framing

a. Framing lumber 50.80 mm and less in thickness: 19%

b. Framing lumber over 50.80 mm thick: 25% Interior millwork, finish and trim: 17%

1003.2.1.4 Substitution in Lumber Species

Any lumber equally good for the purpose intended may be substituted for the specified kind subject to the prior approval of the Engineer, provided the substitution shall be of an equal or better specie acceptable to the Engineer. In case of substitution with a better specie, no additional cost therefore shall be allowed to the Contractor.

1003.2.2 Plyboard

Plyboard shall be good grade and made of laminated wood strips of uniform width and thickness bounded together with water resistant resin glue. The laminated core shall be finished both faces with select grade Tanguile or red Lauan veneers not less than 2 mm thick similarly bonded to the core. The plyboard of not less than 19 mm thick shall be free from defect such as split in veneer, buckling or warping.

1003.2.3 Plywood

Plywood shall conform to the requirements of PNS ISO 12465:2017 Plywood Specifications. Thickness of 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 selected grade timber. The laminae and face veneers shall be bonded with water resistant resin glue, hot pressed and pressure treated.

Two (2) types of plywood based on bonding quality:

1. Type I (Exterior/Marine Plywood)

This is intended for ceiling exposed to moisture such as at toilets and eaves partitions and doors (toilet and bath) and ceiling to be finished with acrytex.

2. Type II (Interior/Ordinary Plywood)

This is intended for interior ceiling, doors and partitions shall be of 6 mm thick tanguile plywood, grade "A", three (3)-ply with high water resistant.

Sample for testing shall comply with the applicable requirements of PNS ISO 12466-1:2016 Plywood - Bonding Quality - Part 1: Test Methods and PNS ISO 12466-2:2016 Plywood - Bonding Quality - Part 2: Requirements.

1003.2.4 Lawanit

Lawanit, when required per plans, shall be 6 mm thick, tempered or oil impregnated for moisture/water resistance. Texture of lawanit shall be subject to the approval of the Engineer.

1003.2.5 Materials Other than Lumber

1003.2.5.1 Plastic Sheet

When required for counter top, plastic sheet such as Formica shall not be less than 1.50 mm thick and shall have hard, durable and glossy surface resistant to stain, abrasion and heat. Color and design shall be as selected from the manufacturer's standard and approved by the Engineer.

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.

Glue in powder form be in sealed container and shall be without evidence of lumping or deterioration in quality.

1003.2.5.3 Fasteners

Nails, screw, bolts 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.

1. Nails of adequate size shall be steel wire, diamond-pointed, ribbed shank and bright finish.

2. Screws of adequate size shall be cadmium or brass plated steel with slotted head.

3. Lag screws of adequate size, for anchoring heavy timber framing in concrete or masonry, shall be galvanized steel.

4. 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.

5. 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.

1003.2.5.4 Fiber Cement Board

It shall comply with the applicable requirements of ASTM C1186, Standard Specification for Flat-Fiber Cement Sheets for exterior application and ASTM C1288, Standard Specification for Fiber-Cement Interior Substrate Sheets for interior application.

1003.2.5.5 Gypsum Board

It shall comply with the applicable requirements of Item 1041, Gypsum Board.

1003.2.5.6 Pre-painted Metal Panel

It shall comply with the applicable requirements of Item 1014, Prepainted Metal Sheets

1003.2.5.7 Aluminum Metal Cladding

Aluminum for metal cladding shall comply with the applicable requirements of Item 1039, Aluminum Cladding.

1003.2.5.8 Polyvinyl Chloride (PVC)

Polyvinyl Chloride (PVC) shall be made from 100% virgin PVC and Class A fire rating in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1003.2.5.9 Moulding

Mouldings may be made of steel, wood, PVC, concrete and precast concrete or as indicated on the Plans. It shall match the surface where it shall be built.

Sizes, dimensions, colors, finishes, locations and design details shall be specified on the approved Plans and in accordance with the manufacturer's recommendation.

1003.2.5.10 Modular Partition

Materials for modular partition shall be in accordance with the manufacturer's recommendation and approved by the Engineer.

Sizes, dimensions, color, finishes, descriptions, locations and framing details of modular partition shall be indicated on the approved Plans.

1003.3 Construction Requirements

1003.3.1 Quality Materials

All materials to be incorporated in the carpentry and joinery works shall be of the quality specified under Section 1003.2, Material Requirements. 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 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 timber structural framing for roof, flooring, siding partition and ceiling.

1. Framing shall be stress grade or common grade lumber of the specie specified under Subsection 1003.2.1.2, Lumber Species and Usage.

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

3. Trusses and other roof framing shall be assembled, fitted and set to exact location and slope indicated on the Plans.

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

5. Structural members shall not be cut, bored or notched for the passage of conduits or pipes without prior approval of the Engineer. Members damaged by such cutting or boring shall be reinforced by means of specifically formed and approved steel plates or shapes, otherwise, damaged structural members shall be removed and replaced to the satisfaction of the Engineer.

6. Timber framing in contact with concrete masonry shall be treated with termite-proofing solution and after drying coated with bituminous paint.

1003.3.5 Finished Carpentry

Finished carpentry covers work on flooring, siding and ceiling boards, stairs. cabinets, fabricated woodwork, millwork and trims.

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

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

3. Panels shall be fitted to allow for contraction or expansion and insure that the panels remain in place without warping, splitting and opening of joints. 4. Plyboard shall be as specified under Subsection 1003.2.2 unless otherwise indicated on the Plans.

5. Plywood shall be specified under Subsection 1003.2.3.

6. Exposed edges of plywood or plywood for cabinets shall be provided with select grade hardwood strips, rabbeted 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.

7. 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.

8. 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 to finish.

1003.3.6 Fiber Cement Board

Examine, clean, and repair as necessary any substrate conditions that would be detrimental to proper installation. Do not begin installation until unacceptable conditions have been corrected.

Prior to commencing installation, verify governing dimensions of building and condition of substrate. If substrate preparation is the responsibility of another installer, notify Engineer of unsatisfactory preparation before proceeding.

Installation requirements shall be in accordance with the manufacturer's instructions and drawing details approved by the Engineer.

a. Use trim details indicated on drawings.

b. Touch up all field cut edges before installing.

c. Pre-drill nail holes if necessary to prevent breakage.

Over wood studs without sheathing. Install building paper over studs prior to installing siding.

Over wood and wood-composite sheathing. Fasten siding through sheathing into studs. For sheathing of 25 mm thickness or less, nail through sheathing into studs using correspondingly longer nails.

Over Masonry Walls. Install furring strips of adequate thickness to accept full length of nails and spaced at 406 mm on center.

Over steel studs. Minimum 20-gauge steel, 92 mm C-studs, size as indicated on drawings or as required by limiting span. Use 41 mm long, # 8-18 x 9.50 mm HD self-tapping, corrosion-resistant ribbed bugle head screws. Attach panel at each stud insuring that at least three (3) screw threads penetrate the studs.

After installation, seal all joints. Seal around all penetrations.

For finish painting, follow manufacturer's recommendation timeline for painting primed and unprimed products. Paint all exposed cut edges.

1003.3.7 Gypsum Board

Installation requirements shall conform to the applicable requirements of Item 1041, Gypsum Board.

1003.3.8 Aluminum Metal Cladding

Installation requirements shall conform to the applicable requirements of Item 1039, Aluminum Cladding.

1003.3.9 Prepainted Metal Panel

It shall comply with the applicable requirements of Item 1014, Prepainted Metal Sheets.

1003.3.10 Moulding

Moulding color finishes shall match the wall or the surface where it will be installed. Cutting details of molding and its installation shall be in accordance with the manufacturer's instructions and detailed drawings approved by the Engineer.

1003.3.11 Modular Partition

Installation requirements shall be in accordance with the manufacturer's instructions and detailed drawings approved by the Engineer.

1003.4 Method of Measurement

The quantity to be paid for will be measured as per individual item detailed in Section 1003.5, Basis of Payment for the complete Carpentry and Joinery as furnished on site and in accordance with these design standard, specifications and as accepted by the Engineer.

1003.5 Basis of Payment

The Items measured and determined as provided in Subsection 1003.4, Method of Measurement shall be paid for at the unit bid price which payment constitute full compensation of materials, labor, equipment, tools and incidentals necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003(1)e1	Ceiling, Metal Frame, Gypsum Board	Square Meter

ITEM 1010 - WOODEN DOORS AND WINDOWS

1010.1 Description

This Item shall consist of furnishing all materials, hardware, plant, tools, labor and services necessary for complete fabrication and installation of wooden doors and windows of the type and size in accordance with the Plans and this Specification and applicable Specifications of Item 1003, Carpentry and Joinery Works.

1010.2 Material Requirements

1010.2.1 Lumber

Lumber of doors, windows and jambs, and panels when required, shall be kiln dried with moisture content of not more than 14% and shall be of the species indicated on the Plans and/or specified under Item 1003, Carpentry and Joinery Works.

1010.2.2 Plywood

Plywood for veneer of solid core and hollow core flush doors shall be 3-ply, rotary cut, 6 mm thick ordinary plywood, Class B grade. Marine or waterproof plywood, rotary cut, 3-ply, 6 mm thick shall be used for flush doors at toilets and bathrooms or at places where these are exposed to moisture.

1010.2.3 Adhesive

Adhesive shall be water resistant resins and shall be non-staining.

1010.2.4 Glass

Glass for window panes shall be 3 mm thick and/or 6 mm thick, tinted, tempered, stained, clear, among others, unless otherwise shown on the Plans or indicated in the Schedule of Doors and Windows. The type of glass used shall conform to the applicable requirements of Item 1012, Glass and Glazing.

1010.2.5 Capiz Shells

Capiz shells, when required for window sashes, shall be of selected quality, free from dirt or blemishes and shall be large enough to obtain flat square piece.

1010.2.6 Hardware

Hardware shall be as specified under Item 1004, Hardware.

1010.3 Construction Requirements

1010.3.1 Fabrication

Wooden doors and windows, including frames, shall be fabricated in accordance with the designs and sizes shown on the Plans. The fabricated products shall be finished square, smoothly sanded and free from damage or warpage.

1. Flush Type Hollow Core Doors

Flush type hollow core doors shall be adequately framed with stiles and top and bottom rails having a minimum thickness of 44 mm and width of 75 mm. Two (2) intermediate rails at least 44 mm wide shall be provided for stiffness.

The stiles and the top and bottom rails shall be rabbeted at least 10 mm wide to receive the 6 mm thick plywood veneer. A lock block shall be provided at each stile, long enough to connect to the two (2) intermediate rails and at least 75 mm wide for mounting the lockset.

The plywood veneer shall be glued and nailed to the framing with 25 mm long finishing nails space at not more than 150 mm on centers.

2. Flush Type Solid Core Doors

Flush type solid core doors shall be fabricated in the same manner as the hollow core type except that spaces between stiles and rails shall be filled and fitted with wood blocks of the same species and of uniform thickness thinner by about the thickness of the plywood veneers. The filler blocks shall be secured to either stiles or rails by nails. Stiles and rails of flush type doors shall be joined by means of blind mortise and tenon joint, tightly fitted, glued and locked with bamboo pin 5 mm round.

3. Panel Doors

Rails with a minimum thickness of 44 mm and width of 140 mm. Rails shall be framed to stiles by mortise and tenon joints. Rabbets or grooves of stiles and rails to receive panels shall be 6.5 mm wide and 20 mm deep. Integral mouldings formed on both faces of stiles and rails framing the panels shall be true to shape and well defined. Intersections of mouldings shall be mitered and closely fitted.

Panels of the same species and having a minimum thickness of 20 mm shall be beveled around its edges up to a minimum width of 50 mm, both faces. The beveled edges shall closely fit into the grooves of stiles and rails, but free to move to prevent splitting when shrinkage occurs.

4. Window Sashes with Glass Panes or Wood Panels

Window sashes shall be fabricated in conformity with the design, size and type of installation shown on the Plans. Unless otherwise shown on the Plans, stiles and rails shall be Tanguile with minimum thickness of 30 mm and width of 70 mm. Jointing of stiles and rails shall be mortise and tenon secured with glue and bamboo pin. Stiles and rails shall be rabbeted at the exterior face for mounting glass panes or wood panels. Integral mouldings formed as frames for panes or panels shall be true to shape, sharply defined and mitered at joints. Separate mouldings of the same design shall be provided for fixing glass panes and wood panel from the outside.

5. Window Sashes with Capiz Shells

Stiles and rails shall be of the same sizes specified under Subsection 1010.3.1(4), Window Sashes with Glass Panes or Wood Panels, and assembled with mortise and tenon joint. Unless otherwise indicated on the Plans, lattices for framing Capiz shall be tanguile, 8 mm thick and 15 mm wide, spaced at not more than 60 mm on centers bothways. Grooves 2 mm wide and 5 mm shall be made at sides of lattices to receive the preformed Capiz shells.

The lattices shall be assembled with half lap joints at their intersections and the assembled lattices containing the Capiz shells shall be framed into the stiles and rails.

Selected Capiz shells shall be washed to remove dirt and blemishes and dried under the sun for bleaching effect. Capiz shells shall be cut square to required sizes with sharp bench cutter to produce non-serrated and non-peeling edges.

6. Sliding Type Window Sashes

Stiles of sliding type window sashes shall be framed to the top and bottom rails with mortise and tenon joints. Tenons shall be formed on the stiles. Joints shall be tightly fitted, glued and locked with bamboo pins. Top and bottom rails shall be 10 mm wider than the stiles. Top rails shall be rabbeted to form a tongue flush with the outer face, with width of 8 mm and height of 10 mm. The stiles and rails shall be rabbeted as specified under Subsection 1010.3.1(4), Window Sashes with Glass Panes or Wood Panels to receive glass panes or wood panels.

7. Awning Type Window Sashes

Tenons of rails shall be fitted into the mortises formed on the stiles and the joints glued and locked. The stiles and rails shall be rabbeted as specified under Subsection 1010.3.1(4), Window Sashes with Glass Panes or Wood Panels for mounting of glass panes. Series of sashes to be installed vertically shall have their meeting rails rabbeted for half lapping when in closed position.

8. Casement Type Window Sashes

Rails of casement type window sashes shall be fitted to stiles with mortise and tenon joint. Tenons shall be formed in the rails. Meeting rails shall be rabbeted to provide for half lapping when in closed position. The stiles and rails shall be rabbeted as specified under Subsection 1010.3.1(4), Window Sashes with Glass Panes or Wood Panels for mounting of glass panes of wood panels.

9. Door and Window Frames

Framing of the species specified under Item 1003, Carpentry and Joinery Works, shall be fabricated in conformity with the profile and sizes as shown on the Plans. Frames shall be assembled with tightly fitted tongue and groove joint mitered at both sides, and nailed. The assembled frames shall be finished square and flat on the same plane. Assembled frames shall be braced temporarily to prevent their distortion during delivery to the site and installation.

1010.3.2 Installation

1. Frames shall be set plumb and square in concrete/masonry work or framework of walls or partitions. Frames set in concrete or masonry shall be provided with two (2) rows of common wire nails 100 mm long for anchorage. The nails shall be staggered and spaced at 300 mm on center along each row. Frame set in concrete shall be installed in place prior to concrete work.

Frames set in masonry work may be installed after laying of hollow concrete blocks, bricks or adobe. Space between frames and masonry shall be fully filled with cement mortar proportioned 1:3.

2. Hinged Doors

Hinged doors, whether panel or flush type with standard height of 2,100 mm and width of not more than 900 mm shall be hung with four (4) loose-pin butt hinges, 100 mm x 100 mm. Swing out exterior doors shall be hung with four (4) fast-pin butt hinges. Two (2) hinges shall be fitted 150 mm from top and bottom edge of door. The other two (2) hinges shall be fitted at third points between top and bottom hinges. Care should be taken to ensure that the hinges are fitted such that their pins are aligned for ease of pin insertion and smoothness of operation. For added smoothness pins should be lightly greased. Hammering of hinges to attain proper alignment shall not be allowed.

For wider and heavier doors, such as Narra panel doors, an additional hinge shall be fitted 100 mm below the top hinge to counteract the door tilting action.

Mounting screws shall be screwed in place in their entire length, not forced into place by hammering. Hammering of screw into place shall not be permitted.

3. Sliding Doors

Overhead tracks, standard, locally manufactured as per Plans shall be installed level and mounting bracket secured in place with tag screws supplied with the set. Bracket shall be spaced 1,000 mm on centers. Hangers, two (2) each per door leaf, shall be perfitted and bolted to the door rail. For panel doors, the hangers shall be centered on the door stiles. For flush doors, the hangers shall be centered 100 mm from the edges of the door. If there is no adequate space for installing the door with its attached rollers, through either end of the track the perfitted hangers shall be disassembled for connection to the rollers.

After installation on the track, set the door plumb and in alignment by means of the adjustment mechanism integrated with the roller assembly.

4. Lock Installation

Locks of doors shall be fitted at the same height, centered 1000 mm above the finished floor level. Locks shall be installed in conformity with the templates and instructions supplied with locksets. Holes for mounting locks shall be properly formed to provide snug fit and rigid attachment of the locks to the doors. Strike plates shall be fitted on the door frame in true alignment with the lock latch. 5. Sliding Type Window Sashes

Sashes shall be trimmed to fit height of opening. A clearance of 2 mm shall be provided between the tongue's base at the top rail and the bottom of the window head. The same clearance shall be provided between the sash tongue and the groove at the window head. Paraffin wax shall be applied to contacts of sliding surfaces. The bottom rails shall be fitted with standard brass guided spaced 75 mm from both ends of the rail, mounted flush with the inner face and secured with three (3) brass screws each guide.

6. Casement Type Window Sashes

Sashes shall be trimmed to fit size of opening, with provision for half lapping of meeting stiles. Right side sash shall lap onto the left side sash. Sashes shall be fitted with two (2) brass-plated narrow hinges, 50 mm x 75 mm spaced 150 mm from top and bottom of stiles. In lieu of hinges, sashes maybe hung with cadmium-plated steel casement adjusters 200 mm long subject to prior approval of the Engineer. The top and bottom rails of casement type window sashes shall be milled to provide for the installation of adjusters.

7. Awning Type Window Sashes

Installation of awning type sashes shall be by means of casement adjusters specified under Subsection 1010.3.2 (6), Casement Type Window Sashes.

1010.4 Method of Measurement

Frames of doors and windows shall be measured on the basis of number of sets completely installed and accepted by the Engineer.

Doors and windows shall be measured based on the number of square meters or lump sum including its hardware involved in the completed and accepted installation.

Payment per square meter or in lumpsum shall include cost of required hardware and all incidental expenses, but exclusive of locks for doors. Locks shall be paid for per set completely installed.

1010.5 Basis of Payment

Payment for completely installed and accepted wooden doors and windows shall be based on actual measurement and the corresponding contract unit price thereof. Payment based on Contract Unit Price shall constitute full compensation.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1010 (2)a	Doors, Flush, Hollow Core	Square Meter
1010 (2)b	Doors, Wood Panel	Square Meter

ITEM 1012 - GLASS AND GLAZING

1012.1 Description

This Item shall consist of furnishing all glass and glazing materials, labor, tools, equipment and safe application requirements in undertaking the proper installation in accordance with the Plans and this Specification.

1012.2 Material Requirements

All glass and glazing materials shall be delivered at jobsite with lebels affixed indicating quality, make type and thickness. Each glass in glazed position shall resist a design pressure based on Subsection 4.2.7, Wind Load of the Design Guidelines, Criteria and Standards, Volume 6 (Public Buildings and Other Related Structures).

1012.2.1 Float Glass

This basic type of glass shall be manufactured by "floating" continuous ribbon of molten glass into a bath of molten tin where it is reheated to obtain a flat tire-polished finish and annealed slowly to produce a transparent float glass thus eliminating grinding and polishing. Used commonly in windows, sliding doors and window walls. Variation of these basic types are as follows:

Quality-Q1 (cut-size or stock sheets)	Recommended/ Intended for use in the production of high quality mirrors.
Quality-Q2 (cut-size or stock Sheets)	Recommended/ Intended for use in the production of general use mirrors and other applications.
Quality-Q3 (cut-size or stock sheets)	Recommended1 Intended for architectural applications including reflective and low emissivity coated glass products, and other select glazing applications.
Quality-Q4 (cut-size or stock sheets)	Recommended/ Intended for general glazing applications.

The requirements for transparent flat glass shall conform to the requirements set by Subsection 5.1 of PNS 193, Flat Glass Specification.

Each glass shall bear the manufacturer's label indicating the type and thickness of glass complying with the standards set by PNS 193 and R.A. 7394, The consumer Act of the Philippines.

For special performance glass such as laminated, heat strengthened, fully tempered or insulated glass unit, the glass shall bear the manufacturer's identification showing the special characteristics and thickness by etching or other permanent identification that shall be visible after the glass is glazed. All glasses shall be procured from certified manufacturers and the product shall conform to government-approved standards specifically defined in the PNS 193.

1012.2.2 Glazing Materials for Glass Installation

Glazing materials for glass installation shall be:

1. Bulk compound such as:
    a. Mastics that are elastic compounds and non-skinning compound.
    b. Sealant shall be chemically compatible with setting blocks, edge blocks and sealing tapes and shall be applied for aluminum, uPVC and equivalent materials.
2. Performed sealant such as:
    a. Synthetic polymer shall be base sealants that is resilient or non-resilient type.
    b. Performed gaskets shall be compression or structural type.
3. Setting and Edge Blocks shall be. made of lead or neoprene; chemically compatible with sealants.
4. Accessories like glazing clips, shims spacer strips, etc. shall be made from non-corroding metal accessories.

1012.2.3 Schedule of Glass and Mirrors

A 6 mm thick sheet glass of locally manufactured clear quality (unless otherwise indicated on the Plans as frosted) shall be used for the following:

1. Aluminum windows and doors, notwithstanding plate glass indicated elsewhere.
2. Jalousie window glass slats.
3. Fixed glass louvers.
4. Glass panels for partitions and counter door panels, if any.
5. Sliding glass doors for cabinets.

All glass panels for cabinets, except sliding doors shall be clear glass of locally manufactured float glass quality, 5 mm thick (unless otherwise indicated on the Plans).

They shall be clear, except where indicated on the Plans as frosted, diffused or opaque. Same shall be used for wooden sashes.

Unless otherwise noted, clear glass that are locally manufactured shall be used for steel windows.

1. For areas not exceeding 0.609 m2, 3 mm thick clear glass shall be used.
2. For areas exceeding 0.609 m2, 5 mm thick clear glass shall be used.

All comfort rooms whether shown or not in the Plans, the Contractor shall provide and fit securely in place at the most convenient height above each lavatory one.(1) mirror, made from

glazing quality polished flat glass 6 mm thick with beveled edges and brass chromium plated frame 12 mm thick waterproof Tanguile marine plywood backing, all in accordance with full size details. Sizes are as follows:

1. Over single lavatories, 600 mm x 750 mm.
2. For two (2) lavatories, 1,200 mm x 750 mm.
3. For three (3) lavatories, 1,800 mm x 750 mm.

1012.3 Construction Requirements

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

1012.3.1 Installation

Safe installation requirements shall comply with the safety standards established by PNS 193, and ASTM C1036, Standard Specification for flat Glass.

1. All glass sheets shall be bedded, applied with sealant at the back, secured in place and applied with sealant on the face. Glass shall be secured in aluminum frame with non-corrosive clips except where glazing beads are required. Sealants shall be applied in uniformly straight lines, with accurately formed bevels and clean-cut corners. Excess sealants shall be removed from glass.

2. Glass shall be set in hollow metal doors and in metal frames of interior partitions in felt channel insets or bedded in sealant to prevent any rattle; glass shall be secured in wood doors and wooden frames with glazing stops; stops shall be secured on doors with screws.

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

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

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 Safety Applications of Glass

Builder shall comply with the PNS 193, ASTM C1048, Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass, and PNS ISO 12543, Laminated Safety Glass for glass and glazing applications and shall also be consistent with the requirements indicated below:

Table 1012.1 Safe Glass Required in Different Buildings

Case	Type of Glass to be Used

1. Vertical walls with residual protection # or Hs > 0.75m (not likely to be subjected to human impact)	Any glass
2. Vertical walls Hs < 0.75m and Hf> l.5m (human impact and risk of fall both)	Tempered or Laminated Glass (as is applicable)
3. Horizontal or Sloped Glazing (risk of fall)	Laminated glass
4. Glass acting as a balustrade / parapet I railing (human impact and risk of fall both)	Laminated glass

Interior glass and glazing which may be subject to accidental human impact shall conform to safety glazing in critical locations as defined in Section 1805.1 of the National Building Code.

Frameless glass doors, glass in doors, fixed glass panels, and similar glazed openings which may be subject to accidental human impact shall conform to the requirements set forth on impact loads of glass; except in the following cases:

1. Bathtub and shower enclosures shall be constructed from approved shatter resistant materials, such as: wire-reinforced glass not less than 5.6 mm thick; fully tempered glass not !ess than 4.8 mm thick; or laminated safety glass not less than 6.4 mm thick.
2. Glass lights located not less than 450 mm above the adjacent finished floor or walking surface.
3. Glass lights when the least dimension is not greater than 450 mm.
4. Glass lights 1.50 m2 or less in area.

Provided that in non-critical locations or those that do not fall under the said definition, the panels shall be within the maximum allowable area of glass as stated or enumerated in Section 1802 of the National Building Code.

1012.3.2.1 Four Sides Framed Glass

In case of framed glass panels supported on four sides starting between the finished floor levels and less than or equal to o. 75 m as described in case 2 given in Table 1012.1, the maximum allowable area of the glass panel
corresponding to thickness shall be as follows:

1. Maximum area of normal or annealed glass less than or equal to 0.5 m2

2. The maximum area of the safety glass with respect to its thickness shall be within the permissible maximum area as defined in the Table 1012.2 below.

Table 1012.2 Maximum Permissible Area of Safety Glass Corresponding to Thickness

Type of Glass	Nominal Thickness	Max. allowable area

	(mm)	(sq.m.)
Tempered Safety glass	4	2
	5	3
	6	4
	8	6
	10	8
	12	10
Laminated Safety Glass	6	2
	8	3
	10	5
	12	7

Note: In case of laminated glass the thickness of PVB is not accounted.

3. In case of glass panels supported on all four (4) sides starting greater than or equal to 0.75 m or a protection I transom I chair rail is in place permanently from the finished floor level as given in Case 1, Table 1012.1, the thickness of annealed glass shall be within the permissible maximum area as defined in Table 1012.3 below.

Table 1012.3 Maximum Permissible Area of Annealed Glass Corresponding to Thickness in Case of Glass Panes Supported on All Four Sides

Type of Glass	Nominal Thickness (mm)	Maximum Allowable Area (sq.m.)
Annealed Glass	4	0.8
	5	1.2
	6	2.1
	8	3.2
	10	4.4
	12	6.3

1012.3.2.2 Two/Three Sides Framed Glass

In case of glass panel supported on two (2) / three (3) sides starting greater than or equal to 0.75 m or has a protection from the finished floor as in Case 1, Table 1012.1, then annealed

glass shall be used in the following case mentioned in Table 1012.4 otherwise, tempered or laminated glass shall be used.

Table 1012.4 Maximum Permissible Area of Annealed Glass Corresponding to Thickness in Case of Glass Panes Supported on Two/Three Sides

Nominal Thick (mm)	Maximum allowable height of Glass (m)	Maximum allowable Glass area (m^2)
6 mm	< 1.2	0.9
8 mm	≥1.2 to < 1.6	1.8
10 mm	≤ 1.6 to < 2	2.7

1012.3.2.3 Frameless / Non-Framed Glass

In case of frameless or non-framed glass panel toughened or laminated glass shall be used.

Table 1012.5 Maximum Permissible Area Corresponding to Thickness in of Frameless Glass Panel

Type of Glass	Nominal Thickness (mm)	Maximum Allowable Area (m^2)
Special Performance Glass or Processed Glass	6	3.0
	8	4.5
	10	6.0
	12	7.5

In all above cases and in cases where in the glass area exceeds 7.5 m^2, it is recommended to check and determine thickness of glass based on wind load capacity in the area.

1012.3.2.4 Point Supported Glass

For point fixed system, the glass area and glass thickness shall be determined by the specific strength analysis and type of point fixing hardware.

Glass firmly supported on all four (4) edges shall be glazed with minimum laps and edge clearance in accordance with Section 1801 paragraph two (2) of the National Building Code provides that glass edge clearance in fixed opening shall not be less than what is required for wind and earthquake drift. For glass not firmly supported on all four (4) edges and design shall

be submitted for approval of the Building Official who shall evaluate the glass supports in accordance with the standards that are spelled out in the Table 1012.6.

Table 1012.6 Glazing Dimensions

Type of Glass		Curtain Wall using sealing Material		
Types	Standard Thickness (mm)	Face Clearance (a)	Edge Clearance (b)	Bite (c*)
Annealed and Safety Glass	3	5	5	6
	5	5	6	8
	6	5	8	8
	8	5	8	8
	10	5	8	10
	12	5	10	12
	15	5	10	15

1012.3.3 Glazing

Glass support shall be considered firm when deflection of the support at design load does not exceed 1/175 of the span.

1012.3.3.1 Louvered Windows

Float and patterned glass in jalousies and louvered shall not be thinner than thickness of 5 mm minimal and shall not be longer than 1219 mm. Exposed glass edges shall be smooth.

1012.3.4 Workmanship

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

2. Sealant shall be neatly run in straight lines parallel with inside of glazing rebate, corners shall be carefully made; all excess sealant shall be removed and surfaces left clean.

3. A thin layer of sealant shall be applied to rebate and set glass or sealant, pressing until and even bed is secured; spring wire or angle glazing clips shall be placed and face sealant shall be ran; excess sealant shall be removed from other side flush with edge of rebate.

1012.3.5 Protection, Cleaning, and Inspection

1. Protection During Construction
   a. Any stickers or protection covers shall be not be removed during construction. The glass shall be properly protected to prevent from stain, cement or foreign materials.

   b. Writing on the glass with chalks or any other instruments shall be avoided. Taping a plastic film to the aluminum column using masking tape shall be recommended.

   c. Glass with soldering stains or any markings that destroy glazing shall be replaced.

   d. Glazing should be cleaned once building works is completed.

2. Protection of Glazing on site

   Glass that has been installed shall be well protected. It is not advisable to apply any protection material as it may leave residues, which would be difficult or impossible to remove later. Taping a plastic film to the aluminum column using masking tape shall be recommended.

3. Cleaning

   All glass shall be cleaned on both sides after sealant has been applied completely. Edge of sealant with scraper shall not be disturbed. At completion of work, glass and glazing works shall be free from cracks and rattles and clean on both sides.

4. Inspections

   Inspection shall be in accordance to Annex B.1, Inspection of end-product of PNS 193 and shall also be made to determine that the glass requirements conform to packing and marking criteria

Table 1012.7 Packing and Marking Criteria

Items	Criteria
Markings	Complete, correct, legible
Materials	Complete king of Glass, Quantity, sizes and without damage
Workmanship	Properly sealed, tight and sufficient straps, robust construction of container box
Quality	Conform with PNS 193

1012.3.6 Samples

The Contractor shall submit for approval a duplicate sample (300 mm x 300 mm) of each type of glass bearing manufacturer’s label and a can of each type of sealant.

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 and in compliance with the approved plans.

1012.5 Basis of Payment

The quantity for this Item a prescribed in Subsection 1012.4, Method of Measurement shall be paid for at the unit bid price which payment constitute full compensation for all glass and glazing materials and other facilities, labor and incidentals necessary to complete this item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measure
1012(3)a6	Tempered Glass, 12mm	Square Meter

ITEM 1013 - CORRUGATED ROOFING

1013.1 Description

This Item shall consist of furnishing all equipment, tools, materials and labor required to properly install and complete the corrugated metal or asphalt roofing, together with related accessories such as ridge/hip rolls, valleys, gutter and flashing in accordance with the Plans and this Specification.

1013.2 Material Requirements

1013.2.1 Corrugated and Plain Galvanized Iron Sheets

Corrugated galvanized iron (G.I.) sheets, including plain G.I. sheets for roofing accessories, shall be cold-rolled meeting ASTM A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware and with spelter coating of zinc of not less than 0.381 kg/m², conforming to ASTM A653M, Standard Specification for Steel Sheet, Zinc Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvanized) by the Hot-Dip Process or PNS 67, Hot-dip Metallic-coated Steel Sheets for Roofing. Unless otherwise specified or shown on Plans, roofing sheets shall be gauge 26 (0.48 mm thick) and provide in long span sizes to minimize end laps. Sheets shall weigh not less than 3.74 kg/m² and shall be marked or stamped showing the gauge, size, amount of zinc coating, brand and name of manufacturer. Test specimens shall stand being bent through 180 degrees fiat on itself without fracture on the base metal and without flaking of the zinc coating.

1013.2.2 Corrugated Asphalt Sheets

All corrugated asphalt roofing materials shall be delivered at the jobsite with labels affixed indicating the quality (including cellulose fiber), make type and thickness. Each roof in position shall withstand up to 200 km/h of wind pressure

1013.2.2.1 Packaging and Marking

Asphalt roofing products may be shipped in container or bill of lading on bulk shipment as agreed upon by the manufacturer and the purchaser where each shall be marked with the following information:

1. Name of manufacturer or seller

2. ASTM designation

3. Type of product

4. Flash point

5. Equiviscous Temperature (EVT) for mop and for mechanical spreader application

1013.2.2.2 Dimensions

Dimensions for each delivered corrugated asphalt roofing sheet shall conform to the Table 1013.1.

Table 1013.1 Dimensions of Corrugated Asphalt Roofing

Physical Property	Dimension (mm)
Width	930.00 - 970.00
Length	1990.00 – 2010.00
Thickness	2.60 – 3.30
Pitch	90.00 – 100.00
Corrugation Height	35.00 – 40.00
No. of Corrugations	9.00 – 11.00

1013.2.2.3 Bitumen Properties

The oxidized bitumen prepared from crude petroleum shall be homogenous and free of water in which each type shall conform to the physical properties prescribed in Table 1013.2. This covers four (4) types of asphalt intended for use in built-up roof construction, bituminous vapor retarder, and some modified bitumen systems and for adhering insulation boards used in various types of roof systems.

Sampling shall conform to the requirements of ASTM D140M, Standard Practice for Sampling Bituminous Materials.

Table 1013.2 Physical Requirements of Asphalt Roofing

Property	Test Method	Type I		Type II		Type III		Type IV	
		Min	Max	Min	Max	Min	Max	Min	Max

Softening point, ^{O}C	ASTM D36	57	66	70	80	85	96	99	107
Flash point, ^{O}C	ASTM D92	260	…	260	…	260	…	260	…
Penetration, units at 25 ^{O}C	ASTM D5	18	60	18	40	15	35	12	25
Ductility at 25 ^{O}C, cm	ASTM D113	10.0	…	3.0	…	2.5	…	1.5	…
Solubility in trichloro-ethylene, %	ASTM D2042	99	…	99	…	99	…	99	…

ASTM D36M-Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus) ASTM D92-Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester ASTM DSM-Standard Test Method for Penetration of Bituminous Materials ASTM D113-Standard Test Method for Ductility of Asphalt Materials

ASTM D2042-Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene

1013.2.3 Strap Fasteners

Strap fasteners shall be from gauge 26 plain G.I. sheet, 25 mm wide and sufficiently long to bend around up to the opposite face of purlin, with corners chipped off at the riveting ends.

1013.2.4 Rivets, Washers and Burrs

Rivets and washers shall be galvanized mild iron. Rivets shall not be less than 5 mm in diameter and 10 mm in length. Washers shall not be less than 1.5 mm thick and 20 mm in outside diameter. Washers inside diameter shall provide snug fit to the rivet.

1013.2.5 Soldering Lead

Soldering lead shall have a composition of 50% tin and 50% lead, conforming to ASTM B32, Standard Specification for Solder Metal.

Rivets and burrs for lap joints of gutters, downspouts and flashing shall be copper not less than 3.175 mm in diameter (No. 8).

1013.2.6 Fabricated Metal Roofing Accessories

Ridge/hip rolls, valleys, flashing and counter flashings, gutters and downspouts whenever required, shall be fabricated from plain G.I. sheets. Ridge/hip rolls and flashing shall be gauge 26. Valleys, gutters and downspouts shall be gauge 24 unless otherwise specified on Plans. Wire baskets strainers shall be galvanized, gauge 24.

Roof ventilators, whenever required shall be fabricated from gauge 26 plain G.I. sheets and constructed to the dimensions and details shown on Plans.

1013.2.7 Rejection and Resubmittal

Materials failing to meet the requirements of this Specification shall constitute grounds for rejection. The Contractor may request for re-inspection/test of the rejected materials and resubmits the lot after removal of those packages not conforming to the requirements as approved by the Engineer.

1013.3 Construction Requirements

1013.3.1 Preparatory Work

Preparatory to the installation of the corrugated roofing, purlins should have been placed and spaced properly to fit the length of roofing sheets to be used such that the centerline of the purlins at end laps are 150 mm from the bottom line of end laps and intermediate purlins are placed equidistantly. Top of purlins should be at the same plane.

1013.3.2 Installation of Corrugated Roofing Sheets

1013.3.2.1 General

Valleys, ridge/hip rolls and flashings when required, shall be installed before fastening the roofing sheets with galvanized straps and rivets. One strap shall be riveted at each alternate corrugation at the gutter line, the ridgeline and at end laps and the straps bent around and nailed to the purlins. Riveting at intermediate purlins between end laps shall be done at every fourth corrugation. Rivet shall be provided with a galvanized mild iron washer below and one (1) lead and one (1) galvanized iron washer above the sheet. Rivet shall be sufficiently long to permit forming a hemispherical head. Riveting shall be done such that the lead washer shall be compressed to provide a watertight fit around the rivet.

1013.3.2.2 Corrugated Metal Roofing

Installation of corrugated G.I. sheets with end laps shall start at the lower pa of the roof and proceed towards the direction of monsoon wind with side laps of 2 ½ corrugations. End laps shall be 250 mm minimum. Each sheet shall be fastened temporarily by 1.83 mm diameter by 25 mm long galvanized flat head nails at valleys of corrugations covered by side or end laps.

Succeeding upper rows of corrugated G.I. sheets shall be installed in the same manner until the entire roof area is covered.

1013.3.2.3 Corrugated Asphalt Roofing

Installation of corrugated asphalt sheets with end laps shall start at the lower part of the roof and proceed towards the direction of monsoon wind with side laps of at least one (1) corrugation. End laps shall be 200 mm minimum. Each sheet shall be fastened temporarily by

1.83 mm diameter by 25 mm long galvanized flat head nails at valleys of corrugations covered by side or end laps.

Sheets at the first stage shall be hanged over at 70 mm maximum.

Succeeding upper rows of corrugated asphalt sheets shall be installed in the same manner until the entire roof area is covered.

1013.3.3 Installation of Roofing Accessories

1. Ridge and Hip Rolls

Ridge and hip rolls shall lap at least 250 mm over roofing sheets and together, shall be riveted at every second corrugation.

2. Valleys

Valleys shall lap at least 450 mm each way under the roofing sheets and shal be secured to the framework with galvanized nails, such nails placed below the roofing sheets. Rivets alongside of the valley shall be at every second corrugation.

3. Flashing

Flashing of gauge 26 plain G.I. sheets, unless otherwise specified shall be installed along intersections of roofs with concrete or masonry walls in accordance with details shown on Plans. Flashing running parallel to sheet corrugation shall lap at least two (2) corrugations with edge turned down. Flashing across sheet corrugation or at an angle thereto, shall lap at least 250 mm and the edge of flashing turned down at each corrugation. The vertical portion of flashing adjoining wall shall be at least 200 mm wide and provided with counter flashing.

4. Counter Flashing

Counter flashing sheets of gauge 24 plain G.I. shall be built into preformed wedge-shape groove of concrete masonry wall. The edge to be built into wall groove shall have a 25 mm strip bent 45 degrees and shall be sealed in the groove with cement mortar or caulking compound.

5. Reglets

Reglets, when required per Plans in connection with counter flashing shall be fabricated products approved by the Engineer, complete with fittings. Reglets shall be located not less than 200 mm or more than 40 mm above roofing. Reglet plugs shall be spaced not more than 300 mm on centers. Open-type reglets shall be filled with fiber board or other suitable separator to prevent crushing of the slot during installation. The counter flashing shall be inserted into the full depth of reglet and the reglet lightly punched every 300 mm to crimp the reglet and the counterflashing together.

6. Gutters

Gutters, from gauge 24 plain G.I sheets, shall be fabricated to the shape and dimensions indicated on the Plans. The rear side of the gutter shall have a 12.5 mm strip bent 30 degrees and shall be not less than 12.5 mm higher than the opposite side. Gutter joints shall be flat seam

folded in the direction of flow and soldered evenly. Otherwise, gutter joints shall be lapped at least 25 mm, fastened together with 3.175 mm diameter (No. 8) copper rivets and burrs, and sealed by soldering along both exposed edges of lap.

Gutter shall be attached to fascia board or roof nailer with galvanized nails or screws spaced at not more than 900 mm on centers and at a point slightly higher than leading edge of gutter. As additional support, gutter shall have plain G.I. strap hangers 25 mm wide fastened to roof nailers by screw shark type nails and riveted to the gutter's leading edge. Strap hangers shall be spaced at not more than 900 mm on centers. When shown on Plans that gutte is not fixed to fascia board or purlin, gutter shall be supported by wrought iron (W.I.) hangers not less than 4.75 mm thick and 19 mm wide spaced at not more than 900 mm on centers. W.I. hanger shall be fabricated to fit configuration of the gutter and attached to fascia board or purlin with two (2) No. 8 flat head wood screws.

Gutter shall be installed with a pitch of 1 in 100 slope to downspout.

7. Downspouts

a. Downspouts

Unless specified otherwise, downspouts shall be plain G.I. sheets thickness fabricated to the dimensions show on the Plans and installed at indicated locations. Downspout shall be secured to the wall with G.I. straps 25 mm wide spaced at more than 1000 mm and anchored with concrete nails. Inlets of downspouts shall be fitted with gauge 14 wire basket strainers.

b. Unplasticized Polyvinyl Chloride Downspouts

When shown on Plans that downspouts are other than G.I. sheets, downspouts shall be unplasticized polyvinyl chloride (UPVC) pipes and fittings with dimensions indicated and conforming to ASTM D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe & Fittings. Joints shall be made with either solvent cement or rubber "O-rings" depending on the design of fitting for the joints. Rubber "O-rings" shall be neoprene type, heat and o resistant, complying with ASTM F477, Standard Specification for Elastomer Seal (Gaskets) for Joining Plastic Pipe. Downspout shall be secured to adjoining wall with plain G.I. straps 25 mm wide and spaced at not more than 1000 mm.

8. Roof Ventilators

Roof ventilators, whenever shown on Plans, shall be firmly secured to the roofing or roof structure by means of rivets. Roof ventilators installed on the roof at places other than the ridge shall be provided with adequate flashing around intersection with roofing to ensure watertight joints.

1013.3.4 Joints of Metal or Asphalt Roofing Accessories

1. Soldered Joints

Joints made by lapping coupled with riveting shall be rendered watertight by soldering. All edges of uncoated sheet metal to be soldered shall be pretinned before soldering. Soldering shall be done slowly with well heated iron in order to thoroughly heat the seam and sweat the solder completely through the full length of the seam. Upon completion of soldering, acid shall be neutralized by washing thoroughly with water.

2. Non-soldered Joints

Non-soldered joints of G.I. gutters, downspouts and flashings shall be done by flat lock seams. Two (2) adjoining edges of lock seam shall be bent 90 degrees. One (1) bent strip shall be at least 15 mm wide and the connecting piece shall have a bent strip twice in width which shall be bent down over the upturned narrower strip and pressed together. Once properly interlocked, the joint shall be flattened such that the edge of the wider strip be concealed.

1013.3.5 Roof Installation on Metal Purlins

Installation on metal purlins shall follow the same procedure as that on wood purlins, except that fastening shall be done with thread-cutting, zinc-coated steel screws, No. 12 by 50 mm having hexagonal heads and provided with neoprene washers. Screw holes shall be drilled using 5 mm diameter bit.

1013.3.6 Water Leak Test

The completed roofing shall be tested for water tightness at side and end laps at joints of roofing sheets with ridge/hip rolls, valleys and flashings by means of water-spray system. The water-spray system shall have nozzle which will deliver water pressure at 2 kg/cm² directly to the joint being tested in such manner and for a duration directed by the Engineer. All defective works as determined by this test shall be remedied by the Contractor at his expense and the test shall be repeated until the work is found satisfactory.

1013.4 Method of Measurement

Roofing sheets shall be measured and paid for on an area basis in square meter or part thereof, such roofing sheets including all laps, fasteners and rivets as installed complete and accepted.

Ridge/hip rolls, flashings, valleys, gutters and downspouts shall be measured in linear meter of completed and accepted work. Such measurement shall include necessary straps and fixings required for complete installation.

Roof ventilators shall be measured and paid for per unit completely installed and accepted.

1013.5 Basis of Payment

The quantity as determined in Section 1013.4, Method of Measurement shall be paid for at unit price stipulated in the Contract's Bill of Quantities. The payment shall constitute the full compensation for furnishing all the necessary materials providing necessary equipment and tools in installing corrugated metal or asphalt roofing, labor cost and all the incidental expenses necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement

1013 (2)	Fabricated Metal Roofing Accessory	Linear Meter

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 in accordance with the Plans and this Specification.

1014.2 Material Requirements

All prepainted metal sheet and roofing accessories shall be oven baked painted true to profiles indicated on the Plans as per approval of the Engineer.

1014.2.1 Prepainted Roofing Sheets

Prepainted 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 Hot-dip Metallic-Coated Steel Sheets for Roofing Specification. Profile section in identifying the architectural moulded rib to be used is as follows: Regular corrugated, Quad rib, Tri-wave, Rib-wide, Twin-rib, and others. Desired color shall be subject to the approval of the Engineer.

Gutters, Valleys, Flashings Hip and Ridge roll shall be fabricated from gauge 24 (0.60 mm thick) cold-rolled plain galvanized iron sheets specially tempered steel. Profile section shall be as indicated on the Plans. Fastening hardware shall be of galvanized iron straps, rivets or J-bolts. G.I. straps are of 0.50 mm thick x 16 mm wide x 267 mm long (gauge 26 x 5/8" x 10-1/2") and standard rivets.

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

1. Coating thickness

Protective Coatings	Thickness (Coating Mass)
Zinc	14 microns (100 g/m^2)
55% Aluminum Zinc	14 microns (50 g/m^2)
Zinc-5% Aluminum	14 microns (95 g/m^2)
Top Coat	15.20 microns

Bottom coat	6.8 microns

2. Overall thickness with protective coats

Nominal thickness (mm)	Thickness Range
0.20	0.16 – 0.25
0.30	0.26 – 0.35
0.40	0.36 – 0.44
0.50	0.45 – 0.54
0.60	0.55 – 0.64
0.70	0.65 – 0.74
0.80	0.75 – 0.86

Note: Nominal thickness refers to the Total Coated Thickness (TCT) and defined as the sum of the Base Metal Thickness (BMT) and coating as per PNS 67.

1014.3 Construction Requirements

Before any installation work is commenced, the top face of the purlins should be checked for 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

The laying of the roofing panels should begin on the end of the building away from the prevailing wind so that the side-lap seams face away from the prevailing wind-driven rain thus providing additional security against water penetration. 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. Fasteners should have corrosion resistance at least of the next sheet over the edge of the first sheet, to provide side lap and hold equivalent to the expected life of the base material. Place the downturned edge of the next sheet over the edge of the first sheet to provide a side lap and hold the side lap firmly in place. Continue the same procedure for subsequent sheet until the whole roofing area is covered and/or (Adopt installation procedure provided in the instruction manual for each type of architectural molded rib profile section). Pre-painted metal sheet should not come in direct contact with wet concrete. Concrete's high alkalinity attacks the aluminum, causing the coating to peel. It shall also not be placed in contact with copper, lead, or the water run-off. Electrochemical reaction between these elements and the aluminum-zinc alloy coating will lead to premature corrosion of the coating. For walling applications follow the procedure for roofing and allow a minimum end lap of 100 mm for vertical walling. For panel lapping, requirements depend on the product installation guide of a specific type of pre-painted metal sheet a per approval of the Engineer. Provide sealant, butyl tape or caulking along the lap edge to prevent any leaking. Specifications of the sealant and butyl tape shall be as per manufacturer's recommendation per Engineers approval.

1014.3.3 Gutters, Valleys, Flashing Ridge and Hip Rolls

Gutters, valleys, flashing ridge and hip rolls shall be fastened where indicated on the Plans by self-tapping screws or galvanized iron straps and rivets. Always begin flashing installation from bottom and work up, so that flashings are lapped on top of the lower flashings. This will prevent moisture from leaking under the flashings and into the structure.

1014.3.4 End Laps

In case handling or transport consideration requires to use two (2) or more end tapped sheets to provide full length coverage for the roof run, each line of sheets shall be from bottom to top or from eave line to apex of roof framing Minimum end lap of 150 mm shall be provided.

1014.3.5 Anchorage/Fastening

Prepainted steel roofing sheets shall be fastened to the wood purlins with standard length G.I. straps, rivets or J-bolts. For steel frame up to 4.5 mm thick self-drilling screw No. 12 by 35 mm long hexagonal head with neoprene washer shall be used. For steel support up to 5 mm thick or more, thread cutting scre No. 12 by 40 mm long hexagonal head with neoprene washer shall be used Self-drilling screw No. 10 by 16 mm long hexagonal head with neoprene washer shall be used for side lap fastener. For valley fastened to lumber and for walling self-drilling wood screw No. 12 by 25 mm long hexagonal head with neoprene washer shall be used. Self-drilling screws hexagonal head with neoprene washer shall be used for valleys fastened to steel supports. Drill size shall be 5 mm diameter.

1014.3.6 Cutting of Sheets

In cutting prepainted steel roofing sheets and accessories, place the exposed color side down. Cutting shall be carried out on the ground and not over the top of other painted roofing product. Power cutting or drilling to be done or carried out on prepainted 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, walling products and accessories should be delivered to the jobsite in strapped bundles. Sheets and/or bundles shall be neatly stacked in the ground dry and if left in the open it shall be protected by covering the stack materials with loose tarpauline. Bundles should be stored above ground at a slight angle, to prevent water or condensation build up between adjacent sheets. Removing installation debris and metal fines due to drilling and cutting from the sheet surface and avoiding exposure of insulation to the weather shall be practice at all times.

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 by the Engineer.

1014.5 Basis of Payment

The area of pre-painted steel roofing and/or walling in square meters as provided in Section 1014.4, Method of Measurement shall be paid for at the unit bid or Contract Unit Price which payment shall constitute full compensation including labor, materials, tools and incidental necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1014(1)b2	Pre-painted Metal Sheets, 0.5mm, Rib Type, Long Span	Square Meter

ITEM 1018 – CERAMIC AND GRANITE TILES

1018.1 Description

This Item shall consist of furnishing and installing ceramic and granite tiles materials including cementitious/adhesive materials, tools and equipment including labor required in the proper installation of floor, wall and countertop as shown on the Plans and in accordance with this Specification,

1018.2 Material Requirements

1018.2.1 Ceramic Tiles

Ceramic Tiles are thin slabs made from clays and/or other organic raw materials, generally used as coverings for floors and walls, usually shaped by extruding, pressing at room temperature but may be formed by other processes, then dried and subsequently fired at temperatures sufficient to develop the required properties. Ceramic tiles can be classified as glazed or unglazed.

All ceramic tiles shall be sound, durable, and free of spalls, cracks, open seams, pits, or other defects, which may impair its structural integrity or function. Table 1018.1 shows the required test methods for ceramic tiles. Texture, finish and color shall be within the range of samples approved by the Engineer.

Table 1018.1 Physical Tests for Ceramic Tiles

Physical Property	Test Method	Description
Abrasion Resistance - Glazed	ASTM C1027	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
	ISO 10545-7	Determination of Resistance to Surface Abrasion of Glazed Tiles
Abrasion Resistance - through body	ISO 10545-6	Ceramic Tiles - Part 6: Determination of Resistance to Deep Abrasion for Unglazed Tiles

Water Absorption	ASTM C373	Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed
		Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products
	ISO 10545-3	Determination of Water Absorption, Apparent Porosity, Apparent Relative Density and Bulk Density
Chemical Resistance	ASTM C650	Standard Test Method for Resistance of Ceramic Tile to Chemical Substances
	ISO 10545-13	Determination of Chemical Resistance
Break Strength	ASTM C648	Standard Test Method for Breaking Strength of Ceramic Tile
	ISO 10545-4	Determination of Modulus Rupture and Breaking Strength
Stain Resistance	ASTM C1378	Standard Test Method for Determination of Resistance to Staining
	ISO 10545-14	Determination of resistance to stains

1018.2.1.1 Glazed Tiles and Trims

Glazed tiles and trims 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. Standard glazes may be bright (glossy), semi-matte (less glossy), matte (dull) or crystalline (mottled and textured; good resistance to abrasion). Glazed tiles are

used principally for walls; crystalline glazed tiles may be used for floors provided however that these are used as light duty floors.

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. It is used primarily for floors and walks.

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 ceramic trim units such as caps, bases, coves, bullnoses, corners, angles and others that are necessary for edging or making a transition between intersecting planes.

1018.2.2 Granite Tiles

Granite tiles shall conform to the applicable requirements of ASTM C615M Standard Specification for Granite Dimension Stone, for material characteristics physical requirements, and sampling for selection of granite.

All granite shall be sound, durable, and free of spalls, cracks, open seams, pits, or other defects, which may impair its structural integrity or function, Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling or mock-up phases will be accepted provided they do not compromise the structural or durability capabilities of the material Texture and finish shall be within the range of samples approved by the Engineer. Table 1018.2 shows the required test methods for granite tiles.

Table 1018.2 Physical Tests for Granite Tiles

Physical Property	Test Method	Description
Absorption by weight	ASTM C97M	Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
Density	ASTM C97M	Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension
Compressive Strength	ASTM C170M	Stone Standard Test Method for Compressive Strength of Dimension Stone

Modulus of Rupture	ASTM C99M	Standard Test Method for Modulus of Rupture of Dimension Stone Resistance of Stone Subjected to Foot traffic
Abrasion Resistance	ASTM C241M	Standard Test Method for Abrasion Resistance of Stone Subjected to Foot traffic
	ASTM C1353	Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser
Flexural Strength	ASTM C880M	Standard Test Method for Flexural Strength of Dimension Stone

Finishes of Granite Tiles:

1. Polish - Highly reflective, mirror gloss finish; shows full color depth and crystal structure of the stone.

2. Hone Smooth, satin surface without reflection; shows full color of the stone.

3, Thermal - Slip-resistant, rough-textured surface. 4. Sandblast - Highly slip resistant; slightly rough textured surface.

1018.2.3 Synthetic Granite Tiles

Synthetic granite tiles are manufactured solid surface that are made of man made materials most often acrylic, polyester resins, marble dust and other pigment, all blended and heated together.

All synthetic granite tiles shall be sound, durable, and free of spalls, tracks, open seams, pits, or other defects, which may impair its structural integrity or function. Texture, finish and color shall be within the range of samples approved by the Engineer.

1018.2.4 Accessories

Tile accessories such as round edge ceramic tiles, cove tiles, step treads and nosing to stairs, landings, and thresholds, skirting, sills, copings, and bath vents, shall match the composition, color and finish of the surrounding tiles.

1018.2.5 Mortar Materials

1018.2.5.1 Portland Cement

Portland Cement shall comply with the applicable requirements of AASHTO M 85, Standard Specification for Portland Cement (ASTM C150M).

1018.2.5.2 Sand

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

1018.2.5.3 Lime

It shall be hydrated lime with free unhydrated oxide and magnesium oxide content not to exceed 8% by weight.

1018.2.6 Grouting Materials

1018.2.6.1 Sand-Portland Cement Grout

Sand-Portland cement grout is used with ceramic mosaic, quarry and paver tiles on floors and walls. Damp curing is necessary.

An on-the-job mixture of one (1) part Portland Cement to one (1) part of sand shall be used for joints up to 4.23 mm wide; one (1) part cement and two (2) parts sand for joints up to 12.70 mm wide; and one (1) part cement and three (3) parts sand for joints over 12.70 mm wide. Up to 1/5 part lime may be added.

1018.2.6.2 Standard Cement Grout

Standard Cement Grout shall be factory prepared mixture of cement, grade sand, and other ingredients to produce a water-resistant, dense, uniformly colored material, meant for joints of 3.18 mm width or greater.

1018.2.6.3 Standard Unsanded Cement Grout

It shall be a factory prepared mixture of cement and additive that provide water retentivity, meant for joints 3.18 mm wide or less.

1018.3 Construction Requirements

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

1018.3.1 Setting Materials

1. Wall Tiling. A mix of one (1) part of cement and four (4) parts of sand backing of 10 mm thick shall be laid as base for wall tiling. The surface of backing shall be scratched in an approved manner, when completely set to form ke. The surface of the backing shall be well wetted before the tiling is apply and same shall be cured for 5 days before tiling starts. Tiles shall be fixed using the appropriate adhesive.

2. Floor Tiling. The Contractor shall either bed the tiles using cement/sand mortar with ratio of 1:3 and 20 mm thick or lay the tiles on screed using the appropriate adhesive.

1018.3.2 Substrates Preparation

1. With the installer present, substrates and areas where tiles are to be installed shall be examined, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

a. Substrates for setting tile shall be firm, dry, clean and free from oil or waxy films and curing compounds.

b. Installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind the tile shall be completed before installation of tile.

2. Substrate Levels shall consider the following allowable variations:

a. For tiles with all edges shorter than 380 mm, the maximum allowable variation is no more than 6 mm in 3 m and no more than 1.6 mm in 0.3 m from the required plane, when measured from the high points in the surface.

b. For tiles with at least one (1) edge is 380 mm or longer, the maximum allowable variation is no more than 3 mm in 3 m and no more than 1.6 mm in 0.6 m from the required plane, when measured from the high points in the surface.

3. For thin set work, the variation can be no more than 1.6 mm in 1 m with no abrupt irregularities greater than 0.80 mm.

4. Concrete, masonry and plaster substrates shall be grinded or filled as required to comply with allowable variations. For fill and underlayment of concrete, masonry and plaster substrates, one (1) part Portland cement, three (3) parts sand and sufficient mortar admixture, if needed, shall be utilized to provide workable mortar mix.

5. Substrates and adjoining construction, and the conditions under which the work will be installed, shall be examined. Before proceeding with the work, all unsatisfactory condition detrimental to the proper completion of the work should be corrected.

1018.3.3 General Installation

1018.3.3.1 Floor

1. Installation of each material requirement shall be in accordance with the manufacturer's instructions.

2. Allowable Variations in Finished Work:

a. Floors: 3 mm in 2 m in any direction ± 3 mm at any location; 0.8 mm offset at any location.

b. Joints: 10.8 mm joint with variation at any locations; 1.6 mm in 1 m deviation from plumb and true.

3. Tile work shall be laid out in pattern using field tile and trim shapes as shown on the Plans. Tile fields shall be centered on both directions in each space or on each wall area, and shall be adjusted to minimize tile cutting. Uniform joint widths for ceramic tile and granite tile shall be used unless otherwise shown on the Plans or approved by the Engineer. Field tiles, not trim shapes, shall be cut unless otherwise shown on the Plans.

4. Tile work shall be extended into recesses and under equipment and fixtures in the spaces shown on the Plans or scheduled to receive tiles. A complete covering without interruptions shall be formed except for control and expansion joints as shown on the Plans and as required to comply with disruption of pattern or joint alignments.

5. Liquid Latex Mortar Thin-Set Installation: Liquid latex mortar for thin-set the work shall be used, unless otherwise shown on the Plans.

6. Work shall be neatly terminated at obstructions, edges, and corners without disrupting pattern or joint alignments.

7. Intersections and return shall be accurately formed. Cutting and drilling of tile shall be performed without damaging visible surfaces. Edges of tile abutting trim, finish or built-in items shall be carefully grind cut for straight aligned joints. Tiles shall be closely fit to electrical outlet, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.

8. Joining Pattern: Unless otherwise shown on the Plans, tiles shall be laid in grid pattern. Joints when adjoining tiles on floor, base, walls, and trim of the same size shall be aligned. Tile work shall be laid out and tile fields shall be centered in both directions in each space or on each wall area. Tile work shall be adjusted to minimize tile cutting. Uniform joint widths shall be provided unless otherwise shown on the Plans.

9. Tile lining shall be laid out to next full tile beyond dimensions indicated.

10. Control joints or expansion joints shall be provided where shown, or required on the Plans, or by job condition for proper workmanship. Removable divider strip of proper width and depth of the tile and setting bed shall be installed. Strips shall be removed after grouting tiles and properly curing the work. Joint fillers and sealants shall be installed in control joints and expansion joints, of type as recommended by the tiling manufacturer.

11. All floor tiling in water present areas such as bathrooms, washing area, kitchens, pantries and mechanical rooms shall be laid with a joint filling of approved polyurethane sealant.

12. For areas with ceramic tile flooring, a thick creamy slurry of neat white or tinted cement mixed with sufficient water shall be brushed over the floor until all joints are thoroughly filled. The surface of the floor shall be gently rubbed with a wood block to bring the surface to true planes. Excess slurry shall be removed, and the floor shall be rubbed with burlap to clean the tiles and finish of the joints to the satisfaction of the Engineer. Walking on tiles shall not be allowed for 5 days after laying and all completed tiled areas shall be protected to the satisfaction and approval of the Engineer.

1018.3.3.2 Wall

1. Cement and sand (1:4) mix backing 10 mm thick shall be laid as base for wall tiling. The surface of the backing shall be scratched in an approved manner when completely set to form key. The surface of the backing shall be well wetted before the tiling is applied and same shall be cured before tiling starts.

2. Allowable Variations in Finished Work:

a. Walls: 3 mm in 2 m in any direction; ± 3 mm at any location; 0.8 mm offset at any location.
b. Joints: ±0.8 mm joint with variation at any locations; 1.6 mm in 1 m deviation from plumb and true.

3. Wall tiles and fittings shall be set in cement and sand mortar (1:4) mix, 6 mm thick to a true vertical face with continuous horizontal and vertical joints. Joints shall be straight, level, perpendicular and of even width not exceeding 1.5 mm. The vertical joints shall be maintained plumb for the entire true level and plane by tamping under a straight edge or rubber faced block. Misfits as well as damaged or defective tiles shall be removed and replaced by and at the Contractor's expense.

4. Tile adhesive for wall tiles shall not be used without the approval of the Engineer.

5. The external and internal angles and side edges of glazed wall tiling shall be formed with angle beads. Whereas top edges of tiles shall be formed with rounded edges tiles. Joints shall match the general tiling and special fittings shall be used.

6. After edges of tiles have been thoroughly wet, joints in glazed wall tiles and fittings shall be grouted with a plastic mix of neat white or colored cement immediately after a suitable area of tile has been laid.

7. The joints shall be tooled slightly concave and the excess mortar shall be cut off and wiped off with a damp cloth from the face tile before it sets hard.

8. All special purpose wall tiles such as skirting tiles, single round edge, adjacent round edge, external round edge and the like, shall be used in wall cladding shall be submitted for approval prior to commencement to work.

9. All service points in wall tiling shall be drilled holes in the tiles if they are located in the center of tiles.

1018.3.3.3 Countertop

1. Solid surfacing components shall be installed plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Woodworking and specialized fabrication tools that are acceptable to the Engineer shall be used.

2. Joint seams shall be formed with specified seam adhesive. Seams shall be in locations as shown on approved shop drawings and acceptable to the Engineer. Excess adhesive shall be promptly removed.

3. A minimum radius of 13 mm shall be provided for countertop inside corners.

4. Gaps shall be filled between countertop and terminating substrates with appropriate sealant.

5. Rout sink cut-outs shall be in accordance to manufacturer's template. Solid surface cast sink units shall be installed to countertops with appropriate adhesive.

6. Backsplashes and end splashes shall be installed where indicated on drawings. Install countertops with appropriate adhesive.

7. Vanities: Front panels shall be secured to solid substrate with appropriate adhesive. A 5 mm gap shall be maintained between fixed and removable panels.

1018.3.4 Grouting and Pointing

1. Tiles shall have laid in place for at least 24 h 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.

2. Grouting mortar shall be applied over the tile by float or squeegee stroked diagonally across the joints. Excess mortar shall be removed with a wet sponge stroked diagonally or in a circular-motion after 12 min to 15 min. A barely damp or dry sponge shall be used to remove remaining haze while smoothing all grouted joints.

1018.3.5 Cleaning

1. Tile surfaces shall be cleaned thoroughly as possible upon completion of grouting.

2. All grout haze shall be removed using the appropriate cleaner.

3. Tiles shall be thoroughly rinsed with clean water before and after using chemical cleaners.

4. Surface of tile shall be polished with soft cloth.

1018.3.6 Protection from Construction Dirt

1. A protective coat of neutral cleanser solution diluted with water in the proportion of 1:4 (1 L cleanser concentrate to 4 L of water) shall be applied.

2. In addition, tile flooring shall be covered with heavy-duty non-staining construction paper, taped in place. The protective paper shall not be torn or removed.

3. Just before final acceptance of the work, the protective paper shall be removed and the protective coat of neutral cleaner from tile surface shall be rinsed off.

1018.3.7 Quality Control

1. Each type and color of tile, mortar, adhesive and grout shall be obtained from a single source to minimize variations in appearance and quality.

2. Before installation of tiles, mock-ups shall be erected for each tile and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of material and execution. Mock-ups shall be built using materials indicated for final of work.

1018.3.8 Delivery, Storage and Handling

1. Packaged materials shall be delivered and stored in original containers with seals unbroken and labels intact until ready for installation.

2. Damage or contamination of materials by water, foreign matter and other causes that may affect its appearance and quality shall be prevented.

3. Tiles and setting materials shall be stored on elevated platforms, under cover and in a dry location and protect from contamination, dampness, or overheating.

1018.4 Method of Measurement

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

1018.5 Basis of Payment

The quantities measured as prescribed in Section 1018.4, Method of Measurement shall be based on the Unit Bid or Contract Unit Price which price and payment constitutes full compensation for furnishing all materials, labor, tools, equipment and other incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1018	Ceramic Tiles	Square Meter

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 in accordance with the Plans and this Specification.

1027.2 Material Requirements

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

1027.2.1 Cement

Portland cement shall conform to the requirements as defined in Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete.

1027.2.2 Hydrated Lime

Hydrated lime shall conform to the requirements as defined in Subsection 900.2.5, Admixtures of Item 900, Structural Concrete.

1027.2.3 Fine Aggregates

Fine aggregates shall be clean, washed river sand and free from dirt, clay, organic matter or other deleterious substances. Sand derived from crushed gravel or stone may be used with the Engineer's approval but in no case shall such sand be derived from stone unsuitable for use as coarse aggregates.

Fine aggregates shall conform to ASTM C897, Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters, Grading.

Table 1027.1 Grading of Fine Aggregates for Portland Cement-Based Plasters

Sieve size No.	% Retaining by Weight
4.75 mm	0
2.36 mm	0
1.18 mm	40

600 um	65
300 um	90
150 um	100
75 um	100

1027.2.4 Water

It shall conform to the Specification requirements defined in Subsection 900.2.3, Water of Item 900, Structural Concrete.

1027.3 Construction Requirements

1027.3.1 Surface Preparation

All plaster bases and accessories shall be free of deleterious amounts of rust, oil, or other foreign matter, which could cause bond failure or unsightly discoloration.

1. After removal of formworks reinforced concrete surfaces shall be roughened to improve adhesion of cement plaster.

2. 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.

3. Metal bases and accessories used to receive plaster shall be installed in conformance with ASTM C1063, Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster, except as other specified. Non-metallic based used to receive plaster shall be installed in conformance with ASTM C1787, Standard Specification for Installation of Non-Metallic Plaster Bases Used with Portland Cement Based Plaster in Vertical Wall Application.

4. Surfaces of solid base to receive plaster, such as masonry, stone, cast in place or precast concrete shall be straight and true within 6 mm in 3 m and shall be free of form oil or other elements, which would interfere with bonding. Conditions where the surfaces are out of tolerance shall be corrected prior to the application of the plaster. Ferrous-containing form ties or other obstructions shall be removed or receded a minimum 3 mm below the surface of the

solid base and treated with a corrosion-resistant coating. Non-ferrous protuberances shall be permitted to be trimmed back even with the surface of the solid base.

1027.3.2 Plaster Proportions

All plaster shall be mixed and proportioned in accordance with the applicable requirements of ASTM C926, Standard Specification for Application of Portland Cement-Based Plaster.

The method of measuring materials for the finish shall be such that the specified proportions are controlled and accurately maintained. The weights per cubic meter of the materials are considered to be as follows:

Table 1027.2 Measurement of Materials

Material	Weight, kg/m^3
Portland Cement	1505
Blended Cement	Weight printed on Bag
Masonry or Plastic Cement	Weight printed on Bag
Hydrated Lime	640
Sand, Damp, and Loose	1280 of dry sand

For purposes of this specification, a weight of 1,280 kg of oven-dried sand shall be used. This is, in most cases, equivalent to 0.028 m^3 of loose, damp sand.

Plaster mix used shall be as designated and referenced to Table 1027.3. Base coat proportions shall be as shown in Table 1027.4 for the mix specified from Table 1027.3. Finish-coat proportions for job-mixed finish coats shall be as specified in Table 1027.5.

Table 1027.3 Plaster Bases - Permissible Mixes

Property Base	Mixes for Plaster Coats

	First (Scratch)	Second (Brown)
Low absorption, such as dense, smooth clay tile, brick, or concrete	C CM or MS P	C, CL, M or CM CM, MS, or M P
High Absorption, such as concrete masonry, absorptive brick, or tile	CL M CM or MS P	CL M CM, MS, or M P
Metal plaster base	C CL CM or MS M CP P	C, CL, M, CM, or MS CL CM, MS, or M CP or P M CP or P P

Where specified, natural or synthetic fibers shall be free of contaminants and used only in the base coat(s). The quantities per batch shall be in accordance with the published directions of the fiber manufacturer.

Table 1027.4 Base-Coat Proportions, [A] Parts by Volume [B]

	Cementitious Materials	

Plaster Mix Symbols	Portland Cement Blend	Plastic Cement	Masonry Cement		Lime	Volume of Aggregate per Sum of Separate Volumes of Cementitious Materials	
			N	M or S		1st coat	2nd coat
C	1	-	-	-	0 – ¾	2 ½ - 4	3 - 5
CL	1	-	-	-	¾ - 1 ½	2 ½ - 4	3 - 5
M	-	-	1	-	-	2 ½ - 4	3 - 5
CM	1	-	1	-	-	2 ½ - 4	3 - 5
MS	-	-	-	1	-	2 ½ - 4	3 - 5
P	-	1	-	-	-	2 ½ - 4	3 - 5
CP	1	1	-	-	-	2 ½ - 4	3 - 5

Note:

A The mix proportions for plaster scratch and brown coats to receive ceramic tile shall be in accordance with the applicable requirements of ANSI A108.1 series applicable to Specified method of setting time.

B Variations of lime, sand, and perlite contents are allowed due to variation in local sands and insulation and weight requirements. A higher lime content will generally support a higher aggregate content without loss of workability. The workability of the plaster mix will govern the amounts of lime, sand or perlite

C The same or greater sand proportion shall be used in the second coat than is used in the first coat.

Table 1027.5 Finish Coat Proportion Parts by Volume Cementitious Materials

Plaster Mix Symbols	Cementitious Materials					Volume of Aggregate per Sum of Separate Volumes of Cementitious Materials
	Portland Cement Blend	Plastic Cement	Masonry Cement		Lime	
			N	M or S		1 ½ - 3
F	1	-	-	-	0 – ¾	1 ½ - 3
FL	1	-	-	-	¾ - 1 ½	1 ½ - 3
FM	-	-	1	-	-	1 ½ - 3
FCM	1	-	1	-	-	1 ½ - 3
FMS	-	-	-	1	-	1 ½ - 3
FP	-	1	-	-	-	1 ½ - 3

Note:

A Additional Portland cement is not required when Type S or M Masonry cement is used.

B In areas not subject to impact, perlite aggregate shall be permitted to be used over bas-coat plaster containing perlite aggregate.

1027.3.2.1 Mixing

All plaster shall be prepared in a mechanical mixer, using sufficient water to produce a workable consistency and uniform color.

Base-coat plasters that have stiffened because of evaporation of water shall be permitted to be tempered one time only to restore the required consistency. Plaster not used within 90 min from start of initial mixing shall be discarded. Finish-coat plaster shall not be tempered.

1027.3.3 Mixture

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

2. Finish coat shall be pure Portland cement properly graded conforming to the requirements of Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete and mixed with water to approved consistency and plasticity.

1027.3.4 Application

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

2. Finish coat shall not be applied until after the brown coat has seasoned for 7 days and corrective measures had been done by the Contractor on surface 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 sandpaper in a circular motion to remove trowel marks, checks and blemishes. All cement plaster finish shall be 10 mm thick minimum on vertical concrete and/or masonry walls.

Wherever indicated on the Plans to be "Simulated Red Brick Finish," or "Decorative Stone" the Contractor shall render brick design or stone on plaster surface before brown coat had properly set and then allowed to dry. Cement plaster shall not be applied directly to:

1. Concrete or masonry surface that had been coated with bituminous compound and; 2. Surfaces that had been painted or previously plastered.

Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1027.3.5 Workmanship

Cement plaster finish shall be true to details and plumbed and do not deviate more than plus or minus 3 mm in 3 m from a true plane in finished plaster surfaces, as measured by a 3 m straight-edge placed at any location on surface. Finish surface shall have no visible junction marks where one (1) day's work adjoins the other. Vertical and horizontal groove joints shall be 25 mm wide and 10 mm deep or as shown on the Plans.

1027.4 Method of Measurement

All cement plaster finish shall be measured in square meters, lump sum 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 shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

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 required and undertaking the proper application of painting, varnishing and related works in accordance with the Plans and this Specification.

1032.2 Material Requirements

1032.2.1 Paint Materials

Paint material shall conform to the requirements of the following Specifications:

Table 1032.1 Paint Material Specification Requirements

Material	PNS Code	Description	Application
Flat Latex Paint	PNS 139	Specification for Flat Latex Paint (white and light tints for exterior and interior use)	Properly prepared plaster, masonry and primed wood and other architectural surfaces
Semi-gloss Latex Paint	PNS 463	Specification for Semi- Gloss Latex Paint (white and light tints for exterior and interior use)	Properly prepared plaster, masonry and primed wood and other architectural surfaces
Semi-gloss Enamel Paint	PNS 225	Specification for Alkyd- based Semi-Gloss Enamel Paint (white and light tints for exterior and interior use)	Properly prepared plaster, masonry and primed wood and other architectural surfaces
Enamel Paint	PNS 226	Specification for Alkyd based Gloss Enamel Paint (white and coloured for exterior and interior use)	Wood, metal and other architectural surfaces

Alkyd-based Metal Primer	PNS 366	Specification for Alkyd based Metal Primer	Ferrous metal
Epoxy Metal Primer	PNS 2113	Specification of Epoxy Metal Primer	Ferrous metal
Flatwall Enamel Paint	PNS 227	Specification for Alkyd based Flat Enamel Paint (white and light tints for exterior and interior use)	Wood
Gloss Latex Paint	PNS 462	Specification for Gloss Latex Paint (white and light tints for exterior and interior use)	Masonry
Water Based Gloss Roof Paint	PNS 612	Specification for Water Based Gloss Roof Paint	Concrete, metal, wood and other paintable roofing materials
Elastomeric Wall Coating	PNS 2116	Specification for Elastomeric Wall Coating	Plaster, masonry, other architectural surfaces
Epoxy Enamel	PNS 2118	Specification for Epoxy Enamel, white and coloured	Concrete, wood, metal and other architectural surfaces
Roof paint (water based, flat)	PNS 464	Specification for Roof paint (water-based, flat)	Paintable roofing materials

Roof paint (Portland Cement)	PNS 465	Specification for Roof paint (Portland Cement)	Paintable roofing materials

1032.2.2 Tinting Colors

Tinting colors shall be first grade quality, pigment ground in alkyd resin that disperses and mixes easily with paint to produce the color desired. Same brand of paint and tinting color shall be used to effect good paint body.

1032.2.3 Acry-colors

It shall be high strength tinting colors for water-based coatings that are specially formulated from the finest blend of pigments combined with pure acrylic latex vehicle that is easy to disperse, fast drying, odorless, and gives maximum color retention.

1032.2.4 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 Silicon Water Repellant

Silicon water repellant shall be transparent water shield especially formulated to repel rain and moisture on exterior masonry surfaces.

1032.2.6 Patching Compound

Patching compound shall be fine powder type material like calciumine that can be mixed into paint that will produce a putty consistency, with oil base primers and paints to fill minor surface dents and imperfections.

1032.2.7 Varnish

Varnish shall be a homogeneous solution of resin, drying oil, drier and solvent. It shall be extremely durable clear coating, highly resistant to wear and tear without cracking, peeling, whitening, spotting, etc. with minimum loss of gloss for a maximum period of time.

1032.2.8 Lacquer

Lacquer shall be any type of organic coating that dries rapidly and solely by evaporation of the solvent. Typical solvent are acetates, alcohols and ketones. Clear gloss lacquer shall be in accordance with the requirements of PNS 368, Specification for Clear Gloss Lacquer.

1032.2.9 Shellac

Shellac shall be a solution of refined lac resin in denatured alcohol. It dries up by evaporation of the alcohol. The resin is generally furnished in orange and bleached grades.

1032.2.10 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 zirk stearate to allow dry sanding of sealer. It shall be in accordance with the requirements of PNS 367, Specification for Lacquer Sanding Sealer.

1032.2.11 Oil Wood Stain

Oil-based stain shall be a penetrating stain for interior doors, windows, trim and furniture. It rejuvenates and transforms interior timber. Oil-based stain penetrates deeply and adds color without raising the grain. Oil-based stain is best used to rejuvenate old or used timber.

1032.2.12 Glazing Putty

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

1032.2.13 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.

1032.2.14 Schedule

Exterior

1. Plain cement plastered finish - Three (3) coats acrylic base masonry paint to be painted
2. Concrete exposed aggregate - One (1) coat water repellant and/or tool finish
3. Ferrous metal - One (1) coat primer and two (2) coats enamel paint
4. Galvanized metal - One (1) coat zinc chromate primer and two (2) coats Portland cement paint
5. Wood paint finish - Three (3) coats oil based paint
6. Wood varnished finish - Varnish water repellant

Interior

1. Plain cement plastered finish to - be painted - Two (2) coats acrylic base masonry paint

2. Concrete exposed aggregate - Clean surface

and/

or tool finish

3. Ferrous metal - One (1) coat primer and two (2) coats

enamel paint

4. Woodwork sea-mist - Three (3) coats of three (3) parts thinner

and one (1) part lacquer

5. Woodwork varnish - First coat of one (1) part sanding sealer

to one (1) part solvent

Second coat of two-third (2/3)

sanding sealer to one-third (1/3) solvent

6. Woodwork painted finish - Three (3) coats oil base paint

7. Ceiling boards textured finish - One (1) coat oil based paint, all to dry the patch surfaces unevenness and apply textured paint coat

1032.2.15 Containers and Markings

It shall be in accordance with the requirements of PNS 140, General Requirements for Packaging, Packing and Marking of Paints and Other Protective Coatings.

All paints, varnishes, and other related products shall be shipped in strong, substantial containers marked in prints distinctive color of the label or in letters clearly visible to the naked eye with the following information:

1. Type of Paint

2. Brand or Trademark

3. Name and address of manufacturer

4. Net Volume and/or mass in metric units

5. Directions for use

6. Safety precautions

7. Batch or lot number

Any package or container not so marked will not be accepted for use under this Specification.

1032.3 Construction Requirements

Prior to commencement of the painting, varnishing and related work, the surfaces to be applied shall be examined 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 knot-holes 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 of 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 the 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 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. Where required to prime coat surface with Red Lead Primer same shall be approved by the Engineer.

In addition, the following shall be undertaken prior to painting, varnishing and ther related works:

I Voids, cracks, nick, and other wood imperfections 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 flawed out after application of paint.

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

Paint is atomized by high pressure pumping rather than broken up by the large volume of air mixed with it. This procedure change the required properties of the paint.

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 one (1) pint of suitable thinner per gallon of the paint.

1032.3.4 Storage

All materials 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 a times. 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, o or stains on adjacent surfaces 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

1. All paints shall be evenly applied. Coats shall be of proper consistency and well brushed out so as to show a minimum of brush marks.

2. All coats shall be thoroughly dry before the succeeding coat is applied.

3. 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.

4. 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.

5. Hardware, lighting fixture and other similar items shall be removed of protected during the painting varnishing and related work operations and re installed after completion of the work.

1032.3.7 Procedure for Sea-Mist Finish

1. Depress wood grain by steel brush and sand surface lightly.
2. Apply sanding sealer.
3. Apply two (2) coats of industrial lacquer paint.
4. Spray last coat of industrial lacquer paint mixed with sanding sealer.
5. Apply wood paste filler thinned with turpentine or paint thinner into the wood surface.
6. Wipe off wood paste filler immediately.
7. Spray flat or gloss lacquer whichever is specified.

1032.3.8 Procedure for Varnish Finish

1. Sand surface thoroughly.
2. Apply putty on all cracks and other wood imperfections with wood paste filler.

3. Apply oil stain.
4. Apply lacquer sanding sealer.
5. Sand surface along the grain.
6. Spray three (3) coats of clear dead flat lacquer.
7. Polish surface coated using cloth pad.
8. Spray gloss lacquer or flat lacquer whichever is desired or specified.

1032.3.9 Procedure for Ducco Finish

1. Sand surface thoroughly.
2. Apply primer surface white or gray by brush or spray.
3. Apply lacquer spot putty in thin coat. Allow each coat to become thoroughly dry before applying next coat.
4.Apply primer surfaces and then allow to dry in 2 h before applying the next coat.
5. Apply a coat of flat tone semi-gloss enamel as per color scheme submitted and approved by the Engineer.

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 and proper application of all materials, labor, equipment, tools and other incidental necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032(1)a	Painting Works, Masonry/Concrete	Square Meter
1032(1)c	Painting Works, Steel	Square Meter

ITEM 1046 - MASONRY WORKS

1046.1 Description

This Item shall consist of furnishing of all the necessary materials, tools, equipment and labor necessary to complete the execution of the masonry works as shown on the plans.

1046.2 Material Requirements

1046.2.1 Hydraulic Cement

Hydraulic Cement shall conform to the applicable requirements of Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete.

1046.2.2 Aggregates

1046.2.2.1 Aggregates for Concrete Hollow Blocks and Louver Blocks

Aggregates shall conform to the applicable requirements of Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete.

1046.2.2.2 Aggregates/Pozzolan for Autoclaved Aerated Concrete (AAC) Blocks

Aggregates and pozzolan shall conform to the applicable requirements of ASTM C332, Standard Specification for Lightweight Aggregates for Insulating Concrete and ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan in Concrete, respectively.

1046.2.3 Water

Water shall conform to the applicable requirements of Subsection 900.2.3, Water of Item 900, Structural Concrete

1046.2.4 Reinforcing Steel

1046.2.4.1 Reinforcing Steel for Concrete Hollow Blocks and Louver Blocks

Reinforcing steel shall conform to the applicable requirements of Item 902, Reinforcing Steel.

1046.2.4.2 Reinforcing Steel for Autoclaved Aerated Concrete (AAC) Blocks

Dowels and tie bars shall conform to the applicable requirements of AASHTO M322M or ASTM A996M, Standard Specification for Rail-Steel and Axle Steel Deformed Bars for Concrete Reinforcement.

1046.2.5 Mortar for Concrete Hollow Blocks and Louver Blocks

Mortar shall consist of sand, cement and water conforming to the requirements of Item 900, Structural Concrete, mixed in the proportion of one (1) part cement to three (3) parts sand by volume, and sufficient water to obtain the required consistency.

1046.2.6 Quicklime for Autoclaved Aerated Concrete (AAC) Bloc

Quicklime shall conform to the applicable requirements of ASTM C5, Standard Specification for Quicklime for Structural Purposes.

1046.2.7 Gypsum for Autoclaved Aerated Concrete (AAC) Blocks

Gypsum shall conform to the applicable requirements of ASTM C22M, Standard Specification for Gypsum.

1046.2.8 Aeration Agent for Autoclaved Aerated Concrete (AAC) Blocks

Aeration agent shall conform to manufacturer's specifications.

1046.2.9 Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Blocks

Thin-bed mortar shall conform to the applicable requirements of ASTM C1660, Standard Specification for Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Masonry.

1046.2.10 Backer Rod for Autoclaved Aerated Concrete (AAC) Blocks

Backer rod shall conform to the applicable requirements of ASTM D5249, Standard Specification for Backer Material Use with Cold- and Hot- Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.

1046.2.11 Concrete Hollow Blocks and Louver Blocks

Width, height and length of concrete hollow blocks and louver blocks shall be +3.20 mm from the specified dimension as shown on the Plans.

1046.2.11.1 Load-Bearing Concrete Hollow Blocks

Load-bearing concrete hollow blocks shall conform to the physical requirements of the Tables 1046.1 and 1046.2 as prescribed on ASTM C90, Standard Specifications for Load-bearing Concrete Masonry Units.

Table 1046.1 Thickness of Face Shells and Webs

Nominal Width (W) of Units, mm	**Minimum Face Shell Thickness (t_{fs}), mm**	**Minimum Web Thickness (t_w)**	
		Webs, mm	**Equivalent Web Thickness, mm/linear m**
76.2 and 102	19	19	136

152	25	25	188
203	32	25	188
254 and greater	32	29	209

Table 1046.2 Strength, Absorption, and Density Classification Requirements

Density Classification	**Oven-Dry Density of Concrete, kg/m³**	**Maximum Water Absorption, kg/m³**		**Minimum Net Area Compressive Strength, MPa (Psi)**	
	Average of 3 Units	**Average of 3 Units**	**Individual Units**	**Average of 3 Units**	**Individual Units**
Lightweight	Less than 1680	288	320	13.1 (1900)	11.7 (1700)
Medium Weight	1680 to less than 2000	240	272	13.1 (1900)	11.7 (1700)
Normal Weight	2000 or more	208	240	13.1 (1900)	11.7 (1700)

1046.2.11.2 Non-load bearing Concrete Hollow Blocks and Louver Blocks

Non-load bearing concrete hollow blocks shall be clearly marked to prevent their use as load bearing units.

1. Type I, Moisture-Controlled Units - Units shall conform to the requirements of Tables 1046.3, 1046.4 and 1046.5.

2. Type II, Non-Moisture-Controlled Units - Units designated as Type II shall conform to the requirements of Table 1046.

Table 1046.3 Weight Classification

Weight Classification	**Oven-Dry Density of Concrete, kg/m³**
Lightweight	Less than 1680
Medium Weight	1680 to less than 2000
Normal Weight	2000 or more

Table 1046.4 Strength Requirements

	Compressive Strength (Average Net Area, Min.) MPa (Psi)
Average of 3 Units	4.14 (600)
Individual Unit	3.45 (500)

Table 1046.5 Moisture-Content Requirements for Type I Units

Total Linear Drying Shrinkage, %	**Moisture Content, max., % of Total Absorption (Average of 3 Units)**		
	Humidity Conditions at Job Site of Point of Use		
	Humid [A]	**Intermediate [B]**	**Arid [C]**

Less than 0.03	45	40	35
0.03 to less than 0.045	40	35	30
0.045 to 0.065, max	35	30	25

Note:

A Mean annual relative humidity above 75%

B Mean annual relative humidity 50 to 75%

C Mean annual relative humidity less than 50%

1046.2.12 Autoclaved Aerated Concrete Blocks

Overall unit dimension (width, height or length) of autoclaved aerated concrete blocks shall not exceed 3 mm from the specified dimension shown on the plans.

Non-load bearing Autoclaved Aerated Concrete Blocks shall conform to the physical requirements of the following tables as prescribed on ASTM C1693, Standard Specifications for Autoclaved Aerated Concrete (AAC).

Table 1046.6 Weight Classification

Strength Class	**Nominal Dry Bulk Density, kg/m3**	**Density Limits, kg/m3**	
		Lower Limit >	**Upper Limit <**
AAC-4	500 600	450 550	550 650

AAC-5	600 700	550 650	650 750
AAC-6	600 700	550 650	650 750

Table 1046.7 Strength Requirements

Strength Class	Minimum Compressive Strength, MPa (Psi)
AAC-4	4.0 (580)
AAC-5	5.0 (725)
AAC-6	6.0 (870)

Table 1046.8 Average Drying Shrinkage Requirement

Strength Class	Average Drying Shrinkage
AAC-4	≤0.02%
AAC-5	≤0.02%
AAC-6	≤0.02%

1046.2.13 Other Constituents for Concrete Hollow Blocks and Louver Blocks

Air-entraining agents, coloring pigments, integral water repellents, finely ground silica, and other constituents that are previously established as suitable for use in concrete masonry shall conform to applicable ASTM standards.

1046.2.14 Adobe Blocks

Adobe units shall have an average compressive strength of 2068 KPa when tested in accordance with ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay. Five (5) samples shall be tested and individual units are not permitted to have a compressive strength of less than 1724 KPa.

1046.2.15 Mortar for Adobe Blocks

Mortar for adobe shall conform to ASTM C270, Standard Specification for Mortar for Unit Masonry.

1046.3 Construction Requirements

1046.3.1 Concrete Hollow Blocks and Louver Blocks

1046.3.1.1 Installation

1. All masonry work shall be laid true to line, level, plumb and neat in accordance with the Plans.

2. Units shall be cut accurately to fit all plumbing ducts, opening for electrical works, and all holes shall be neatly patched.

3. No construction support shall be attached to the wall except where specifically permitted by the Engineer.

4. Masonry unit shall be sound, dry, clean and free from cracks when placed in the structure.

5. Proper masonry units shall be used to provide for all window, doors, bond beams, lintels, plasters etc., with a minimum of unit cutting. 6. Where masonry units cutting is necessary, all cuts shall be neat and true to line.

7. Units shall be placed while the mortar is soft and plastic. Any unit disturbed to the extent that the initial bond is broken after initial positioning shall be removed and re-laid in fresh mortar.

8. Mortar shall not be spread too far ahead of units, as it will stiffen and loose plasticity, especially in hot weather. Mortar that has stiffened shall not be used. ASTM C270, Standard Specification for Mortar for Unit Masonry requires that mortar be used within 2½ hours of initial mixing.

1046.3.1.2 Reinforcement for Concrete Hollow Blocks

Reinforcement shall be done in accordance with the structural Plans as to size, spacing and other requirements of Section 902.3, Construction Requirements of Item 902, Reinforcing Steel. Reinforcement shall be clean and free from loose, rust, scales and any coatings that will reduce bond.

1046.3.1.3 Sampling and Testing for Concrete Hollow Blocks and Louvers

Method of Sampling for Quality Test shall be as follows:

1. One (1) Quality Test for every 10,000 units or fraction thereof.

2. Six (6) specimens shall be submitted for one (1) quality test in which three (3) specimens for Compression Test and the remaining three (3) for Moisture Content and Water Absorption.

Units shall be tested in accordance with ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units and ASTM C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1046.3.1.4 Storage and Handling of Masonry Works

The blocks shall be stockpiled on planks or other supports free from contact with ground and covered. The blocks shall be handled with care and damaged units shall be rejected.

1046.3.2 Autoclaved Aerated Concrete (AAC) Blocks

1046.3.2.1 Installation

1. Reference lines shall be established based on the given Plan.

2. Layout adjustments or opening rectifications (plumbing ducts or opening for electrical works) shall be made before laying masonry units.

3. Masonry unit shall be clean and free from dust or loose particles on it.

4. Floor and wall area shall be moistened prior to laying first layer of masonry unit. Mortar setting with 2:1 sand: cement ratio shall be provided as starter blocks if slab is unleveled beyond 2 cm

5. Adhesive shall be mixed using manufacturer's specified proportion of water using a power mixer and a non-absorptive pail or mixing container. Adhesive that has stiffened shall not be used. The pot life of the adhesive mix shall be referred to the manufacturer's instructions.

6. Thin bed adhesive shall be set and screed with notched trowel on the starter blocks to receive initial layer of masonry unit.

7. Laying of masonry unit shall be continued until the lateral layer is complete before moving on to the next layer. Adhesive shall be applied at 5 mm thick using a notched trowel on the required portions and maintaining 3 mm to 5 mm gap on the wall side surface to allow any wall movement. Alignment and levelness shall be regularly checked using rubber mallet and level bar.

8. Gaps and joints shall be filled with adhesive. Excess adhesive shall be spread on the surface or used to fill the gaps.

9. Rebar dowels, 10 mm in diameter, shall be installed spaced at 600 mm on the wall sides and along the affected beam and slab soffit. Dowels shall be embedded at least 50 mm into the side and top structures, exposing 100 mm to support lateral movement. No epoxy is needed.

10. Polyethylene backer rod, 20 mm in diameter, shall also be simultaneously installed at the slab or beam soffit.

11. When cutting of masonry unit is necessary, it shall be downsized first before applying the adhesive. Ice or wood saw can be used for this matter.

12. Corner interlocking setup is recommended.

1046.3.2.2 Finish and Appearance

1. All units shall be sound and free of cracks or other defects that interfere with the proper placement of the unit or significantly impair the strength or permanence of the construction. Minor cracks, incidental to the usual method of manufacture or minor chipping resulting from customary methods of handling in shipment and delivery, are not grounds for rejection.

2. Where units are to be used in wall construction, the face or faces that are to be exposed shall not show chips or cracks, not otherwise permitted, or other imperfections when viewed from a distance of not less than 6.1 m under diffused lighting. 5% of a shipment containing chips and cracks not longer than 1/3 of the dimension where it is found and not wider than 5 mm shall be permitted.

3. The color and texture of units shall be specified by the Engineer. The finished surfaces that will be exposed in place shall conform to an approved sample, consisting of not less than four (4) units, representing the range of texture and color permitted.

4. A shipment shall not contain more than 5% of units, including broken unit that do not meet requirements of the above provisions.

1046.3.2.3 Sampling and Testing of AAC Blocks

Method of Sampling for Quality Test shall be as follows:

1. Two (2) Quality Tests for every 10,000 units or a fraction thereof

2. Three (3) specimens shall be submitted for every one (1) quality test namely, Compression Test and Moisture Content & Bulk Density Determination.

Units shall be tested in accordance with ASTM C1693, Standard Specifications for Autoclaved Aerated Concrete (AAC).

1046.4 Method of Measurement

The work to be paid for under this Item shall be the number of square meters of masonry units that are satisfactorily completed and accepted.

1046.5 Basis of Payment

Measurement shall be paid for at the Contract Unit Price for Masonry Works The accepted quantity, measured as prescribed in Section 1046.4, Method of which price and payment shall include the cost of furnishing all labor, materials and equipment necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (1)a1	CHB Non-Load Bearing (including Reinforcing Steel), 100 mm	Square Meter
1046 (1)a2	CHB Non-Load Bearing (including Reinforcing Steel), 150 mm	Square Meter

ITEM 1047 - METAL STRUCTURES

1047.1 Description

This work shall consist of furnishing, fabricating, hauling, erecting, welding and painting of metal structure and accessories constructed in accordance with the Plans and this Specifications.

1047.2 Material Requirements

1047.2.1 Classes of Structural Steels

1047.2.1.1 Built-Up Shapes

Built-up shapes are defined as structural steel sections made up of steel plates with thickness ranging from 5 mm to 45 mm, welded together to form structural shapes. It shall conform to the requirements of ASTM A36M, Standard Specification for Carbon Structural Steel.

Built-up cross sections consisting of plates with a thickness exceeding 50 mm, used as members subject to primary tensile forces due to tension or flexural and spliced or connected to other members using complete joint-penetration groove welds that fuse through thickness of plate, shall conform to ASTM A6M, Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes and Sheet Piling, Supplementary Requirement S5, Charpy V-Notch Impact Test and ASTM A673M, Standard Specification for Sampling Procedure for Impact Testing of Structural Steel.

1047.2.1.2 Cold Formed Plate Shapes

Cold formed plate shapes are made from steel plates with thickness ranging from 6 mm to 20 mm formed by cold rolling or by press brake bending into the desired shape. It shall conform to ASTM A36M.

1047.2.1.3 Cold-Formed Light Gage Shapes

Structural steel shapes cold-formed from coils or sheets with thicknesses ranging from 2 mm to 6 mm.

1047.2.1.4 Rolled Steel Shapes

Rolled Steel shapes are structural steel sections produced by passing red hat blooms (for larger sections) or billets (for smaller sections) through rolls unit the desired shape is attained.

Rolled steel shapes shall conform to the billet specifications for PNS 49, Ste Bars for Concrete Reinforcement - Specification, Grade 230.

1047.2.1.5 Metal Decks

Metal decks or panels shall conform to Item 1033, Metal Decks.

1047.2.2 Structural Steel Materials

1047.2.2.1 General

For hot-rolled structural shapes, plates and bars, such tests shall be made in accordance in ASTM A6M; for sheets, such tests shall be made in accordance with ASTM A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements; for tubing and pipe, such tests shall be made in accordance with the requirements of the applicable ASTM standards listed for those product forms.

Structural steel shall be furnished according to the following applicable ASTM specifications:

1047.2.2.2 Hot-Rolled Structural Shapes

Hot-rolled structural shapes shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTM A36M	Standard Specification for Carbon Structural Steel
ASTM A529M	Standard Specification for High-Strength Carbon- Manganese Steel of Structural Quality
ASTM A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588M	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50ksi (345Mpa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A709M	Standard Specification for Structural Steel for Bridges
ASTM A913M	Standard Specification for High-Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)
ASTM A992M	Standard Specification for Structural Steel Shapes

1047.2.2.3 Structural Tubing

Structural tubing shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTM A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501M	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A618M	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A847M	Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance

1047.2.2.4 Steel Pipes

It shall conform to the requirements of ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless, Grade B.

1047.2.2.5 Steel Plates

Steel plates shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTM A36M	Standard Specification for Carbon Structural Steel
ASTM A242M	Standard Specification for High-Strength Low-Alloy Structural Steel

ASTM A283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A514M	Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A529M	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588M	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50ksi (345Mpa) Minimum Yield Point with Atmospheric Corrosion Resistance
ASTM A709M	Standard Specification for Structural Steel for Bridges
ASTM A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

1047.2.2.6 Steel Bars

Steel bars shall conform to the following specification or as indicated in the Plans:

Designation	Title
ASTM A36M	Standard Specification for Carbon Structural Steel
ASTM A529M	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality

ASTM A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A709M	Standard Specification for Structural Steel for Bridges

1047.2.2.7 Steel Sheets

Steel sheets shall conform to the following specification or as indicated in the Plans:

Designation	Title
ASTM A606M	Standard Specification for Steel, Sheet and Strip, High Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, with Improved Atmospheric Corrosion Resistance
ASTM A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength

1047.2.3 Steel Casting and Forgings

Cast steel shall conform to ASTM A216M, Standard Specification for Steel Castings, Carbon Suitable for Fusion Welding, for High Temperature Service.

Steel forging shall conform to ASTM A668M, Standard Specification for Steel Forgings, Carbon and Alloy, for General Industrial Use.

1047.2.4 Bolts, Washer and Nuts

Bolts, washer and nuts shall conform to the requirements of the following specifications or as indicated in the Plans:

Designation	Title
Bolts	

ASTM A307	Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength
ASTM F3125M	Standard specification for High Strength Structural Bolts, Steel and Alloy Steel, Heat Treated, 120 ksi (830 MPa) and 150 ksi (1040 MPa) Minimum Tensile Strength, Inch and Metric Dimensions
ASTM A449	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
Nuts	
ASTM A194M	Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service or Both
ASTM A563	Standard Specification for Carbon and Alloy Steel
Washers	
ASTM F436M	Standard Specification for Hardened Steel Washers Inch and Metric Dimensions
ASTM F959M	Standard Specification for Compressible-Washer-Type Direct Tension Indicators for Use with Structural Fasteners, Inch and Metric Series

1047.2.5 Anchor Rods and Threaded Rods

Anchor rod and threaded rod material shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTM A36M	Standard Specification for Carbon Structural Steel
ASTM A193M	Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications
ASTM A354	Standard Specification for Quenched and Tempered Alloy Steel Bolts, Studs, and Other Externally Threaded Fasteners
ASTM A449	Standard Specification for Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength

1047.2.6 Consumables for Welding

Filler metals and fluxes shall conform to the following applicable specifications of American Welding Society or as indicated in the Plans:

Designation	Title
AWS A5.1M	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding

AWS A5.5M	Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
AWS A5.17M	Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.18M	Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
AWS A5.23M	Specification for /Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.25M	Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding
AWS A5.26M	Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding
AWS A5.32M	Welding Consumables - Gases and Gas Mixtures for Fusion Welding and Allied Processes
AWS A5.36M	Specification for Carbon and Low-Alloy Steel Flux Cored Electrodes for Flux Cored Arc Welding and Metal Cored Electrodes for Gas Metal Arc Welding

1047.2.7 Headed Stud Anchors

Steel stud shear connectors shall conform to the requirements of AWS D1.1M, Structural Welding Code - Steel.

Studs are made from cold drawn bar, either semi-killed or killed aluminum or silicon deoxidized, conforming to the requirements of ASTM A29M, Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.

1047.2.8 Turnbuckle

Unless otherwise specified, turnbuckle shall conform to the applicable Welded, Forged and AASHTO M 269, Standard Specification for Turnbuckles requirements of ASTM F1145, Standard Specification for Turnbuckles, Swaged, and Shackles.

1047.2.9 Stainless Steel Flagpole Post

Unless otherwise specified, stainless steel for flagpole shall conform to the applicable requirements of ASTM A312M, Standard Specification for Seamless Welded, and Heavily Cold Worked Austenitic Stainless Steel Pipes and ASTM A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.

1047.3 Construction Requirements

1047.3.1 Shop and Erection Drawings

Shop and erection drawings are permitted to be prepared in stages. Shop drawings shall be prepared in advance of fabrication and give complete information necessary for the fabrication of the component parts of the structure, including the location, type and size of welds and bolts. Erection drawings shall be prepared in advance of the erection and give information necessary for erection of the structure. Shop and erection drawings shall clearly distinguish between shop and field welds and bolts and shall clearly identify pretensioned ad slip-critical high-strength bolted connections.

1047.3.2 Fabrication

1047.3.2.1 Cambering, Curving and Straightening

Local application of heat or mechanical means is permitted to be used to introduce or correct camber, curvature and straightness. The temperature of heated areas as measured by the approved methods, shall not exceed 593 °C for ASTM A514M or as indicated in the Plans.

1047.3.2.2 Thermal Cutting

Thermally cut edges shall meet the requirements of AWS D1.1M clauses 5.14.5.2, 5.14.8.3 and 5.14.8.4, with the exception that thermally cut free edge that will be subject to calculated static tensile stress shall be free of round bottom gouges greater than 5 mm and sharp V-shaped notches. Gouges deeper than 5 mm and notches shall be removed by grinding or repaired by welding.

Reentrant corners, except reentrant corners of beam copes and weld access holes, shall meet the requirements of AWS D1.1, Section 5.16. If another specified contour is required, it shall be shown on the contract. Beam copes and weld access shall meet the geometrical requirements of Section 510.1.6, Bearn Copes and Weld Access Holes of Chapter 5, Structural Steel of National Structural Code of the Philippines (NSCP), 2015 Edition. Beam copes and weld access holes in shapes that are to be galvanized shall be ground. For shapes with a flange thickness not exceeding 50 mm the roughness of thermally cut surfaces of copes shall be no greater a surface roughness value of 50 um as defined in ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay). For beam copes and weld access holes in which the curved part of the access hole is thermally cut in ASTM A6M hot rolled shapes with a flange thickness exceeding 50 mm and welded built-up shapes with material thickness greater than 50 mm, a preheat temperature of not less than 66 C shall be applied prior to thermal cutting. The thermally cut surface of access holes in ASTM A6M hot rolled shapes and built-up shapes with

a thickness greater than 50 mm shall be ground and inspected for cracks using magnetic particle inspection in accordance with ASTM E709, Standard Guide for Magnetic Particle Testing. Any crack is unacceptable regardless of size and location.

1047.3.2.3 Planning of Edges

Planning or finishing of sheared or thermally cut edges of plates or shapes is not required unless specifically called for in the Contract documents or included in a stipulated edge preparation for welding.

1047.3.2.4 Welded Construction

The technique of welding, workmanship, appearance and quality of welds, and the methods used in correcting nonconforming work shall be in accordance with AWS D1.1M.

1047.3.2.5 Bolted Construction

Parts of bolted members shall be pinned or bolted and rigidly held together during assembly. Use of a drift pin in bolt holes during assembly shall not distort the metal or enlarge the holes. Poor matching of holes shall be cause for rejection.

Bolts shall comply with the provisions of the Research Council on Structural Connections (RCSC) Specification for Structural Joints using ASTM F3125M except that thermally cut holes shall be permitted with a surface roughness profile not exceeding 25 μm as defined in ASME B46.1. Gouges shall not be a depth of 2 mm.

Fully inserted finger shims, with a total thickness of not more than 6 mm a joint, are permitted in joints without changing the strength (based upon hole type) for the design connections. The orientation of such shims is independent of the direction of application of the load. The use of high-strength bolts she conform to the requirements of the RCSC Specification for Structural Joints using ASTM F3125M.

1047.3.2.6 Dimensional Tolerances

Dimension tolerances shall be in accordance with the American Institute of Ste Construction (AISC) Code of Standard Practice for Steel Buildings and Bridges

1047.3.2.7 Finish of Column Bases

Column bases and base plates shall be finished in accordance with the following requirements:

1. Steel bearing plates 50 mm or less in thickness are permitted without milling provided a satisfactory contact bearing is obtained. Steel bearing plates over 50 mm but not over 100 mm in thickness are permitted to be straightened by pressing, or presses are not available, by milling for bearing surfaces (except as noted in subparagraph 2 and 3 of this section), to obtain a satisfactory contact bearing. Steel bearing plates over 100 mm in thickness shall be milled for bearing surfaces (except as noted in subparagraph 2 and 3 of this section).

2. Bottom surfaces of bearing plates and column bases that are grouted to ensure full bearing contact on foundations need to be milled.

3. Top surfaces of bearing plates need not be milled when complete-joint penetration groove welds are provided between the column and bearing plate.

1047.3.2.8 Holes for Anchor Rods

Holes for anchor rods shall be permitted to be thermally cut in accordance with the provisions of Subsection 1047.3.2.2, Thermal Cutting.

1047.3.2.9 Drain in Holes

When water can collect inside Hollow Structural Sections (HSS) or box members, either during construction or during service, the member shall be sealed, provided with a drain hole at the base.

1047.3.2.10 Requirements for Galvanized Members

Members and parts to be galvanized shall be designed, detailed and fabricated to provide for flow and drainage of pickling fluids and zinc and to prevent pressure built up in enclosed parts.

Design and detailing of of galvanized members shall conform to the requirements the following:

1. ASTM A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings and Iron and steel Products.

2. ASTM A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

3. ASTM A384M, Standard Practice for Safeguarding Against Warpage and Distortion During Hot-Dip Galvanizing of Steel Assemblies.

4. ASTM A780M, Standard Specification for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

1047.3.3 Shop Painting

1047.3.3.1 General Requirements

Shop painting and surface preparation shall be in accordance with the provision of the AISC Code of Standard Practice for Steel Building and Bridges. Shop paint is not required unless specified in the Contract Documents.

1047.3.3.2 Inaccessible Surfaces

except for contact surfaces, surfaces inaccessible after shop assembly shall be Cleaned and painted prior to assembly.

1047.3.3.3 Contact Surfaces

Paint is permitted in bearing-type connections. For slip critical connections, the faying surface requirements shall be in accordance with the RCSC Specification for Structural Joints Using ASTM F3125M.

1047.3.3.4 Finished Surfaces

Machine-finished surfaces shall be protected against corrosion by a rust inhibitive coating that can be removed prior to erection, or which has 10 characteristics that make removal prior to erection unnecessary.

1047.3.3.5 Surfaces Adjacent to Field Welds

Unless otherwise specified, surface within 50 mm of any field weld location shall be free of materials that would prevent proper welding or produce objectionable fumes during welding.

1047.3.4 Erection

1047.3.4.1 Alignment of Column Bases

Column bases shall be set level to the required elevation with full bearing of concrete or masonry.

1047.3.4.2 Bracing

The frame of steel skeleton buildings shall be carried up true and plumb within the limit defined in the AISC Code of Standard Practice for Steel Buildings and Bridges. Temporary bracing shall be provided, in accordance with the requirements of the Code of Standard Practice for Steel Buildings and Bridge wherever necessary to support the loads to which the structure may subjected, including equipment and the operation of same. Such bracing shall be left in place as long as required safety.

1047.3.4.3 Alignment

No permanent bolting or welding shall be performed until the adjacent affect portions of the structure have been properly aligned.

1047.3.4.4 Fit of Column Compression Joints and Base Plate Lack of contact bearing not exceeding a gap of 2 mm, regardless of the type of splice used (partial-joint-penetrating groove welded or bolted), is permitted. If the gap exceeds 2 mm, but is less than 6 mm, and if an engineering investigation shows that sufficient contact area does not exist, the gap shall be packed out with non-tapered steel shims. Shims need not be other than mild steel, regardless of the grade of the main material.

1047.3.4.5 Field Welding

Shop paint on surfaces adjacent to joints to be field welded shall be wire brushed to assure weld quality. Field welding of attachments to installed embedment in contact with concrete shall be done in such a manner as to avoid excessive thermal expansion of the embedment which could result in spalling or cracking of the concrete or excessive stress in the embedment anchors,

1047.3.4.6 Field Painting

Responsibility for touch-up painting, cleaning and field painting shall be allocated in accordance with accepted local practices, and this allocation, shall be set forth explicitly in the design documents.

1047.3.4.7 Field Connections

As erection progresses, the structure shall be securely bolted or welded to support the dead, wind and erection loads.

1047.3.5 Quality Control

The fabricator shall provide quality control procedures to the extent that the fabricator deems necessary to assure that the work performed is in accordance with this Specification. In addition to the fabricator's quality control procedures, material and workmanship at all times may be subject to inspection by the Engineer.

1047.3.5.1 Cooperation

As much as possible, the inspection by the Engineer shall be made at the fabricator's plant. The fabricator shall cooperate with the Engineer, permitting access for inspection to all places where work is being done.

1047.3.5.2 Rejection

Material or workmanship not in conformance with the provision of the Specification shall be rejected by the Engineer at any time during the progress of work.

1047.3.5.3 Inspection and Testing of Welding

The inspection and testing of welding shall be performed in accordance with the provisions of AWS D1.1 except as modified in Section 510.2, Welds of National Structural Code of the Philippines, 2015. The process, extent and standards of acceptance shall be clearly defined in the Contract.

1047.3.5.4 Inspection Connections of Slip-Critical High Strength Bolted Connection

The inspection of slip-critical high strength bolted connections shall be accordance with the provisions of the RCSC Specification for Structural Join Using ASTM F3125.

1047.3.5.5 Identification of Steel

The fabricator shall be able to demonstrate by a written procedure and by actual practice a method of material identification, visible at least through the "fit operation for the main structural elements of each shipping piece.

1047.4 Method of Measurement

The quantity of structural steel to be paid for shall be the number of kilograms or lump sum installed in place and accepted.

The quantity of metal structure accessories to be paid for shall be the number of kilograms, pieces or lump sum installed in place and accepted.

1047.5 Basis of Payment

The accepted quantity, measures as prescribed in Section 1047.4, Method Measurement shall be paid for at the Contract Unit Price for Metal Structures which price and payment shall

constitute 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 shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum

ITEM 1100-CONDUITS, BOXES AND FITTINGS

1100.1 Description

This Item shall consist of furnishing and installation of the complete conduit work consisting of electrical conduits; conduit boxes; conduit fittings and other electrical materials in accordance with the Plans and this Specification.

1100.2 Material Requirements

All materials shall be of the approved type in accordance with the requirements of the Philippine Electrical Code (PEC), Part I and bearing the Philippine Standard (PS) mark for locally manufactured and Import Commodity Clearance (ICC) certification marks duly issued by Bureau of Philippine Standards (BPS) for imported materials.

1100.2.1 Rigid Metal Conduit (RMC)

A threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings.

RMC shall be made of steel with protective coatings, aluminum, red brass or stainless steel.

Markings in each length of RMC shall be clearly and durably identified in every 3,000 mm as required in the Subsection 1.10.1.21 (A) of Article 1.10 Requirements for Electrical Installations of PEC, Part I. Nonferrous conduit of corrosion-resistant material shall have suitable markings.

The standard length of RMC shall be 3,000 mm, including an attached coupling and each end shall be threaded. Longer or shorter lengths with or without coupling and threaded or unthreaded shall be permitted.

RMC shall have a minimum size of metric designator 16 (trade size 1/2) and a maximum size of metric designator 155 (trade size 6).

1100.2.2 Intermediate Metal Conduit (IMC)

A steel threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings.

IMC shall be made of either steel with protective coatings or stainless steel.

Markings in each length of IMC shall be clearly and durably marked at least every 1,500 mm with the letters IMC. Each length shall be marked as required in Subsection 1.10.1.21 of Article 1.10, Requirements for Electrical Installations of PEC, Part I.

The standard length of IMC shall be 3,000 mm, including an attached coupling, and each end shall be threaded. Longer or shorter lengths with or without coupling and threaded or unthreaded shall be permitted.

IMC shall have a minimum size of metric designator 16 (trade size ½) and a maximum size of metric designator 103 (trade size 4).

1100.2.3 Flexible Metal Conduit (FMC)

A raceway of circular cross section made of helically wound, formed, interlocked metal strip.

Sizes of FMC shall comply with the requirements of subsection 3.48.2.11, Size of Article 3.48, Flexible Metal Conduit: Type FMC of PEC, Part I.

1100.2.4 Electrical Metallic Tubing (EMT)

An unthreaded thin-wall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings. EMT is generally made of steel (ferrous) with protective coatings or aluminum (nonferrous).

EMT shall be clearly and durably marked at least every 3,000 mm as required in the Subsection 1.10.1.21 (A) of Article 1.10, Requirements for Electrical Installations of PEC, Part 1.

EMT shall have a minimum size of metric designator 16 (trade size 1/2) and maximum size of metric designator 103 (trade size 4).

1100.2.5 Rigid Polyvinyl Chloride Conduit (PVC)

PVC Conduit shall be made of rigid (non plasticized) polyvinyl chloride (PVC) PVC conduit and fittings shall be composed of suitable nonmetallic material that is resistant to moisture and chemical atmospheres. For use above ground, it shall also be flame retardant, resistant to impact and crushing, resistant to distortion from heat under conditions likely to be encountered in service, and resistant to low temperature and sunlight effects. Where intended for di burial, without encasement in concrete, the material shall also be capabled withstanding continued loading that is likely to be encountered after installation.

Markings in each length of PVC conduit shall be clearly and durably marked at least every 3,000 mm as required in the Subsection 1.10.1.21 (A) of Article 1 Requirements for Electrical Installations of PEC, Part I. The type of material shall also be included in the marking unless it is visually identifiable. For conduit recognized for use aboveground, these markings shall be permanent. For conduit limited to underground use only, these markings shall be sufficiently durable to remain legible until the material is installed. Conduit shall be permitted to be surfaced marked to indicate special characteristics of the material.

The physical and mechanical properties of PVC conduit shall conform to the requirements of PNS 14:2005, Unplasticized Polyvinyl Chloride (UPVC) electric conduit - Specification.

PVC shall have a minimum size of metric designator 16 (trade size ½) and a maximum size of metric designator 155 (trade size 6).

1100.2.6 Liquidtight Flexible Nonmetallic Conduit (LFNC)

A raceway of circular cross section of various types as follows

1. A smooth seamless inner core and cover bonded together and having one d more reinforcement layers between the core and covers, designated as Tip LFNC-A.

2. A smooth inner surface with integral reinforcement within the conduit wall designated as Type LFNC-B.

3. A corrugated internal and external surface without integral reinforcement within the conduit wall, designated as LFNC-C.

LFNC-B as a prewired manufactured assembly shall be provided in continuous lengths capable of being shipped in a coil, reel, or carton without damage. LFNC shall be marked at least in every 600 mm in accordance with Subsection 1.10.1.21 (A) of Article 1.10, Requirements for Electrical Installations of PEC, Part I. The marking shall include a type designation and the trade size. Conduit that is intended for outdoor use or direct burial shall be marked.

The type, size and quantity of conductors used in prewired manufactured assemblies shall be identified by means of a printed tag or label attached to each end of the manufactured assembly and either the carton, coil or reel. The enclosed conductors shall be marked in accordance with Subsection 3.10.3.17, Markings of Article 3.10, Conductors for General Wiring of PEC, Part I.

Sizes of LFNC shall comply with the requirements of subsection 3.56.2.11, Size of Article 3.56, Liquidtight Flexible Nonmetallic Conduit: Type LFNC of PEC, Tot Part I.

1100.2.7 Weatherhead

Weatherhead is installed at the point of connection to service-drop connectors to protect the service raceways and service cables from exposure to weather or rain.

Weatherhead material shall be of the same material as conduit where it will be connected.

1100.2.8 Conduit Boxes, Fittings and Accessories

Conduit boxes, fittings and accessories shall comply with the applicable requirements of Article 3.14- Outlet, Device, Pull and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures of PEC, Part I

1100.3 Construction Requirements

All works throughout shall be executed satisfactorily by qualified electrician under the supervision of a duly Registered Electrical Engineer and shall be in accordance with the requirements of PEC, Part I.

1100.3.1 Rigid Metal Conduit (RMC)

1100.3.1.1 Uses Permitted

1. Atmospheric Conditions and Occupancies

a. **Galvanized Steel and Stainless Steel RMC**. Galvanized steel and stainless steel RMC shall be permitted under all atmospheric conditions and occupancies.

b. **Red Brass RMC.** Red brass RMC shall be permitted to be installed for direct embedment and swimming pool applications.

c. **Aluminum RMC.** Aluminum RMC shall be permitted to be installed where approved for the environment. Rigid aluminum conduit encased in concrete or in direct contact with the earth shall be provided with approved supplementary corrosion protection.

d. **Ferrous Raceways and Fittings**. Ferrous raceways and fittings protected from corrosion solely by enamel shall be permitted only indoors and in occupancies not subject to severe corrosive influences.

2. Corrosive Environments

a. **Galvanized Steel, Stainless Steel and Red Brass RMC, Elbows Couplings and Fittings.** Galvanized steel, stainless steel and red brass RMC, elbows, couplings and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to server corrosive influences where protected by corrosion protection approved for the condition.

b. **Supplementary Protection of Aluminum RMC.** Aluminum RMC shal be provided with approved supplementary corrosion protection where encased in concrete or in direct contact with the earth.

3. Cinder Fill

Galvanized steel, stainless steel and red brass RMC shall be permitted to be installed in or under cinder fill where subject to permanent moisture where protected on all sides by a layer of noncinder concrete not less than 50 mm thick; where the conduit is not less than 450 mm under the fill; or where protected by corrosion protection and judged suitable for the condition.

4. Wet Location

All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or protected by corrosion-resistant materials exposed to moisture.

1100.3.1.2 Dissimilar Metals

Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action. Aluminum fittings and enclosures shall be permitted to be used with galvanized steel RMC, and galvanized steel fittings and enclosures shall be permitted to be used with aluminum RMC where not subject to severe corrosive influences. Stainless steel RMC shall only be used with stainless steel fittings and approved accessories, outlet boxes, and enclosures.

1100.3.1.3 Number of Conductor

The number of conductors in a conduit and tubing shall not exceed the permitted percentage fill specified in table below.

Table 1100.1. Percent of Cross Section of Conduit and Tubing for Conductors

Number of Conductors and/or Cables	Cross-sectional Area (%)
1	53
2	31
Over 2	40

Notes:

1. Table 1100.1 is based on common conditions of proper cabling and alignment of conductors where the length of the pull and the number of bends are within reasonable limits. It should be recognized that, for certain conditions, a larger size conduit or lesser conduit fill should be considered.

2. When pulling three (3) conductors or cables into a raceway, if the ratio of the inside diameter (raceway) to the outside diameter (conductor or cable) is between 2.8 and 3.2, jamming can occur. While jamming can occur when pulling four (4) or more conductors into a raceway, the Probability is very low.

3. Table 1100.1 applies only to complete conduit or tubing systems and is not intended to ap probability is very low. to sections of conduit or tubing used to protect exposed wiring from physical damage.

Cables shall be permitted to be installed where such use is not prohibited by the respective cable articles of PEC, Part I. The number of cables shall no exceed the allowable percentage fill specified in Table 1100.1.

1100.3.1.4 Bends

Bends of RMC shall be so made that the conduit will not be damaged and s that the internal diameter of the conduit will not be effectively reduced. The radius of the curve of any field bend to the centerline of the conduit shall be less than indicated in Table 1100.2.

Table 1100.2. Radius of Conduit and Tubing Bends

Conduit or Tubing Size	One Shot and Full Shoe Benders	Other Bends
Raceway Size (mm)	**(mm)**	**(mm)**

15	100	100
20	115	125
25	145	150
32	180	200
40	210	250
50	240	300
65	265	375
80	325	450
90	375	525
100	400	600
125	600	750
150	750	900

There shall not be more than the equivalent of four (4) quarter bends (38 degrees total) between pull points, for example, conduit bodies and boxes

1100.3.1.5 Reaming and Threading

All cut ends shall be reamed or otherwise finished to remove rough edges Where conduit is threaded in the field, a standard cutting die with a one (1) 16 taper (62.5 mm per meter) shall be used.

1100.3.1.6 Securing and Supporting

RMC shall be installed as a complete system in accordance with Subsection 30.1.18, Raceway Installations of Article 3.0, General Requirements for Wiring Methods and Materials of PEC, Part I and shall be securely fastened in place and supported in accordance with the following:

1. Securely Fastened. RMC shall be secured in accordance with the following:

a. RMC shall be securely fastened within 0.90 m of each outlet box, junction box, device box, cabinet, conduit body, or other conduit termination.

b. Fastening shall be permitted to be increased to a distance of 1.50 m where structural members do not readily permit fastening within 0.90 m.

c. Where approved, conduit shall not be required to be securely fastened within 0.90 m of the service head for above-the-roof termination of a mast

2. Supports. RMC shall be supported in accordance with one of the following:

a. Conduit shall be supported at intervals not exceeding 3.0 m.

b. The distance between supports for straight runs of conduit shall be permitted in accordance with Table 1100.3, provided the conduit is made up with threaded couplings, and such supports prevent transmission of stresses to termination where conduit is deflected between supports.

Table 1100.3 Supports for Rigid Metal Conduit

Conduit Size		**Maximum Distance Between Rigid Metal Conduit Supports**
Metric Designator	**Trade Size**	**(m)**
16 – 21	½ - ¾	3.0
27	1	3.6
35 – 41	1 ¼ - 1 ¼	4.2
53 – 63	2 – 2 ½	4.8

73 and larger	3 and larger	6.0

c. Exposed vertical risers from industrial machinery or fixed equipment shall be conduit is made up with threaded couplings, the conduit is supported and securely fastened at the top and bottom of the riser and no other means of intermediate support are readily available.

d. Horizontal runs of RMC supported by openings through framing members at intervals not exceeding 3.0 m and securely fastened within 0.90 m of termination points shall be permitted.

1100.3.1.7 Couplings and Connectors

Threadless couplings and connectors used with conduit shall be made tight Where embedded in masonry or concrete, they shall be the concrete tight type where installed in wet locations, they shall comply with Subsection 3.14.21, Damp or Wet Locations of Article 3.14, Outlet, Device, Pull Junction Boxes Conduit Bodies; Fittings; and Handholes Enclosures of PEC, Part I. Threadless couplings and connectors shall not be used on threaded conduit ends unless listed for the purpose.

Running threads shall not be used on conduit for connection at couplings.

1100.3.1.8 Locknut and Bushings

Where a conduit enters a box, fitting, or other enclosure, a locknut and bushing shall be provided to protect the wire from abrasion unless the design of the box, fitting, or enclosure is such as to afford equivalent protection.

1100.3.2 Intermediate Metal Conduit (IMC)

1100.3.2.1 Uses Permitted

1. All Atmospheric Conditions and Occupancies

Use of IMC shall be permitted under all atmospheric conditions and occupancies

2. Corrosion Environments

IMC, elbows, couplings and fittings shall be permitted to be installed in concrete in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection approved for the condition

3. Cinder fill

IMC shall be permitted to be installed in or under cinder fill where subject to permanent moisture where protected on all sides by a layer of noncinder concrete not less than 50 mm thick; where the conduit is less than 450 mm under the fill; or where protected by corrosion protection approved for the condition.

4. Wet locations

All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or protected against corrosion by corrosion-resistant materials.

1100.3.2.2 Dissimilar Metals

Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action.

Aluminum fittings and enclosures shall be permitted to be used with galvanized steel IMC where not subject to severe corrosive influences. Stainless steel IMC shall only be used with stainless steel fittings and approved accessories, outlet boxes, and enclosures.

1100.3.2.3 Number of Conductors

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.2.4 Bends

It shall comply with the requirements of Subsection 1100.3.1.4, Bends.

1100.3.2.5 Reaming and Threading

It shall comply with the requirements of Subsection 1100.3.1.5, Reaming and Threading.

1100.3.2.6 Securing and Supporting

It shall comply with the requirements of Subsection 1100.3.1.6, Securing and Supporting.

1100.3.2.7 Couplings and Connectors

It shall comply with the requirements of Subsection 1100.3.1.7, Couplings and Connectors.

1100.3.2.8 Bushings

It shall comply with the requirements of Subsection 1100.3.1.8, Locknut and Bushings.

1100.3.3 Flexible Metal Conduit

1100.3.3.1 Uses Permitted

FMC shall be permitted to be used in exposed and concealed locations.

1100.3.3.2 Uses Not Permitted

FMC shall not be used in the following:

1. In wet locations.

2. In hoistways, other than as permitted in Subsection 6.20.3.1(A) (1), Hoistways and Pits of Article 6.20, Elevators, Dumbwaiters, Escalators, Moving Walks, Platforms Lifts of PEC, Part I.

3. In storage battery rooms.

4. In any hazardous (classified) location except as permitted by other articles in the PEC, Part I.

5. Where exposed to materials having a deteriorating effect on the installed conductors, such as oil or gasoline.

6. Underground or embedded in poured concrete aggregate.

7. Where subject to severely physical damage.

1100.3.3.3 Number of Conductors

The number of conductors shall not exceed that permitted by the percentage fill specified in Table 1100.1 or as permitted in Table 3.48.2.13, Maximum Number of Insulated Conductors in Metric Designator 12 (Trade Size) Flexible Metal Conduit of Article 3.48, Flexible Metal Conduit: Type FMC of PEC, Part I or for metric designator 12 (trade size 3/8)

Cable shall be permitted to be installed where such use is not prohibited by the respective cable articles of PEC, Part I. The numbers of cables shall not exceed the allowable percentage fill specified in Table 1100.1.

1100.3.3.4 Bends

Bends in conduit shall be made so that the conduit is not damaged and the internal diameter of the conduit is not effectively reduced. Bends shall be permitted to be made manually without auxiliary equipment. The radius of the curve to the centerline of any bend shall not be less than as shown in Table 1100.2 using the column "Other Bends".

There shall not be more than the equivalent of four (4) quarter bends (360) degrees total) between pull points, for example, conduit bodies and boxes.

1100.3.3.5 Trimming

All cut ends shall be trimmed and smoothened.

1100.3.3.6 Securing and Supporting

FMC shall be secured and supported in accordance with the requirements of Subsection 3.48.2.21, Securing and Supporting of Article 3.48, Flexible Metal Conduit: Type FMC of PEC, Part I.

1100.3.3.7 Couplings and Connectors

Angle connectors shall not be used for concealed raceway installations.

1100.3.4 Electrical Metallic Tubing (EMT)

1100.3.4.1 Uses Permitted

1. Exposed and Concealed. The use of EMT shall be permitted for both exp and concealed work for the following:

a. In concrete, in direct contact with the earth or in areas subject to see corrosive influences where installed in accordance with Subsection 1100.3.4.1 (b).

b. In dry, damp and wet locations.

c. In any hazardous (classified) location as permitted by other articles in be PEC, Part 1.

2. Corrosive Environments

a. Galvanized Steel and Stainless Steel EMT, Elbows and Fittings. Galvanized steel and stainless steel EMT, elbows and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection and approved as suitable for the condition.

b. Supplementary Protection of Aluminum EMT. Aluminum EMT shall be provided with approved supplementary corrosion protection when encased in concrete or in direct contact with the earth.

3. Cinder Fil

Galvanized steel and stainless steel EMT shall be permitted to be installed in cinder concrete or cinder fill where subject to permanent moisture whe protected on all sides by a layer of noncinder concrete not less than 50 m thick or when the tubing is installed at 450 mm under the fill.

4. Wet Locations

It shall comply with the requirements of Subsection 1100.3.1.1 (4), We Locations.

1100.3.4.2 Uses Not Permitted

EMT shall not be used under the following conditions:

1. Where subject to severe physical damage.

2. Where protected from corrosion solely by enamel.

1100.3.4.3 Number of Conductors.

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.4.4 Bends

It shall comply the requirements of Subsection 1100.3.1.4, Bends.

1100.3.4.5 Reaming and Threading

All cut ends of EMT shall be reamed or otherwise finished to remove rough edges.

EMT shall not be threaded.

1100.3.4.6 Securing and Supporting

EMT shall be securely fastened in place at least every 3.0 m. In addition, each EMT run between termination points shall be securely fastened within 0.90 m of each outlet box, junction box, device box, cabinet, conduit body, or other tubing termination except to the following conditions:

1. Fastening of unbroken lengths shall be permitted to be increased to a distance of 1.5 m where structural members do not readily permit fastening within 0.90 m.

2. For concealed work in finished buildings or prefinished wall panels where such securing is impracticable, unbroken lengths (without coupling) of EMT shall be permitted to be fished.

3.Horizontal runs of EMT supported by openings through framing members at intervals not greater than 3.0 m and securely fastened within 0.90 m of termination points shall be permitted.

1100.3.4.7 Couplings and Connectors

Couplings and connectors used with EMT shall be made up tight when embedded in masonry or concrete. Where installed in wet locations, they shall comply with Subsection 3.14.2.1, Damp or Wet Locations of Article 3.14, Outlet, Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures of PEC, Part I.

1100.3.5 Rigid Polyvinyl Chloride Conduit

1100.3.5.1 Uses Permitted

The use of PVC conduit shall be permitted in accordance with the following:

1. Concealed. PVC conduit shall be permitted in walls, floors and ceilings.

2. Corrosive Influences. PVC conduit shall be permitted in location subject to severe corrosive influences as covered in Subsection 3.0.1.6, Protection against Corrosion and Deterioration of Article 3.0, General Requirements for Wiring Methods and Materials of PEC Part I.

3. Cinders. PVC conduit shall be permitted in cinder fill.

4. Wet Locations. PVC conduit shall be permitted in portions of dairies, laundries, canneries, or other wet locations, and in locations where walls are frequently washed, the entire conduit system, including boxes and fittings used therewith, shall be installed and equipped so as to prevent water from entering the conduit. All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or be protected against corrosion by approved corrosion-resistant materials.

5. Exposed. PVC conduit shall be permitted for exposed work. PVC conduit used exposed in areas of physical damage shall be identified for the use.

6. Underground Installations. For underground installations, PVC shall be permitted for direct embedment and underground encased in concrete in accordance with Subsections 3.0.1.5 and 3.0.2.20, Underground Installations of Article 3.0, General Requirements for Wiring Methods and Materials of PEC, Part I.

7. Support of Conduit Bodies. PVC conduit shall be permitted to support nonmetallic conduit bodies not larger than largest trade size of an entering raceway. These conduit bodies shall not

support devices other than splicing devices as permitted by Subsection 1.10.1.14 (B), Mounting and Cooling of Equipment of Article 1.10, Requirements for Electrical Installations and Subsection 3.14.2.2(C)(2), Conduit Bodies of Article 3.14, Outlet, Device, Pull, and Junction boxes; Conduit Bodies; Fittings; and Handhole Enclosures of PEC, Part I.

8. Insulations Temperature Limitations. Conductors or cables rated at a temperature higher than the listed temperature rating of PVC conduit shall be permitted to be installed in PVC conduit, provided the conductors or cables are not operated at a temperature higher than the listed temperature rating of the PVC conduit.

1100.3.5.2 Uses Not Permitted

PVC conduit shall not be used under the conditions specified in the following: 1. Hazardous (Classified) Locations. In any hazardous (classified) location, except as permitted by other articles of the PEC, Part I.

2. Support of Luminaires. For the support of luminaires or other equipment not described in Subsection 1100.3.5.1 (7) Support of Conduit Bodies.

3. Physical Damage. Where subject to physical damage unless identified for such use.

4. Ambient Temperatures. Where subject to ambient temperatures in excess of 50°C unless listed otherwise.

5. Theaters and Similar Locations. In theaters and similar locations, except as provided in Subsection 5.18.1.4, Wiring Methods of Article 5.18, Assembly Occupancies and Subsection 5.20.1.5, Wiring Methods of Article 5.20, Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations of PEC, Part I.

1100.3.5.3 Number of Conductors

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.5.4 Bends

It shall comply with the requirements of Subsection 1100.3.1.4, Bends.

1100.3.5.5 Trimming

All cut ends shall be trimmed & smoothen.

1100.3.6.6 Securing and Supporting

PVC Conduit shall be installed as a complete system as provided in Subsection 3.0.1.18 Raceway Installation of Article 3.0, General Requirements for Wiring Methods and Materials of PEP, Part I and shall be fastened so that the movement from thermal expansion or contraction is permitted. PVC conduit shall be securely fastened ans supported in accordance with the following:

1. Securely Fastened. PVC conduit shall be securely fastened within 900mm of each outlet box, junction box, device box, conduit body, or other conduit termination. Conduit

listed for securing at the other than 900mm shall be permitted to be installed in accordance with the listing.

2. Supports. PVC conduit shall be supported as required in table 1100.4 listed for support at spacings other than as shown in table 1100.4 shall be permitted to be installed in accordance with the listing. Horizontal runs of PVC conduit supported by openings through framing members at intervals not exceeding those in table 1100.4 and securely fastened within 900 mm of termination points shall be permitted.

Table 1100.4 Supports for Rigid Polyvinyl Chloride Conduit (PVC)

Conduit Size		**Maximum Spacing Between Supports**
Metric Designator	**Trade Size**	**(m)**
16 - 27	½ - 1	0.90
35 - 53	1 ¼ - 2	1.5
63 - 78	22 ½ - 3	1.8
91 - 129	3 ½ - 5	2.1
155	6	2.4

1100.3.5.7 Expansion Fittings.

Expansion fittings for PVC conduit shall be provided to compensate for thermal expansion and contraction where the length change, in accordance with Table 3.52.2.35, Expansion Characteristics of PVC Rigid Nonmetallic Conduit Coefficient of Thermal Expansion = 6.084 x 10^{-5}mm/mm/^{o} C, of PEP, Part 1 is expected to be 6 mm or greater in a straight run between securely mounted items such as boxes, cabinets, elbows, or other conduit terminations.

1100.3.5.8 Locknut and Bushings

Where a conduit enters a box. fittings, or other enclosures, a bushing or PVC adapter shall be provided to protect the wire from abrasion unless the box, fitting or enclosures designs provides equivalent protection

1100.3.5.9 Joints

All joints between lengths of conduit, and between conduit and couplings, fittings, and boxes, shall be provided with PVC solvent and made by an approved method

1100.3.6 Liquidtight Flexible Nonmetallic Conduit (LFNC)

1100.3.6.1 Uses Permitted

LFNC shall be permitted to be used in exposed or concealed locations for the following purposes:

1. Where flexibility is required for installation, operation and maintenance.
2. Where the protection of contained conductors is required for vapors, liquids or solids
3. For outdoor locations listed and marked as suitable for the purpose.
4. For direct embedment where listed and marked for the purpose.
5. Type LFNC-B shall be permitted to be installed in lengths longer than1.8 m where secured in accordance with Subsection 1100.3.6.7, Securing and Supporting.
6. Type LFNC-B as a listed manufactured prewired assembly, metric designator 16 through 27 (trade size 1/2 through 1) conduit.
7. For encasement in concrete where listed for direct embedment and install accordance with Subsection 1100.3.6.8, Couplings and Connectors.

1100.3.6.2 Uses Not Permitted

LFNC shall not be used as follows:

1. Where subject to severe physical damage.

2. Where any combination of ambient and conductor temperatures is in excess of that for which the LFNC is approved.

3. In lengths longer than 1.8 m, except as permitted by Subsection 1100.351(5) or where a longer length is approved as essential for a required degree of flexibility.

4. In any hazardous (classified) location, except as permitted by other articles in PEC, Part I.

1100.3.6.3 Number of Conductors

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.6.4 Bends

It shall comply with the requirements of Subsection 1100.3.3.4, Bends.

1100.3.6.5 Trimming

All cut ends of conduit shall be permitted inside and outside to remove rough

edges.

1100.3.6.6 Securing and Supporting

LFNC shall be securely fastened and supported in accordance with Subsector 3.56.2.21, Securing and Supporting of Article 3.56, Liquidtight Flee Nonmetallic Conduit: Type LFNC of PEC, Part I.

1100.3.6.7 Couplings and Connector

Only fittings listed for use with LFNC shall be used. Angle connectors shall not be used for concealed raceway installations. Straight LFNC fittings are permitted for direct burial or encasement in concrete.

1100.3.7 Weatherhead

Weatherhead shall be installed in accordance with the PEC, Part I.

1100.3.8 Test and Guarantee

Upon completion of the electrical construction work, the Contractor shall provide all test equipment, materials and personnel for conducting the test and shall submit written copies of all test results to the Engineer.

The Contractor shall guarantee that the electrical installations are done in accordance with the approved Plans and Specifications.

The Contractor shall furnish a guaranty or warranty covering all labor and materials for period of 1 year from the date of the final acceptance of works and shall agree to repair all defects and any part of the work not satisfactory to the Engineer which may develop during the defects liability period arising from defective workmanship or materials at his own expenses.

1100.4 Method of Measurement

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

1100.5 Basis of Payment

All works performed and measured in Section 1100.4, Method of Measurement 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
1100(10)	Conduits, Boxes & Fittings (Conduit Works/Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

1101.1 Description

This Item shall consist of 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 in accordance with the approved Plans and this Specification.

1101.2 Material Requirements

1101.2.1 Wires and Cables

1101.2.1.1 Wires

All wires shall meet the requirements specified in the Philippine Electrical Code (PEC), Part 1 and PNS 35-1, Electric wires and cables-Thermoplastic-insulated copper wires and cables rated 600 volts - Part 1: General Specifications, and shall bear the Philippine Standard (PS) mark unless specified or indicated otherwise and shall be marked to indicate the following information:

1. The maximum rated voltage

2. The proper type letter or letters for the type of wire or cable as specified in the PEC Part 1

3. The manufacturer's name, trademark, or other distinctive marking by which the organization responsible for the product can be readily identified

4.The size in square millimeter or millimeter diameter

5.Cable assemblies where the neutral wire is smaller

The letters such as TW, THHN, THWN and THW represent the main insulation types of individual wires. These letters depict the following requirements: 1.

1. T-Thermoplastic Insulation

2. H-Heat Resistance

3. HH-High Heat Resistance

4. W-Suitable for Wet locations

5. N-Thermoplastic Polyester, Tough and

6. X-Flame-Resistant Synthetic Polymer

7. Z-Modified ethylene tetrafluoroethylene

Conductors shall be insulated for 600 V and shall be aluminum, copper-clad aluminum, or copper unless otherwise specified. The minimum diameter size of conductors shall be 1.6 mm (2.0 mm2) for copper and 2.0 mm (3.5 mm) for aluminum or copper-clad aluminum conductors. Solid aluminum conductors of diameters 3.2 mm, 2.6 mm, and 2.0 mm shall be made of an AA-8000 series electrical grade aluminum alloy conductor material. Stranded

aluminum conductors 8.0 mm² through 500 mm² marked as Type RHH, RHW, XHHW THW, THHW, THWN, THHN, service-entrance Type SE Style U and SE Style R shall be made of an AA-8000 series electrical grade aluminum alloy conductor material.

Ampacities for conductors shall be as specified in the PEC Part 1. Where bare or covered conductors are used with insulated conductors, their allowable ampacities shall be limited to those permitted for the adjacent insulated conductors.

1101.2.1.2 Cables

1. Armored Cables (Type AC)

Type AC shall have ready identification of the manufacturer by distinctive external markings on the cable sheath throughout its entire length.

Type AC cable shall have an armor of flexible metal tape and shall have an internal bonding strip of copper or aluminum in intimate contact with the armor for its entire length. Insulated conductors of type AC shall be of type listed in the PEC Part 1. In addition, the conductors shall have an overall moisture resistant fibrous covering and fire-retardant fibrous covering. For Type ACT, a moisture-resistant fibrous covering shall be required only on the individual conductors.

2. Flat Cable Assemblies (Type FC)

Flat cable assemblies shall consist of two, three, four, or five conductors. The conductors shall be 5.5 mm² (2.6 mm dia.) special stranded copper wires Type FC cable shall have the temperature rating durably marked on the surface at intervals not exceeding 600 mm.

3. Flat Conductor Cable (Type FCC)

Type FCC cable shall be clearly and durably marked on both sides at intervals of not more than 600 mm with the information required by the PEC Part 1. It shall consist of three (3), four (4), or five (5) flat copper conductors, one of which shall be an equipment grounding conductor. The insulating material of the cable shall be moisture resistant and flame retardant.

4. Integrated Gas Spacer Cable (Type IGS)

The conductors shall be solid aluminum rods, consisting of one to nineteen 13 mm diameter rods. The minimum conductor size shall be 125 mm², and the maximum size shall be 2375 mm². The insulation shall be dry kraft paper tapes and a pressurized sulfur hexafluoride gas (SF6), both approved for electrical use. The nominal gas pressure shall be 138 kPa gauge.

5. Medium Voltage Cable (Type MV)

Type MV cables shall have copper, aluminum, or copper-clad aluminum conductors and shall be marked as required by the PEC Part 1.

6. Metal-Clad Cable (Type MC)

The conductors for type MC shall be of copper, aluminum, or copper-clad aluminum, solid or stranded. The minimum conductor size shall be 0.75 mm² (1.0 mm dia.) copper and 3.5 mm² (2.0 mm dia.) aluminum or copper-clad aluminum. Metallic covering shall be one of the

following types: smooth metallic sheath, corrugated metal sheath, interlocking metal tape armor. The metallic sheath or armor shall be used on single conductor type MC. Supplemental protection of an outer covering of corrosion-resistant material shall be permitted and shall be required where such protection is needed. The sheath shall not be used as current-carrying conductor.

7. Mineral-Insulated, Metal-Sheathed Cable (Type MI)

Type MI cable conductors shall be of solid copper, nickel, or nickel-coated copper with a resistance corresponding to standard mm² and mm dia. sizes. The conductor insulation in Type MI cable shall be a highly compressed refractory mineral that provides proper spacing for all conductors.

8. Non-metallic - Sheathed Cable (Types NM, NMC, and NMS)

The 600 volt insulated conductors shall be sizes 2.0 mm² (1.6 mm dia.) through 30 mm² copper conductors or sizes 3.5 mm² (2.0 mm dia.) through 2.0 mm aluminum or copper-clad aluminum conductors. The signaling and communication conductors shall comply with the PEC Part 1. The insulated power conductors shall be one of the types listed in the PEC Part I that are suitable for branch circuit wiring or one that is identified for use in these cables Conductor insulation shall be rated at 90°C.

The outer sheath of non-metallic-sheathed cable shall comply with the following:

a. Type NM The overall covering shall be flame retardant and moisture resistant.

b. Type NMC - The overall covering shall be flame retardant, moisture resistant, fungus resistant, and corrosion resistant.

c. Type NMS - The overall covering shall be flame retardant and moisture resistant. The sheath shall be applied so as to separate the power conductors from the communications and signaling conductors. The signaling conductors shall be permitted to be shielded. An optional outer jacket shall be permitted.

9. Power and Control Tray Cable (Type TC)

A metallic sheath or armor shall not be permitted either under or over the nonmetallic jacket. Metallic shield(s) shall be permitted over groups of conductors, under the outer jacket, or both. The insulated conductors of Type TC tray cable shall be in sizes 0.75 mm² (1.0 mm dia.) through 500 m aluminum or copper-clad aluminum. Insulated conductors of sizes 2.0 mm (1.6 mm dia.) and larger copper and sizes 3.5 mm² (2.0 mm dia.) and larger aluminum or copper-clad aluminum shall be one of the types listed in the PEC Part 1 that is suitable for branch circuit and feeder circuits or one that is defined for such use.

The outer jacket for Type TC shall be a flame-retardant, nonmetallic material. There shall be no voltage marking on a Type TC cable employing thermocouple extension wire.

10. Service-Entrance Cable (Type SE and USE)

Cabled, single-conductor, Type USE constructions recognized for underground use shall be permitted to have a bare copper conductor cable with the assembly. Type USE single, parallel, or cabled conductor assemblies recognized for underground use shall be permitted to have a

bare copper concentric conductor applied. These constructions shall not an outer overall covering. Type SE or USE cable containing two or more conductors shall be permitted to have one conductor uninsulated.

11. Underground Feeder and Branch-Circuit Cable (Type UF)

The conductors shall be sizes 2.0 mm (1.6 mm dia.) copper or 3.5 mm² 2 (2.0 mm dia.) aluminum or copper-clad aluminum through 100 mm². The conductors of Type UF shall be moisture-resistant type that is suitable for branch-circuit wiring or one that is identified for such use. Where installed as a substitute wiring method for NM cable, the conductor insulation shall be rated 90°C. The overall covering shall be flame retardant; moisture, fungus, and corrosion resistant; and suitable for direct burial in the earth.

1101.2.2 Switches

All switches shall conform to the requirements of the PEC Part 1. Switches shall be marked with the current voltage, and, if horsepower rated, the maximum rating for which they are designed. They shall be of the externally type mounted in an enclosure listed for the intended use.

Metal faceplates for switches shall be of ferrous metal not less than 0.75 mm in thickness or of non-ferrous metal not less than 1.00 mm in thickness. Faceplates of insulating material shall be non-combustible and not less than 0.25 mm in thickness, but they shall not be permitted to be less than 0.25 mm in thickness if formed or reinforced to provide adequate mechanical strength.

1101.2.3 Receptacles

All receptacles shall conform to the requirements of the PEC Part 1. Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings. The rating for receptacles shall not be less the 15 A, 125 V, or 15 A, 250 V. Table 1101.1 shows the receptacle ratings various size circuits.

Table 1101.1 Receptacle Rating for Various Size Circuits

Circuit Rating (Amperes, A)	Receptacle Rating (Amperes, A)
15	15 Not over
20	15 - 20
30	30

40	40 or 50
50	50

Metal faceplates for receptacles shall be of ferrous metal not less than 0.75mm in thickness or of non-ferrous metal not less than 1.00 mm in thickness Faceplates of insulating material shall be non-combustible and not less the 0.25 mm in thickness if formed or reinforced to provide adequate mechanic strength.

1101.3 Construction Requirement

Installation of electric wiring and wiring devices shall comply with the governing laws and applicable codes and standards such as the PEC Part 1 and Safety Standards.

1101.3.1 Installation

1101.3.1.1 Conductors

1. Conductors of the Same Circuit

All conductors of the same circuit and, where used, the grounded conductor and all equipment grounding conductors and bonding conductors shall be contained within the same raceway, auxiliary gutter, cable tray, cable bus assembly, trench, cable, or cord, unless otherwise permitted in accordance with the PEC 1.

a. Paralleled Installations

Conductors shall be permitted to be run in parallel in accordance with the provisions of the PEC Part 1. The requirement to ru2021/9/9 09:18 circuit conductors with the same raceway, auxiliary gutter, cable tray, trench, cable, or cord shall apply separately to each portion of the paralleled installation, and the equipment grounding conductors shall comply with the provisions of the PEC Part 1. Parallel runs in cable tray shall comply with the provisions of the PEC Part 1.

b. Grounding and Bonding Conductors

Equipment grounding conductors grounding conductors shall be permitted to be installed outside a raceway or cable assembly in accordance with the provisions of the PEC Part 1.

c. Non-ferrous Wiring Methods

Conductors in wiring methods with a nonmetallic or other nonmagnetic sheath, where run in different raceways, auxiliary gutters, cable trays, trenches, cables, or cords shall comply with the provisions of the PEC Part 1.

2. Conductors of Different Systems

Conductors of circuits rated 600 V, nominal or less, ac circuits, and dc circuits shall be permitted to occupy the same equipment wiring enclosure, cable, or e raceway. All conductors shall have an insulation rating equal to at least the maximum circuit voltage applied to any conductor within the enclosure, cable, or raceway.

Conductors of circuits over 600 V, nominal, shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 V, nominal, or less unless otherwise permitted in the PEC Part 1.

1101.3.1.2 Switches

Installation of switches shall conform to the requirements of the PEC Part 1. All switches and circuit breakers used as switches shall be located in an accessible place to facilitate operation. They shall be installed such that the center of the position, is not more than 1980 mm above the floor or working platform. Sip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 1980 mm above the floor or working platform.

Faceplates provided for snap switches mounted in boxes and other enclosures shall be installed so as to completely cover the opening and, where the switch is flush mounted, seat against the finished surface.

Metal enclosures for switches shall be grounded. Where nonmetallic endosures are used with metal raceways or metal-armored cables, provision shall be made for grounding continuity. Snap switches, including dimmer and similar cont switches, shall be effectively grounded and shall provide a means to ground metal faceplates, whether or not a metal faceplate is installed. Snap switches shall be considered effectively grounded if either of the following conditions met:

1. The switch is mounted with metal screws to a metal box or to a nonmetal box with integral means for grounding devices.

2. An equipment grounding conductor or equipment bonding jumper connected to an equipment grounding termination of the snap switch.

1101.3.1.3 Receptacles

General installation requirements for receptacles shall be in accordance with the PEC Part 1. Receptacle outlets shall be located in branch circuits in accordance with the PEC Part 1.

Receptacles shall be mounted in boxes or assemblies designed for the purpose and such boxes or assemblies shall be securely fastened in place unless otherwise permitted in the PEC Part 1.

Receptacles installed on 15- and 20-A branch circuits shall be of the grounding type, Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in the PEC Par

Receptacles and cord connectors that have grounding contacts shall have these contacts effectively grounded. They shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or co connector. The branch circuit wiring method shall include or provide equipment-grounding conductor to which the grounding contacts of the receptacle or cord connector are connected.

1101.3.2 Personnel Qualification

The installation of electrical wiring and devices shall be done by a certified installer under the supervision of an Electrical Engineer based on the guidelines of Republic Act No. 7920, New Electrical Engineering Law

1101.3.3 Locations

1101.3.3.1 Dry Locations

Insulated conductors and cables, receptacles, switches and other devices used in dry locations shall be any of the types identified in the PEC Part 1.

1101.3.3.2 Dry and Damp Locations

Insulated conductors and cables used in dry and damp locations shall be Types FER, FEPB, MTW, PFA, RHH, RHW-2, SA, THHN, THW, THW-2, THHW, THHW 2, THWN, THWN-2, TW, XHH, XHHW, XHHW-2, Z, or ZW.

Receptacles installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

1101.3.3.3 Wet Locations

Insulated conductors and cables used in wet locations shall be Moisture impervious metal-sheathed, Types MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THHW-2, THWN, THWN-2, Z, or ZW and Type for use in wet locations. Receptacles installed in wet locations shall have an enclosure that is weatherproof. Switches in a wet location or outside of a building shall be enclosed in a weatherproof enclosure or cabinet.

1101.3.3.4 Locations Exposed to Direct Sunlight

Insulated conductors or cables used where exposed to direct rays of the sun shall comply with one of the following:

1.Cables listed, or listed and marked, as being sunlight resistant.

2.Conductors listed, or listed and marked, as being sunlight resistant.

3.Covered with insulating material, such as tape or sleeving.

1101.4 Method of Measurement

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

1101.5 Basis of Payment

The quantity as determined in Section 1101.4, Method of Measurement shall be paid for at unit price stipulated in the Contract's Bill of Quantities. The payment shall constitute the full compensation for furnishing all the necessary materials, providing necessary equipment and

tools in installing the wires and wire devices labor cost and all the incidental expenses necessary to complete the work.

Payment shall be made under:

Pay Item Number	**Description**	**Unit of Measurement**
1101 (33)	Wires and Wiring Devices	Lumpsum

ITEM 1102 – POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

1102.1 Description

This Item shall consist of furnishing and installation of the power load center unit substation or low voltage switchgear and distribution panelboards at the location shown on 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 shat conform to the applicable requirements of the Philippine Electrical Code Part and the products locally manufactured shall bear a Philippine Standard (PS) mark, while imported products shall bear Import Commodity Clearance (ICO certification marks duly issued by the Bureau of Philippine Standards (BPS).

1102.2.1 Power Load Center Unit Substation

The Contractor shall furnish and install an indoor-type Power Load Center Unit Substation at the location shown on the approved Plans. It shall be metal-enclosed, dead front and shall consist of the following parts:

1102.2.1.1 High Voltage Primary Section:

High voltage primary incoming line section consisting of the following parts and related accessories:

1. One (1) air-filled interrupter Switch, Two (2)-position (open-close) installed in a suitable air-filled metal enclosure and shall have sufficient interrupting capacity to carry the electrical load. It shall be provided with key interlock with the cubicle for the power fuses to prevent access to the fuses unless the switch is open.

2. Three (3)-power fuses mounted in separate compartments within the switch housing and accessible by a hinged door.

3. One (1) set of high voltage potheads or three (3)-conductor cables or three (3) single conductor cables.

4 Lightning arresters shall be installed at the high voltage cubicle with the proper neutral and grounding system.

Items (1) and (2) above could be substituted with a power circuit breaker with the correct rating and interrupting capacity.

1102.2.2 Transformer Section

The transformer section shall consist of a power transformer with ratings and capacities as shown on the plans. It shall be oil liquid-filled non-flammable or dry type and designed in accordance with the latest applicable standards.

The transformer shall be provided with four (4) approximately 2.5% rated KVA ups on the primary winding in most cases one (1) above and three (3) below rated primary voltage and shall be changed by means of externally gang-operated manual tap changer only when the transformer is de-energized. Tap changing under load is allowed, if necessary.

The following accessories shall be provided with the transformer, namely: drain valve, sampling device, filling connection, oil liquid level gauge, ground pad, top filter press connection, lifting lugs, diagrammatic nameplate, relief valve, thermometer and other necessary related accessories.

The high-voltage and low-voltage bushings and transition flange shall be properly coordinated for field connection to the incoming line section and low voltage switchboard section, respectively.

1102.2.2.1 Current Transformers

Current transformers shall be of the straight-through type with suitable ratio, output and class of accuracy for their function and shall comply with IEC 600-44, Instrument transformers. Measuring current transformers shall have accuracy of Class 1 and protective transformers shall have an accuracy of SP10.

Groups of current transformers used on three (3) phase systems shall have their secondary connections starred and earthed. When measuring line current value using a common meter with a selector switch, they shall be connected so that the current transformers shall be shorted out when not being used for indication. This shall be carried out in the selector switch by "make before break" contacts.

1102.2.2.2 Potential Transformers

Potential transformers shall conform to IEEE C57.13, IEEE Standard Requirements for Instrument Transformers for installation in metal-clad switchgear. Standard 120-volt secondary transformers shall be used. The transformer shall provide with burden, frequency, and accuracy as required. Indoor dry type two-winding construction for disconnecting potential transformers with integral fuse mountings and current-limiting fuses with primary and secondary voltage ratings as required.

1102.2.2.3 Distribution Transformer

A distribution transformer is a static device constructed with two or more windings used to transfer alternating current electric power by electromagnetic induction from one circuit to another at the same frequency but with different values of voltage and current. It is equipped with a lightning arrester, a weak link or protective-link expulsion-type fuse (installed under oil in the transformer tank), a secondary circuit breaker, and a warning light. The transformer primary bushing conductor is connected to one phase of the three-phase primary circuit through a partial-range current-limiting fuse. The transformer tank is grounded and connected to the primary and secondary common-neutral ground wire. The self-protected transformer contains

core and coils, a primary fuse mounted on the bottom of the primary bushing, a secondary terminal block, and a low voltage circuit breaker.

Pad-mounted transformers are used with underground systems. Three-phase pad-mounted transformers are used for commercial installations, and single-phase pad-mounted transformers are used for underground residential installations. Vault-type distribution transformers are installed for commercial customers where adequate space is not available for pad-mounted transformers. The vault-type transformer may be installed in a vault under a sidewalk or in a building. They are often used in underground electric network areas. Submersible single-phase distribution transformers are used in some underground systems installed in residential areas.

1102.2.3 Low-Voltage Switchboard Section

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

1. Switchboard Housing

The housing shall be fully type tested switchgear as duly certified by the Original Electrical Manufacturer.

2. Secondary Metering Section

The secondary metering section shall be digital type consisting 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 3-phase; 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.

3. 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 overcurrent protection and instantaneous short circuit trip and all necessary accessories to ensure safe and efficient operation.

4. Feeder Circuit Breaker

There shall be as many feeder breakers as shown on the single line diagram, or schematic riser diagram or schedule of loads. The circuit breakers shall be Air Circuit Breaker (ACB) draw-out or fixed type, Molded Case Circuit Breaker (MCCB). The circuit breakers shall each have sufficient interrupting capacity and shall be manually operated complete with trip devices and all necessary accessories to ensure safe and efficient operation. The number, ratings, capacities of the feeder branch circuit breakers shall be as shown on the approved Plans with short circuit and arc flash analysis.

Circuit breakers shall each be of the indicating type, with "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.

5. Automatic Transfer Switch

Automatic transfer switches shall be open transition switches, four-pole, draw out construction, electrically operated, mechanically held open contact without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.

Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.

Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.

Automatic transfer switches Markings shall be in accordance with UL 1008, Transfer Switch Equipment.

Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstanding and closing tests when used with the upstream overcurrent device and available fault current specified.

Enclose automatic transfer switches in wall or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, Standard for Industrial Control Equipment, or in a switchboard assembly in accordance with UL 891, Switchboards, as shown on the Plans.

The enclosure shall be constructed so that personnel is protected from energized bypass-isolation components during automatic transfer switch maintenance.

Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.

Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.

Actuated by an electrical operator.

Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal or emergency position.

Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of the transfer. Release of the locking mechanism shall be possible only by normal operating action.

Contact transfer time shall not exceed six cycles. Operating mechanism components and mechanical interlocks shall be insulated or grounded.

1102.2.4 Low-Voltage Switchgear

The Contractor shall furnish and install a low-voltage fully type tested switchgear as duly certified by the Original Electrical Manufacturer at the location shown on the Plans.

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.

The equipment mounted in the Low voltage switchgear and controlgear assembly shall be fitted and wired in accordance with corresponding Manufacturer's instructions and recommendations. Minimizing the Low voltage switchgear and controlgear assembly size shall be taken into account. The equipment and circuits in the Low voltage switchgear and controlgear assembly shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

The equipment mounted within the assembly shall have a clearance of 100 mm minimum around the perimeter of the enclosure and 50 mm from the door.

All electrical equipment, bus bars, terminal blocks and covers of connections of Switching devices, mounted inside the assembly, shall be IP 20 or NEMA Type 1 (general use) protected at least.

1102.2.5 Grounding Systems

It shall conform to the applicable requirements of Item 1109, Grounding Systems.

1102.2.6 Panelboards and Cabinets

Panelboards shall be fully type tested panels as duly certified by the Original Electrical Manufacturer.

Main and branch circuit breakers for panelboards 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

1102.2.7 Busbars

Four pole air insulated busbars of the uniform cross-sectional area throughout their length with a continuous rating or dimensions not less than that indicated in the drawings shall be arranged neatly.

The busbars and busbar connections between the busbar and various items of the switchgear shall be manufactured from copper.

All busbars shall be tinned, and continuous lengths without connections shall be insulated with heat shrink sleeves.

Busbars shall be mounted on non-hygroscopic, anti-tracking insulators strong enough to endure, without damage, forces set up by any thermal expansion within the bars under normal operating conditions and forces created by prospective fault currents.

Busbars shall be housed in separate compartments and these compartments shall not contain any wiring or apparatus other than that required for coupling to the busbars.

Access to busbars and busbar connections shall be gained only by the removal of a cover secured by bolts. Behind the covers, an insulating sheet with warning labels bearing the word "DANGER" in bold letters and the lighting symbol shall be provided so that final access can be gained only through removing this sheet secured by round head screws.

1102.2.8 Diesel-Generator Set Stationary 100-2500 Kw, With Auxiliaries

1. Provide and install each engine-generator set complete and very functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

2. Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified. Each engine-generator-set shall provide power equal to the sum of Service Load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

3. Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

4. Each engine-generator set specified for parallel operation shall be configured for automatic or manual parallel operation.

5. Each set shall be capable of parallel operation with a commercial power source on an infinite bus and with one or more sets on an isolated bus

6. Each engine-generator set specified for parallel operation shall be configure to manually load share or automatically load share with other sets by proportional loading. Proportional loading shall load each set to within 5% of its fair share. A set's fair share is its nameplate-rated capacity times the total load, divided by the sum of all nameplate-rated capacities of on-line sets. Load sharing shall incorporate both the real and reactive components of the load.

7. The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of

being removed without disassembly of the engine-generator set or removal of components other than the exhaust system.

1102.2.9 Station Battery System

A station battery system shall be provided to include the battery, battery rack spacers, automatic battery charger and distribution panelboards with overcurrent protection, metering and relaying. Components shall be sized to withstand the seismic acceleration forces specified.

1102.2.9.1 Battery

The battery shall be lead-acid or nickel-cadmium, sized in accordance with IEEE 485, Lead Acid Batteries for Stationary Applications, and conform to the requirements of IEEE 484, IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications, Valve regulated lead-acid batteries are not acceptable

1102.2.10 Motor Control

Motor Controllers shall conform to NEMA ICS 3, Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 V AC and UL 508, Standard for Industrial Control Equipment. Controllers shall have thermal overload protection in each phase.

1102.2.10.1 Manual Motor Controllers

Full-voltage, manually operated manual motor controllers shall be provided for the control and protection of single-phase 60-hertz ac small wattage rating fractional-horsepower squirrel-cage induction motors.

Single-throw, single or double-pole, three-position controllers rated at not more than 750 W, rated 1 hp at 115 V and 230 V single phase shall be provided. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal overload relay, and terminal connectors. Controllers shall clearly indicate operating condition: on, off, or tripped.

Toggle or key-operated type manual motor controllers shall be provided as indicated and arrange so that they are lockable with a padlock in the "OFF" position.

Recessed manual motor controllers shall be provided for single-speed, small wattage rating fractional-horsepower squirrel-cage induction motors that include a single controller and indicating light in a 100-millimeter square wall outlet box for flush-wiring devices with matching corrosion-resistant steel flush cover plate. Surface-mounted manual motor controllers shall be provided for single-speed, small wattage rating fractional-horsepower squirrel cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 General-purpose enclosure.

Recessed and surface-mounted manual motor controllers shall be provided for two-speed, small wattage rating fractional-horsepower squirrel-cage induction motors that include two controllers, two indicating lights, and a selector switch in a multiple-gang wall outlet box for flush-wiring devices with matching corrosion-resistant steel flush-cover plate. Surface-mounted manual motor controllers shall be provided for two-speed small wattage rating fractional horsepower squirrel-cage induction motors that include two controllers, two Indicating lights, and a selector switch in a NEMA 250, Type 1 General-purpose enclosure.

1102.2.10.2 Magnetic Motor Controllers

1. Full-Voltage Controllers

Magnetic motor controllers shall be provided for the control and protection of single and three-phase, 60-hertz, squirrel-cage induction motors with fa voltage, full magnetic devices in accordance with NEMA ICS 1, Industrial Control and Systems General Requirements, NEMA ICS 2, Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts, and Ut 508, Industrial Control Equipment.

Overcurrent protection includes three manual reset thermal overload devices, one in each pole of the controller. Thermal overload relays of the melting-alloy or bimetallic nonadjustable type with continuous current ratings and service limit current ratings and with a plus or minus 15% adjustment to compensate for ambient operating conditions.

An externally operable manual-reset button shall be provided to re-establish control power to the holding coil of the electromagnet. The Contractor sha ensure that after the controller has tripped from overload, resetting the motor overload device will not restart the motor.

2. High-Voltage Motor Controllers

High-voltage motor controllers shall be provided for the control and protection of squirrel-cage induction motors, wound-rotor induction motors, and synchronous machines rated 2.4 through 7.2 kilovolts, three-phase, that are NEMA ICS 2, Class E2, type as required.

Unless enclosed within a switchgear or unit-substation cubide, house high-voltage motor controllers in floor-mounted structures of the NEMA type indicated, approximately 2.3 m high, 750 mm wide, and 750 mm deep, with suitable draw-out compartments. Include structural provisions for padlocking the doors.

The structure shall be subdivided into low-voltage control compartment with separate door, high-voltage control compartment with separate door, ac bus compartment, and cable-entrance compartment.

Isolate controller by externally operated draw-out stabs with shutter mechanism which also opens the secondary of the control-power transformer. Interlocks shall be provided to prevent inadvertent operation of the isolating mechanism under load, opening the medium-voltage compartment door without isolating the starter, and closing the line contactor with the door open. Include an isolating switch assembly.

For overload protection, include ambient-compensated thermal overload relays and hand reset in all three phases. Utilizing solid-state multifunction overload protection is acceptable when approved.

Fused type controllers shall be provided employing current-limiting power fuses of the interrupting rating indicated. Single-phase anti-trip protection shall be provided. Magnetic air-break line contactors rated not less than 5 kilovolts shall be provided on starters. Control circuit shall be provided with provisions for external testing of a 120-volt control circuit and a minimum of one (1) set of normally open and normally closed auxiliary contacts.

1102.2.11 Fuses

All switches and switchgear shall be provided with a complete set of fuses. Fuses shall be provided voltage rating of not less than the circuit voltage.

For ratings 30 A, 125 V or less, nonrenewable cartridge type fuses shall be provided. Renewable cartridge type fuses shall be provided for ratings above 30 A, 600 V or less with time-delay dual elements, except where otherwise indicated. It shall conform to NEMA FU

1, Low Voltage Cartridge Fuses, for fuses.

Special fuses shall be installed such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Power fuses shall be provided on ac systems above 600 volts in accordance with NEMA SG 2, High Voltage Fuses.

Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable. Clearly, list fuse information on equipment drawings.

Porcelain fuse holders shall be provided when field-mounted in a cabinet or box. Do not use fuse holders made of such materials such as ebony asbestos, bakelite, or pressed fiber for field installation.

1102.2.12 Protective Relays

1102.2.12.1 Overcurrent Relays

Overcurrent relays shall conform to IEEE C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus. For protection against phase and ground faults provide a single-phase non-directional removable induction type overcurrent relays with built-in testing facilities designed for operation on the de or ac control circuit indicated.

Ground-fault overcurrent relays with short-time inverse time characteristics and with adjustable current tap range shall be provided as required.

Phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range shall be provided as required. Indicate instantaneous-trip attachments with an adjustable current range as required.

Trip unit shall employ a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modem distribution system.

Complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Switchable or easily defeatable instantaneous and ground fault trips shall be provided.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Trip devices shall be furnished with three visual indicators to denote the automatic tripping mode of the breaker including overload; short circuit; and ground fault.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

All trip units shall be with test jacks for in-service functional testing of the long time instantaneous and ground fault circuits using a small hand-held test kit.

1102.2.12.2 Directional Overcurrent Relays

Directional overcurrent relays shall conform to IEEE C37.90.

Single-phase induction type relays shall with adjustable time delay and instantaneous trip attachments for directional overcurrent and protection against reverse-power faults. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

1102.2.13 Apitong or Approved Equal Creosoted Wood Pole

It shall conform to the applicable requirements of ANSI 05.1, Wood Poles - Specifications and Dimensions.

1102.3 Construction Requirements

The Contractor shall install the Power Load Center Substation and Low-Voltage fully type tested Switchgear and Panelboards at the locations shown on the Plans.

The switchboards shall be of enclosed assembly design, suitable for indoor use in the form of free standing or wall mounting, self-contained, flush fronted cubicles sectionalized as necessary to facilitate easy transportation and erection. The assembly shall be Type Tested in accordance with IEC 61439. The main incoming unit, functional units of metered and unmetered supply, the metered and unmetered busbar sections shall be separately housed in their own cubicles.

Wall mounted switchboards shall be suitable for front access only and the maximum height shall be 2.0 m.

Floor mounted switchboards shall be suitable for front and back access.

The cubicle sections shall be constructed of electro-galvanized sheet steel frames of a minimum thickness of 2.0 mm and the panels shall be constructed from electro-galvanized sheet steel of a minimum thickness of 1.6 mm. It shall be able to withstand a fault level of 36 KA for one (1) second unless otherwise specified in the single-line-diagrams. The enclosures for the switchboards shall provide a degree of protection of IP 4X.

Each cubicle unit shall be incorporated with a removable cover with hidden hinges. The front cover shall have apertures for the protrusion of operating handles of circuit breakers.

The various units comprising a complete switchboard shall be grouped in a multi-tier arrangement including cabling and wiring chamber of ample dimensions to accommodate terminal boards, cable boxes and gland plates.

All external panels of the switchboard shall be treated with a coat of finishing paint, giving a total paint thickness of not less than 50 microns. All coats of paint shall be oven-baked and dried.

Installation of panelboards and enclosures shall be coordinated with cable a e and raceway installation work.

Enclosures shall be anchored firmly to walls and structural surfaces to ensure that they are permanently and mechanically secure.

Panelboard's circuit directory shall be filled out upon completion of installation work and it shall be typewritten or printed.

Bus bar shall be of high conductivity tinned copper, fully insulated, and installed in a segregated compartment completely shielded and isolated from other circuits with sheet metal. Barriers are to be provided between adjacent panels Bus bar shall be supported on non-hygroscopic material, braced and rated to withstand the short-circuit currents. They are to be drilled for future extensions at each end of the switchgear and insulated boots shall be fitted at the ends of the bus bars. Heaters suitable for operating at 230V, 60Hz, AC shall be provided to prevent moisture condensation on bus bars, current transformers, feeder/bus bar spouts and inside the switchgear enclosure.

The switchgear shall be provided with all small wiring, terminal boards, fuses links, labels, cable sockets, foundation bolts test, and earth connections

The Contractor shall follow the manufacturer's instructions for receiving handling, storage, and installation of a unit substation.

1102.3.1 Inspection and Tests

The Contractor shall submit a proposal of preliminary Test and Inspection Plan. Each Low voltage switchgear and controlgear assembly shall be tested in accordance with IEC Standard 60439-1, Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies.

1102.4 Method of Measurement

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

1102.5 Basis of Payment

All works performed and measured and as provided for in this 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
1102 (1)	Panelboard with Main & Branch Breakers	Lump Sum

ITEM 1103 - LIGHTING FIXTURES

1103.1 Description

This Item shall consist of furnishing all lighting fixtures, accessories and fixings necessary for installation as shown on the Plans and in accordance with this Specification.

A light fixture or luminaire is an electrical device to create artificial light that serves as a tool to direct light using reflective and shielding materials.

1103.2 Material Requirements

1103.2.1 General

All fixtures shall be suitable for 220 V single phase 60 Hz power supply system. They shall be complete with accessories and fixings necessary for installation. Fixture housing, frame or canopy shall have a suitable cover for the fixture outlet box or fixture opening.

Fixtures shall be installed at mounting heights as shown on the Plans. The weight of the fixtures shall be adequately supported by hangers. The design of hangers and method of fastening other than shown on the Plans or herein specified shall be submitted to the Engineer for approval.

Wiring within the fixture and for connection to the branch circuit wiring shall not be less than 1.5 mm² or equivalent for 250 V application. Insulation shall be silicon rubber for the lower temperature (fluorescent fixtures) and impregnated asbestos for the higher temperatures (incandescent fixtures).

All materials to be used for lighting fixtures shall be in accordance with the Plans and Specifications. The fixtures shall be completely free from burrs and tool marks, and solder shall not be used as a mechanical fastening device on any part of the fixture.

The color rendering index (CRI) scale shall be used to compare the effect of a light source on the color appearance of its surroundings. A scale of 0 to 100 defines the CRI. CRI shall not be less than 65. Under higher CRI sources, surface colors appear brighter, improving the aesthetics of the space.

Table 1103.1 Efficacy Ranges of Various Lamps

Lamp Type	Rated Power Ranges (watts)	Efficacy Range (lumens/watts)
Linear/Tubular Fluorescent Lamp		
Halophosphate	10 - 40	55 – 70

Triphosphor	14 - 65	60 – 83
Compact Fluorescent Lamp (CFL)	3 - 125	41 – 65
Light Emitting Diode (LED)	3 - 100	80 – 95
Incandescent Lamp	10 - 100	10 – 25
Mercury Vapor Lamp	50 - 2000	40 – 63
Metal Halide Lamp	Up to 1000	75 – 95
Low Pressure Sodium Lamp	20 - 200	100 – 180
High Pressure Sodium Lamp	50 - 250	80 – 130

Source: Guidelines on Energy Conserving Designs of Buildings

1103.2.1.1 Interior Lighting Fixtures

1. Linear Fluorescent Fixtures

a. It shall be suitable for single or twin approximately 1.20 m of 40 watts alternatively 36 watts fluorescent tube as specified. It shall be complete with low loss heavy duty ballast(s), starter(s) and power improvement capacitor.

b. It shall be decorative, commercial or industrial type as specified. In case of industrial type, stove/vitreous enameled reflector shall be provided wherever specified. In case of decorative luminaire, Opal Acrylic diffuser/square polystyrene/vertical metal louvers shall be provided as specified.

c. The fixture shall be surface or recessed mounted as indicated on the Plans. In some cases, single/twin tube fixtures for Offices/Commercial areas shall be decorative recessed mounting type with specially designed aluminum bright anodized reflectors. It shall have a bat wing wide spread distribution light and high optical efficiency. The reflector shall have Matt anodized cross louvers to minimize glare.

d. Only single and/or two lamp ballast shall be used in any one fixture. Ballast shall be completely enclosed inside sheet steel casing, and shall have a corrosion resistant finish. Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. Under no condition shall the thermal device permit the enclosure temperature of the ballast to exceed 90ºC Make sure that the compound shall not support combustion.

e. All fluorescent fixtures shall be provided with white lamp holders while industrial type shall have turret type lamp holders.

f. Surface mounted fixtures longer than 600 mm shall have one (1) additional point of support besides the outlet box fixture stud when installed individually. Pendant individually mounted fixtures 1.2 m long and small-sized shall be provided with twin stem hangers. It shall have ball aligners or any similar device and having a provision of 25 mm (minimum) vertical adjustment.

g. Items with appropriate length to suspend fixtures are required mounting height as specified on the approved Plans.

h. Lamps shall be rapid or trigger start, bi-pin base and a minimum approximate rated life of 20,000 hours.

2. Compact Fluorescent Fixtures

There are two (2) units specified under this type of fixture:

a. Integral units - These consist of a compact fluorescent lamp and ballast in self-contained units. Some integral units also include a reflector and/or glass enclosure.

b. Modular units - The modular type of retrofit compact fluorescent lamp is similar to the integral units, except that the lamp is replaceable.

Considerations before the installation include:

a. Reflectors shall be clear, with integral white trim ring, unless noted otherwise. Open reflectors shall have a minimum 18 mm diameter.

b. Fixtures installed outdoors and over food handling areas shall be lensed.

c. Fixtures installed in shower locations shall be provided with flush type plastic reflector with opal lens.

Special Application and Function

a. Teleconferencing areas shall have fixtures which match and are compatible with existing facility installations, including lamp type, lamp color, fixture and lens type, controls, and minimum lighting levels for the vertical and horizontal planes.

b. Low voltage fixtures utilizing MR16 lamps shall be lensed.

c "Clean-room" type fixtures for high purity areas and special laboratory functions shall be triple gasketed, with sealed cam latches.

d. Warning signs (In Use, Beam On, X-Ray In Use, etc.) shall be light emitting diode (LED) illuminated with housing and face color as specified.

e. Task lights shall be equipped with an integral rocker switch. Where two or more task lights are located in a room, a wall switch shall be installed at the entry door for control.

1103.2.1.2 Environmental Rooms and Exterior Lighting Fixtures

Enclosures shall be complete with gaskets to form weatherproof seal where no water can enter or accumulate in wiring compartments, lampholders, or other electrical parts. It shall be provided with low temperature ballasts starting at 0 °C.

Garden and driveway lighting fixtures requirements:

1. It shall be suitable for mounting on GI poles of 2 m to 3 m height. The fittings shall be waterproof, robust and shall have components which are not easily corroded.

2. The connectors shall be easily accessible and suitable for a minimum 2 x 4 mm² PVC aluminum conductor cables. 3.

3. The appearance with the reflector/shade shall be pleasing and aesthetic.

4. The fittings shall be suitable for mounting GLS lamps/ MLL blended lamps/80W/125W/ High Power Micro Wave (HPMW) /70W High Pressure Sodium Vapor (HPSV).

1103.2.1.3 Return Air Troffer

1. The return air troffer where indicated on the Plans, shall have white enamel finish, 4 mm clear prismatic acrylic lens, and shall be recessed in inverted "T" bar ceiling.

2. It shall have the capacity to handle 200 CFM of return air through the side slots of the nominal 1.2 m long fixture (without return air attachment) with a total pressure drop from the rooms to the return air ceiling plenum not to exceed 1.27 mm.

1103.2.2 Emergency Exit Signs

1. Provide exit signs with red Light-Emitting Diode (LED) illumination.

2. Exit signs shall have covers that are composed of a black face and body, smooth red diffusion material, with 152 mm high red letters on black background, directional arrows as indicated. Individual LED's shall not be visible through the diffusion material.

3. Fixtures installed in these areas shall have minimum five (5) year warranty.

4. Exit signs shall be rated for auto-volt (100-240) with back-up power supply.

1103.2.3 Lamps

1. Pin-based compact fluorescent lamps shall be quad or triple tube, 13, 18, 26 or 32 watt similar to NEMA lamp type CFQ13W/G24Q/835 CFTR26W/GX240/835. Compact fluorescent lamps in nominal 39 and 40 watt sizes shall be acceptable. Compact fluorescent

lamps shall be 3,500K color temperature. Original equipment manufacturer lamps that are only available from a single manufacturer shall not be acceptable.

2. Linear fluorescent rapid or instant-start lamps shall be medium bi-pin with minimum CRI of 85. If different lamp manufacturers are submitted, no noticeable difference in color temperature shall be allowed and performance shall be equal to or better than the base lamp. T-8 fluorescent lamps shall have a color temperature of 4,100 K and be specified in 610 mm, 915 mm and 1,220 mm lengths only. Linear 1.2 m lamps used in open fixtures in environments below 21°C, or in operation rooms, shall be full wattage type.

3. Metal halide High Intensity Discharge (HID) lamps shall be ceramic metal halide type, clear, unless noted otherwise, with mogul or medium bases. Acceptable medium base lamp sizes are 50, 100 and 150 watts. Double ended lamps are not acceptable. Any base type other than medium or mogul shall be submitted for Engineer's review and approval in advance. Metal halide fixtures shall be lensed or utilize a lamp (PAR type) which does not require special arc tube protection.

4. Cold cathode, neon, T-5 and T-2 systems shall not be approved for use.

5. The use of LED, induction and fiber optic lighting systems for special applications shall be approved by the Engineer.

6. Lamps, including linear fluorescent, compact fluorescent and high intensity discharge, shall be low-mercury and shall pass all federal Toxicity Characteristic Leaching Procedure (TCLP) test requirements at the time of manufacture.

1103.2.4 Ballasts

1103.2.4.1 Ballasts for Fluorescent

1. High frequency (20 kHz or greater) electronic type.

2. Total Harmonic Distortion (THD) shall be less than 10%.

3. Power factor shall be greater than or equal to 95%.

4. Ballast shall operate with 265 MA Lamps.

5. Unless noted otherwise (such a dual switching, etc.), provide one ballast per fixture.

6. All ballast shall be auto-volt rated.

7. Ballasts shall be Class P Minimum thermally protected.

1103.2.4.2 Ballasts for Compact Fluorescent Lamp

1. All ballasts shall be of high-power factor and capable of independent switching, if two (2) ballasts are provided with a fixture.

2. Dimming ballasts shall be electronic and compatible for line voltage or control wire dimming systems as specified on the Plans.

3. Ballasts shall be magnetic for 2-pin lamp application. Electronic ballasts for other applications shall be submitted for Engineer's approval in advance.

1103.2.4.3 Ballasts for High Intensity Discharge (HID) Lamp

1. HID ballast shall be of the lead-peak auto-transformer type for metal halide lamps. The ballast shall start and operate the lamp at ambient temperatures ranging from minus 7°C to 41°C. All ballasts shall have automatic thema protection, and high power factor, minimum of 90%. Ballasts for interior applications shall be encased and potted, or be of the electronic type.

2. HID ballasts for M90, M110, M130, M139 and M140 rated lamps shall be electronic-type.

1103.3 Construction Requirements

1103.3.1 Locations

1. Wet and Damp Locations - It shall be installed in areas where no water can enter or accumulate in wiring compartments, lampholders, or other electrical parts and shall be marked with "Suitable for Wet Locations" based on the Philippine Electrical Code (PEC) Part 1.

2. Corrosive Locations Ferrous metal shall be bonded and given a corrosion resistant phosphate treatment or other approved rust inhibiting prime cost before application of finish.

3. Fixtures in Indoor Sports, Mixed-Use, and All-Purpose Facilities Fixtures subject to physical damage, using mercury vapour or metal halide lamp installed in playing and spectator seating areas of indoor sports, mixed-use or all-purpose facilities shall be of the type that protects the lamp with a glass or plastic lens. Such fixtures shall be permitted to have additional guard.

4. Fixtures Near Combustible Material - Fixtures shall be installed, or equipped with shades or guards so that combustible material is not subjected to temperatures in excess of 90 °C in compliance with the hazardous area of the PEC, Part 1.

5. Fixtures Over Combustible Material Lampholders installed over highly combustible material shall be of the unswitched type. Unless an individual switch is provided for each luminaire (fixture), lampholders shall be located at least 2,400 mm above the floor or shall be located or guarded so that the lamps cannot be readily removed or damaged.

6. Fixtures in Show Windows - Chain-supported fixtures used in a show window shall be permitted to be externally wired. No other externally wired fixtures shall be allowed.

7. Fixtures in Clothes Closets fixtures in clothes closets shall be permitted to be installed as follows:

a. Surface-mounted fluorescent or LED fixtures installed on the wall above. the door or on the ceiling, provided there is a minimum clearance of 300 mm between the fixture and the nearest point of a storage space.

b. Surface-mounted fluorescent or LED fixtures installed on the wall above the door or on the ceiling, provided there is a minimum clearance of 150 mm between the fixture and the nearest point of a storage space.

c. Recessed fluorescent or LED fixtures with a completely enclosed lamp installed in the wall or the ceiling, provided there is a minimum clearance of 150 mm between the fixture and the nearest point of a storage space.

d. Recessed fluorescent or LED fixtures installed in the wall or the ceiling, provided there is a minimum clearance of 150 mm between the luminaire (fixture) and the nearest point of a storage space

1103.3.2 Installation

1. Installation shall conform to the specifications of the PEC Part 1 and in accordance with the manufacturer's written instructions.

2. Building electrical system requirements shall be checked. Regardless of the catalog number prefixes and suffixes shown, fixtures shall be furnished with the proper trim, frames, supports, hangers, ballasts, voltage rating, and other miscellaneous appurtenances to properly coordinate with Project conditions.

3. The type of ceilings to be installed shall be checked in each room and verify that the recessed lighting fixtures are proper for the type of ceiling to be installed before ordering fixtures. A frame compatible with the type of celling shall be provided in which the recessed lighting fixture is installed. The specified ceiling type shall be referred to the Architectural Room Finish Schedule.

4. Fixtures shall be securely attached to the ceiling-framing members by mechanical means. Clips identified for use with the type of ceiling framing member(s) and fixture(s) shall also be permitted. Lighting fixtures shall be fastened in areas where there is no ceiling securely installed to the structure

5. Immediately before final observation, all fixtures shall be cleaned, inside and out, including plastics and glassware, and all trim shall be adjusted to properly fit adjacent surface, broken or damaged parts and lamps shall be replaced, and all fixtures for electrical as well as mechanical operation shall be tested.

6. Installed fixtures shall be protected from damage during the remainder of the construction period.

7. When replacing an existing fixture, the old fixture shall be disconnected and removed.

8. Pendant fixtures within the same room shall be installed plumb and at a uniform height from the finished floor. Adjustment of height shall be made during installation as per Architect's instructions.

9. Flush mounted recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface. It shall be rigidly secured to a fixture stud in the outlet box. Extension pieces shall be installed where required to facilitate proper installation. Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.

10. Fixture shall be completely wired and constructed to comply with the regulations and standards of PEC, Part 1 for electric lighting fixtures, unless otherwise specified.

1103.3.3 Wiring

Wiring of fixtures shall comply with the existing standards of the PEC Part 1.

1. Lighting fixtures shall be connected to a typical metal conduit, junction box, and wire lighting grid system. MC (Metal-Clad Cable) and FMC (Flexible Metal Conduit), when permitted to be used, shall be properly concealed to prevent physical damage. Exposed MC and FMC installations shall not be acceptable.

2. Modular cabling, flexible whip assemblies, feed through wiring, 'daisy-chain' feeds, tandem wiring and other similar wiring methods shall not be acceptable for the lighting circuit distribution and wiring system.

1103.3.4 Testing

Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, electrical energy shall be applied to demonstrate capability and compliance with requirements. When possible, malfunctioned units at the Project Site shall be rectified, then retested to demonstrate compliance; otherwise, defective items shall be removed and replaced with new units, and another test shall be conducted.

1103.3.5 Outlet Boxes, Canopies, and Pans

It shall be in accordance with the requirements of Item 1100, Conduits, Boxes and Fittings.

1103.3.6 Grounding and Bonding

Bonding and grounding shall be provided where necessary to ensure electrical continuity as well as the capacity to conduct safe installation. It shall be in accordance with the PEC Part 1.

1103.4. Method of Measurement

The work under this Item shall be measured in lump sum placed and installed as shown on the Plans.

1103.5. Basis of Payment

The accepted quantity, measured as prescribed in Section 1103.4, Method of Measurement shall be paid for at the 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
1103 (1)	Lighting Fixtures and Lamps	Lump Sum

Section VII. Drawings

Section VIII. Bill of Quantities

Bill of Quantities

Construction of Tanquigan Elementary School Water System, City of San Fernando, La Union

Item No.	Description	Unit	Quantity	Unit Price	Amount (Pesos)
B.5	Project Billboards / Signboard *(Amount in Words)*	ea	1		
B.7(2)	Occupational Safety and Health Program *(Amount in Words)*	L.S	1		
803(1)a	Structure Excavation (Common Soil) *(Amount in Words)*	cu.m	6.55		
804(1)b	Embankment from Common borrow *(Amount in Words)*	cu.m	10.40		
900(1)c1	Structural Concrete for Footing and Slab on Fill (Class A,28 days) *(Amount in Words)*	cu.m	11.73		
902(1)a	Reinforcing Steel(Deformed) (Grade 40) *(Amount in Words)*	kg	451.47		
903(2)a	Formworks and Falseworks (for one-storey building) *(Amount in Words)*	sq.m	14.16	-	
1002(27)	Plumbing Works *(Amount in Words)*	l.s.	1		
1003 (1)e1	Ceiling (Gypsum Board on Metal Frame) *(Amount in Words)*	sq.m.	30		
1010(2) a	Hollow Core Flush Door *(Amount in Words)*	sq.m.	2.10		
1012(6)	Glass and Glazing *(Amount in Words)*	l.s.	1		
1014(1) b2	Prepainted Metal Sheets (above 0.427mm, Rib Type, Long Span) *(Amount in Words)*	sq.m	49.80		
1018 (2)	Unglazed Tiles *(Amount in Words)*	sq.m	20		

PROVINCIAL GOVERNMENT OF LA UNION

REFERENCE NUMBER: _____

Construction of Tanquigan Elementary School Water System, City of San Fernando, La Union

Standard Form Number: SF-INFR-55
Revised on: August 11, 2004

Bill of Quantities

Construction of Tanquigan Elementary School Water System, City of San Fernando, La Union

Item No.	Description	Unit	Quantity	Unit Price	Amount (Pesos)
1018 (3)	Granite Tiles *(Amount in Words)*	sq.m	3.23		
1027(1)	Cement Plaster Finish (Plain) *(Amount in Words)*	sq.m	115.20		
1032(1) a	Painting Works (Masonry Painting) *(Amount in Words)*	sq.m	115.20		
1032(1)c	Painting Works (Metal Painting) *(Amount in Words)*	sq.m	31.25		
1046(2) a1	CHB Non Load Bearing (including RSB, 100mm) *(Amount in Words)*	sq.m	80.94		
1047(1)	Structural Steel *(Amount in Words)*	l.s.	1		
1100(6)i	Polyvinyl Chloride Pipes (PVC/uPVC, 100 mm dia) *(Amount in Words)*	l.s.	1		
1100(10)	Conduits, Boxes & Fittings (Conduit Works/ Conduit Rough-in) *(Amount in Words)*	l.s.	1		
1101(33)	Wires and Wiring Devices *(Amount in Words)*	l.s.	1		
1102(1)	Panelboard with Main & Branch Breakers *(Amount in Words)*	l.s.	1		
1103(1)	Lighting Fixtures and Lamps *(Amount in Words)*	l.s.	1		
				Total Bid Amount	

Submitted by:

_____

_____

_____

Date: _____

Section IX. Checklist of Technical and Financial Documents

Checklist of Technical and Financial Documents

I. TECHNICAL COMPONENT ENVELOPE

Class "A" Documents

Legal Documents

☐ (a) Valid PhilGEPS Registration Certificate (Platinum Membership) (all pages) in accordance with Section 8.5.2 of the IRR;

Technical Documents

☐ (b) Statement of the prospective bidder of all its ongoing government and private contracts, including contracts awarded but not yet started, if any, whether similar or not similar in nature and complexity to the contract to be bid; **and**

☐ (c) Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid, except under conditions provided under the rules; **and**

☐ (d) Special PCAB License in case of Joint Ventures;
and registration for the type and cost of the contract to be bid; **and**

☐ (e) Original copy of Bid Security. If in the form of a Surety Bond, submit also a certification issued by the Insurance Commission;
or
Original copy of Notarized Bid Securing Declaration; **and**

(f) Project Requirements, which shall include the following:

☐ a. Organizational chart for the contract to be bid;

☐ b. List of contractor's key personnel (*e.g.*, Project Manager, Project Engineers, Materials Engineers, and Foremen), to be assigned to the contract to be bid, with their complete qualification and experience data;

☐ c. List of contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership or certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be; **and**

☐ (g) Original duly signed Omnibus Sworn Statement (OSS);
and if applicable, Original Notarized Secretary's Certificate in case of a corporation, partnership, or cooperative; or Original Special Power of Attorney of all members of the joint venture giving full power and authority to its officer to sign the OSS and do acts to represent the Bidder.

Financial Documents

☐ (h) The prospective bidder's computation of Net Financial Contracting Capacity (NFCC).

Class "B" Documents

☐ (i) If applicable, duly signed joint venture agreement (JVA) in accordance with RA No. 4566 and its IRR in case the joint venture is already in existence;
or

duly notarized statements from all the potential joint venture partners stating that they will enter into and abide by the provisions of the JVA in the instance that the bid is successful.

II. FINANCIAL COMPONENT ENVELOPE

☐ (j) Original of duly signed and accomplished Financial Bid Form; **and**

Other documentary requirements under RA No. 9184

☐ (k) Original of duly signed Bid Prices in the Bill of Quantities; **and**

☐ (l) Duly accomplished Detailed Estimates Form, including a summary shee indicating the unit prices of construction materials, labor rates, and equipmen rentals used in coming up with the Bid; **and**

☐ (m) Cash Flow by Quarter.

SEALING AND MARKING OF BID ENVELOPES