PHILIPPINE BIDDING DOCUMENTS

(As Harmonized with Development Partners)

Procurement of INFRASTRUCTURE PROJECTS

Government of the Republic of the Philippines

IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK SINACABAN, MISAMIS OCCIDENTAL

Sixth Edition
July 2020

Preface

These Philippine Bidding Documents (PBDs) for the procurement of Infrastructure Projects (hereinafter referred to also as the "Works") through Competitive Bidding have been prepared by the Government of the Philippines for use by all branches, agencies, departments, bureaus, offices, or instrumentalities of the government, including government-owned and/or -controlled corporations, government financial institutions, state universities and colleges, local government units, and autonomous regional government. The procedures and practices presented in this document have been developed through broad experience, and are for mandatory use in projects that are financed in whole or in part by the Government of the Philippines or any foreign government/foreign or international financing institution in accordance with the provisions of the 2016 revised Implementing Rules and Regulations (IRR) of Republic Act (RA) No. 9184.

The PBDs are intended as a model for admeasurements (unit prices or unit rates in a bill of quantities) types of contract, which are the most common in Works contracting.

The Bidding Documents shall clearly and adequately define, among others: (i) the objectives, scope, and expected outputs and/or results of the proposed contract; (ii) the eligibility requirements of Bidders; (iii) the expected contract duration; and (iv) the obligations, duties, and/or functions of the winning Bidder.

Care should be taken to check the relevance of the provisions of the PBDs against the requirements of the specific Works to be procured. If duplication of a subject is inevitable in other sections of the document prepared by the Procuring Entity, care must be exercised to avoid contradictions between clauses dealing with the same matter.

Moreover, each section is prepared with notes intended only as information for the Procuring Entity or the person drafting the Bidding Documents. They shall not be included in the final documents. The following general directions should be observed when using the documents:

a. All the documents listed in the Table of Contents are normally required for the procurement of Infrastructure Projects. However, they should be adapted as necessary to the circumstances of the particular Project.

b. Specific details, such as the "*name of the Procuring Entity*" and "*address for bid submission*," should be furnished in the Instructions to Bidders, Bid Data Sheet, and Special Conditions of Contract. The final documents should contain neither blank spaces nor options.

c. This Preface and the footnotes or notes in italics included in the Invitation to Bid, BDS, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings, and Bill of Quantities are not part of the text of the final document, although they contain instructions that the Procuring Entity should strictly follow.

d. The cover should be modified as required to identify the Bidding Documents as to the names of the Project, Contract, and Procuring Entity, in addition to date of issue.

e. Modifications for specific Procurement Project details should be provided in the Special Conditions of Contract as amendments to the Conditions of Contract. For easy completion, whenever reference has to be made to specific clauses in the Bid Data Sheet or Special Conditions of Contract, these terms shall be printed in bold typeface on Sections I (Instructions to Bidders) and III (General Conditions of Contract), respectively.

f. For guidelines on the use of Bidding Forms and the procurement of Foreign-Assisted Projects, these will be covered by a separate issuance of the Government Procurement Policy Board.

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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

Notes on the Invitation to Bid

The Invitation to Bid (IB) provides information that enables potential Bidders to decide whether to participate in the procurement at hand. The IB shall be posted in accordance with Section 21.2 of the 2016 revised IRR of RA No. 9184.

Apart from the essential items listed in the Bidding Documents, the IB should also indicate the following:

a. The date of availability of the Bidding Documents, which shall be from the time the IB is first advertised/posted until the deadline for the submission and receipt of bids;

b. The place where the Bidding Documents may be acquired or the website where it may be downloaded;

c. The deadline for the submission and receipt of bids; and

d. Any important bid evaluation criteria.

The IB should be incorporated into the Bidding Documents. The information contained in the IB must conform to the Bidding Documents and in particular to the relevant information in the Bid Data Sheet.

Republic of the Philippines

Tourism Infrastructure & Enterprise Zone Authority

Invitation to Bid

IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK SINACABAN, MISAMIS OCCIDENTAL

Project Identification/Invitation to Bid No. **25-06-0007**

1. The Tourism Infrastructure and Enterprise Zone Authority, through the Approved Corporate Budget, intends to apply the sum of **ONE HUNDRED TWENTY SEVEN MILLION NINE HUNDRED NINETY NINE THOUSAND FOUR HUNDRED SIXTY FIVE PESOS AND SIXTEEN CENTAVOS ONLY (P 127,999,465.16)** being the Approved Budget for the Contract (ABC), as payment contract for the **IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK SINACABAN, MISAMIS OCCIDENTAL** bids received in excess of the ABC shall be automatically rejected at Bid Opening.

2. The Tourism Infrastructure and Enterprise Zone Authority now invites bids for the above procurement project. Completion of the works is required within Three Hundred Thirty (330) calendar days. Bidders should have completed, within five (5) years period from the date of submission and receipt of bids, 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 criteria as specified in the Implementing Rules and Regulations (IRR) of Republic Act 9184 (R.A. 9184), otherwise known as the "Government Procurement Reform Act".

4. Bidding is restricted to Filipino citizens/sole proprietorships, partnership, or organizations with at least seventy-five percent (75%) interest or outstanding capital stock belonging to citizens of the Philippines.

5. Interested bidders may obtain further information from the TIEZA BAC Secretariat **(please see contact details below)** and inspect the Bidding Documents on our website and at the posting on the Philippine Government Electronic Procurement Service (PhilGEPS) website.

6. A complete set of bidding documents may be acquired by interested Bidders through the following modes:

   ON-PREMISE:

   The prospective bidders shall accomplish the issued Authority to Accept Payment (ATAP) form for payment at the Treasurer's Office.

   The bidding documents will be issued to the prospective bidder upon settlement of the Order of Payment.

ONLINE:

The Authority to Accept Payment (ATAP) is available at TIEZA's website. Interested bidders can download the ATAP, completely fill out the form and send the scanned copy to the BAC Secretariat's email. An instruction to settle thru bank deposit will be given thereafter.

Bidders who will buy the bidding documents shall deposit the amount in either one of the following TIEZA bank accounts:

Account Name: TIEZA

Development Bank of the Philippines (DBP) Account #: 0405-018676-030 (Makati Branch)

Land Bank of the Philippines (LBP) Account #: 1782-1046-47 (Pasong Tamo Branch) The deposit slip shall be kept and a scanned copy shall be sent to tieza.bacsecretariat@gmail.com.

Please note further that purchase of the bidding documents are available on **June 9, 2025 to July 2, 2025 at 8:00 am to 5:00 pm**, except Fridays, Saturdays, Sundays and Holidays and on **July 3, 2025** from **8:00 to 9:00 a.m**. Please note the payment for the bid documents is a non-refundable fee in the amount of **Fifty Thousand Pesos Only** (**PhP 50,000.00**).

It may also be downloaded free of charge from the website of the Philippine Government Electronic Procurement System (PhilGEPS) and the website of the Procuring Entity, provided that bidders shall pay the applicable fee for the Bidding Documents not later than the submission of their bids. **Bidders must submit to the BAC Secretariat a copy of the official receipt as proof of the purchase of bidding documents on or before 5:00 p.m. on the day of bidding.**

7. The Tourism Infrastructure and Enterprise Zone Authority will hold face to face Pre-Bid Conference on **June 19, 2025** @ 10:00 A.M. at 7th Floor TIEZA TEZ Conference Room Double Dragon Plaza Pasay City

8. Bids (Technical and Financial) in hard copies (one original and two duplicates, sealed in their respective envelopes) enclosed in one outer envelope must be submitted face toface and duly received by the BAC Secretariat at the address below on or before **July 3, 2025 @** 9: 30 A.M. **Proper tabbing of every requirement is encouraged**.

   Bidder shall submit its bid in one (1) outer envelope containing three (3) envelopes (Original, Copy 1, and Copy 2). Each of the three (3) envelopes shall contain two envelopes corresponding to Technical and Financial Proposals. Soft Copy of Financial Proposal in the form of Flash Drive (USB) must be included inside the Original Financial Envelope. Failure to comply with this requirement shall render the bidder disqualified from the bidding.

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

10. Bid opening shall be done face to face on **July 3, 2025 @**10: 00 A.M. at the Legal Conference Room on the 7th Floor, Tower 1 Double Dragon Plaza Double Dragon Meridian Park Macapagal Avenue corner EDSA Extension Bay Area Pasay City. Bids will be opened in the presence of the bidders' representatives who choose to attend theactivity. Late bids shall not be accepted.

11. The Tourism Infrastructure and Enterprise Zone Authority reserves the right to reject any and all bids, declare a failure of bidding or not award the contract in accordance with the applicable provision of the 2016 Revised IRR of R.A. 9184.
For further information, please refer to:
BAC Secretariat
7th Floor, Tower 1 Double Dragon Plaza Double Dragon Meridian Park Macapagal Avenue corner EDSA Extension Bay Area Pasay City
(+632) 249-5986 loc. 713 or 714
bacsecretariat@tieza.gov.ph
http.//www.tieza.gov.ph

12. You may visit the following websites:
For downloading of Bidding Documents:
https://notices.philgeps.gov.ph/stieza.gov.ph
For inquiries/concerns: bacsecretariat@tieza.gov.ph
For purchase of bidding documents: tieza.bacsecretariat@gmail.com

RAQUEL S. DELA CRUZ
Chairperson, Bids and Awards Committee

Section II. Instructions to Bidders

Notes on the Instructions to Bidders

This Section on the Instruction to Bidders (ITB) provides the information necessary for bidders to prepare responsive bids, in accordance with the requirements of the Procuring Entity. It also provides information on bid submission, eligibility check, opening and evaluation of bids, post-qualification, and on the award of contract.

1. Scope of Bid

The Procuring Entity, *[Tourism Infrastructure and Enterprise Zone Authority]* invites Bids for the **IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK SINACABAN, MISAMIS OCCIDENTAL** with Project Identification Number *[Invitation to Bid no.* **25-06-0007**

[Note: The Project Identification Number is assigned by the Procuring Entity based on its own coding scheme and is not the same as the PhilGEPS reference number, which is generated after the posting of the bid opportunity on the PhilGEPS website.]

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 *[2025]* in the amount of **ONE HUNDRED TWENTY SEVEN MILLION NINE HUNDRED NINETY NINE THOUSAND FOUR HUNDRED SIXTY FIVE PESOS AND SIXTEEN CENTAVOS ONLY (P 127,999,465.16)** The source of funding is:

a. the Corporate Operating Budget.

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

a. Subcontracting is not allowed

8. Pre-Bid Conference

The Procuring Entity will hold face to face Pre-Bid Conference on **June 19, 2025** @ 10:00 A.M.. at its physical address at **7th Floor TIEZA TEZ Conference Room Double Dragon Plaza Pasay City** 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. A valid PCAB License is required, and in case of joint ventures, a valid special PCAB License, and registration for the type and cost of the contract for this Project. 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:*

a. 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 *[120 Calendar Days]*. 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

Notes on the Bid Data Sheet (BDS)

The Bid Data Sheet (BDS) consists of provisions that supplement, amend, or specify in detail, information, or requirements included in the ITB found in Section II, which are specific to each procurement.

This Section is intended to assist the Procuring Entity in providing the specific information in relation to corresponding clauses in the ITB and has to be prepared for each specific procurement.

The Procuring Entity should specify in the BDS information and requirements specific to the circumstances of the Procuring Entity, the processing of the procurement, and the bid evaluation criteria that will apply to the Bids. In preparing the BDS, the following aspects should be checked:

a. Information that specifies and complements provisions of the ITB must be incorporated.

b. Amendments and/or supplements, if any, to provisions of the ITB as necessitated by the circumstances of the specific procurement, must also be incorporated.

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: *Civil Works*
7.1	*Subcontracting is not allowed.*
10.3	*Preferred Contractors License* *Building – Medium A , Category B*
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> *See attached end-user requirements* *In addition the bidder must certify that the foregoing personnel shall perform work exclusively for the project until completion of the project. Please see the attached Form for the purpose.*
10.5	The minimum major equipment requirements are the following: <u>Equipment</u> <u>Capacity</u> <u>Number of Units</u> *See attached end-user requirements* *In addition the bidder must certify under oath that the equipment shall be exclusively used for the project until completion of the project. Please see attached Form for the purpose*
	Not Applicable
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 **2%** 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 **5%** if bid security is in Surety Bond.
19.2	Partial bids are allowed, as follows: *[Insert grouping of lots by specifying the items and the quantity for every identified lot.]*
20	*Not Applicable*
21	**Additional contract documents** relevant to the Project as required by existing laws and/or the Procuring Entity, such as construction schedule and S-curve, manpower schedule, construction methods, equipment utilization schedule, and PERT/CPM, and a copy Construction Safety and Health Program **shall be included in the submission of Technical Proposal.**

	Construction Safety and Health Program approved by the Department of Labor and Employment or proof of application with DOLE shall be submitted as part of the contract with winning bidder.

Section IV. General Conditions of Contract

Notes on the General Conditions of Contract

The General Conditions of Contract (GCC) in this Section, read in conjunction with the Special Conditions of Contract in Section V and other documents listed therein, should be a complete document expressing all the rights and obligations of the parties.

Matters governing performance of the Contractor, payments under the contract, or matters affecting the risks, rights, and obligations of the parties under the contract are included in the GCC and Special Conditions of Contract.

Any complementary information, which may be needed, shall be introduced only through the Special 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

4.1. 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.

4.2. 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

Notes on the Special Conditions of Contract

Similar to the BDS, the clauses in this Section are intended to assist the Procuring Entity in providing contract-specific information in relation to corresponding clauses in the GCC found in Section IV.

The Special Conditions of Contract (SCC) complement the GCC, specifying contractual requirements linked to the special circumstances of the Procuring Entity, the Procuring Entity's country, the sector, and the Works procured. In preparing this Section, the following aspects should be checked:

a. Information that complements provisions of the GCC must be incorporated.

b. Amendments and/or supplements to provisions of the GCC as necessitated by the circumstances of the specific purchase, must also be incorporated.

However, no special condition which defeats or negates the general intent and purpose of the provisions of the GCC should be incorporated herein.

Special Conditions of Contract

GCC Clause	
2	*Completion of work shall be within* Three Hundred Thirty (330) calendar days
4.1	The Procuring Entity shall give possession of all parts of the Site to the Contractor upon receipt of the Notice to Proceed.
6	The site investigation Report is: Technical Evaluation Report
7.2	*[Select one, delete the other.]* *[In case of permanent structures, such as buildings of types 4 and 5 as classified under the National Building Code of the Philippines and other structures made of steel, iron, or concrete which comply with relevant structural codes (e.g., DPWH Standard Specifications), such as, but not limited to, steel/concrete bridges, flyovers, aircraft movement areas, ports, dams, tunnels, filtration and treatment plants, sewerage systems, power plants, transmission and communication towers, railway system, and other similar permanent structures:] Fifteen (15) years.* *[In case of semi-permanent structures, such as buildings of types 1, 2, and 3 as classified under the National Building Code of the Philippines, concrete/asphalt roads, concrete river control, drainage, irrigation lined canals, river landing, deep wells, rock causeway, pedestrian overpass, and other similar semi-permanent structures:] Five (5) years.* *[In case of other structures, such as bailey and wooden bridges, shallow wells, spring developments, and other similar structures:] Two (2) years.*
10	Dayworks are applicable at the rate shown in the Contractor's original Bid.
11.1	The Contractor shall submit the Program of Work to the Procuring Entity's Representative within ten (10) calendar days after receipt of the Notice of Award.
11.2	The amount to be withheld for late submission of an updated Program of Work is one tenth (1/10) of one percent (1%) per day of delay chargeable against the current progress billing
13	The amount of the advance payment is no more that fifteen percent (15%) of the Contract Price subject to approval by the Authority and compliance with the conditions under RA 9184 and its IRR.
14	No further instructions.
15.1	The date by which operating and maintenance manuals are required is thirty (30) days from the receipt of Notice to Proceed. The date by which "as built" drawings are required is required as part of final payment.
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 ten percent (10%) of the Contract Price.

Section VI. Specifications

Notes on Specifications

A set of precise and clear specifications is a prerequisite for Bidders to respond realistically and competitively to the requirements of the Procuring Entity without qualifying or conditioning their Bids. In the context of international competitive bidding, the specifications must be drafted to permit the widest possible competition and, at the same time, present a clear statement of the required standards of workmanship, materials, and performance of the goods and services to be procured. Only if this is done will the objectives of economy, efficiency, and fairness in procurement be realized, responsiveness of Bids be ensured, and the subsequent task of bid evaluation facilitated. The specifications should require that all goods and materials to be incorporated in the Works be new, unused, of the most recent or current models, and incorporate all recent improvements in design and materials unless provided otherwise in the Contract.

Samples of specifications from previous similar projects are useful in this respect. The use of metric units is mandatory. Most specifications are normally written specially by the Procuring Entity or its representative to suit the Works at hand. There is no standard set of Specifications for universal application in all sectors in all regions, but there are established principles and practices, which are reflected in these PBDs.

There are considerable advantages in standardizing General Specifications for repetitive Works in recognized public sectors, such as highways, ports, railways, urban housing, irrigation, and water supply, in the same country or region where similar conditions prevail. The General Specifications should cover all classes of workmanship, materials, and equipment commonly involved in construction, although not necessarily to be used in a particular Works Contract. Deletions or addenda should then adapt the General Specifications to the particular Works.

Care must be taken in drafting specifications to ensure that they are not restrictive. In the specification of standards for goods, materials, and workmanship, recognized international standards should be used as much as possible. Where other particular standards are used, whether national standards or other standards, the specifications should state that goods, materials, and workmanship that meet other authoritative standards, and which ensure substantially equal or higher quality than the standards mentioned, will also be acceptable. The following clause may be inserted in the SCC.

Sample Clause: Equivalency of Standards and Codes

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes are national, or relate to a particular country or region, other authoritative standards that ensure

a substantially equal or higher quality than the standards and codes specified will be accepted subject to the Procuring Entity's Representative's prior review and written consent. Differences between the standards specified and the proposed alternative standards shall be fully described in writing by the Contractor and submitted to the Procuring Entity's Representative at least twenty-eight (28) days prior to the date when the Contractor desires the Procuring Entity's Representative's consent. In the event the Procuring Entity's Representative determines that such proposed deviations do not ensure substantially equal or higher quality, the Contractor shall comply with the standards specified in the documents.

These notes are intended only as information for the Procuring Entity or the person drafting the Bidding Documents. They should not be included in the final Bidding Documents.

Republic of the Philippines

Tourism Infrastructure & Enterprise Zone Authority

PROJECT SPECIFICATIONS

I. GENERAL CONDITIONS

The work to be undertaken shall include the furnishing of labor, materials, tools and equipment for the following:

Project : **IMPROVEMENT OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK**

Location : SINACABAN, MISAMIS OCCIDENTAL

A. Scope of Work

The construction work must be executed strictly in accordance with the plans and specifications. The following principal items of work shall include but not limited to the following:

1. General Requirements
2. Mobilization
3. Back of the House
4. Restaurant
5. Employee's Lounge
6. Cabana – 4 Units
7. Life Guard Station – 2 Units
8. Sewage Treatment Plant
9. Solar Street Light
10. Tourism Road
11. Other Items

The construction procedures shall be done in accordance with the DPWH Standard Specifications, and in full compliance with the approved plans and specifications.

All items not specifically mentioned in the specifications or noted on the plans but which are obviously necessary for the completion of the work shall be included.

In the event that there is/are discrepancy/ies found between the detailed estimates and the plans, the latter should prevail to be implemented.

II. FIELD OFFICE FOR THE ENGINEER

The Contractor shall construct field offices, laboratories and living quarters, including all the necessary air conditioning, electricity, water, and drainage and security services for the use of the Engineer and his staff for 24 h a day or provide the same on a rental basis until end of Contract. All offices, laboratories and living quarters shall be ready for occupancy and use by the Engineer immediately for rental basis; or if to be constructed within 3 months upon the commencement of the Works. Their location and final plan shall require the approval of the Engineer prior to the start of construction. It is the intent of this Specification to locate the field offices, laboratories and living quarters in Government owned lots so that the use by the Government of these facilities can be maximized even after the completion of the project. In the selection of construction site of the Engineer's Building/s and Recreational Facilities, first priority shall be on DPWH

property lots, second is public school lots, third is public health lots, fourth is Local Government Unit (LGU) lots, and then other government property lots. The proximity, access road and cost of development of the proposed site shall be properly evaluated. The construction of building/s and recreational facilities on property other than DPWH-owned shall be covered by an approved Memorandum of Agreement (MOA) between the concerned parties. The Implementing Office shall be allowed to use the other government lots for the construction of the field offices, laboratories and living quarters free of charge until the completion of the project and shall be turned over without cost, effective after completion or acceptance of the project from the Contractor. The transfer/turnover shall be supported by applicable document and shall be a requirement to support the issuance of project Completion Certificate of the Contractor. If no Government lot is available, and these structures are to be erected on private property, it is the responsibility of the Contractor to make the necessary arrangements for the negotiation with the property owner for the lease/rental of the lot. The field office shall display an appropriate sign that identifies the DPWH facility to the public in locating it. The field offices, laboratories, and living quarters, the improvements thereon, including appurtenances shall be removed or transferred if so required in the Contract upon completion of the project. All facilities provided by the Contractor shall be within the 5 km radius or preferably near the job site, where necessary and shall conform to the best standard for the required types. On completion of the Contract, the facilities provided by the Contractor including utilities shall revert to the Government including office equipment, apparatus, pieces of furniture, laboratory equipment, etc. unless otherwise specified in the Contract documents. The Contractor shall be responsible for raising the ground (if necessary), grading and drainage in the vicinity of each facility with suitable access 2 walkways, seeding and sodding of the ground around as directed and approved by the Engineer. Also, the Contractor shall construct a parking area for the compound near the buildings and a satisfactory access road to the parking areas. The whole area of the Engineer's compound shall be fenced with barbed wire (or equivalent) with necessary gates as directed by the Engineer.

III. OCCUPATIONAL SAFETY AND HEALTH

A. 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. Construction Safety and Health Program (CSHP)

Every construction project shall have a 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 CSHP shall include but not limited to the following:

1. Composition of the Safety and Health personnel responsible for the proper 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 sanctions for violations of the CSHP.

4. Frequency, content and persons responsible for orienting, instructing and training all workers at the site with regard to the CSHP which they operate.

5. The manner of disposing waste arising from the construction.

C. Construction Safety and Health Personnel

At the start of the project, the Contractor shall establish 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. General Safety Engineer/Officer

The General Contractor (under which are a number of subcontractors) must provide for a full time Officer, who shall be assigned as the CSHP to oversee and enforce full time the overall management of the 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 26 Section 7.0, Safety Personnel of Department of Labor and Employment (DOLE) Department Order (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 to 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.

D. 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.

E. Construction Safety and Health Training

The Construction Safety and Health Seminar (COSH) shall be a 40 h 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.

F. Construction Safety and Health Reports

The Contractor shall be required to submit a monthly construction safety and health report to the 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 h 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.

G. Personal 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 27 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 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.

H. 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.

I. 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 for workers and as may be applicable for their families.
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 300. In addition, there should be one (1) bed capacity for every 100 employees in excess of three hundred (300).

J. 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 materials and equipment such as medicines, beds and linens, other related accessories shall be to the account of the Contractor implementing the project and shall be in accordance with the 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 such as portable toilets, waste disposal, sanitary and washing facilities, convenient dwellings and office, adequate lighting, and other facilities related to construction safety and health shall be in accordance with OSHS 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. 29

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.

K. 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 30 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.

L. 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.

M. Method of Measurement

Occupational safety and health program shall be measured by lump sum.

N. Basis of Payment

The accepted quantities, measured as prescribed in Section B.7.13, Method of Measurement shall be paid for at the Contract Unit Price or for the pay item listed below that is included in the Bill of Quantities. Such payment shall be full compensation for furnishing, maintaining and ensuring against loss of the equipment/tools.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
B.7	Occupational Safety and Health	Lump Sum

IV. PROJECT BILLBOARD / SIGNBOARD

A. General Requirements

The Contractor shall install two (2) Project Information Signs at/or near the beginning and the end of the project or upon the discretion of the Engineer.

The signs are prescribed separately by the Department of Public Works and Highways (DPWH) for government infrastructure projects to inform the public of the implementation of the project and to advise the road users of the ongoing construction.

The new billboard design layout, dimension and letter sizes on white background, shall be depicted on a standard billboard measuring 1,220 mm x 2,440 mm using 12.50 mm thick marine plywood or tarpaulin of the same size posted on 5 mm marine plywood. For each building project, the billboard shall be installed in front of the project site. For each road/bridge/flood control project, two billboards shall be installed, one (1) at the beginning and one (1) at the end of the project.

For road projects with a length of 10 km or more, additional billboard shall also be installed at every five (5) km interval. Name(s) and/or picture(s) of any personages should not appear in the billboard.

No other billboards shall be allowed to be installed 100 m before and 100 m after all DPWH projects and in-between the project limits or within the road right-of-way. DPWH contractors shall not be allowed to place names of politicians or carry political billboard on their equipment.

The Contractor shall also install one (1) Billboard as per COA Circular No. 2013-004, Information and Publicity on Programs/Projects/Activities of Government Agencies.

Upon completion of the work, all signs installed shall be removed from the site.

B. Method of Measurement

All expenses incurred in the furnishing/installation/illumination of the signs shall be paid for each billboard installed.

C. Basis of Payment

The accepted quantities, measured as provided in Section B.5.2, Method of Measurement shall be paid for at the Contract Unit Price of the Pay Item listed below that is included in the Bill of Quantities. The unit price shall cover full compensation for all related services necessary to complete the item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
B.5	Project Billboard / Signboard	Each

V. TEMPORARY FENCE (TEMPORARY ENCLOSURE)

A. Description

This work shall consist of furnishing, erecting, moving and removing chain link fencing and metal gates of the size and type shown on top of the temporary concrete barriers, and in sidewalk and roadway areas at the locations, as shown on the Plans or as directed by the Engineer.

B. Material Requirements

a. **Barbed Wire**

Barbed wire shall conform to the requirements of ASTM A121, Class I, Standard Specification for Metallic-Coated Carbon Steel Barbed Wire. The barbed wire shall consist of two (2) strands of 12.5 gauge wire, twisted with two (2) points, 14 gauge barbs spaced 100 mm apart.

b. Chain Link Fence Fabric

Chain link fence fabric shall be fabricated from ten (10) gauge-galvanized wire conforming to AASHTO M 181, *Chain Link Fence*, and shall be of the type shown on the Plans. Before ordering the chain link fence fabric, the Contractor shall submit a sample of the material to the Engineer for testing and for approval.

c. Concrete Post

Concrete posts shall be made of Class A concrete in accordance with Item 900, Structural Concrete. The posts shall be cast to a tapered section as shown on the Plans and shall have a smooth surface finish.

d. Steel Post

Steel posts shall be of the sections and length as specified or as shown on the Plans. The posts shall be copper bearing steel and shall conform to the requirements of ASTM A702, Standard Specification for Steel Fence Post, Hot Wrought, for the grade specified.

e. Steel Reinforcement

Steel reinforcement for concrete posts shall be deformed steel bars conforming to the provisions of Item 902, Reinforcing Steel.

f. Hardware

Nuts, bolts, washers and other associated hardware shall be galvanized after fabrication as specified in ASTM A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.

C. Construction Requirements

The Contractor shall perform such clearing and grubbing as may be necessary to construct the fence to the required grade and alignment. The Contractor shall install fence posts on the concrete barrier in 38 *mm* diameter, 300 *mm deep drilled or formed* holes near each end of each section of the barrier. In addition, if the concrete barrier is furnished in lengths exceeding 3 m, it will be necessary for the Contractor to provide an additional hole at the center of the section to permit the installation of an intermediate post. Line posts, corner and end posts on grade, and gate posts shall be installed in accordance with the Plans. Heights of the posts and fencing shall conform to the dimensions shown on the Plans. At locations where breaks in a run of fencing are required, or at interactions with existing fences, appropriate adjustments in post spacing shall be made to conform to the requirement for the type of closure indicated. When the Plans require that the posts, braces, or anchors be embedded in concrete, the Contractor shall install temporary guys or braces, as may be required to hold the posts in proper position until such time as the concrete has set sufficiently to hold the posts. Unless otherwise permitted, no materials shall be installed on posts or strain placed on guys or bracing set in concrete until seven days elapsed from the time of placing the concrete. All posts shall be set vertically and to the required grade and alignment. Cutting off the tops of the posts will be allowed only

with the approval of the Engineer and under conditions specified by the Engineer. The fence fabric of the size and type required shall be firmly attached to the posts and braces in the manner indicated. All fence fabric shall be stretched taut and installed to the required elevations. The fence shall generally follow the contour of the ground, with the bottom of fence fabric not less than 50 mm nor more than 150 mm from the ground surface. Grading shall be performed where necessary to provide a neat appearance. Line posts shall be spaced equidistantly in the fence line at the spacing shown on the Plans or as directed by the Engineer. The end, corner, and intermediate posts shall be placed at the locations indicated on the Plans or where directed by the Engineer, and shall be braced as shown on the Plans. When chain-link fence is on a long curve, intermediate posts shall be evenly spaced so that the strain of the fence will not bend the line posts. All end, corner, and intermediate posts shall be set plumb in concrete bases of the depth and diameter shown on the Plans. The Contractor shall have the option of setting the line posts in concrete bases or using methods of driving and anchoring specified by the fence manufacturer and approved by the Engineer.

a. Chain Link Fencing with Top Rail

Posts shall be set so they are equidistant with a maximum of three (3) meters on center.

All top rails shall pass through the base of the post caps and shall form a continuous brace from end to end of each stretch of fence. Top rail lengths shall be joined with sleeve couplings with expansion sleeves provided at 30 m intervals. Top rails shall be securely fastened to end posts by means of approved rail end connectors. Horizontal braces shall be provided at all intermediate posts, midway between the top rail and ground as shown on the Plans.

Diagonal truss rods shall be installed with the horizontal braces as indicated in the Plans.

Fence fabric shall be installed approximately 50 mm above the ground level and securely fastened along the bottom and to all braces, top rails, line and pull posts, at the intervals indicated on the Plans. The fabric shall be secured to all end, corner, and gate posts with stretcher bars fastened to the posts, with stretcher bands spaced at a maximum of 355 mm and in a manner permitting adjustment of the fabric tension.

If the Contractor selects the option of using pieces, roll-formed sections, the fence fabric shall be integrally woven into the fabric loops on the end, corner, pull and gate posts. The fabric shall be attached to the end, corner and line posts as shown on the Plans.

b. Chain Link with Top Tension Wire

The construction details specified in Chain-Link Fencing with top Rail shall apply with the following modifications:

i. Top tension wire shall be installed as shown on the Plans or as directed by the Engineer.
ii. All posts shall be spaced equidistant in the fence line on a maximum of 2.44 m on center, except that a 3 m spacing will be permitted on concrete barriers.

iii. Additional pull posts shall be placed at locations indicated on the Plans. Brace assemblies shall be installed at each intermediate post as indicated on the Plans or Standard Sheets.

c. Vinyl Coated Chain-link Fencing on Plastic Coated Frame

The construction details specified on Chain-Link Fencing with Top Rail or ChainLink Fencing with Top Tension Wire shall apply with the following addition: If any of the resin-clad material specified under Item that has the protective resin coating is damaged that impairs its effectiveness to prevent corrosion of 58 the base material, the Contractor shall repair such parts by applying one coat of an approved compound of color to match the original material.

d. Fence Gates

The Contractor shall construct metal fence gates of the type and size as indicated on the Plans, and in the location shown or ordered by the Engineer. Upon removal, fence gates shall become the property of the Contractor and shall be removed from the project site.

D. Method of Measurement

This work under this Item shall be measured by lump sum of temporary fence installed as measured along the top of the fencing, including gates, center to center of end posts erected in place and accepted.

VI. STRUCTURE EXCAVATION

A. 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 fill 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.

B. Construction Requirements

a. 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.

b. Excavation

i. 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. 101 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.

ii. **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.

iii. **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. 102

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.

c. 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.

d. 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.

i. 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.

C. Method of Measurement

a. 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:

i. 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.
ii. The volume of excavation for culvert and sections outside the vertical plane for culverts stipulated in (1) above.
iii. The volume outside of neat lines of underdrains as shown on the Plans, and outside the limits of foundation fill as ordered by the Engineer.
iv. 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.
v. Volume of water or other liquid resulting from construction operations and which can be pumped or drained away.
vi. The volume of any excavation performed prior to the taking of elevations and measurements of the undisturbed ground.
vii. 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.
viii. 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.

b. 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.

c. 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.

D. Basis Of Payment

The accepted quantities, measured as prescribed in Section 1702.3, 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:

A. 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.

B. 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.

C. Any excavation or borrow excavation required in excess of the quantity excavated for structures shall be measured and paid for as provided under Item 1702, Excavation.

D. 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
1702 (1)a	Structure Excavation (Common Soil)	Cubic Meter
1702 (1)b	Structure Excavation (Soft Rock)	Cubic Meter
1702 (1)c	Structure Excavation (Hard Rock)	Cubic Meter
1702 (2)a	Excavation (Common Soil)	Cubic Meter
1702 (2)b	Excavation (Soft Rock)	Cubic Meter
1702 (2)c	Excavation (Hard Rock)	Cubic Meter
1702 (3)	Excavation ordered below Plan elevation	Cubic Meter
1702 (4)a	Shoring, cribbing and drain excavation (Shoring)	Lump Sum
1702 (4)b	Shoring, cribbing and drain excavation, (Cribbing/ Cofferdamming)	Lump Sum
1702 (5)a	Pipe culverts and drain excavation (Common Soil)	Cubic Meter
1702 (5)b	Pipe culverts and drain excavation (Soft Rock)	Cubic Meter
1702 (5)c	Pipe culverts and drain excavation (Hard Rock)	Cubic Meter
1702 (6)	Trimming Works	Square Meter

VII. EMBANKMENT

A. Description

This Item shall consist of the construction of 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.

B. Material Requirements

a. Suitable Material

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

i. 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.

ii. 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
25.0	1"	50 - 85
4.75	No. 4	26 - 44
0.425	No. 40	16 max
0.075	No. 200	9 max

iii. 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.

b. Unsuitable Material

Materials that are not acceptable for use are the following:

i. Organic soils such as peat and muck.
ii. Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.
iii. Soils with a natural water content exceeding 100%.
iv. Soils with very low natural density, 800 kg/m3 or lower.
v. 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.

C. Construction Requirements

a. 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.

b. 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. 109

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 ½ 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 the fill may be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the hauling equipment while placing subsequent layers. Fill material shall be placed 110 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.

c. Compaction

i. 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 or such amendments thereto as may be found necessary to 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. 111 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.

ii. 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 MoistureDensity 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.

iii. **Gravel Fill**

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.

iv. **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.

v. **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.

d. **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.

e. **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.

f. **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.

g. 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.

h. 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.

i. 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 Rammer 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.

ii. 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.

i. 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.

j. 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.

k. 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.

D. 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.

E. Basis Of Payment

The accepted quantities, measured as prescribed in Section 1704.4, Method of Measurement shall be paid for at the Contract Unit Price for each of the Pay 885 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
1704 (1)a	Embankment (From roadway/structure excavation)	Cubic Meter
1704 (1)b	Embankment (From Borrow)	Cubic Meter
1704 (2)a	Selected Borrow for topping (Case 1)	Cubic Meter
1704 (2)b	Selected Borrow for topping (Case 2)	Cubic Meter
1704 (3)	Earth Berm	Cubic Meter
1704 (4)	Gravel Fill	Cubic Meter

VIII. TERMITE CONTROL WORK

A. Description

This Item shall consist of furnishing and applying termite control chemicals, including the use of equipment and tools in performing such operations in accordance with this Specification.

B. Material Requirements

Termite control chemicals or toxicants shall be able to immediately exterminate termites or create barriers to discourage entry of subterranean termites into the building areas. Chemical or toxicants to be used shall be in accordance with the governing laws and the manufacturer shall be accredited by the Department of Health through Food and Drug Administration (FDA). The toxicants may be classified into the following types and according to use:

Type I. Liquid Termicide Concentrate

This type of toxicant shall be specified for drenching soil beneath foundations of proposed buildings. The concentrate shall be diluted with water in the proportion of 1 L of concentrate material to 65 L of water or as specified by the manufacturer.

Type II. Liquid Termicide Ready Mixed Solution

This type of toxicant which comes in ready mixed solution shall be used as wood preservative by drenching wood surfaces to the point of run-off.

Type III. Powder Termicide

This type of toxicant shall be applied to visible or suspected subterranean termite mounds and tunnels where termites are exterminated through Trophallaxes method (exchange or nourishment between termites while greeting each other upon meeting).

C. Construction Requirements

Before any termite control work is started, thorough examination of the site shall be undertaken by the Contractor so that the appropriate method of soil poisoning can be applied.

The Contractor shall coordinate with other related trades through the Engineer to avoid delay that may arise during the different phases of application of the termite control chemicals.

This work shall be done by a trained personnel with a minimum two (2) years' experience for proper execution of the work of this Specification.

a. Soil Poisoning

There are two (2) methods usually adopted in soil poisoning which are as follows. Other methods as recommended by the manufacturers and approved by the Engineer may also be used.

i. **Cordoning**

This method is usually adopted when there is no visible evidence of termite infestation. Trenches in concentric circles, squares or rectangles are dug 150 mm to 220 mm wide and at least 1 m apart and applied with Type I working solution at the rate of 8 L/l.m within the cordoned area.

ii. **Drenching**

When soil show termite infestation, this method shall be applied. The building area shall be thoroughly drenched with Type I working solution at the rate of 24 L/m^2.

b. Surface preparation

All organic matter, construction debris, rubbish, etc. which could decrease effectiveness of treatment on areas to be treated shall be removed. Water logged foundations shall be treated after drying when the soil is absorbent. For low penetration and sloping sites, surface to be scarified shall be 75 mm deep. Cutting, excavation, leveling and grading shall be completed before starting treatment. Loosen, rake and level soil to be treated, except previously compacted areas under slabs and foundations.

c. Application

Before the application of soil treatment, the Contractor shall coordinate with the Engineer prior to excavating, filling, grading and concreting works.

At the time soil poisoning is to be applied, the soil to be treated shall be in friable condition with low moisture content so as to allow uniform distribution of the toxicant agents. Toxicant shall be applied at least 12 h prior to placement of concrete which shall be in contact with treated materials.

Treatment of the soil on the exterior sides of the foundation walls, grade beams and similar structures shall be done prior to final grading and planting or landscaping work to avoid disturbance of the toxicant barriers by such operations.

Areas to be covered by concrete slab shall be treated before placement of granular fill used as capillary water barrier at a rate of 12 L/m^2 with Type I working solution after it has been compacted and set to required elevation. Additional treatment shall be applied as follows:

1. In critical areas, such as utility openings for pipes, conduits and ducts, apply additional treatment at the rate of 6 L/l.m. in a strip 150 mm to 200 mm wide.

2. Along the exterior perimeter of the slab and under expansion joint, at the rate of 2.5 L/l.m. in a strip 150 mm to 200 mm wide in a shallow trench.

Apply an overall treatment under entire building slab, and moving strips adjacent to the building. Treat sidewalks or other such paved areas abutting the building for a distance not less than 1 m from the building. Apply along each side of foundation walls and at penetrations through slabs such as pipes, ducts, etc. apply at application rate of 5 L per linear meter around the perimeter of the building.

Post signs in areas of application to warn workers that soil termicide treatment has been applied. Remove signs when areas are covered by other construction.

d. Wood Protection

Where the application of wood preservative is necessary, the Contractor shall use Type II working solution as recommended by the manufacturer.

All wood materials not pressure treated as specified in Item 1003, Carpentry and Joinery shall be treated with Type II ready mixed solution as herein called for or as directed by the Engineer.

Wood treatment shall be applied after framing, sheathing, and exterior weather protection is completed but before the electrical and mechanical systems are installed.

e. Powder Termicide

When powder termicide is to be applied to eradicate subterranean termites, extreme caution and care shall be done at the time of application. It shall not be allowed to enter drains, waterways, streams or rivers. It shall not be used if rain is expected to occur within 48 h of application. All heating and air conditioning ducts, air vents, floor drains, and edible plants shall be covered prior to application of powder termicide.

f. Delivery, Storage and Handling

Deliver termicides to the project site in sealed and labeled containers in good condition as supplied by the manufacturer. Store, handle and use termicides in accordance with manufacturer's labels. Labels shall bear evidence of registration and Material Safety Data Sheet (MSDS) shall also be provided.

g. Safety Requirements

Formulate, treat and dispose of termicides and their containers in accordance with label directions. Draw water for formulating only from sites designated by the Engineer and fit the filing hose with backflow preventer meeting local plumbing codes or standards. The filling operation shall be under the direct and continuous observation of the Contractor to prevent overflow. Secure pesticides and related materials under lock and key when unattended. Ensure 200 that proper protective clothing and equipment are worn and used during all phases of termiticide operation.

Disposal of used pesticide containers off the project site shall comply with the latest requirements of DENR Administrative Order for Revised Procedures and Standards for Management of Hazardous Waste, Material Safety Data Sheet (MSDS) shall also be strictly followed.

h. Warranty

Upon completion and acceptance of the work, the Contractor shall furnish the Engineer a written guarantee stating that termite control is guaranteed for a minimum period of three (3) years and annual inspections or as requested by the Engineer shall be done by both the Contractor and Engineer to ensure the quality of their work.

D. Method Of Measurement

Liquid termite control chemicals or toxicants shall be measured by actual number of liters used in the cordoning and drenching of lot areas and soil poisoning of granular fill or actual number of liters used in drenching wood surfaces, while powder chemical/toxicant shall be measured by kilograms applied to suspected subterranean termite mounds and tunnels. The quantity to be paid for shall be determined and accepted by the Engineer.

E. BASIS OF PAYMENT

The accepted quantities, measured as prescribed in Section 1000.4, Method of Measurement shall be paid for at the Contractor Unit Price for Termite Control Work which price and payment shall be full compensation for furnishing and applying termite control chemicals including the use of equipment and tools, labor and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1000 (1)	Soil Poisoning	Liter
1000 (2)	Wood Preservative	Liter
1000 (3)	Powder Termicide	Kilogram

IX. STRUCTURAL CONCRETE

A. Description

a. 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.

b. 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, shearwalls, 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

B. Materials Requirements

a. Portland Cement

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

b. 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

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 Below:

Grading Requirements for Fine Aggregate

Sieve Designation (mm)	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

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.

Gradiation shall conform to next table.

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*

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

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 shall 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.

c. **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 1:00 earlier to 1:30 later

Note: [A]Comparisons shall be based on fixed proportions for concrete or mortar mixtures. The control mixture shall be made with 100% potable or distilled water. The test mixture shall be made with the mixing water that is being evaluated.

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	500	ASTM C114
2. Other reinforced concrete in moist environments or containing aluminum embedments or dissimilar metals or with stay-in-place	1000	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

Note: ASTM C114 - Standard Test Methods for Chemical Analysis of Hydraulic Cement
ASTM C1603 - Standard Test Method for Measurement of Solids in Water

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

d. **Metal Reinforcement**

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

e. **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 maybe 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.

f. 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.

g. 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

h. 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 151 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)

C. Construction Requirements

The notation used in these regulations is defined as follows:
fc' = compressive strength of concrete

a. 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 (ACI 613A)."

b. 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 152 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 concrete		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

c. 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.

d. 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 Mixed 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 be 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 Content (Gravimetric) of Concrete
Slump of Portland Cement Concrete	:	AASHTO T 119M, Standard Method of Test for Slump of Hydraulic Cement Concrete

Tests 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 Compressive Strength of Cylindrical Concrete Specimens (ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens)

e. 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. 154 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 m³ 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 150 mm x 300 mm Concrete Cylinder Specimen at 28 days, MN/m²
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

*Note: * The measured cement content shall be within plus or minus 2 mass percent of the design cement content.*
*** Based on 40 kg/bag*

f. 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.

g. 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 m3 . 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. 155 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 jobcured 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.

h. 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 156 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 hours 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 mesures 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 (CaCl2) as an admixture will not be permitted.

i. **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 157 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 m3 or less. For mixers having a capacity greater than 1.5 m3 , 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 m3 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 on 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 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 oC, 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. 160 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.

j. 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 161 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 that 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.

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 m3 . 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.

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 m3/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.

3. Placing Concrete in Water

Concrete deposited in water shall be Class Seal concrete with a minimum cement content of 380 kg/m3 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.

k. 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 preceding layer has taken initial set to prevent injury to the green concrete and avoid surfaces of separation between the layers. Each layer shall be 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 163 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.

l. **Concrete Surface Finishing: General**

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.

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.

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.

m. **Curing Concrete**

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:

i. **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.

ii. **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. 165 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.

iii. **Waterproof Membrane Method**

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

iv. 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.

v. 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.

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

i. 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 167 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.

n. 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

D. 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 168 volume occupied by the pipe less than 101 mm outside diameter nor for reinforcing steel, anchors, weephole(s) or expansion materials.

E. 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 Schedule.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)a	Structural Concrete, Class A, 3000 psi, 7 days	Cubic Meter
900 (1)b	Structural Concrete, Class A, 3000 psi, 14 days	Cubic Meter
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter
900 (1)d	Structural Concrete, Class A, 4000 psi, 28 days	Cubic Meter
900 (1)e	Structural Concrete, Class A, 5000 psi, 28 days	Cubic Meter
900 (1)f	Structural Concrete, Class A, 6000 psi, 28 days	Cubic Meter
900 (1)h	Structural Concrete, Class A, 14 days	Cubic Meter
900 (1)i	Structural Concrete, Class A, 28 days	Cubic Meter
900 (2)a	Structural Concrete, Class B, 7 days	Cubic Meter
900 (2)b	Structural Concrete, Class B, 14 days	Cubic Meter
900 (2)c	Structural Concrete, Class B, 28 days	Cubic Meter
900 (3)a	Structural Concrete, Class C, 7 days	Cubic Meter
900 (3)b	Structural Concrete, Class C, 14 days	Cubic Meter
900 (3)c	Structural Concrete, Class C, 28 days	Cubic Meter
900 (4)a	Structural Concrete, Class P, 7 days	Cubic Meter
900 (4)b	Structural Concrete, Class P, 14 days	Cubic Meter
900 (4)c	Structural Concrete, Class P, 28 days	Cubic Meter
900 (5)	Seal Concrete	Cubic Meter
900 (6)	Reinforced Concrete	Cubic Meter

X. LEAN CONCRETE

A. Description

This Item shall consist of furnishing and placing of lean concrete in accordance with this Specification and in conformance with the lines, grades, and dimensions shown on the Plans. Lean Concrete shall consist of a mixture of Portland cement, fine aggregate, coarse aggregate, and water mixed in the proportions specified or approved by the Engineer. It is primarily used to provide a suitable base layer for concrete structures. It is produced with cementitious material to obtain the required compressive strength.

B. Materials Requirements

Portland Cement - Cement shall conform to the applicable requirements of Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete.

Concrete Aggregates - Concrete aggregates shall conform to the applicable requirements of Subsection 900.2.2, Concrete Aggregates of Item 900, Structural Concrete.

Fine Aggregates - Fine aggregates shall conform to the applicable requirements of Subsection 900.2.2.1, Fine Aggregates of Item 900, Structural Concrete.

Coarse Aggregates - Coarse aggregates shall conform to the applicable requirements of Subsection 900.2.2.2, Coarse Aggregates of Item 900, Structural Concrete, except for the gradation which shall conform to Table 901.1, considering a 50 mm thick lean concrete.

Table 901.1 Grading Requirements for Coarse Aggregate

Sieve Size	Mass Percent Passing
37.5 mm	100
25 mm	87 – 100
19 mm	45 – 100
9.5 mm	35 – 80
4.75 mm	30 – 65
No. 30	6 – 34
No. 200	0 – 15

Water - Water shall conform to the applicable requirements of Subsection 900.2.3, Water of Item 900, Structural Concrete.

Curing Materials - The curing compound shall be a wax-base product to provide a bond-breaking membrane between the lean concrete base and overlying concrete which conforms to the requirements of ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.

Storage of Cement and Aggregates - Cement and aggregates shall be stored in accordance to the applicable requirements of Subsection 900.2.6, Storage of Cement and Aggregates of Item 900, Structural Concrete.

Proportioning, Consistency and Strength of Concrete - The Contractor shall prepare the design mix based on the absolute volume method or as outlined in the American Concrete Institute (ACI) Standard 211.1, Recommended Practice for Selecting Proportions for Normal and Heavyweight Concrete. For lean concrete to be placed prior to placing of reinforcing steel bar or any prefabricated structure shall have a minimum compressive strength of 80% of the required strength of 13.8 MPa at 7 days. Slump shall be 25 mm to 75 mm and determined using AASHTO T 119, Standard Method of Test for Slump of Hydraulic Cement Concrete.

C. Construction Requirements

Quality Control of Concrete - The Contractor shall be responsible for the quality control of all materials during the handling, blending, and mixing and placement operations. The Contractor shall furnish the Engineer a Quality Control Plan detailing his production control procedures and the type and frequency of sampling and testing to ensure that the concrete produced complies with the Specifications. The Contractor shall be responsible for determining the gradation of fine and coarse aggregates and for testing the concrete mixture for slump, air content, water-cement ratio and temperature. He shall conduct his operations so as to produce a mix conforming to the approved mix design. The Contractor shall maintain adequate records of all inspections and tests. The records shall indicate the nature and number of observations made, the number and type of deficiencies found, the quantities approved and rejected, and nature of any corrective action taken. The Engineer may take independent assurance samples at random location for acceptance purposes as he deems necessary.

Site Preparation

For structures requiring subgrade preparation, it shall be as follows:

1. Subgrade shall conform to the specified lines and grades, elevation as indicated on the Plans and compacted to the required density. Any low areas shall be identified and filled with additional base and that any high areas shall be trimmed as specified. Additional thickness shall be paid for as part of the lower layer and shall not be included in calculating base thickness.
2. Subgrade shall be free of loose or extraneous materials.
3. Subgrade shall be uniformly moist but free of standing or flowing water.

Handling and Placing of Concrete: General

Handling and Placing of Concrete shall conform to the applicable requirements of Subsection 900.3.10, Handling and Placing of Concrete: General of Item 900, Structural Concrete.

Placing of Concrete by Pneumatic Means

Placing of concrete by pneumatic means shall conform to the applicable requirements of Subsection 900.3.10.1, Placing Concrete by Pneumatic Means of Item 900, Structural Concrete.

Placing of Concrete by Pumping - placing of concrete by pumping shall conform to the applicable requirements of Subsection 900.3.10.2, Placing of Concrete by Pumping of Item 900, Structural Concrete.

Finishing - Finishing shall conform to the applicable requirements of Subsection 900.3.12, Concrete Surface Finishing: General of Item 900, Structural Concrete.

Curing - Curing of lean concrete shall be in accordance to Subsection 900.3.13, Curing Concrete of Item 900, Structural Concrete.

Sampling, Testing and Acceptance - Sampling and testing shall conform to the applicable requirements of Subsection 900.3.4, Sampling and Testing of Structural Concrete of Item 900, Structural Concrete. Acceptance of concrete shall conform to the applicable requirements of Subsection 900.3.14, Acceptance of Concrete of Item 900, Structural Concrete.

Method of Measurement - The quantity of lean concrete to be paid for shall be the final quantity measured in cubic meter, placed and accepted in the completed structure as shown on the approved Plans and accepted to the satisfaction of the Engineer.

Basis of Payment - The accepted quantities, measured as prescribed in Section 901.4, Method of Measurement shall be for at the Contract Unit Price for each of the Pay Item listed below that is included in the Bill of Quantities. Payment shall constitute full compensation for furnishing and placing of concrete including labor, materials, equipment, tools and incidentals necessary to complete the work prescribed in the Item.

XI. REINFORCING STEEL

A. 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.

B. 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-Steel 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	AASHTO M 336M, Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement (ASTM 1064M, Standard Specification for

Type of Reinforcing Steel	Specification
Fabric of Concrete Reinforcement	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

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 straightened during construction. Tie bars shall be deformed bars. Dowel bars shall be plain round bars. They shall be free from burring or other deformation restricting slippage in the concrete. Before delivery to the site of the work, a minimum of 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.

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.

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 strand or rope : AASHTO M 203 M, Standard Specification 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	1,000 MPa followed by stress relieving
Minimum yield strength, measured by the 0.7% extension under load method	895.7 MPa
Minimum modulus of elasticity	25,000,000

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 colddrawn 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%

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 Reinforcements	ASTM A996/AASHTO M 322

a. 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.

b. 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 178 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.

c. 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.

d. Requirements for Epoxy-Coated Reinforcing Steel Bars

i. **Coating Thickness**

For acceptance purpose, at least 90% of all recorded thickness measurements of the coating after curing shall be 175 µm 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.

ii. **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 Ω, 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.

iii. 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.

C. Construction Requirements

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.

2. Protection of Material

a. 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.

b. Epoxy-Coated Reinforcing Steel Bars

i. 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.

ii. 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.

iii. Reinforcement steel bars shall be handled and stored in manner to prevent damage to bars or the epoxy coating.

iv. Coated reinforcing steel bars, whether individual bars or bundles of bars or 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.

v. All systems for handling the epoxy coated bars shall have padded contact areas to eliminate damage.

vi. 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.

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.

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 or brick, 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.

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.

a. Lap splices shall not be permitted for bars larger than 36 mm Ø.

b. 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.

i. 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).

c. For non-contact splices in flexural members, the transverse center-tocenter spacing of spliced bars shall not exceed the lesser of one-fifth the required lap splice length and 150 mm.

d. Lap splices of bundled bars shall be in accordance with the requirements below.

i. Lap splices of bars in the bundle shall be based on the lap splice length required for the individual bars within the bundle.
ii. Individual bar splices within a bundle shall not overlap.
iii. Entire bundles shall not be lap spliced.

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.

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.

D. 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.

E. 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 steel which price and payment shall be full compensation for furnishing and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a1	Reinforcing Steel (Deformed) Grade 40	Kilogram
902 (1) a2	Reinforcing Steel (Deformed) Grade 60	Kilogram
902 (1) b	Reinforcing Steel (Plain/Round)	Kilogram
902 (2) a1	Epoxy-Coated Reinforcing Steel (Deformed) Grade 40	Kilogram
902 (2) a2	Epoxy-Coated Reinforcing Steel (Deformed) Grade 60	Kilogram
902 (2) b	Epoxy-Coated Reinforcing Steel (Plain/Round)	Kilogram

XII. FORMS AND FALSEWORKS

A. Description

This Item covers the furnishing, fabrication, installation, erection, and removal of forms and falseworks for cast-in-place concrete.

B. 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.

C. Construction Requirements

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 thick or 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 185 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.

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 or 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 186 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.

a. Proper foundations on ground, such as mudsills, spread footings, or pile footings should be provided. If soil under mudsills is or may become incapable of supporting superimposed loads without appreciable settlement, it should be stabilized or other means of support should be provided.

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.

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.

5. 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 Design Strength
Walls, column and vertical sides of beams	1 to 2	70%
Beam soffits (steel formwork props/shoring left under)	7	80%
Soffits of slabs (steel formwork props/shoring left under)	7	70%
Removal of steel formwork props/shoring to slabs: Soffits of slabs, for slabs spanning up to 4.5 m	7	70%
Removal of steel formwork props/shoring to slabs: Soffits of slabs, for slabs spanning over 4.5 m	14	70%
Removal of steel formwork props/shoring to beams and	14	80%

Order and method of removing formwork:

a. 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.
b. Shuttering forming soffit of slabs shall be removed next.

c. 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.

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 posttensioning 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 all 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	**Days to Elapse prior to Salt**

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 189 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.

D. 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.

E. 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
903 (2)	Formworks and Falseworks	Square Meter

XIII. METAL STRUCTURES

A. 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.

B. Material Requirements

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 189 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.

D. 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.

E. 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
903 (2)	Formworks and Falseworks	Square Meter

XIII. METAL STRUCTURES

A. 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.

B. Material Requirements

a. Classes of Structural Steels

i. 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.

ii. 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.

iii. Cold Formed Light Gage Shapes

Structural steel shapes cold-formed from coils or sheets with thicknesses ranging from 2 mm to 6 mm.

iv. Rolled Steel Plates

Rolled Steel shapes are structural steel sections produced by passing red hot blooms (for larger sections) or billets (for smaller sections) through rolls until the desired shape is attained. Rolled steel shapes shall conform to the billet specifications for PNS 49, Steel Bars for Concrete Reinforcement – Specification, Grade 230.

v. Metal Decks

Metal decks or panels shall conform to Item 1033, Metal Decks.

b. Structural Steel Materials

i. 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:

ii. 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

iii. **Structural Tubing**

Structural tubing shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTN 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

iv. **Steel Pipe**

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.

v. **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

vi. Steel Bars

Steel bars 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 A709M	Standard Specification for Structural Steel for Bridges

vii. Steel Sheets

Steel sheets shall conform to the following specifications 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

c. 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.

d. **Bolts, Washers and Nuts**

Bolts, washers 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

Designation	Title
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 Nuts
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

e. **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

f. **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 A5.17 M	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

g. **Head 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, HotWrought.

h. **Turnbuckle**
Unless otherwise specified, turnbuckle shall conform to the applicable requirements of ASTM F1145, Standard Specification for Turnbuckles, Swaged, Welded, Forged and AASHTO M 269, Standard Specification for Turnbuckles and Shackles.

i. **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.

C. Construction Requirements

a. **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 458 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 and slip-critical high-strength bolted connections.

b. **Fabrication**

i. **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.

ii. 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 edges 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, Beam 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 µm 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.

iii. Planing of Edges

Planing 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.

iv. 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.

v. 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 exceed a depth of 2 mm.

Fully inserted finger shims, with a total thickness of not more than 6 mm within 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 shall conform to the requirements of the RCSC Specification for Structural Joints using ASTM F3125M.

vi. **Dimensional Tolerances**

Dimension tolerances shall be in accordance with the American Institute of Steel Construction (AISC) Code of Standard Practice for Steel Buildings and Bridges.

vii. **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 if 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.

viii. **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.

ix. **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.

x. **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 galvanized members shall conform to the requirements of 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.

c. Shop Painting

i. 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.

ii. Inaccessible Surfaces

Except for contact surfaces, surfaces inaccessible after shop assembly shall be cleaned and painted prior to assembly

iii. 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.

iv. 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 characteristics that make removal prior to erection unnecessary.

v. 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.

d. Erection

i. Alignment of Column Bases

Column bases shall be set level to the required elevation with full bearing on concrete or masonry.

ii. Bracing

The frame of steel skeleton buildings shall be carried up true and plumb within the limits 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 Bridges, wherever necessary to support the loads to which the structure may be subjected, including equipment and the operation of same. Such bracing shall be left in place as long as required safety.

iii. Alignment

No permanent bolting or welding shall be performed until the adjacent affected portions of the structure have been properly aligned.

iv. 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.

v. **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.

vi. **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.

vii. **Field Connections**
As erection progresses, the structure shall be securely bolted or welded to support the dead, wind and erection loads.

e. **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.

i. **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.

ii. **Rejection**
Material or workmanship not in conformance with the provision of this Specification shall be rejected by the Engineer at any time during the progress of work.

iii. **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.

iv. **Inspection of Slip-Critical High Strength Bolted Connections**
The inspection of slip-critical high strength bolted connections shall be in accordance with the provisions of the RCSC Specification for Structural Joints Using ASTM F3125.

v. **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-up" operation for the main structural elements of each shipping piece.

D. **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.

E. Basis Of Payment

The accepted quantity, measures as prescribed in Section 1047.4, Method of 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
1047 (2)a	Structural Steel, Trusses	Kilogram
1047 (2)b	Structural Steel, Purlins	Kilogram
1047 (2)c	Structural Steel, Cladding	Kilogram
1047 (3)a	Metal Structure Accessories, Bolts	Each
1047 (3)b	Metal Structure Accessories, Sagrods	Each
1047 (3)c	Metal Structure Accessories, Turnbuckle	Each
1047 (3)d	Metal Structure Accessories, Cross Bracing	Each
1047 (4)	Metal Structure Accessories, Cross Bracing	Kilogram
1047 (5)	Metal Structure Accessories, Steel Plates	Each
1047 (6)	Metal Structure Accessories, Steel Plates	Kilogram
1047 (7)a	Metal Structure Accessories, Bolts	Kilogram
1047 (7)b	Metal Structure Accessories, Sagrods	Kilogram
1047 (7)c	Metal Structure Accessories, Turnbuckle	Kilogram
1047 (8)	Structural Steel, Roof Framing	Lump Sum
1047 (9)	Stainless Steel Pipe, Flagpole Post	Kilogram
1047 (10)	Metal Structure Accessories	Lump Sum

XIV. MASONRY WORKS

A. Description

This item shall consist of furnishing of all necessary materials, tools, equipment and labor necessary to complete the execution of the masonry works as shown on the Plans.

B. Material Requirements

a. Hydraulic Cement

Hydraulic Cement shall conform to the applicable requirements of Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete.

b. Aggregates

i. Aggregates for Concrete Hollow Blocks and Louver Blocks

Aggregates shall conform to the applicable requirements of Subsection 900.2.2, Concrete Aggregates of Item 900, Structural Concrete.

ii. 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.

iii. Water

Water shall conform to the applicable requirements of Subsection 900.2.3, Water of Item 900, Structural Concrete.

iv. Reinforcing Steel

1. **Reinforcing Steel for Concrete Hollow Blocks and Louver Blocks**

   Reinforcing steel shall conform to the applicable requirements of Item 902, Reinforcing Steel.

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.

v. 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.

vi. Quicklime for Autoclaved Aerated Concrete (AAC) Blocks

Quicklime shall conform to the applicable requirements of ASTM C5, Standard Specification for Quicklime for Structural Purposes.

vii. Gypsum for Autoclaved Aerated Concrete (AAC) Blocks

Gypsum shall conform to the applicable requirements of ASTM C22M, Standard Specification for Gypsum.

viii. Aearation Agent for Autoclovaed Aerated Concrete (AAC) Blocks

Aeration agent shall conform to manufacturer's specifications.

ix. 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.

x. 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.

xi. **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

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_s), 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)

2. **Non-Load Bearing Concrete Hollow Blocs and Louver Blocks**
Non-load bearing concrete hollow blocks shall be clearly marked to prevent their use as load bearing units.

a. **Type I, Moisture-Controlled Units** – Units shall conform to the requirements of Tables 1046.3, 1046.4 and 1046.5.
b. **Type II, Non-Moisture-Controlled Units** – Units designated as Type II shall conform to the requirements of Table 1046.4.

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%

xii. **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	450	550
	600	550	650
AAC-5	600	550	650
	700	650	750
AAC-6	600	550	650
	700	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%

xiii. 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.

xiv. 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.

xv. Mortar for Adobe Blocks

Mortar for adobe shall conform to ASTM C270, Standard Specification for Mortar for Unit Masonry.

C. Construction Requirements

a. Concrete Hollow Blocks and Louver Blocks

i. 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.

ii. **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.

iii. **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.

iv. **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.

b. **Autoclaved Aerated Concrete (AAC) Blocks**

i. **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.

ii. 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.

iii. 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).

D. 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.

E. Basis Of Payment

The accepted quantity, measured as prescribed in Section 1046.4, Method of Measurement shall be paid for at the Contract Unit Price for Masonry Works 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 Load-Bearing (including Reinforcing Steel), 100 mm	Square Meter
1046 (1)a2	CHB Load Bearing (including Reinforcing Steel), 150 mm	Square Meter
1046 (2)a1	CHB Non-Load-Bearing (including Reinforcing Steel), 100 mm	Square Meter
1046 (2)a2	CHB Non-Load Bearing (including Reinforcing Steel), 150 mm	Square Meter
1046 (3)	Louver Block	Square Meter
1046 (4)a1	AAC Non-load Bearing, 100mm	Square Meter
1046 (4)a2	AAC Non-load Bearing, 150mm	Square Meter
1046 (5)	Adobe blocks	Square Meter

XV. WOODEN DOORS AND WINDOWS

A. 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.

B. Material Requirements: 1010.2.

1. Lumber Lumber of doors, windows and jambs, and panels when required, shall be kilndried 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.
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.
3. Adhesive Adhesive shall be water resistant resins and shall be non-staining.
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.
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.
6. Hardware Hardware shall be as specified under Item 1004, Hardware. 267 1010.3 Construction Requirements
7. 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 268 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 nonpeeling 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 269 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 or 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.

C. 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) loosepin 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 lag screws 270 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. 271 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 (1)	Frames (Jambs, Sills, Head Transoms and Mullions)	Set
1010 (2)a	Doors (Flush)	Square Meter
1010 (2)b	Doors (Wood Panel)	Square Meter
1010 (2)c	Doors (Glass Panel)	Square Meter
1010 (3)	Window Sashes	Square Meter
1010 (4)	Wooden Doors and Windows	Lump sum

XIV. ALUMINUM GLASS DOORS

A. Description

This Item shall consist of furnishing all aluminum glass door materials, labor, tools and equipment required in undertaking the proper installation in accordance with the Plans and this Specification.

B. Material Requirements

Frame and panel members shall be fabricated from extruded aluminum sections true to details with clean, straight, sharply defined profiles and free from defects impairing strength or durability. Extruded aluminum sections shall conform to the Specification requirements as defined in ASTM B 211, Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.

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

Hardware for fixing and locking devices shall be closely matched to the extruded aluminum section and adaptable to the type and method of opening.

Vinyl weatherstrip shall be first class quality flexible vinyl forming an effective seal and without adverse deformation when installed.

Pile weather strip shall be silicon treated and free from residual wetting agents and made of soft fine hair as on wool, fur, among others.

Glazing shall conform to the requirement specified in Item 1012, Glass and Glazing.

C. Construction Requirements

For all assembly and fabrication works, the cut ends shall be true and accurately jointed, free of burrs and rough edges. Cut-out recesses, mortising, grinding operation for hardwares shall be accurately made and properly reinforced when necessary.

a. Installation Procedure

The width for door stiles and top, bottom and center rails shall be as shown on the Plans.

Main frame shall consist of head sill and jamb stiles specifically designed and machined to interfit and be joined at corners with self-threading screws

Frame sill shall be stepped and sloped with offset weep holes for efficient drainage to the exterior.

Door panel shall be accurately joined at corners, assembled and fixed rigidly to ensure weather tightness.

Aluminum glass door and main frame shall be installed in a prepared opening to be set plumb, square, level and true to details.

All joints between metal surface and masonry shall be fully caulked to ensure weather tightness.

Sliding type door panel shall be equipped with concealed roller overhead tracks with bottom guide.

Double action type door panel shall be equipped with heavy duty hinges that will control the door leaf in a close or open position.

Weatherstrip shall be furnished on edges at the meeting stiles of doors. Where aluminum is to be in contact with steel concrete cinder, block, tile, plaster or other similar masonry construction the aluminum surface shall be back painted before erection with a bituminous paint.

b. Shop Finish

Exposed aluminum surfaces shall be electro type hard coats.

c. Protection

All aluminum parts shall be protected adequately to ensure against damage during transit and construction operations.

Aluminum parts in contact with steel members shall be properly insulated by a coat of zinc chromate primer applied to the steel or by application of bituminous paint.

d. Cleaning

The Contractor is responsible for protecting all entrance units during construction, as well as the removal of protective materials and cleaning of aluminum surfaces.

Pay Item Aluminum shall be thoroughly cleaned with plain water mixed with kerosene or gasoline and then wipe surfaces using clean cotton fabric. No abrasive cleaning agents shall be permitted.

D. Method Of Measurement

Aluminum glass door, fully equipped with fixing accessories and locking devices shall be measured by square meter or by lump sum based on what is actually installed as shown on the Plans and approved by the Engineer.

E. Basis Of Payment

The area in square meter or in lump sum of aluminum glass doors installed including main frame and ready for service as provided in Section 1007.4, Method of Measurement shall be the basis of payment based on the unit bid or Contract Unit Price.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1007(1)a	Aluminum Framed Glass Door, Sliding Type	Square Meter
1007(1)b	Aluminum Framed Glass Door, Swing Type	Square Meter
1007(2)	Aluminum Framed Glass Door	Lump Sum

XVI. ALUMINUM GLASS WINDOWS

A. Description

This Item shall consist of furnishing all aluminum glass window materials, labor, tools and equipment required in undertaking the proper installation in accordance with the Plans and this Specification.

B. Material Requirements

Frame and panel members shall be fabricated from extruded aluminum section true to details with clean, straight, sharply defined profiles and free from defects impairing strength or durability. Extruded aluminum section shall conform to the specification requirements defined in ASTM B211, Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire. Screws, nuts, washers, bolts, rivets and other miscellaneous fastening devices shall be made of non-corrosive materials such as aluminum, stainless steel, etc. Hardware for fixing and locking device shall be closely matched to the extruded aluminum section and adaptable to the type and method of opening. Weather strip shall be first class quality flexible vinyl forming an effective seal and without adverse deformation when installed. Glazing shall conform to the requirements specified in Item 1012, Glass and Glazing.

C. Construction Requirements

For all assembly and fabrication works the cut end shall be true and accurate, free of burrs and rough edges. Cut-outs recesses, mortising and grinding operation for hardware shall be accurately made and properly reinforced. Main frame shall consist of head, silt and jamb. All joints between metal surface and masonry shall be fully caulked. Aluminum parts in contact with steel members shall be properly insulated by a coat of zinc chromate, primer/bituminous paint applied to the steel surface. Weather strip shall be furnished on edges at the meeting stiles. Shop drawings which include window schedules, sections and multiple window assembly details shall be submitted to the Engineer for approval before installation.

a. Window Sash

Window panel shall be jointed at corners with miter and fixed rigidly to ensure weather tightness. Corners should be fastened with corrosion resistant screws and aluminum corner angles sealed with an acrylic sealant. All fixed glass is exterior glazed and all sashes are marine glazed with flexible PVC glazing. The fixed glazing shall be removed without disassembly of a sash. The vents will need to be disassembled to replace the glazing.

b. Sliding Window

Sliding windows shall be provided with nylon sheave. Sliding panels shall be suspended with concealed roller overhead tracks with bottom guide pitch outward and slotted for complete

drainage. The sliding panels shall be provided with interior handles. The locking device shall be a spring loaded extruded latch that automatically engages special frame hips.

c. **Casement Window**
Casement window type shall be provided with two (2) hinges fabricated from extruded aluminum alloy. They shall open on stay arms having adjustable sliding friction shoes to control window panel operations. Locking device shall be one arm action handle for manual operations complete with strike plate.

d. **Awning Window**
The perimeter frame of the awning window type can be supplied with nailing fins. Awning window units to be installed in prepared openings in accordance with the manufacturer's recommendations and installation drawings. Frames must be securely fastened, set plumb and level without twisting, bowing or distortion

e. **Fixed Type**
Fixed type window members including any mullions, shall be made of aluminum. Secondary members such as friction tabs, shoes, and weather stripping guides, shall also be made of aluminum or a compatible material. The tilt housing and latch units shall be mechanically anchored to the sash rails. The latches shall be spring loaded and afford positive lock into the jamb profile. In a tilted position, the sash shall be removable to the interior.

f. **Shop Finish**
Exposed aluminum surfaces shall be electrolyte hand coats such as anodize, satin, powder coated, among others.

g. **Protection**
All aluminum parts shall be protected adequately to ensure against damage during transit and construction phase.

h. **Cleaning**
The Contractor does not only protect all entrance units during the construction phase but shall also be responsible for removal of protective materials and clearing the aluminum surface including glazing before work is accepted by the Engineer. Aluminum shall be thoroughly cleaned with aluminum and glass cleaning solution and then wipes surface using clean cloth rugs. No abrasive cleaning materials shall be permitted in cleaning surface.

D. Method Of Measurement
Aluminum glass window fully equipped with fixing accessories and locking devices shall be measured in lump sum or square meters actually installed inplace and accepted to the satisfaction of the Engineer.

E. Basis Of Payment
The area of aluminum glass windows in square meters ready for service as provided in the Bill of Quantities shall be the basis of payment based on the unit bid or Contract Unit Price which price and payment constitute all materials, labor including incidentals.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1008 (1)a	Aluminum Glass Windows, Sliding Type	Square Meter
1008 (1)b	Aluminum Glass Windows, Casement Type	Square Meter
1008 (1)c	Aluminum Glass Windows, Awning Type	Square Meter
1008 (1)d	Aluminum Glass Windows, Fixed Type	Square Meter
1008 (2)	Aluminum Glass Windows	Lump Sum

XVII. PRE-PAINTED METAL SHEETS

A. 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.

B. 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.

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 MetallicCoated Steel Sheets for Roofing - Specification. Profile section in identifying the architectural moulded rib to be used is as follows: Regular corrugated, Quadrib, 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)
Paint coatings	
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

Nominal thickness (mm)	Thickness Range
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 thickness as per PNS 67.

C. 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.

D. 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.

E. 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 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 side lap and hold the side lap firmly in place. Continue the same procedure for subsequent sheets 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 prepainted metal sheet as 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.

F. **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 295 lapped on top of the lower flashings. This will prevent moisture from leaking under the flashings and into the structure.

1. 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.

2. 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 screw 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.

3. 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.

4. 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.

5. 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.

G. 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)a1	Pre-painted Metal Sheets, below 0.427 mm, Corrugated, Short Span	Square Meter
1014 (1)a2	Pre-painted Metal Sheets, below 0.427 mm, Rib Type, Short Span	Square Meter
1014 (1)b1	Pre-painted Metal Sheets above 0.427 mm, Corrugated, Long Span	Square Meter
1014 (1)b2	Pre-painted Metal Sheets, above 0.427 mm, Rib Type, Long Span	Square Meter

XVIII. CARPENTRY AND JOINERY WORKS

A. 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.

B. Material Requirements

a. 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.

i. 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 nailers.

ii. 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, ceiling 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.

iii. 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%

iv. 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

b. 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 232 plyboard of not less than 19 mm thick shall be free from defect such as split in veneer, buckling or warping.

c. 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.

d. 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.

e. Materials Other than Lumber

i. 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.

ii. 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.

iii. *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.

iv. 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.

v. Gypsum Board

It shall comply with the applicable requirements of Item 1041, Gypsum Board.

vi. Pre-Painter Metal Panel

It shall comply with the applicable requirements of Item 1014, Prepainted Metal Sheets.

vii. Aluminum Metal Cladding

Aluminum for metal cladding shall comply with the applicable requirements of Item 1039, Aluminum Cladding.

viii. **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.

ix. **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.

x. **Modular Partition**
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.

C. ***Construction Requirements***

a. **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.

b. **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.

c. **Shop Drawings**
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.

d. **Rough Carpentry**
Rough carpentry covers timber structural framing for roof, flooring, siding, partition and ceiling.

i. Framing shall be stress grade or common grade lumber of the specie specified under Subsection 1003.2.1.2, Lumber Species and Usage.
ii. Rough carpentry shall be done true to lines, levels and dimensions. It shall be squared, aligned, plumbed and well fitted at joints.
iii. Trusses and other roof framing shall be assembled, fitted and set to exact location and slope indicated on the Plans.

iv. Fasteners, connectors and anchors of appropriate type and number shall be provided and fitted where necessary.
v. 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.
vi. Timber framing in contact with concrete masonry shall be treated with termite-proofing solution and after drying coated with bituminous paint.

e. Finished Carpentry

Finished carpentry covers work on flooring, siding and ceiling boards, stairs, cabinets, fabricated woodwork, millwork and trims.

i. Framing lumber shall be select grade, free from defects and where exposed in finished work, shall be selected for color and grain.
ii. Joints of framing shall be tenoned, mortised or doweled where suitable, closely fitted and secured with water resistant resins and glue. Exterior joints shall be mitered and interior angles coped.
iii. 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.
iv. Plyboard shall be as specified under Subsection 1003.2.2 unless otherwise indicated on the Plans.
v. Plywood shall be specified under Subsection 1003.2.3.
vi. 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.
vii. 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.
viii. 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.

f. 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.

i. Use trim details indicated on drawings.
ii. Touch up all field cut edges before installing.
iii. 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.

g. **Gypsum Board**
Installation requirements shall conform to the applicable requirements of Item 1041, Gypsum Board.

h. **Aluminum Metal Cladding**
Installation requirements shall conform to the applicable requirements of Item 1039, Aluminum Cladding.

i. **Prepainted Metal Panel**
It shall comply with the applicable requirements of Item 1014, Prepainted Metal Sheets.

j. **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.

k. **Modular Partition**
Installation requirements shall be in accordance with the manufacturer's instructions and detailed drawings approved by the Engineer.

D. **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.

E. **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)a1	Ceiling, 4.5 mm, Metal Frame, Fiber Cement Board	Square Meter
1003 (1)a2	Ceiling, 4.5 mm, Wood Frame, Fiber Cement Board	Square Meter
1003 (1)b1	Ceiling, 4.5 mm, Metal Frame, Marine Plywood	Square Meter
1003 (1)b2	Ceiling, 4.5 mm, Wood Frame, Marine Plywood	Square Meter
1003 (1)c1	Ceiling, 6 mm, Metal Frame, Marine Plywood	Square Meter
1003 (1)c2	Ceiling, 6mm, Wood Frame, Marine Plywood	Square Meter
1003 (1)d1	Ceiling, 6 mm, Metal Frame, Ordinary Plywood	Square Meter

Pay Item Number	Description	Unit of Measurement
1003 (1)d2	Ceiling, 6 mm, Wood Frame, Ordinary Plywood	Square Meter
1003 (1)e1	Ceiling, Metal Frame, Gypsum Board	Square Meter
1003 (1)e2	Ceiling, Metal Frame, Prepainted Metal Panel	Square Meter
1003 (1)e3	Ceiling, Metal Frame, Aluminum Metal Cladding	Square Meter
1003 (1)f	Ceiling, Wood Frame, Wood	Square Meter
1003 (2)a1	Wall, 4.5 mm, Metal Frame, Fiber Cement Board	Square Meter
1003 (2)a2	Wall, 4.5 mm, Wood Frame, Fiber Cement Board	Square Meter
1003 (2)b1	Wall, 6 mm, Metal Frame, Fiber Cement Board	Square Meter
1003 (2)b2	Wall, 10 mm, Metal Frame, Fiber Cement Board	Square Meter
1003 (2)b3	Wall, 12 mm, Metal Frame, Fiber Cement Board	Square Meter
1003 (2)be4	Wall, 6 mm, Wood Frame, Fiber Cement Board	Square Meter
1003 (2)c1	Wall, 4.5 mm, Metal Frame, Marine Plywood	Square Meter
1003 (2)c2	Wall, 4.5 mm, Wood Frame, Marine Plywood	Square Meter
1003 (2)d1	Wall, 6 mm, Metal Frame, Marine Plywood	Square Meter
1003 (2)d2	Wall, 6mm, Wood Frame, Marine Plywood	Square Meter
1003 (2)e1	Wall, 6 mm, Metal Frame, Ordinary Plywood	Square Meter
1003 (2)e2	Wall, 6 mm, Wood Frame, Ordinary Plywood	Square Meter
1003 (2)f	Wall, Aluminum Metal Cladding	Square Meter
1003 (2)g	Wall	Lump Sum
1003 (3)	Cabinets	Square Meter
1003 (4)	Cabinets	Each
1003 (5)	Roof Frame, Wood	Board Foot
1003 (6)	Floor Frame, Wood	Board Foot
1003 (7)	Flooring, Wood	Square Meter
1003 (8)	Flooring, Wood	Board Foot
1003 (9)	Wall Frame, Wood	Each
1003 (10)	Wall Frame, Wood	Meter

Pay Item Number	Description	Unit of Measurement
1003 (11)a1	Fascia Board, 19 mm, Fiber Cement Board	Meter
1003 (11)a2	Fascia Board, 25 mm, Lumber	Meter
1003 (12)	Fascia Board, Metal	Kilogram
1003 (13)	Phenolic Board	Each
1003 (14)	Phenolic Board	Square Meter
1003 (15)a	Moulding, Wood	Meter
1003 (15)b	Moudling, Concrete	Meter
1003 (15)c	Moulding, Precast	Meter
1003 (15)d	Moulding, PVC	Meter
1003 (15)e	Moulding, Steel	Meter
1003 (16)	Pressurized Laminated Wood Particles	Square Meter
1003 (17)	Carpentry and Joinery Works	Lump Sum
1003 (18)	Lawanit	Square Meter
1003 (19)	Wooden Post, Good Lumber	Board Foot
1003 (20)	Coco Lumber	Board Foot
1003 (21)	Moulding	Lump Sum
1003 (22)	Modular Partition	Square Meter
1003 (23)	Modular Partition	Lump Sum

XIX. RAILINGS

A. Description

This Item shall consist of furnishing, fabricating and installing the railings for buildings and other similar structures of the material or combination of materials in accordance with this Specification and in conformity with the Plans.

Railings shall be classified as concrete, wooden, masonry, stone, metal, stainless steel and glass, in accordance with the predominating material contained in each.

Railing shall not be considered a part of the structural system of the building unless it is stated in the design.

B. Material Requirements

a. Concrete

It shall conform to the applicable requirements prescribed in Section 900.2, Material Requirements of Item 900, Structural Concrete.

b. Forms and Falseworks

It shall conform to the applicable requirements prescribed in Subsection 903.2 Material Requirements of Item 903, Formworks and Falseworks.

c. Lumber, Plywood and Other Related Materials

It shall conform to the applicable requirements prescribed in Section 1003.2, Material Requirements of Item 1003, Carpentry and Joinery Works.

d. **Hardware**
This shall conform to the applicable requirements of prescribed in Section 1004.2, Material Requirements of Item 1004, Hardware.

e. **Masonry**
These shall conform to the requirements of Section 1046.2, Material Requirements of Item 1046, Masonry Works.

f. **Mortar**
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.

g. **Reinforcing Steel**
It shall conform to the applicable requirements of Subsection 902.2.2, Material Requirements of Item 902, Reinforcing Steel.

h. **Stone**
Stones shall be clean, hard, and durable and shall be subjected for the Engineer's approval. Adobe stones shall not be used unless otherwise specified.

i. **Metal**
Steel base metal to be welded shall be open-hearth or electric furnace steel conforming to AASHTO M 183, Standard Specification for Structural Steel, unless otherwise shown on the Plans.

j. **Stainless Steel (Non-Ferrous Metal)**
It shall conform to the requirements of ASTM A276M, Standard Specification for Stainless Steel Bars and Shapes or as called for in the Plan

k. **Glass and Glazing**
It shall conform to the applicable requirements prescribed in Section 1012.2 Material Requirements of Item 1012, Glass and Glazing.

Glass shall be laminated, heat strengthened, and tempered unless otherwise indicated in the Plans. If laminated glass were called for in the Plans it shall conform to ASTM C1048, Standard Specification for Heat-Treated Flat GlassKind HS, Kind FT Coated and Uncoated Glass and ASTM C1172, Standard Specification for Laminated Architectural Flat Glass. The minimum thickness of glass shall be 6 mm unless otherwise indicated in the Plans. If glass is intended for exterior railing in-fill panels, it shall comply with the following:

i. Test shall be in accordance with ASTM E2353, Standard Test Methods for Performance of Glass in Permanent Glass Railing Systems, Guards and, Balustrades. The said standard evaluates static strength, impact resistance, and post-break retention.
ii. Railing systems shall be in accordance to ASME E 2358, Standard Specification for the Performance of Glass in Permanent Glass Railing Systems, Guards, and Balustrades. These systems include glazing in-fill, as well as structural glass railing types. The four (4) levels of performance are shown.

Table 1051.1 Levels of Performance

Performance Level	ASTM E935 (Structural [A]) (Minimum)	ANSI Z97.1 (Safety Impact [B]) (Minimum)
1	Concentrated load: 890 N Uniform Load: 290 N/m Infill Horizontal Load: 220N	Pass 230 J
2	Concentrated load: 890 N Uniform Load: 290 N/m Infill Horizontal Load: 220 N	Pass 542 J
3	Concentrated load: 1330 N Uniform Load: 730 N/m Infill Horizontal Load: 220N	Pass 542 J
4	Concentrated load: 1620 N Uniform Load: 880 N/m Infill Horizontal Load:220 N	Pass 542 J

Note: [A] Tests performed as outlined in ASTM E935, Standard Test Methods for Performance of Permanent Metal Railing Systems and Rails for Buildings.
[B] Tests performed as described in ANSI Z97.1 2015, For safety glazing materials used in buildings – safety performance specifications and method test.

l. **Aluminum**
It shall conform to the requirements of ASTM B221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.

m. **Painting, Varnishing and Other Related Works**
These shall conform to the applicable requirements prescribed in Section 1032.2, Material Requirements of Item 1032, Painting, Varnishing and Other Related Works.

C. Construction Requirements

a. General
Railings shall be constructed in accordance with the Plans and shall not reflect any unevenness in the structure/building. All railing posts shall be set plumb unless otherwise indicated on the Plans.

b. Concrete Railing
Concrete railing shall be constructed in accordance with the requirements of Subsection 900.3 Construction Requirements of Item 900, Structural Concrete.

i. Concrete Railing Cast in Place
Forms shall be secured to be smooth and tight fitting which can be rigidly held in line and grade and removed without damage to the casted concrete structure.

Forms shall either be of single width boards or shall be lined with suitable material to have a smooth surface which shall meet the approval of the Engineer or as shown in the Plans.

All moldings, panel work and bevel strips shall be constructed according to the detailed Plans with mitered joints. All corners in the finished work shall be true,

sharp and clean cut, and shall be free from cracks, spalls, honeycombs and other defects.

ii. **Precast Railings**
Moist tamped mortar precast members shall be removed from the molds as soon as it is practicable and shall be kept damp for a period of at least ten (10) days. Any member that shows cracking of soft corners of surfaces shall be rejected.

iii. **Wooden Railing**
The construction requirements shall be in conformance, whenever applicable, with Subsection 1003.3 Construction Requirements of Item 1003, Carpentry and Joinery Works.

iv. **Masonry Railing**
The construction requirements shall be in conformance, whenever applicable, with Subsection 1046.3 Construction Requirements of Item 1046, Masonry Works

v. **Stone Railing**
The maximum projection of stones beyond the pitch lines and shall not be more than 50 mm.

vi. **Metal Railing**
The metal railing shall be fabricated in accordance with the dimensions shown on the approved Plans. In case of welded railings, all exposed joints shall be finished by grinding or filing after welding to give a neat appearance. Welding may be substituted for rivets or bolts with the approval of the Engineer

vii. **Stainless Steel Railing**
The metal railing shall be fabricated in accordance with the dimensions shown on the Plans. During installation, stainless steel railing shall be free from rust and surface blemish. It shall be rust free until ten (10) years after completion.

viii. **Glass Railing**
The construction requirements shall be in conformance, whenever applicable, with Section 1012.3 Construction Requirements of Item 1012, Glass and Glazing.

D. Method Of Measurement
The quantity to be paid for shall be the number of meters of specified railing materials and sizes or by lump sum for actually completed and accepted measured from center to center of end posts as shown on the Plans or as directed by the Engineer.

E. Basis Of Payment
The accepted quality, measured as prescribed in Section 1051.4, Method of Measurement shall be paid for at the Contract Unit Price for Railing, which price and payment shall be full compensation for furnishing and placing all materials including all labor, equipment, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1051 (1)a	Railing	Lump Sum
1051 (1)b	Railing	Meter
1051 (2)a	Concrete Railing, Standard	Meter
1051 (2)b	Concrete Railing, Baluster	Meter
1051 (2)c	Concrete Railing, Parapet	Meter
1051 (3)	Wooden Railing	Meter
1051 (4)	Stone and Brick Railing	Meter
1051 (5)	Metal Railing	Meter
1051 (6)	Stainless Steel Railing	Meter
1051 (7)	Glass Railing	Meter

XX. PAINTING, VARNISHING AND OTHER RELATED WORK

A. 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.

B. Material Requirements

a. 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		Specification for	Concrete, metal, wood
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

b. 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.

c. 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.

d. 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.

e. Silicon Water Repellant

Silicon water repellant shall be transparent water shield especially formulated to repel rain and moisture on exterior masonry surfaces.

f. 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.

g. 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.

h. 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.

i. 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.

j. Sanding Sealer

Sanding sealer shall be quick drying lacquer, formulated to provide quick dry, good holdout of succeeding coats, and containing sanding agents such as zinc stearate to allow dry sanding of sealer. It shall be in accordance with the requirements of PNS 367, Specification for Lacquer Sanding Sealer.

k. 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.

l. Glazing Putty

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

m. **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.

n. **Schedule**
Exterior
i. Plain cement plastered finish to be painted - Three (3) coats acrylic base masonry paint
ii. Concrete exposed aggregate and/or tool finish - One (1) coat water repellant
iii. Ferrous metal - One (1) coat primer and two (2) coats enamel paint
iv. Galvanized metal - One (1) coat zinc chromate primer and two (2) coats Portland cement paint
v. Wood paint finish - Three (3) coats oil based paint
vi. Wood varnished finish - Varnish water repellant

Interior
i. Plain cement plastered finish to be painted - Two (2) coats acrylic base masonry paint
ii. Concrete exposed aggregate and/ or tool finish - Clean surface
iii. Ferrous metal - One (1) coat primer and two (2) coats enamel paint
iv. Woodwork sea-mist - Three (3) coats of three (3) parts thinner and one (1) part lacquer
v. 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
vi. Woodwork painted finish - Three (3) coats oil base paint
vii. Ceiling boards textured finish - One (1) coat oil based paint, allow to dry then patch surfaces unevenness and apply textured paint coat

o. **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:

i. Type of Paint
ii. Brand or Trademark
iii. Name and address of manufacturer
iv. Net Volume and/or mass in metric units
v. Directions for use
vi. Safety precautions
vii. Batch or lot number any package or container not so marked will not be accepted for use under this Specification.

C. 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.

a. **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 other related works:

i. Voids, cracks, nick, and other wood imperfections will be repaired with proper patching material and finished flushed with surrounding surfaces.
ii. Marred or damaged shop coats on metal shall be spot primed with appropriate metal primer.
iii. Painting and varnishing works shall not be commenced when it is too hot or cold.
iv. Allow appropriate ventilation during application and drying period.
v. All hardware will be fitted and removed or protected prior to painting and varnishing works.

b. ***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 ai

c. **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.

d. **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 all times. Necessary precaution to avoid fire must be observed by removing oily rags, waste, etc. at the end of daily work.

e. **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 374 drips, oil, 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.

f. **Workmanship in General**

i. 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.
ii. All coats shall be thoroughly dry before the succeeding coat is applied.
iii. 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 or protected during the painting varnishing and related work operations and re-installed after completion of the work.

g. **Procedure for Sea-Mist Finish**

i. Depress wood grain by steel brush and sand surface lightly.
ii. Apply sanding sealer.
iii. Apply two (2) coats of industrial lacquer paint.
iv. Spray last coat of industrial lacquer paint mixed with sanding sealer.
v. Apply wood paste filler thinned with turpentine or paint thinner into the wood surface.
vi. Wipe off wood paste filler immediately.
vii. Spray flat or gloss lacquer whichever is specified.

h. **Procedure for Varnish Finish**

i. Sand surface thoroughly.
ii. Apply putty on all cracks and other wood imperfections with wood paste filler.
iii. Apply oil stain.
iv. Apply lacquer sanding sealer. 375
v. Sand surface along the grain.
vi. Spray three (3) coats of clear dead flat lacquer.
vii. Polish surface coated using cloth pad.
viii. Spray gloss lacquer or flat lacquer whichever is desired or specified.

i. **Procedure for Ducco Finish**

i. Sand surface thoroughly
ii. Apply primer surface white or gray by brush or spray.

iii. Apply lacquer spot putty in thin coat. Allow each coat to become thoroughly dry before applying next coat.
iv. Apply primer surfaces and then allow to dry in 2 h before applying the next coat.
v. Apply a coat of flat tone semi-gloss enamel as per color scheme submitted and approved by the Engineer

D. 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.

E. 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)b	Painting Works, Wood	Square Meter
1032 (1)c	Painting Works, Steel	Square Meter
1032 (2)	Varnishing	Square Meter
1032 (3)	Sea-mist Finish	Square Meter
1032 (4)	Ducco Finish	Square Meter
1032 (5)	Texture Finish	Square Meter

XXI. PLUMBING WORKS

A. Scope of Work

1. Furnish all materials, tools, equipment, and fixtures as required in the plans for the satisfactory performance of the entire plumbing system and perform labor in accordance with the latest edition of the National Plumbing Code, Mechanical Code of the Philippines, and this specification.
2. All sanitary/plumbing works shall be done under the supervision of a Mechanical/Sanitary Engineer and in strict accordance with these specifications and of the methods as prescribed by the latest edition of the Philippine Plumbing Code, Sanitation Code of the Philippine and the Mechanical Code of the Philippines.

B. Materials

1. Soil and waste pipe shall be "Branded" conforming to ASTM-D1784 and made from class 12454 with dimensions of pipe and fitting conforming to ISO 161/1 and ISO 3606 and furnished in standard cutting length of 3 meters with sockets designed for rubber O-ring seal.

2. Polypropylene Random Copolymer piping shall be PN-20, type ASTM F-2389 and in accordance to NSF/ANSI Standard 61 Drinking Water System Components

3. Gate valves and hose bibs shall be bronze as per ASTM B-62 "Great Volume".

4. Faucets shall be chrome plated with stem length suitable for its intended location. Faucets and other accessories shall be approved brand.

5. Trap each fixture trap, except those cast integral or in combination with fixture in which the top seal is readily accessible for is the trap is removable shall have an accessible brass trap screw of ample size.

6. Clean-out shall be of the same size and materials as soil and waste pipe.

7. Pipe sleeves shall be galvanized iron pipe schedule 40.

8. Pipe support shall be fabricated from flat bar, round bar or angular bar of approximate sizes.

9. Water closets, Lavatories, Urinals and other fixtures and accessories shall be designer approved brand and approved model, for all units.

C. Installation

1. Install all plumbing fixtures free and open in a manner to afford access in cleaning.

2. Water piping shall intended to all fixtures, outlets and equipment from the gate valve installed in the branch near the riser.

3. All piping above ground shall run parallel with the line of the buildings unless otherwise shown in the drawings.

4. All soil and drainage pipe shall be pitched at 2% but in no case flatter than 1%.

5. All joints shall be air and water tight.

6. Roughing-in for pipes and fixtures shall be carried along the line of building constructor correctly located opening of proper sizes shall be provided where required in the wall and floor for the passage of the pipes. All items to be embedded in concrete shall be thoroughly clean.

7. Every plumbing fixture or equipment requiring connection to the drainage system shall be equipped with a trap, which shall be placed as near to the fixture as possible. No fixture shall be double trapped.

SANITARY WASTE AND VENT PIPING

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Pipe, tube, and fittings.
   2. Specialty pipe fittings.
   3. Encasement for underground metal piping.

1.3 PERFORMANCE REQUIREMENTS

A. Components and installation shall be capable of withstanding the following minimum working pressure unless otherwise indicated.
   1. Soil, Waste, and Vent Piping: 10-foot head of water (30 kPa).
B. Seismic Performance: Soil, waste, and vent piping and support and installation shall withstand the effects of earthquake motions determined according to ASCE/SEI 7.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated.
B. Shop Drawings: For sovent drainage system. Include plans, elevations, sections, and details.

1.5 INFORMATIONAL SUBMITTALS

A. Seismic Qualification Certificates: For waste and vent piping, accessories, and components manufacturer.
   1. Basis for Certification: Indicate whether withstand certifications based on actual test of assembled components or on calculation.
   2. Detailed description of piping anchorage devices on which the certification is based and their installation requirements.
B. Field quality-control reports.

1.6 QUALITY ASSURANCE

A. Piping materials shall bear label, stamp, or other markings of specified testing agency.
B. Comply with NSF/ANSI 14, "Plastic Piping Systems Components and Related Materials," for plastic piping components. Include marking with "NSF-dwv" for plastic drain, waste, and vent piping and "NSF-sewer" for plastic sewer piping.

1.7 PROJECT CONDITIONS

A. Interruption of Existing Sanitary Waste Service: Do not interrupt service to facilities occupied by Owner of others unless permitted under the following conditions and then only after arranging to provide temporary service according to requirements indicated.
   1. Notify Owner] no fewer than two days in advance of proposed interruption of sanitary waste service.

2. Do not proceed with interruption of sanitary waste service without Owner's written permission.

PART 2 – PRODUCTS

2.1 PIPING MATERIALS

A. Comply with requirements in "Piping Schedule" Article for applications of pipe, tube, fitting materials, and joining methods for specific services, service locations, and pipe sizes.

2.2 HUB-AND-SPIGOT, CAST-IRON SOIL PIPE AND FITTINGS

A. Pipe and Fittings: ASTM A 74, Service and Extra Heavy class (es).
B. Gaskets: ASTM C 564, rubber.
C. Calking Materials: ASTM B 29, pure lead and oakum or hemp fiber.

2.3 HUBLESS, CAST-IRON SOIL PIPE FITTINGS

A. Pipe and Fittings: ASTM A 888 or CISPI 301.
B. CISPI, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements.
   2. Standard: ASTM C 1277 and ASTM C 1540.
   3. Description: Stainless-steel corrugated shield with stain-less bands and tightening devices; and ASTM C 546, rubber sleeve with integral, center pipe stop.
C. Heavy-Duty, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements.
   2. Standard: ASTM C 1277 and ASTM C 1540.
   3. Description: Stainless-steel shield with stainless-steel bands and tightening devices; and ASTM C 564, rubber sleeve with integral, center pipe stop.
D. Cast-Iron, Hubless-Piping Couplings:
   1. Manufacturers: Subject to compliance with requirements.
   2. Standard: ASTM C 1277.
   3. Description: Two-piece ASTM A 48/A 48M, cast-iron housing; stainless-steel bolts and nuts; and ASTM C 564, rubber sleeve with integral, center pipe stop. PVC PIPE AND FITTINGS.
E. Solid-Wall PVC Pipe: ASTM D 2665, drain, waste, and vent.
F. Cellular-Core PVC Pipe: ASTM F 891, Schedule 40.
G. PVC Socket Fittings: ASTM D 2665, made to ASTM D 3311, drain, waste, and vent patterns and to fit Schedule 40 pipe.
H. Adhesive Primer: ASTM F 656.
   1. Adhesive primer shall have a VOC content of 550 g/L or less when they calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Adhesive primer shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
I. Solvent Cement: ASTM D 2564.
   1. PVC solvent cement shall have a VOC content of 510 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
   2. Solvent cement shall comply with the testing and product requirements of the California Department of Health Services "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers.

2.4 SPECIALTY PIPE FITTINGS

A. Transition Couplings:
   1. General Requirements: Fitting or device for joining piping with small different in OD's or of different materials. Include end connections same size as and compatible with pipes to be joined.
   2. Fitting-Type Transition Couplings: Manufactured piping coupling or specified piping system fitting.
   3. Unshielded, Nonpressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements.
      b. Standard: ASTM C 1173.
      c. Description: Elastomeric, sleeve-type, reducing or transition pattern. Include shear ring and corrosion-resistant-metal tension band and tightening mechanism on each end.
      d. Sleeve Materials:
         1. For Cast-Iron Soil Pipes: ASTM C 546, rubber.
         2. For Plastic Pipes: ASTM F 477, elastomeric seal or ASTM D 5926, PVC.
         3. For Dissimilar Pipes: ASTM D 5926, PVC or other material compatible with pipe materials being joined.
   4. Shielded, No pressure Transition Couplings:
      a. Manufacturers: Subject to compliance with requirements.
      b. Standard: ASTM C 1460.
      c. Description: Elastomeric or rubber sleeve with full-length, corrosion-resistant outer shield and corrosion-resistant-metal tension band and tightening mechanism on each end.

2.5 ENCASEMENT FOR UNDERGROUND METAL PIPING

A. Standard: ASTM A 647 or AWWA C105/A 21 .5.
B. Material: Linear low-density polyethylene fil of 0.008-inch (0.20-mm) or high-density, cross-laminated polyethylene film of 0.004-inch (0.10-mm)] minimum thickness.
C. Form: Sheet or tube].
D. Color: Black or natural.

PART 3 – EXECUTION

3.1 EARTH MOVING

A. Comply with requirements for excavating, trenching, and backfilling specified in Section 312000 "Earth Moving."

3.2 PIPING INSTALLATION

A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on coordination drawings.
B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.

C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
D. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
E. Install piping to permit valve servicing.
F. Install piping at indicated slopes.
G. Install piping free of sags and bends.
H. Install fittings for changes in direction and branch connections.
I. Install piping to allow application of insulation.
J. Install seismic restraints on piping. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment."
K. Make changes in direction for soil and waste drainage and vent piping using appropriate branches, bends, and long-sweep bends. Sanitary tees and short-sweep 1/4 bends may be used on vertical stacks if change in direction of flow is from horizontal to vertical. Use long-turn, double Y-branch and 1/8-bend fittings if two fixtures are installed back to back or side by side with common drain pipe. Straight tees, elbows, and crosses may be used on vent lines. Do not change direction of flow more than 90 degrees. Use proper size of standard increasers and reducers if pipes of different sizes are connected. Reducing size of drainage piping in direction of flow is prohibited.
L. Lay buried building drainage piping beginning at low point of each system. Install true to grades and alignment indicated, with unbroken continuity of invert. Place hub ends of piping upstream. Install required gaskets according to manufacturer's written instructions for use of lubricants, cements, and other installation requirements. Maintain swab in piping and pull past each joint as completed.
M. Install soil and waste drainage and vent piping at the following minimum slopes unless otherwise indicated:
    1. Building Sanitary Drain: 2 percent downward in direction of flow for piping NPS 3 (DN 80) and smaller; 1 percent slope downward in direction of flow for piping NPS 4 (DN 100) and larger.
    2. Horizontal Sanitary Drainage Piping: 2 percent slope downward in direction of flow.
    3. Vent Piping: 1 percent slope> down toward vertical fixture vent or toward vent stack.
N. Install cast-iron soil piping according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook," Chapter IV, "Installation of Cast Iron Soil Pipe and Fittings."
    1. Install encasement on underground piping according to ASTM A 674 or AWWA C105/A 21.5.
O. Install aboveground PVC piping according to ASTM D 2665.
P. Install underground PVC piping according to ASTM D 2321.
Q. Install engineered soil and waste drainage and vent piping systems as follows:
    1. Combination Waste and Vent: Comply with standards of authorities having jurisdiction
R. Plumbing Specialties:
    1. Install backwater valves in sanitary waster gravity-flow piping. Comply with requirements for backwater valves specified in Section 221319 "Sanitary Waste Piping Specialties."
    2. Install cleanouts at grade and extend to where building sanitary drains connect to building sanitary sewers in sanitary drainage gravity-flow piping. Install cleanout fitting with closure plug inside the building in sanitary drainage force-main piping. Comply with requirements for cleanouts specified in Section 221319 "Sanitary Waste Piping Specialties."
    3. Install drains in sanitary drainage gravity-flow piping. Comply with requirements for drains specified in Section 221319 "Sanitary Waste Piping Specialties."
S. Do not enclose, cover, or put piping into operation until it is inspected and approved by authorities having jurisdiction.
T. Install sleeves for piping penetrations of walls, ceilings and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."
U. Install sleeve seals for piping penetrations of concrete walls and slabs. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

V. Install escutcheons for piping penetrations pf walls, ceilings and floors. Comply with requirements for sleeves specified in Section 220517 "Sleeves and Sleeve Seals for Plumbing Piping."

3.3 JOINT CONSTRUCTION

A. Join hub-and-spigot, cast-iron soil piping with gasket joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for compression joints.
B. Join hub-and-spigot, cast-iron soil piping with calked joints according to CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for lead-and-oakum calked joints.
C. Join hubless, cast-iron soil piping according to CISPI's 310 and CISPI's "Cast Iron Soil Pipe and Fittings Handbook" for hubless-piping coupling joints.
D. Plastic, No pressure-Piping, Solvent-Cement Joints: Clean and dry joining surface. Join Pipe and fittings according to the following:
    1. Comply with ASTM 402 for safe-handling practice of cleaners, primers, and solvent cements.
    2. PVC Piping: Join according to ASTM D 2855 and ASTM D 2665 Appendixes.

3.4 SPECIALTY PIPE FITTING INSTALLATION

A. Transition Couplings:
    1. Install transition couplings at joints of piping with small differences in OD's.
    2. In Drainage Piping: Shielded, no pressure transition couplings.
    3. In Aboveground Force Main Piping: Fitting-type transition couplings.
    4. In Underground Force Main Piping:
        a. NPS 1-1/2 (DN 40) and Smaller: Fitting-type transition couplings.
        b. NPS 2 (DN 50) and Larger: Pressure transition couplings.

3.5 VALVE INSTALLATION

A. General valve installation requirements are specified in Section 220523 "General-Duty Valves for Plumbing Piping."
B. Shutoff Valves:
    1. Install shutoff valve on each sewage pump discharge.
    2. Install gate or full-port ball valve for piping NPS 2 (DN 50) and smaller.
    3. Install gate valve for piping NPS 2-1/2 (DN 65) and larger.
C. Check Valves: Install swing check valve, between pump and shutoff valve, on each sewage pump discharge.
D. Backwater Valves: Install backwater valves in piping subject to backflow.
    1. Horizontal Piping: Horizontal backwater valves. Use normally closed type unless otherwise indicated.
    2. Floor Drains: Drain outlet backwater valves unless drain ha integral backwater valve.
    3. Install backwater valves in accessible locations.
    4. Comply with requirements for backwater valve specified in Section 221319 "Sanitary Waste Piping Specialties."

3.6 HANGER AND SUPPORT INSTALLATION

A. Comply with requirements for seismic-restraint devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and equipment."
B. Comply with requirements for pipe hanger and support devices and installation specified in Section 220529 "Hangers and Supports for Plumbing Piping and Equipment."
    1. Install carbon-steel pipe hangers for horizontal piping in noncorrosive environments.

2. Install stain-steel pipe hangers for horizontal piping in corrosive environments.
3. Install carbon-steel pipe support clamps for vertical piping in noncorrosive environments.
4. Install stainless-steel pipe support clamps for vertical piping in corrosive environments.
5. Vertical Piping: MSS Type 8 or Type 42, clamps.
6. Install individual, straight, horizontal piping runs.
   a. 100 Feet (30 m) and Less: MSS Type 1, adjustable, steel clevis hangers.
   b. Longer than 100 feet (30 m): MSS Type 43, adjustable roller hangers.
   c. Longer than 100 Feet (30 m) if indicated: MSS Type n49, spring cushion rolls.
7. Multiple, Straight, Horizontal Piping Runs 100 feet (30 m) or Longer: MSS Type 44, pipe rolls. Support pipe rolls on trapeze.
8. Base Vertical Piping: MSS Type 52, spring hangers.

C. Support horizontal piping and tubing within 12 inches (300 mm) of each fitting, valve, and coupling.
D. Support vertical piping and tubing at base and at each floor.
E. Rod diameter may reduce on size for double-rod hangers, with 3/8-inch (10-mm) minimum rods.
F. Install hangers for cast-iron soil piping with the following maximum horizontal spacing and minimum rod diameters:
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 60 inches (1500 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 60 inches (1500 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 60 inches (1500 mm) with 5/8 inch (16-mm) rod.
   4. NPS 6 and NPS 8 (DN 150 and DN 200): 60 inches (1500 mm) with 3/4 inch (19-mm) rod.
   5. NPS 10 and NPS 12 (DN 250 and DN 300): 60 inches (1500 mm) with 7/8 inch (22-mm) rod.
   6. Spacing for 10-foot (3-m) lengths may be increase to 10 feet (3 m). Spacing for fittings is limited to 60 inches (1500 mm).
G. Install supports for vertical cast-iron soil piping every 15 feet (4.5 m).
H. Install hangers for [ABS] [and] [PVC] piping with the following maximum horizontal spacing and minimum rod diameters.
   1. NPS 1-1/2 and NPS 2 (DN 40 and DN 50): 48 inches (1200 mm) with 3/8-inch (10-mm) rod.
   2. NPS 3 (DN 80): 48 inches (1200 mm) with 1/2-inch (13-mm) rod.
   3. NPS 4 and NPS 5 (DN 100 and DN 125): 48 inches (1200 mm) with 5/8-inch (16-mm) rod.
   4. NPS 6 and NPS 8 (DN 150 and DN 200): 48 inches (1200 mm) with 3/4 inch (19-mm) rod.
   5. NPS 10 and NPS 12 (DN 250 and DN 300): 40 inches (1200 mm) with 7/8 inch (22-mm) rod.
I. Install supports for vertical PVC piping every 48 inches (1200 mm).
J. support piping and tubing not listed in above according to MSS SP-69 and manufacturer's written instructions.

3.7 CONNECTIONS

A. Drawings indicate general arrangement of piping, fittings, and specialties.
B. Connect soil and waste piping to exterior sanitary sewage piping. Use transition fitting to join dissimilar piping materials.
C. Connect drainage and vent piping to the following:
   1. Plumbing Fixtures: Connect drainage piping sizes indicated, but not smaller than required by plumbing code.
   2. Plumbing Fixtures and Equipment: Connect atmospheric vent piping in sizes indicated, but not smaller than required by authorities having jurisdiction.
   3. Plumbing Specialties: Connect drainage and vent piping in sizes indicated, but not smaller than required by code.
   4. Install test tees (wall cleanouts) in conductors near floor and floor cleanouts with cover flush with floor.
   5. Install horizontal backwater valves in pit with pit cover flush with floor.

6. Comply with requirements for backwater valves, cleanouts and drains specified in Section 221319 "Sanitary Piping Specialties."
7. Equipment: Connect drainage piping as indicated. Provide shutoff valve if indicated and union for each connection. Use flanges instead of unions for connections NPS 2-1/2 (DN 65) and larger.

D. Where installing piping adjacent to equipment, allow space for service and maintenance of equipment.

E. Make connections according to the following unless otherwise indicated:
1. Install unions, in piping NPS 2 (DN 50) and smaller, adjacent to each valve and at final connection to piece of equipment.
2. Install flanges, in piping NPS 2-1/2 (DN 65) and larger, adjacent to flanged valves and final connection to each piece of equipment.

3.8 IDENTIFICATION

A. Identify exposed sanitary waste and vent piping. Comply with requirements for identification specified in Section 220553 "Identification for Plumbing Piping and Equipment."

3.9 FIELD QUALITY CONTROL

A. During installation, notify authorities having jurisdiction at least 24 hours before inspection must be made. Perform tests specified below in presence of authorities having jurisdiction.
1. Roughing-in Inspection: Arrange for inspection of piping before concealing or closing-in after roughing-in and before setting fixtures.
2. Final Inspection: Arrange for final inspection by authorities having jurisdiction to observe tests specified below and to ensure compliance with requirements.

B. Reinspection: If authorities having jurisdiction find that piping will not pass test or inspection, make required corrections and arrange for inspection.

C. Reports: Prepare inspection reports and have them signed by authorities having jurisdiction.

D. Test sanitary drainage and vent piping according to procedures of authorities having jurisdiction or, in absence of published procedures, as follows:
1. Test for leaks and defects in new piping and parts of existing piping that have been altered, extended, or repaired. If testing is performed in segments, submit separate report for each test, complete with diagram of portion of piping tested.
2. Leave uncovered and unconcealed new, altered, extended, or replaced drainage and vent piping until it has been tested and approved. Expose work that was covered or concealed before it was tested.
3. Roughing-in Plumbing Test Procedure: Test drainage and vent piping except outside leaders on completion of roughing-in. Close openings in piping system and fill with water to point of overflow, but not less than 10-foot head of water (30 kPa). From 15 minutes before inspection starts to completion of inspection, water level must not drop. Inspect joints for leaks.
4. Finished Plumbing Test Procedure: after plumbing fixtures have been set and traps filled with water, test connections and prove they are gastight and watertight. Plug vent-stack openings on roof and building drains where they leave building. Introduce air into piping system equal to pressure of 1-inch wg (250 Pa). Use U-Tube or manometer inserted in trap of water closet to measure this pressure. Air pressure must remain constant without introducing additional air throughout period of inspection. Inspect plumbing fixture connections for gas and water leaks.
5. Repair leaks and defects with new materials and retest piping, or portion thereof, until satisfactory results are obtained.

6. Prepare reports for tests and required corrective action.

3.10 CLEANING AND PROTECTION

A. Clean interior of piping: Remove dirt and debris as work progresses.
B. Protect drains during remainder of construction period to avoid clogging with dirt and debris and to prevent damage from traffic and construction work.
C. Place plugs in ends of uncompleted piping at the end of the day and when work stops.
D. Exposed PVC Piping: Protect plumbing vents exposed to sunlight with two coats of water-based latex paint.

3.11 PIPIND SCHEDULE

A. Flanges and unions may be used on aboveground pressure piping unless otherwise indicated.
B. Aboveground, soil and waste piping NPS 4 (DN 100) and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings, CISPI heavy-duty hubless-piping couplings; and coupled joints.
   3. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
C. Aboveground, soil and waste piping NPS 5 (DN 125) and Larger shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings, CISPI heavy-duty hubless-piping couplings; and coupled joints.
   3. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
D. Aboveground, vent piping NPS 4 (DN 100) and smaller shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings, CISPI hubless-piping couplings; and coupled joints.
   3. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
E. Aboveground, vent piping NPS 5 (DN 125) and Larger shall be any of the following:
   1. Service class, cast-iron soil pipe and fittings; gaskets; and gasketed joints.
   2. Hubless, cast-iron soil pipe and fittings, CISPI hubless-piping couplings; and coupled joints.
   3. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
F. Underground, soil, waste and vent piping NPS 4 (DN 100) and smaller shall be any of the following:
   1. Extra Heavy class, cast-iron soil piping; gaskets; and gasketed calking materials; and calked joints.
   2. Hubless, cast-iron soil pipe and fittings, heavy-duty hubless-piping couplings; and coupled joints.
   3. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.
G. Underground, soil and waste piping NPS 5 (DN 125) and Larger shall be any of the following:
   1. Extra Heavy class, cast-iron soil piping; calking materials; and calked joints.
   2. Hubless, cast-iron soil pipe and fittings, heavy-duty hubless-piping couplings; and coupled joints.
   3. Solid-wall or Cellular-core PVC pipe, PVC socket fittings, and solvent-cemented joints.
   4. Dissimilar Pipe-Material Couplings: Shielded, non-pressure transition couplings.

COMMON MOTOR REQUIREMENTS FOR PLUMBING EQUIPMENT

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Divisions 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section includes general requirements for single-phase and polyphaser, general-purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment5 manufacturer for field installation.

1.3 COORDINATION

A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
1. Motor controllers.
2. Torque, speed, and horsepower requirements of the load.
3. Ratings and characteristics of supply circuit and required control sequence.
4. Ambient and environmental conditions of installation location.

PART 2- PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS
A. Comply with NEMA MG 1 unless otherwise indicated
B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS
A. Duty: Continuous duty at ambient temperature of 40 deg C at altitude of 3300 feet (1000 m) above sea level.
B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

A. Description: NEMA MG 1, Design B, medium induction motor.

B. Efficiency: Energy efficient, as defined in NEMA MG 1

C. Service Factor: 1.5.

D. Multispeed Motors: Variable torque.

1. For motors with 2:1 speed ratio, consequent pole, single winding.
2. For motors with other than 2:1 speed ratio, separate winding for each speed.

E. Multispeed Motors: Separate winding for each speed

F. Rotor: Random-wound, squirrel cage.

G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.

H. Temperature Rise: Match insulation rating.

I. Insulation: Class F.

J. Code Letter Designation:
   1. Motors 15 HP and Larger: NEMA starting Code F or Code G.
   2. Motors Smaller than 15 HP: Manufacturer's standard starting characteristics.

K. Enclosure Material: Cast iron for motor frame sizes 324T and larger: rolled steel for motor frame sizes smaller than 324T.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

A. Motors Used with Reduced-Voltage and Multispeed Controllers: Match wiring connection requirements for controller with required motor leads. Provide terminals in motor terminal box, suited to control method.

B. Motors Used with Variables Frequency Controllers: Ratings, characteristics, and features coordinated with and approved by controller manufacturer.
   1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
   2. Energy- and Premium-Efficient Motors: Class B temperature rise, Class F insulation.
   3. Inverter-Duty Motors: Class F temperature rise, Class H insulation.
   4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

C. Severe-Duty Motors: Comply with IEEE 841, with 1.15 minimum service factor.

2.5 SINGLE-PHASE MOTORS

A. Motors larger than 1/20 HP shall be one of the following, to suit starting torque and requirements of specific motor application:
   1. Permanent-split capacitor.
   2. Split phase.
   3. Capacitor start, inductor run.
   4. Capacitor start, capacitor run.

B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.

C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.

D. Motors 1/20 HP and smaller: Shaded-pole type.

E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation.

Thermal-protection device shall automatically reset when motor temperature returns to normal range.

WATER PUMPS

PART 1 – GENERAL

1.1 RELATED DOCUMENTS

A. Drawing and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

A. Section Includes:
   1. Horizontally mounted, in-line, close-coupled centrifugal pumps.
   2. Vertically mounted, in-line, close-coupled centrifugal pumps.
B. Related Sections include the following:
   1. Section 221123. 12 "Domestic-Water Packaged Booster Pumps" for booster systems.

1.3 DEFINITIONS

A. Low Voltage: As defined in NFPA 70 for circuits and equipment operating at less than 50 V or for remote-control, signaling power-limited circuits.

1.4 ACTION SUBMITTALS

A. Product Data: For each type of product indicated. Include materials of construction, rated capacities, certified performance curves with operating points plotted on curves, operating characteristics, electrical characteristics, and furnished specialties and accessories.
B. LEED Submittals:
   1. Product Data for Prerequisite EA 2: Documentation indicating that units comply with applicable requirements in ASHRAE/IESNA 90.1, without amendments, Section 7 – "Service Water Heating."

1.5 CLOSEOUT SUBMITTALS

A. Operation and Maintenance Data: For domestic pumps to include in operation and maintenance manuals.

1.6 QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.
B. UL Compliance: Comply with UL 778 for motor-operated water pumps.

1.7 DELIVERY, STORAGE, AND HANDLING

A. Retain shipping flange protective covers and protective coatings during storage.
B. Protect bearings and couplings against damage.
C. Comply with pump manufacturer's written rigging instructions for handling.

1.8 COORDINATION

A. Coordinate sizes and locations of concrete bases with actual equipment provided.

PART 2 – PRODUCTS

2.1 VERTICALLY MOUNTED, IN-LINE, CLOSE-COUPLED CENTRIFUGAL CONSTANT PRESSURE SYSTEM BOOSTER PUMPS

A. Manufacturers: Subject to compliance with requirements.
B. Description: Factory-assembled and –tested, in-line, single-stage, close-coupled, overhung-impeller centrifugal pumps designed for installation with pump and motor shaft mounted vertical.
C. Pump Construction:
   1. Casing: Radially split, cast iron, with wear rings and threaded companion-flange connections for pumps with NPS 2 (DN 50) pipe connections and flanged connections for pumps with NPS 2-1/2 (DN 65) pipe connections. Include pump manufacturer's base attachment for mounting pump on concrete base.
   2. Impeller: Statically and dynamically balanced, closed, and keyed to shaft.
   3. Shaft and Shaft Sleeve: Stainless-Steel shaft, with copper-alloy shaft sleeve.
   4. Seal: Mechanical, with carbon-steel rotating ring, stainless-steel spring, ceramic seat, and rubber bellows and gaskets. Include water slinger on shaft between motor and seal.
   5. Bearings: Oil-lubricated; bronze-journal or ball type.
   6. Shaft Coupling: Flexible or rigid type if pump is provided with coupling.

D. Motor: Single speed, with grease-lubricated ball bearings; and rigidly mounted to pump casing.

E. Capacities and Characteristics
   1Set – Duplex Type CPS Booster Pumps.
   1. Capacity: 90 GPM
   2. Total Dynamic Head: 138.6 Ft.
   3. Casing Material: Cast iron.
   4. Impeller Material: ASTM B 584, cast bronze or stainless steel.
   5. Pressure Setting: 60 psig
   6. Maximum Continuous Operating Temperature: 225 deg F (107 deg C).
   7. Inlet and Outlet Size: 100mm
   8. Pump Control: Pressure switch.
   9. Pump speed: 1760
   10. Motor Horsepower: Approx. 5.0hp, Each
   11. Electrical Characteristics:
      a. Volts: 240.
      b. Phase: Three.
      c. Hertz: 60.
      d. Full-Load Amperes: See Electrical Specs .
      e. Minimum Circuit Ampacity: See Electrical Specs.
      f. Maximum Overcurrent Protection: See Electrical Specs.

2.2 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Section 220513 "Common Motor Requirements for Plumbing Equipment."
   1. Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

2.3 CONTROLS

A. Pressure Switches: Electric, adjustable for control of water-supply pump.
   1. Type: Water-immersion pressure sensor, for installation in piping.
   2. Enclosure: NEMA 250, Type 4X.
   3. Operation of Pump: On or off.
   4. Transformer: Provide if required.
   5. Power Requirement: 120 V, ac.
   6. Settings: Star pump at 20 psi and stop pump at 70 psi.

B. Time-Delay Relays: Electric, for control of hot-water circulation pump between water heater and connected hot-water storage tank.
   1. Type: Adjustable time-delay relay.
   2. Range: Up to five minutes.
   3. Setting: Five minutes.
   4. Enclosure: NEMA 250, Type 4X.
   5. Operation of Pump: On or off.
   6. Transformer: Provide if required.
   7. Power Requirement: 120-V ac.
   8. Programmable Sequence of Operation: Limit pump operation to periods of burner operation plus maximum five minutes after the burner stops.

PART 3 – EXECUTION

3.1 EXAMINATION

A. Examine roughing-in of domestic-water-piping system to verify actual locations of connections before pump installation.

3.2 PUMP INSTALLATION

A. Comply with HI 1.4.
B. Install in-line, seal less centrifugal pumps with shaft horizontal unless otherwise indicated.
C. Install horizontally mounted, in-line [separately coupled] [and] [close-coupled] centrifugal pumps with shaft(s) horizontal.
D. Install vertically mounted, in-line, close-coupled centrifugal pumps with shaft(s) vertical.
E. Pump Mounting: Install vertically mounted, in line, close-coupled centrifugal pumps with cast-iron base mounted on concrete base using [elastomeric pads] [elastomeric mounts] [restrained spring isolators] <Insert device>. Comply with requirements for concrete base specified in [Section 033000 "Cast-in-Place Concrete."] [Section 033053 "Miscellaneous Cast-in-Place-Concrete."]
   1. Minimum Deflection: [1/4 inch (6mm)] [1 inch (25 mm)] <Insert Dimension>.
   2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
   3. For Supported equipment, install epoxy-coated anchor bolts that extend through concrete base and anchor into structural concrete floor.
   4. Place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

5. Install anchor bolts to elevations required for proper attachment to supported equipment.

F. Install continuous-thread hanger rods and [spring hangers] [spring hangers with vertical-limit stop] of size required to support pump weight.
   1. Comply with requirements for vibration isolation devices specified in Section 220548 "Vibration and Seismic Controls for Plumbing Piping and Equipment." Fabricate brackets or supports as required.
   2. Comply with requirements for hangers and supports specified in Section 220529 "Hangers and Supports for plumbing Piping and Equipment."

G. Install pressure switches in water supply piping.

H. Install thermostats in hot-water return piping.

I. Install timers [on wall in engineer's office] <insert location>.

J. Install time-delay relays in piping between water heaters and hot-water storage tanks.

3.3 CONNECTIONS

A. Comply with requirements for piping specified in Section 221116 "Domestic Water Piping." Drawings indicate general arrangement of piping, fitting and specialties.

B. Install piping adjacent to pumps to allow service and maintenance.

C. Connect domestic water piping to pumps. Install suction and discharge piping equal to or greater than size of pump nozzles.
   1. Install flexible connectors adjacent to pumps in suction and discharge piping of the following pumps:
      a. Horizontally mounted, in-line, separately coupled centrifugal pumps.
      b. Horizontally mounted, in-line, close-coupled centrifugal pumps.
      c. Vertically mounted, in-line, close-coupled centrifugal pumps.
      d. Comply with requirements for flexible connectors specified in Section 221116 "Domestic Water Piping."
   2. Install shutoff valve and strainer on suction side of each pump, and check, shutoff, and throttling valves on discharge side of each pump. Install valves same size as connected piping. Comply with requirements for valves specified in Section 220523 "General-Duty Valves for Plumbing Piping" and comply with requirements for strainers specified in Section 221119 "Domestic Water Piping Specialties."
   3. Install pressure gage [and snubber] at suction of each pump and pressure gage [and snubber] at discharge of each pump. Install at integral pressure-gage tapping where provided or install pressure-gage connectors in suction and discharge piping around pumps. Comply with requirements for pressure gages and snubbers specified in Section 220519 "Meters and Gages for Plumbing Piping."

D. Connect [pressure switched,] [thermostats,] {time-delay relays,} [and] [timers] to pumps that they control.

E. Interlock pump between water heater and hot-water storage tank with water heater burner and time-delay relay.

3.4 IDENTIFICATION

A. Comply with requirements for identification specified in Section 220553 "Identification for

B. Plumbing Piping and Equipment" for identification of pumps.

3.5 STARTUP SERVICE

A. [Engage a factory-authorized service representative to perform] [Perform] startup service.
   1. Complete installation and startup checks according to manufacturer's written instruction

2. Check piping connections for tightness.
3. Clean strainers on suction piping.
4. Set [pressure switches,] [timers,] [and] [time-delay relays] for automatic starting and stopping operation of pumps.
5. Perform the following startup checks for each pump before starting:
   a. Verify bearing lubrication.
   b. Verify that pump is free to rotate by hand and that pump for handling hot liquid is free to rotate with pump hot and cold. If pump is bound or drags, do not operate until cause of trouble is determined and corrected.
   c. Verify that pump is rotating in the correct direction.
6. Prime pump by opening suction valves and closing drains, and prepare pump for operation.
7. Start motor.
8. Open discharge valve slowly.
9. Adjust temperature settings on thermostats.
10. Adjust timer settings.

3.6 ADJUSTING

A. Adjust domestic water pumps to function smoothly, and lubricate as recommended by manufacturer.
B. Adjust initial temperature set points.
C. Set field-adjustable switches and circuit-breaker trip ranges as indicated.

XXIII. ELECTRICAL WORKS

A. Scope of Work

1. The work of the contractor consists of furnishing of all tools, labor, equipment, and materials and performing all operations in connection with the electrical system shown on the drawing, their test and inspection, complete and in accordance with these specifications and drawings and subject to the terms and conditions of the contract, and all other labor and materials not specifically mentioned under sections, to bring the electrical system of **"CONSTRUCTION OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK (AMORAP)"** located at **Libertad Bago, Sinacaban, Misamis Occidental** to operating conditions and be ready for use by the Owner.

B. Applicable Documents

1. The works covered by these specifications shall be governed by the requirements of the Philippine Electrical Code, US Federal Specifications, NEMA standards.

C. Materials

1. Rigid steel conduit shall be hot-dipped galvanized mild steel pipe and shall 3m lengths including coupling.

2. PVC electrical conduit shall be supplied in standard effective lengths of 3.0m.

3. Wires and cables shall be insulated for 600 volts. Feeder and branch circuit wires and cables shall be type THHN, THWN, TW as specified on plans and as manufactured by a reputable company.

4. Conduits fittings shall be US Underwriters Laboratories (UL) listed or approved local equivalent.

5. Outlet boxes shall be hot-dipped galvanized or case metal as required. Thickness of pressed steep boxes shall not be less than gauge #16.

6. Circuit breakers for panel boards shall be molded case circuit breaker with quick-made, quick-break, trip-free mechanisms. They shall meet US Federal Specifications and NEMA standard.

7. Panel board shall be bolt-on type as manufactured by NEMA or approved equal.

8. Wiring devices such as switches and convenience outlets shall have ratings of 15 amperes, 250V and 16 amperes, 250V, respectively.

D. Installation

1. Grounding

The following shall be grounded in accordance with the drawings and the requirements of the Philippine Electrical Code with standards grouping practices:

Metallic conduit and raceway system including gutters, cabinets and boxes.

Non-current carrying metal parts of all electrical equipment including fixtures and motors.

2. Feeders

Distribution voltage shall be 230V, 1-phase, 3-wire feeder conductors and conduit shall be installed as shown on the drawing and no change in size shall be made without consent of the Owner. Feeder conductors shall be continuous and without splices between terminals.

3. Branch Circuit

The drawing indicates the general methods of installations of all circuit wiring and the outlet which are to be supplied from this circuit. Branch circuit conduits shall be run from outlets to panel boards as directed and as the building conditions will allow. Circuit allocations shall be as indicated on the drawings, where it becomes necessary to correct any outlet to circuit other than shown on the drawings, this shall be done without extra charge and only upon written consent of the Owner. No wire smaller than $3.5mm^2$ and $14.0mm^2$ shall be used for any lighting and power circuits, respectively.

4. Panel boards and cabinets

Panel boards shall be mounted with their centers at 1.40m above the floor unless otherwise indicated by field conditions.

5. Locations of outlets and switches

The approximate location of each fixture receptacle, special purpose outlet and switch is indicated on the drawings. The exact location is to be determined later at the site as the work progresses.

6. Wires and boxes

No wire shall be drawn into the raceway until works, which may cause injury to the wires, is completed and until permission is given by the Owner in writing. Only powdered lubricant not injurious to cable insulation and raceways shall be used only when lubrication is necessary.

7. Splices

Branch circuit splices shall be soldered or joined by used insulated splicing device (wire nuts). All soldered joints shall be made mechanically strong before soldering and shall be carefully soldered without the use of acid, then taped with rubber tape to a thickness equal to that of the insulation and with a covering of friction tape of two layer. . Where solid conductors are to be connected directly to devices without the use of lugs, such as lighting switches and plug receptacles, the wires shall be formed into a clockwise loop fitted around the screws.

8. Outlets, switches and junction boxes

The Contractor shall install standard boxes at all outlets for lights, appliances and switches and other point as required by the constructions.

9. Conduit System

Not more than four 90 degrees bend shall occur in any run. When it becomes necessary to have more than four 90 degrees bends in any run, an intermediate pull box shall be installed to facilitate pull-in wires. All conduits run shall be as called for on the drawings. Conduits shall be installed in such manner as not to weaken or interfere with the structure or the building. No horizontal runs embedded conduit shall be permitted in solid wall and partitions. Conduits below grade line shall be encased in concrete enveloped with minimum thickness of 50mm (2") or embedded in floor slab. Exposed conduit shall run parallel or at right angles with lines of the buildings and shall be securely fastened in place by means of approved fastening. Conduits support shall be fastened to walls by means of screws or bolts with expansion sleeves. The use of wooden or lead plug is not permitted. Conduits shall be cut by hacksaw, the ends shall be reamed after being firmly attached to cabinets or boxes by means of locknuts.

10. Lighting Fixtures

The Contractor shall furnish and install all lighting fixture as indicated on the drawings, including mounting channels and supports.

11. Testing

a. Ground test

The entire installation shall be free from improper ground and from short circuits. Each panel shall be tested with means connected. Lamps removed or omitted from the sockets and all switches closed. Each individual power equipment shall be connected for proper and intended operation. In no case shall the resistance be less than that allowed

by the Regulations for electrical equipment of building. Failures shall be corrected in any manner satisfactory to the Architect and Engineer.

b. Performance test

The electrical contractor shall test all system of entire electrical installation for proper operational conditions. These conditions shall apply to the power and lighting installation, voltage drop, grounding defects.

12. Warranty

1. The Contractor warrants that the Goods supplied under the Contract are new, unused, made of the most recent or current models and incorporated all recent improvements in the design and materials.
2. The Contractor further warrants that all Goods supplied under the Contract shall have no defects, arising from the design of luminaires, materials or workmanship or from any act or omission of the Contractor that may develop under normal use of the supplied Goods in the conditions prevailing in the country of final destination.
3. The Contractor shall bear all materials, transportations and engineering costs as well as other charges that may be incurred in connection with the defects in the design, materials and workmanship appearing within the warranty period.
4. The supplies delivered are free from patent and latent defects and all condition under this Contract have been fully met.
5. In order to assure that the manufacturing defects shall be corrected by the Contractor, a warranty shall be required from the Contractor for a minimum period of five (5) years for all lighting equipment's.
6. The lamp depreciation must be kept to its original illumination level within its warranty period. If the lamp illumination depreciation found to be below 50% of its original illumination level, it should be replaced immediately by the Contractor without any cost to the client or TIEZA.

XXIV. MECHANICAL WORKS

AIR CONDITIONING AND REFRIGERATION SYSTEM

Description

This item shall consist of furnishing and installation of air conditioning, refrigeration and ventilation systems, inclusive of necessary electrical connections, ductworks, grilles, pipes and condensate drains and all other necessary accessories, ready for service in accordance with the Plans and Specifications.

Material Requirements

The types, sizes, capacities, quantities and power characteristics of the compressor, evaporator,

condenser chilled water pump and condenser water pump shall be as specified or as shown on the Plans.

Refrigerant Pipes

Refrigerant pipes shall be copper tubing, type Lor K or black steel pipe, Schedule 40 lor size of 100 mm diameter and smaller. Pipes over 100 mm shall be black steel pipe Schedule 40. Black steel pipe shall be standard seamless, lap-welded, or electric resistant welded for size 50 mm diameter and larger, screw type for size 38 mm diameter and smaller, fittings for copper tubing shall be cast bronze fitting designed expressly for brazing.

Pipes for Cooling Water

Chilled and condenser cooling water pipes shall be black steel pipe, Schedule 40. Pipes and fittings for size 50 mm diameter and smaller shall be screwed type. Pipes and fittings for size 62 mm diameter and larger shall be welded or flanged type.

Pipe Insulations

Insulations shall be preformed fiberglass or its equivalent.

The insulating materials shall be covered with 100 mm x .13 mm thick polyethylene film which shall be overlapped not less than 50 mm. Pipe insulations shall be adequately protected at point of support by means of ' suitable metal shield to avoid damage from compression. Insulated pipes, valves and fittings located outdoors shall be provided with metal jackets.

AUTOMATIC WATER SPRINKLER SYSTEM

Description

This Item shall consist of furnishing and installation of Automatic Water sprinkler System, inclusive of all pipings and pipe fittings connections, valves, controls, electrical wiring connection and all other accessories ready for service in accordance with the Plans and Specifications.

Material Requirements

Fire Pump

The type, size, capacity and quantity and power characteristics shall be specified or as shown on the plans.

The fire pump shall be diesel engine driven and capable of delivering a minimum of residual pressure of 103 kPa at the top-most and remotest sprinkler. The pump unit shall be supplied with relief valve, gate valve, suction gauge and discharge, pressure gauge.

The diesel engine shall be designed specifically intended for an automatic water sprinkler protection system. A drop in system pressure due to the operation of one sprinkler pressure shall be triggered a series of automatic operations that will result in the instantaneous operation of the engine to drive the fire pump with the aid of a battery automatic controller. The required accessories are: tachnometer, oil pressure gauge, temperature gauge and control panel. A diesel fuel day tank shall be provided to supply the engine for a minimum of two (2) hours running time.

A fuel storage tank shall be asphalt coated with necessary pipings and fittings for connection.

Jockey Pump

Jockey pump shall be electric motor driven, 220V, 3-phase, 60 hertz, power connection. The capacity to be supplied shall not be less than that indicated on the Plans. Sprinkler

Head

a) Type-spray unit, pendant and upright unit
b) Flow capacity, 83 LPM per head
c) Pressure rating
1) Residual pressure – 103 kPa minimum
2) Maximum pressure – 1035 kPa
d) Temperature rating – fusing at 57.5 C to 74 C
e) Finish – chrome – pendant – chrome or brass upright
f) Pipe Thread – 13mm nominal
g) Stock of extra heads and tools required
   1) Pendant and upright – 6 pcs. For 300 sprinkler, 12 pcs. for 300 to 1000 sprinkler, 24 pcs. for 1000 sprinkler above.
   2) Sprinkler tongs – 2 pcs.
   3) Sprinkler wrench – 2 pcs.

Alarm Check Valve and Fire Alarm System

a) The alarm assembly shall be constructed and installed that any flow of water from the sprinkler system equal to or greater than that from the single automatic head shall result in an audible and visual signed in the vicinity of the building.
b) The alarm apparatus shall be substantially supported and so located and installed that all parts shall be readily accessible for inspection, removal and repair.
c) The actual waterflow, through the use of a test connection, shall be employed to test the operation of the sprinkler alarm units as a whole.
d) An approved identification sign shall be installed near the outdoor alarm device in a conspicuous positions.

"Sprinkler Fire Alarm" when bell rings call Fire Department and Police Alarm and

Supervisory System

The alarm and supervisory system of the automatic water sprinkler shall include ythe monitoring of the following:

a) Waterflow switch at each floor of the building.
b) Fire pump and jockey pump running condition and power supplies.
c) Level of water in the reservoir
d) Control Valves

The water flow switches on each floor of the building shall be connected to the fire alarm system and annunciator in such a manner that the operation of any sprinkler system will activate the fire alarm system, with the location of the operating waterflow switch simultaneously indicated in the annunciator panel.

Pipes and Fittings

Pipes shall be B.I. Schedule 40. Screw fittings shall be used for inside piping. Welding and torch cutting shall not be permitted. Piping shall be painted with red enamel paint.

Siamese Twin

The siamese twin shall be 64 mm x 64 mm x 102 mm, 90 C female coupling cap and joint lug.

Pipe Hangers

Pipe hangers shall be steel bars, 3 mm minimum thickness, with corrosion protection.

a) Anchorage in concrete - expansion shield should preferably be used in a horizontal position in the sides of concrete beams.
b) Expansion shield in vertical position. When pipes 102 mm and larger are supported entirely by expansion shield in the vertical position, the supports shall be spaced not more than 3 m apart.
c) For pipe running through concrete beams use sleeves at least two (2) sizes larger than the piping.

Foundation Refer to sub-section, Air Conditioning System, Electrical Work Refer to sub-

section, Air Conditioning System, Construction Requirements

Acceptance Tests

System operation and maintenance chart shall be submitted to the Owner upon completion of the Contract. This shall include the locations of control valves and care of the new equipment.

Marked instructions and identification sign boards: These sign boards shall be made of #14 gauge B.1. sheet with baked enamel finish paint and letter instructions are shown on the Plans. Additional sign boards as may be required and riot specifie8 herewith shall be furnished at no extra cost.Sign boards shall be mounted on the equipment or wall nearest the equipment for easy identification and reading. Paints shall be basically gloss fire red and white.

A. Conduct of Tests - shall be by the Sprinkler System Contractor in the presence of an inspector or Authority having jurisdiction.
B. Flushing of Underground Connections - To remove foreign materials which may have entered. the piping during installation of same as required before sprinkler piping is connected.
C. Hydrostatic Test·

1. The Pressure - All systems, including piping shall be tested hydrostatically at not less than 1378 kPa pressure for two (2) hours, or at 344.5 kPa in excess of the maximum static pressure when the maximum static pressure is in excess of 1033.5 kPa. .
2. Operating Test - All control valves shall be fully closed and opened under water pressure to insure proper operation. Use clean, non-corrosive water.
3. Fire Department Connection - Piping between the check valve in the fire department inlet pipe and the outside connection shall be tested the same as the balance of the system.

D. Tests of Drainage Facilities - Tests of drainage facilities shall be made while the control valve is wide open. The main drain valve shall be opened and remain open until the system pressure stabilizes.
E. Test Certificate - Upon completion of work, inspection and tests made by the contractor's representative and witnessed by an owner's representative, a test certificate shall be filled out and signed by both representative.

Maintenance Service

a) The contractor shall provide free of charge, maintenance seNice of the system for a period of at least one (1) year reckoned from the date of acceptance of the work by the Engineer.
b) Upon completion of the work and all tests, the services of one or more qualified engineers shall be provided by the contractor for a period of not less than five (5) working days to instruct and train the representative of the owner in the operation and maintenance of the fire protection system.

Guarantee & Service Refer to sub-section, Air Conditioning System, Miscellaneous Refer

to sub-section, Air Conditioning System Method of Measurement

The work under this Item shall be measured either by set, piece, length actually placed and installed as indicated on the Plans. Fire pump and jockey pump shall be measured by set, sprinkler heads, valves and fittings by piece, pipes by length.

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

Prepared By:

RUSSELL U. SORIANO
Sr. PPDO

ENGR. JERRY S. ESPINA
Electrical – Designer/Estimator

ENGR. JUNELL IAN MEDINO
Sanitary – Designer/Estimator

ENGR. JOHN ARNIE PASTRANA
Mechanical – Designer/Estimator

Checked By:

ENGR. NOEL F. YAMBAO
Manager, PMD

Noted By:

ENGR. JEOFFREY L. MACALALAD
Manager, PEPD

Section VII. Drawings

[Insert here a list of Drawings. The actual Drawings, including site plans, should be attached to this section, or annexed in a separate folder.]

Section VIII. Bill of Quantities

Notes on the Bill of Quantities

Objectives

The objectives of the Bill of Quantities are:

a. to provide sufficient information on the quantities of Works to be performed to enable Bids to be prepared efficiently and accurately; and

b. when a Contract has been entered into, to provide a priced Bill of Quantities for use in the periodic valuation of Works executed.

In order to attain these objectives, Works should be itemized in the Bill of Quantities in sufficient detail to distinguish between the different classes of Works, or between Works of the same nature carried out in different locations or in other circumstances which may give rise to different considerations of cost. Consistent with these requirements, the layout and content of the Bill of Quantities should be as simple and brief as possible.

Daywork Schedule

A Daywork Schedule should be included only if the probability of unforeseen work, outside the items included in the Bill of Quantities, is high. To facilitate checking by the Entity of the realism of rates quoted by the Bidders, the Daywork Schedule should normally comprise the following:

a. A list of the various classes of labor, materials, and Constructional Plant for which basic daywork rates or prices are to be inserted by the Bidder, together with a statement of the conditions under which the Contractor will be paid for work executed on a daywork basis.

b. Nominal quantities for each item of Daywork, to be priced by each Bidder at Daywork rates as Bid. The rate to be entered by the Bidder against each basic Daywork item should include the Contractor's profit, overheads, supervision, and other charges.

Provisional Sums

A general provision for physical contingencies (quantity overruns) may be made by including a provisional sum in the Summary Bill of Quantities. Similarly, a contingency allowance for possible price increases should be provided as a provisional sum in the Summary Bill of Quantities. The inclusion of such provisional sums often facilitates budgetary approval by avoiding the need to request periodic supplementary approvals as the future need arises. Where such provisional sums or contingency allowances are used, the SCC should state the manner in which they will be used, and under whose authority (usually the Procuring Entity's Representative's).

The estimated cost of specialized work to be carried out, or of special goods to be supplied, by other contractors should be indicated in the relevant part of the Bill of Quantities as a particular provisional sum with an appropriate brief description. A separate procurement procedure is normally carried out by the Procuring Entity to select such specialized contractors. To provide an element of competition among the Bidders in respect of any facilities, amenities, attendance, etc., to be provided by the successful Bidder as prime Contractor for the use and convenience of the specialist contractors, each related provisional sum should be followed by an item in the Bill of Quantities inviting the Bidder to quote a sum for such amenities, facilities, attendance, etc.

Signature Box

A signature box shall be added at the bottom of each page of the Bill of Quantities where the authorized representative of the Bidder shall affix his signature. Failure of the authorized representative to sign each and every page of the Bill of Quantities shall be a cause for rejection of his bid.

These Notes for Preparing a Bill of Quantities are intended only as information for the Procuring Entity or the person drafting the Bidding Documents. They should not be included in the final documents.

Tourism Infrastructure and Enterprise Zone Authority
7th Floor, Tower 1 Double Dragon, Double Dragon Meridian Park,
Macapagal Ave. cor. EDSA Extension,Bay Area, Pasay City

SUMMARY OF BID

PROJECT : the **IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK SINACABAN, MISAMIS OCCIDENTAL**

DURATION: 330 Calendar Days

Item No.	ITEM OF WORK	AMOUNT
I.	**GENERAL REQUIREMENTS**	
a.1	**Temporary Barracks**	
a.2	**Health and Safety**	
a.3	**Project Signboard**	
II.	**MOBILIZATION/DEMOBILIZATION**	
III.	**BACK OF THE HOUSAE**	
IV.	**RESTAURANT**	
V.	**EMPLOYEE'S LOUNGE**	
VI.	**CABANA – 4 UNITS**	
VII.	**LIFE GUARD STATION 2 UNITS**	
VIII.	**SEWAGE TREATMENT PLANT**	
IX.	**SOLAR STREETLIGHT**	
X.	**TOURISM ROAD**	

AMOUNT IN WORDS

_____

_____

Name of Company

Name & Signature of
Authorized Representative

Business Address

Designation

BILL OF QUANTITIES

Project : **IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK**
Location : Sinacaban, Misamis Occidental

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
I.	**GENERAL REQUIREMENTS**	1.00	L.S.		
	Temporary Barracks	1.00	lot		
	Health and Safety	1.00	lot		
	Project Signboard	1.00	set		
II.	**MOBILIZATION/DEMOBLIZATION**	1.00	L.S.		
III.	**BACK OF THE HOUSE**	792.00	m^2		
	Structure Excavation (Common Soil)	131.08	m^3		
	Embankment from Structure Excavation	54.72	m^3		
	Embankment from Common Borrow by Equipment	96.80	m^3		
	Gravel Bedding	111.61	m^3		
	Structural Concrete for Footing and Slab on Fill (Class A, 28 days)	183.73	m^3		
	Structural Concrete for Footing Tie Beam, Column, Suspended Slab, Girder/Beam (Class A, 28 days)	113.63	m^3		
	Reinforcing Steel of Reinforced Concrete Structures for One-Storey Grade 40	21,952.16	kg		
	Formworks and Falseworks (for one-storey building)	868.14	m^2		
	Soil Poisoning	178.37	length		
	Structural Steel Roof Truss	21,057.88	kg		
	Structural Steel Purlins	8,138.02	kg		
	Metal Structure Accessories (Anchor Bolts)	112.00	pc		
	Metal Structure Accessories (Anchor Bolts)	24.00	pc		
	Metal Structure Accessories (Sagrods)	427.00	pc		
	Metal Structure Accessories (Crossbracing)	1,147.36	kg		
	Metal Structure Accessories (Steel Plates)	924.00	kg		
	Metal Structure Accessories (Steel Plates)	47.10	kg		
	Metal Structure Accessories (Stainless Railings)	1.00	l.s.		
	Roofing Works (Nipa)	1.00	l.s.		
	Liquid Waterproofing	1,279.43	m^2		
	Wood Preservatives	673.48	m^2		
	6 mm UPVC Spandrel on Metal Frame Ceiling	1.00	l.s.		
	12 mm Fiber Cement Board on Metal Frame	624.89	m^2		
	PVC Panel in Teak Finish on Metal Frame Ceiling	1.00	l.s.		
	CHB # 6 (Non-Load Bearing including	1,257.09	m^2		
	CHB #4 Non Load Bearing (including Reinfocing	22.02	m^2		
	Cement Plaster Finish	2,383.36	m^2		
	Wooden Panel Door	23.10	m^2		
	Tempered Glass Door (15mm)	16.80	m^2		

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
	Stainless Steel Door and Frames	2.31	m^2		
	Aluminum Louver Door	4.20	m^2		
	Frames (Jambs, Sill, Head, Transoms, and	1.00	set		
	Door Accessories - Hinges & Locksets	1.00	l.s.		
	Stainless Steel Door and Frames	29.89	m^2		
	PVC Doors and Frames	3.36	m^2		
	Aluminum Glass Windows (Fixed Type)	20.32	m^2		
	Aluminum Glass Windows (Awning / Sliding	37.96	m^2		
	Wood Glass Windows (Awning Type)	13.37	m^2		
	Accessories - Windows	1.00	l.s.		
	Accessories & Finishes - Windows	1.00	l.s.		
	Paver Tiles	1.00	l.s.		
	Porcelain Tiles - Floor Tiles (Wood Grain Matte Finish)	144.90	m^2		
	Porcelain Tiles - Floor Tiles (Espana Premium CC 6657 Verbena Lt. Gray Matte Finish)	549.47	m^2		
	Porcelain Tiles - Floor Tiles (Arte Ceramiche Tamiya Ash Polished floor tiles in matte finish)	57.65	m^2		
	Porcelain Tiles - Floor Tiles (Espana Premium LH Gres Por TT603 Cemento Lt. Gray Polished floor tiles in matte finish)	62.58	m^2		
	Floor Topping	1,184.09	m^2		
	Ceramic Tiles - Wall Tiles (Cast Grey in Matte	22.68	m^2		
	Ceramic Tiles - Wall Tiles (Espana Premium LH	137.29	m^2		
	Tactile Blocks	1.00	l.s.		
	Painting Works (Metal) - Trusses	1,728.73	m^2		
	Painting Works (Masonry/Concrete)	1,477.36	m^2		
	Stucco Concrete Smooth Finish	737.29	m^2		
	Quartz Slab	1.00	l.s.		
	Wall Partition - C.R.	1.00	l.s.		
	Lighting Fixtures	1.00	l.s.		
	Panelboard w/ Main & Branch Breakers	1.00	l.s.		
	Wires & Wiring Devices	1.00	l.s.		
	Conduit, Boxes and Fittings	1.00	l.s.		
	Pipes & Fittings	1.00	l.s.		
	Air Conditioning Unit	1.00	l.s.		
IV.	**RESTAURANT**	**601.75**	**m^2**		
	Structure Excavation (Common Soil Manual)	124.59	m^3		
	Embankment (from Structure Excavation, Manual)	68.04	m^3		
	Damproofing (Polyethylene Sheets)	502.11	m^2		
	Aggregate Subbase Course	100.42	m^2		
	Gravel Bedding	63.83	m^3		
	Structural Concrete For Footing and Slab on Fill (Class A, 28 Days)	78.98	m^3		
	Structural Concrete, Column and Suspended Slab, Girder/Beam (Class A, 28 Days)	62.22	m^3		
	Reinforcing Steel for One-Storey, Grade 40	13,517.80	kg		

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
	Formworks and Falseworks (for one-storey	656.01	m^2		
	CHB # 6 (Non-Load Bearing including	780.75	m^2		
	Cement Plaster Finish	1,624.83	m^2		
	Roofing Works (Palmex Faux Nipa Thatched	1.00	l.s.		
	Steel Roof Trusses	16,804.59	kg		
	Galvanized Steel C-Purlins	4,446.99	kg		
	Metal Structure Accessories (anchor bolt,16mm	324.00	pc		
	Metal Structure Accessories (Steel Plate)	282.76	kg		
	Metal Structure Accessories (Sagrods)	462.00	pc		
	Facia(Senepa)	1.00	l.s.		
	Liquid Waterproofing	773.51	m^2		
	Wood Preservative	2,307.97	m^2		
	Porcelain Floor Tiles (Unglazed)	471.34	m^2		
	Plain Cement Floor Finish	25.62	m^2		
	Warning Tactile Blocks	1.00	l.s.		
	Porcelain Wall Tiles (Unglazed)	253.78	m^2		
	Gypsum Board on Metal Frame Ceiling	238.54	m^2		
	Wood Plastic Composite (WPC) Panel on Metal	19.07	m^2		
	Stainless Steel Railing	1.00	l.s.		
	Toilet Cubicle Partition with Complete	1.00	l.s.		
	Facial Mirror	7.97	m^2		
	Painting Works (Masonry/Concrete)	1,446.98	m^2		
	Painting Works Concrete (Surface Preparation)	1.00	l.s.		
	Painting Works Metal (Truss, & Purlins)	1,757.56	m^2		
	Wooden Panel Door	25.74	m^2		
	Aluminum Louvered Door	10.92	m^2		
	Awning Glass Window with Wood Framing	1.00	l.s.		
	Fixed Glass Window with Wood Framing	1.00	l.s.		
	Fixed Transom Window with Wooven Amakan Pattern and Wood Framing	1.00	l.s.		
	Frames (Jambs)	1.00	l.s.		
	Door and Window Accessories	1.00	l.s.		
	Pipes & Fittings	1.00	l.s.		
	Fdas & Cctv	1.00	l.s.		
	Lighting Fixtures	1.00	l.s.		
	Panelboard w/ Main & Branch Breakers	1.00	l.s.		
	Wires & Wiring Devices	1.00	l.s.		
	Conduit, Boxes and Fittings	1.00	l.s.		
	Fire Protection System(Restaurant)	1.00	l.s.		
	Air Conditioning Unit(Restaurant)	1.00	l.s.		
V.	**EMPLOYEE'S LOUNGE**	**112.00**	m^2		
	Structure Excavation (Common Soil Manual)	28.99	m^3		
	Embankment (from Structure Excavation,	19.69	m^3		
	Gravel Bedding	11.34	m^3		
	Structural Concrete For Footing and Slab on Fill	14.58	m^3		
	Structural Concrete for Footing Tie Beam,	14.70	m^3		
	Reinforcing Steel of Reinforced Concrete	2,539.90	kg		

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
	Formworks and Falseworks (for one-storey	254.04	m^2		
	Rib-Type Roofing	205.56	m^2		
	Fabricated Metal Roofing Accessory (Flashing)	78.80	m		
	Wood Truss	1.00	l.s.		
	Wood Purlins	1.00	l.s.		
	Ceiling (Hardiflex)	1.00	l.s.		
	Fascia Board	1.00	l.s.		
	CHB # 6 (Non-Load Bearing including	180.29	m^2		
	CHB # 4 (Non-Load Bearing including	58.50	m^2		
	Cement Plaster Finish	477.58	m^2		
	Wood Door	1.00	l.s.		
	Doors (Accessories)	1.00	l.s.		
	Frames (Jambs, Sills, Head, Transoms and	6.00	set		
	Aluminum Glass Windows (Awning Type)	5.18	m^2		
	Aluminum Glass Windows (Sliding Type)	12.20	m^2		
	Windows (Accessories)	1.00	l.s.		
	Floor Tiles	74.76	m^2		
	Floor Bricks	1.00	l.s.		
	Ceramic Tiles	9.24	m^2		
	Bar Counter Finish	1.00	l.s.		
	Railing	1.00	l.s.		
	Canopy	1.00	l.s.		
	Wall hung Cabinet	1.00	l.s.		
	Bar Sunk	1.00	l.s.		
	Vanishing Works	7.30	m^2		
	Rough Cement Floor Finish	23.93	m^2		
	Painting Works (Masonry/Concrete)	475.85	ls		
	Lighting Fixtures	1.00	l.s.		
	Panelboard w/ Main & Branch Breakers	1.00	l.s.		
	Wires & Wiring Devices	1.00	l.s.		
	Conduit, Boxes and Fittings	1.00	l.s.		
	Fdas & Cctv	1.00	l.s.		
	Pipes & Fittings	1.00	l.s.		
VI.	**CABANA - 4 UNITS**	**22.09**	**m^2**		
	Structure Excavation (Common Soil Manual)	23.42	m^3		
	Embankment (from Structure Excavation, Manual)	15.12	m^3		
	Embankment from Common Borrow by Equipment	6.49	m^3		
	Gravel Bedding	2.03	m^3		
	Structural Concrete For Footing and Slab on Fill	14.04	m^3		
	Structural Concrete, Column and Suspended	6.98	m^3		
	Reinforcing Steel for One-Storey, Grade 40	1,373.40	kg		
	Formworks and Falseworks (for one-storey	135.69	m^2		
	Rib-Type Roofing	63.48	m^2		
	Fabricated Metal Roofing Accessory (Flashing)	36.80	m		
	Wood Truss	1.00	l.s.		
	Wood Purlins	1.00	l.s.		

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
	Ceiling (Metal Frame, Fiber Cement Board)	43.10	m^2		
	Fascia Board	1.00	l.s.		
	CHB # 4 (Non-Load Bearing including	165.36	m^2		
	Cement Plaster Finish	251.36	m^2		
	Wood Door	1.00	l.s.		
	Doors (Accessories)	1.00	l.s.		
	Frames (Jambs, Sills, Head, Transoms and	4.00	set		
	Ceramic Tiles	24.01	m^2		
	Paver Block	1.00	l.s.		
	Painting Works (Masonry/Concrete)	251.36	m^2		
	Lighting Fixtures	1.00	l.s.		
	Panelboard w/ Main & Branch Breakers	1.00	l.s.		
	Wires & Wiring Devices	1.00	l.s.		
	Conduit, Boxes and Fittings	1.00	l.s.		
VII.	**LIFE GUARD STATION - 2 UNITS**	**2.00**	**unit**		
	Structure Excavation (Common Soil Manual)	3.84	m^3		
	Embankment (from Structure Excavation,	3.41	m^3		
	Gravel Bedding	0.26	m^3		
	Structural Concrete For Footing and Slab on Fill	0.64	m^3		
	Structural Concrete, Column and Suspended	0.36	m^3		
	Reinforcing Steel for One-Storey, Grade 40	129.41	kg		
	Formworks and Falseworks (for one-storey	11.56	m^2		
	Polycarbonate Long Span Roof	14.04	m^2		
	Structural Steel Roof Truss	32.19	kg		
	Structural Steel Purlins	145.27	kg		
	Deck Framing	1.00	l.s.		
	Life Guard Station Framing	1.00	l.s.		
	Wood Bench	1.00	kg		
	Painting Works (Metal)	33.34	m^2		
VIII.	**SEWAGE TREATMENT PLANT**	**1.00**	**LOT**		
	Structure Excavation (Common Soil)	1,994.00	m^3		
	Gravel Bedding	33.30	m^3		
	Embankment (from Structure Excavation, Manual)	14.74	m^3		
	Structural Concrete For Footing and Slab on Fill (Class A, 28 Days)	317.85	m^3		
	Structural Concrete for Footing Tie Beam, Column, Suspended Slab, Girder/Beam (Class A, 28 days)	334.09	m^3		
	Lean Concrete (For Manual Mixing)	539.00	m^3		
	Reinforcing Steel of Reinforced Concrete Structures for One-Storey Grade 40/Grade 60	53,886.38	kg		
	Formworks and Falseworks (for one-storey building)	4,319.13	m^2		
	Rib-Type Roofing	21.12	m^2		
	Fabricated Metal Roofing Accessory (Ridge Roll)	14.80	m		

ITEM No.	DESCRIPTION	QUANTITY	UNIT	UNIT COST	AMOUNT
	Fabricated Metal Roofing Accessory (Gutter)	26.40	m		
	Structural Steel Roof Truss	831.20	kg		
	Structural Steel Purlins	101.53	kg		
	Metal Structure Accessories (Anchor Bolts)	16.00	pc		
	Metal Structure Accessories (Steel Plate)	8.48	kg		
	CHB # 6 (Non-Load Bearing including Reinforcing Steel 150mm)	80.00	m^2		
	Cement Plaster Finish	144.00	m^2		
	Wood Panel Door	1.80	m^2		
	Doors (Accessories)	1.00	l.s.		
	Frames (Jambs, Sills, Head, Transoms and Mullions)	1.00	set		
	Window (Concrete Louver)	1.00	l.s.		
	Painting Works (Masonry/Concrete)	144.00	m^2		
	Waterproofing Cement Base	980.00	m^2		
	Pipes & Fittings	1.00	l.s.		
	Electro-Mechanical System	1.00	l.s.		
IX.	**ROADWAY LIGHTING**	**16.00**	**set**		
	Roadway Lighting Solar LED Streetlight	16.00	set		
X.	**TOURISM ROAD**	**1,890.00**	**m^2**		
	Removal of Existing Concrete Pavement	1,890.00	m^2		
	Clearing and Grubbing (with Stripping)	0.20	ha		
	Roadway Excavation (Surplus Common)	630.00	m^3		
	Structure Excavation (Common Soil)	880.58	m^3		
	Pipe Culvert and Drain Excavation	135.49	m^3		
	Embankment (from Borrow)	1,762.18	m^3		
	Subgrade Preparation	9,086.30	m^3		
	Aggregate Subbase Course (for Intermittent	1,926.99	m^3		
	Gravel Surface Course (Uncrushed)	1,136.60	m^3		
	PCC Pavement Plain - Coventional Method	8,016.54	m^2		
	Concrete Curb and Gutter	1,960.00	lm		
	RC Culvert Pipe, 24"	154.60	lm		
	Structural Concrete (Covered Line Canal &	374.41	m^3		
	Reinforcing Steel, Grade 40 (Covered Line Canal	16,209.91	kg		
	Formworks and Falseworks (Covered Line	260.00	m^2		
GRAND TOTAL			In Words: Pesos		
			In Figures: Php		

Submitted By

_____
Name of the Representative of the Bidder

_____
Name of the Bidder

Section IX. Checklist of Technical and Financial Documents

Notes on the Checklist of Technical and Financial Documents

The prescribed documents in the checklist are mandatory to be submitted in the Bid, but shall be subject to the following:

a. GPPB Resolution No. 09-2020 on the efficient procurement measures during a State of Calamity or other similar issuances that shall allow the use of alternate documents in lieu of the mandated requirements; or

b. any subsequent GPPB issuances adjusting the documentary requirements after the effectivity of the adoption of the PBDs.

The BAC shall be checking the submitted documents of each Bidder against this checklist to ascertain if they are all present, using a non-discretionary "pass/fail" criterion pursuant to Section 30 of the 2016 revised IRR of RA No. 9184.

Checklist of Technical and Financial Documents

I. TECHNICAL COMPONENT ENVELOPE

Class "A" Documents

Legal Documents

☐ (a) Valid PhilGEPS Registration Certificate (Platinum Membership) (all pages);
and

☐ (b) Registration certificate from Securities and Exchange Commission (SEC) with Articles of Incorporation (AOI), Department of Trade and Industry (DTI) for sole proprietorship, or Cooperative Development Authority (CDA) for cooperatives or its equivalent document;
and

☐ (c) Mayor's or Business permit issued by the city or municipality where the principal place of business of the prospective bidder is located, or the equivalent document for Exclusive Economic Zones or Areas;
and

☐ (e) Tax clearance per E.O. No. 398, s. 2005, as finally reviewed and approved by the Bureau of Internal Revenue (BIR).

Technical Documents

☐ (f) 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 with attached supporting documents such as, NOA, NTP, Contract.**

☐ (g) Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid, except under conditions provided under the rules; **with attached supporting documents such as, NOA, NTP, Contract and Certificate of Final Acceptance or a final rating of at least Satisfactory in the Constructors Performance Evaluation System (CPES).**

☐ (h) Philippine Contractors Accreditation Board (PCAB) License;
or
Special PCAB License in case of Joint Ventures;
and registration for the type and cost of the contract to be bid; **and**

☐ (i) 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**

(j) 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**

☐ (k) 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.

☐ (l) Statement of Exclusivity (the bidder must certify that the foregoing personne shall perform work and equipment shall be used exclusively for the project unti completion of the project. Please see the attached Form for the purpose.)

☐ (m) Certificate or Affidavit of Site Inspection

☐ (n) Additional Technical Requirements:

- construction schedule and S-curve ss
- manpower schedule
- construction methods
- equipment utilization schedule
- PERT/CPM
- Construction Safety and Health Program

☐ (o) Contractors Registration Certificate by DPWH for the list of all ongoing projects if none, affidavit that there is none.

Financial Documents

☐ (p) The prospective bidder's audited financial statements, showing, among others, the prospective bidder's total and current assets and liabilities, stamped "received" by the BIR or its duly accredited and authorized institutions, for the preceding calendar year which should not be earlier than two (2) years from the date of bid submission; **and** if filed electronically, shall be accompanied by a copy of the BIR's system-generated confirmation or acknowledgment receipt as proof of electronic filing, such as through the Electronic Filing and Payment System (eFPS) or the Electronic Audited Financial Statement (eAFS) submission facility

☐ (q) The prospective bidder's computation of Net Financial Contracting Capacity (NFCC).

Class "B" Documents

(r) 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

- ☐ (s) Original of duly signed and accomplished Financial Bid Form; **and**
- ☐ (t) Soft Copy of Financial Proposal in the form of Flash Drive (USB) must be included inside the Original Financial Envelope

Other documentary requirements under RA No. 9184

- ☐ (u) Original of duly signed Bid Prices in the Bill of Quantities; **and**
- ☐ (v) 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**
- ☐ (w) Cash Flow by Quarter.

Republic of the Philippines
Tourism Infrastructure & Enterprise Zone Authority

MANPOWER & EQUIPMENT

Project : **IMPROVEMENTS OF ASENSO MISAMIS OCCIDENTAL RESORT AND AQUAMARINE PARK**
Location: Sinacaban, Misamis Oriental
Duration: 330 CD

Minimum Required Manpower	Quantity
a. Project Manager	1
b. Project Engineer	1
c. Materials Engineer	1
d. Project Foreman	1
e. Skilled Worker	17
f. Helper/Laborer	30
g. Safety Officer	1

Minimum Required Equipment	Quantity
a. Basic Construction Tools	1
b. Concrete Mixer	1
c. Concrete Vibrator	1
d. Plate Compactor	1
e. Welding Machine	1
f. Cutting Outfit	1
g. Bar Cutter	1
h. Backhoe	1
i. Backhoe w/ Pavement Breaker	1
j. Payloader	1
k. Dump Truck	2
l. Bulldozer	1
m. Motorized Road Grader	1
n. Vibratory Roller	1
o. Water Truck /Pump	1
p. Concrete Vibrator	1
q. Concrete Screeder	1
r. Concrete Saw	1

Prepared by:

RUSSEL U. SORIANO
Sr. PPDO

Checked by:

ENGR. NOEL F. YAMBAO
Manager, PMD

Noted:

ENGR. JEOFFREY L. MACALALAD
Manager, PEPD

Bid Form for the Procurement of Infrastructure Projects

[shall be submitted with the Bid]

BID FORM

Date : _____

Project Identification No. : _____

To: [name and address of Procuring Entity]

Having examined the Philippine Bidding Documents (PBDs) including the Supplemental or Bid Bulletin Numbers *[insert numbers]*, the receipt of which is hereby duly acknowledged, we, the undersigned, declare that:

a. We have no reservation to the PBDs, including the Supplemental or Bid Bulletins, for the Procurement Project: *[insert name of contract]*;

b. We offer to execute the Works for this Contract in accordance with the PBDs;

c. The total price of our Bid in words and figures, excluding any discounts offered below is: *[insert information]*;

d. The discounts offered and the methodology for their application are: *[insert information]*;

e. The total bid price includes the cost of all taxes, such as, but not limited to: *[specify the applicable taxes, e.g. (i) value added tax (VAT), (ii) income tax, (iii) local taxes, and (iv) other fiscal levies and duties]*, which are itemized herein and reflected in the detailed estimates,

f. Our Bid shall be valid within the a period stated in the PBDs, and it shall remain binding upon us at any time before the expiration of that period;

g. If our Bid is accepted, we commit to obtain a Performance Security in the amount of *[insert percentage amount]* percent of the Contract Price for the due performance of the Contract, or a Performance Securing Declaration in lieu of the the allowable forms of Performance Security, subject to the terms and conditions of issued GPPB guidelines[1] for this purpose;

h. We are not participating, as Bidders, in more than one Bid in this bidding process, other than alternative offers in accordance with the Bidding Documents;

i. We understand that this Bid, together with your written acceptance thereof included in your notification of award, shall constitute a binding contract between us, until a formal Contract is prepared and executed; and

j. We understand that you are not bound to accept the Lowest Calculated Bid or any other Bid that you may receive.

---

[1] currently based on GPPB Resolution No. 09-2020

k. We likewise certify/confirm that the undersigned, is the duly authorized representative of the bidder, and granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for the [Name of Project] of the [Name of the Procuring Entity].

l. We acknowledge that failure to sign each and every page of this Bid Form, including the Bill of Quantities, shall be a ground for the rejection of our bid.

Name: _____

Legal Capacity: _____

Signature: _____

Duly authorized to sign the Bid for and behalf of: _____

Date: _____

Bid Securing Declaration Form

[shall be submitted with the Bid if bidder opts to provide this form of bid security]

REPUBLIC OF THE PHILIPPINES)
CITY OF _____) S.S.

BID SECURING DECLARATION
Project Identification No.: *[Insert number]*

To: *[Insert name and address of the Procuring Entity]*

I/We, the undersigned, declare that:

1. I/We understand that, according to your conditions, bids must be supported by a Bid Security, which may be in the form of a Bid Securing Declaration.

2. I/We accept that: (a) I/we will be automatically disqualified from bidding for any procurement contract with any procuring entity for a period of two (2) years upon receipt of your Blacklisting Order; and, (b) I/we will pay the applicable fine provided under Section 6 of the Guidelines on the Use of Bid Securing Declaration, within fifteen (15) days from receipt of the written demand by the procuring entity for the commission of acts resulting to the enforcement of the bid securing declaration under Sections 23.1(b), 34.2, 40.1 and 69.1, except 69.1(f),of the IRR of RA No. 9184; without prejudice to other legal action the government may undertake.

3. I/We understand that this Bid Securing Declaration shall cease to be valid on the following circumstances:

   a. Upon expiration of the bid validity period, or any extension thereof pursuant to your request;
   b. I am/we are declared ineligible or post-disqualified upon receipt of your notice to such effect, and (i) I/we failed to timely file a request for reconsideration or (ii) I/we filed a waiver to avail of said right; and
   c. I am/we are declared the bidder with the Lowest Calculated Responsive Bid, and I/we have furnished the performance security and signed the Contract.

IN WITNESS WHEREOF, I/We have hereunto set my/our hand/s this ____ day of *[month] [year]* at *[place of execution]*.

[Insert NAME OF BIDDER OR ITS AUTHORIZED REPRESENTATIVE]
[Insert signatory's legal capacity]
Affiant

[Jurat]
[Format shall be based on the latest Rules on Notarial Practice]

Omnibus Sworn Statement (Revised)

[shall be submitted with the Bid]

REPUBLIC OF THE PHILIPPINES)
CITY/MUNICIPALITY OF _____) S.S.

AFFIDAVIT

I, [Name of Affiant], of legal age, [Civil Status], [Nationality], and residing at [Address of Affiant], after having been duly sworn in accordance with law, do hereby depose and state that:

1. *[Select one, delete the other:]*

   [If a sole proprietorship:] I am the sole proprietor or authorized representative of [Name of Bidder] with office address at [address of Bidder];

   [If a partnership, corporation, cooperative, or joint venture:] I am the duly authorized and designated representative of [Name of Bidder] with office address at [address of Bidder];

2. *[Select one, delete the other:]*

   [If a sole proprietorship:] As the owner and sole proprietor, or authorized representative of [Name of Bidder], I have full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached duly notarized Special Power of Attorney;

   [If a partnership, corporation, cooperative, or joint venture:] I am granted full power and authority to do, execute and perform any and all acts necessary to participate, submit the bid, and to sign and execute the ensuing contract for [Name of the Project] of the [Name of the Procuring Entity], as shown in the attached [state title of attached document showing proof of authorization (e.g., duly notarized Secretary's Certificate, Board/Partnership Resolution, or Special Power of Attorney, whichever is applicable;)];

3. [Name of Bidder] is not "blacklisted" or barred from bidding by the Government of the Philippines or any of its agencies, offices, corporations, or Local Government Units, foreign government/foreign or international financing institution whose blacklisting rules have been recognized by the Government Procurement Policy Board, **by itself or by relation, membership, association, affiliation, or controlling interest with another blacklisted person or entity as defined and provided for in the Uniform Guidelines on Blacklisting;**

4. Each of the documents submitted in satisfaction of the bidding requirements is an authentic copy of the original, complete, and all statements and information provided therein are true and correct;

5. [Name of Bidder] is authorizing the Head of the Procuring Entity or its duly authorized representative(s) to verify all the documents submitted;

6. *[Select one, delete the rest:]*

   [If a sole proprietorship:] The owner or sole proprietor is not related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical

Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

[If a partnership or cooperative:] None of the officers and members of *[Name of Bidder]* is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

[If a corporation or joint venture:] None of the officers, directors, and controlling stockholders of *[Name of Bidder]* is related to the Head of the Procuring Entity, members of the Bids and Awards Committee (BAC), the Technical Working Group, and the BAC Secretariat, the head of the Project Management Office or the end-user unit, and the project consultants by consanguinity or affinity up to the third civil degree;

7. *[Name of Bidder]* complies with existing labor laws and standards; and

8. *[Name of Bidder]* is aware of and has undertaken the responsibilities as a Bidder in compliance with the Philippine Bidding Documents, which includes:

    a. Carefully examining all of the Bidding Documents;
    b. Acknowledging all conditions, local or otherwise, affecting the implementation of the Contract;
    c. Making an estimate of the facilities available and needed for the contract to be bid, if any; and
    d. Inquiring or securing Supplemental/Bid Bulletin(s) issued for the *[Name of the Project]*.

9. *[Name of Bidder]* did not give or pay directly or indirectly, any commission, amount, fee, or any form of consideration, pecuniary or otherwise, to any person or official, personnel or representative of the government in relation to any procurement project or activity.

10. **In case advance payment was made or given, failure to perform or deliver any of the obligations and undertakings in the contract shall be sufficient grounds to constitute criminal liability for Swindling (Estafa) or the commission of fraud with unfaithfulness or abuse of confidence through misappropriating or converting any payment received by a person or entity under an obligation involving the duty to deliver certain goods or services, to the prejudice of the public and the government of the Philippines pursuant to Article 315 of Act No. 3815 s. 1930, as amended, or the Revised Penal Code.**

IN WITNESS WHEREOF, I have hereunto set my hand this __ day of ___, 20__ at _____, Philippines.

[Insert NAME OF BIDDER OR ITS AUTHORIZED REPRESENTATIVE]
[Insert signatory's legal capacity]
Affiant

[Jurat]
[Format shall be based on the latest Rules on Notarial Practice]

STATEMENT OF EXCLUSIVITY

I certify that the personnel and the equipment pledged for the bidding for (name of the project) shall be **exclusively used** for the project during its entire duration.

(Date)

(Authorized Representative)

Name of contractor

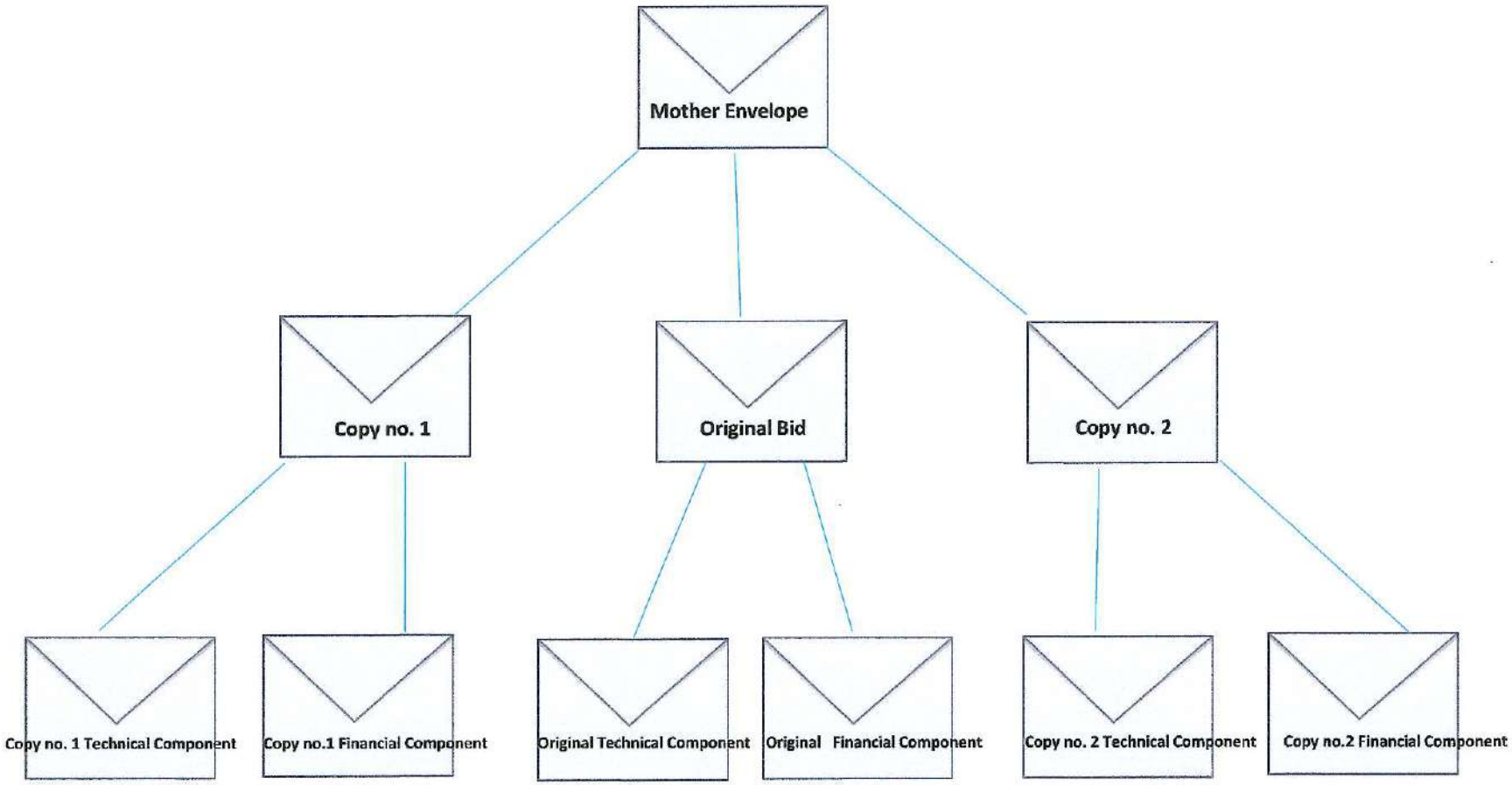
_____

Signature

IN WITNESS WHEREOF, I have hereunto set my hand this __ day of ___, 20__ at _____, Philippines.

NAME OF NOTARY PUBLIC
Serial No. of Commission _____
Notary Public for _____ until _____
Roll of Attorneys No. _____
PTR No. _____
IBP No. _____

Doc. No. _____
Page No. _____
Book No. _____
Series of _____


Mother Envelope
Copy no. 1
Original Bid
Copy no. 2
Copy no. 1 Technical Component
Copy no.1 Financial Component
Original Technical Component
Original Financial Component
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FORMAT FOR 360 CD

Use you letter Head

Project ID. No:

Project :

Location:

Duration : Calendar Days

CASH FLOW BY QUARTER

PARTICULAR	TOTAL	1st Quarter	2nd Quarter	3 rd Quarter	4th Quarter
ACCOMPLISHMENT, IN %					
CASH FLOW, IN Php					
CUMULATIVE ACCOMPLISHMENT, IN %					
CUMULATIVE CASH FLOW, IN Php					

Prepared By:


Republic of the Philippines
gppb
Government Procurement Policy Board