PHILIPPINE BIDDING DOCUMENTS

(As Harmonized with Development Partners)

Construction of Pangasinan Bangus Breeding and Hatchery

Identification No.
PRDP-SU-IB-R001-PAN-003-000-000-2023-VCI

Fifth Edition

May 7, 2024

BID OPENING CHECKLIST

Envelope 1

ELIGIBILITY DOCUMENTS
a. Registration Certification of the Company (from SEC or DTI or CDA)
b. Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid and average Annual Turnover as specified in ITB Clause 5.4 hereof: **Basis of Critical Eligibility and Qualification Criteria:** - At least one (1) work of a nature and complexity equivalent to the Works generally within the last ten (10) years with at least fifty percent (50%) of the Estimated Project Cost (EPC) in the amount of **PhP119,496,000.00**; and - Average Annual turnover of Construction Income for the last three (3) years of at least 100% of the EPC in the amount of **PhP238,992,000.00** of the EPC as evidenced by the submitted Audited Financial Statements for the last three (3) years.
c. Audited Financial Statements for the last three (3) years [with supporting Income Tax Return stamped "received" by BIR or its duly accredited and authorized institutions or eBIR Tax Return Receipt Confirmation (if submitted through eBIR), and eFPS/validated bank deposit slip payment]
d. In case of Joint Venture, a duly notarized Joint Venture agreement and a copy of the duly accomplished application form for Special License of the Joint Venture filed with the PCAB, or a copy of the Special License of the Joint Venture if already issued.
e. Qualification Information (please follow the **link** PRDP Pangasinan SU Form Qualification Information.docx for the template)
TECHNICAL DOCUMENTS
f. Bid Security, in the form of **Bid Securing Declaration** (please follow the **link** PRDP Pangasinan SU Form Bid Securing Declaration.docx for the template)
g. Project requirements, which shall include the following:
(i) List of Contractor's personnel to be assigned to the contract to be bid, **with their complete qualifications and experience data**, viz: a. **Project Manager** – Licensed Civil Engineer with minimum of five (5) years relevant work experience as Project Manager in Building Construction; b. **Two (2) Project Engineers** – Each should have a minimum of five (5) years' experience as a Licensed Civil/Agricultural Engineer with a minimum of two (2) projects handled in building construction as Project Engineer, each has a value of at least twenty percent (20%) of the Estimated Project Cost; c. **Materials Engineer** – Licensed Civil Engineer duly accredited by DPWH following DPWH D.O. 98, S. of 2016 as Materials Engineer II *(as required under SCC Clause 6.5)*; d. **Mechanical Engineer** - Licensed Mechanical Engineer with minimum of five (5) years' experience as a Licensed Mechanical Engineer with a minimum of two (2) projects handled in mechanical related works/projects as Mechanical Engineer, each has a value of at least twenty percent (20%) of the Mechanical Component of the EPC (PhP2,992,000.00) or equivalent value of at least PhP598,400.00;

e. **Electrical Engineer** - Licensed Professional Electrical Engineer with minimum of five (5) years' experience as a Licensed Professional Electrical Engineer with a minimum of two (2) projects handled in electrical related works/projects as Electrical Engineer, each has a value of at least twenty percent (20%) of the Electrical Component of the EPC (PhP10,929,000.00) or equivalent value of at least PhP2,185,800.00;

f. **Sanitary Engineer** - Licensed Sanitary Engineer with minimum of five (5) years' experience as a Licensed Sanitary Engineer and has at least two (2) projects handled in sanitary related works/projects as Sanitary Engineer, each has a value of at least twenty percent (20%) of the Sanitary Component of the EPC (PhP18,160,000.00) or equivalent value of at least PhP3,632,000.00;

(ii) List of Bidder's major and critical equipment units, which are owned and are supported by proof of ownership, such as, without limitation, Deed of Sale, Official Receipt/Certificate of Registration, Sales Invoice, Charge Invoice or Delivery Receipt, which must meet the minimum requirement for the contract set in the Bid Data Sheet

Pass (if all the above documents are present)
Fail (if non-historical documents are absent, such as JV agreement, Bid Securing Declaration, Bid Form and
Bill of Quantities)

Notwithstanding the BAC's declaration of non-responsiveness of the first bid envelope, the financial proposals contained in the second bid envelopes of all the bidders shall be read. The first and second envelopes shall not be returned to the bidders.
Foreign bidders may submit the equivalent documents, if any, issued by the country of the foreign bidder.

Envelope 2

FINANCIAL PROPOSAL
Bid price in approved **Bid form** (please follow the **link** PRDP Pangasinan SU Form Bid Form.docx for the template); and Bid prices in the **Bill of Quantities** (please follow the **link** bit.ly/bangushatcheryBOQ for the Bill of Quantities)

BID DATA SHEET
Clause 20.3 Each bidder shall submit one (1) original and four (4) copies of the first and second components of its bid. An electronic copy of the bid should also be submitted in PDF file format in a flash drive. Should there be discrepancies, the original copy would prevail.

BID OPENING CHECKLIST (JOINT VENTURE)

Envelope 1

ELIGIBILITY DOCUMENTS
a. Registration Certification of the Company (from SEC or DTI or CDA) *(each partner)*
b. Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid and average Annual Turnover as specified in ITB Clause 5.4 hereof *(each partner/either one of the partners):*
Basis of Critical Eligibility and Qualification Criteria: - At least one (1) work of a nature and complexity equivalent to the Works generally within the last ten (10) years with at least fifty percent (50%) of the Estimated Project Cost (EPC) in the amount of **PhP119,496,000.00** *(each partner/either one of the partners)* and 25% of the EPC *for the rest of the partners);* and - Average Annual Turnover of Construction Income for the last three (3) years of at least 100% of the EPC in the amount of **Php238,992,000.00** of the EPC as evidenced by the submitted Audited Financial Statements for the last three (3) years *(each partner/either one of the partners)* and 50% of the EPC for the rest of the partners.
c. Audited Financial Statements for the last three (3) years [with supporting Income Tax Return stamped "received" by BIR or its duly accredited and authorized institutions or eBIR Tax Return Receipt Confirmation (if submitted through eBIR), and eFPS/validated banbk deposit slip payment] *(each partner)*
d. In case of Joint Venture, a duly notarized Joint Venture agreement and a copy of the duly accomplished application form for Special License of the Joint Venture filed with the PCAB, or a copy of the Special License of the Joint Venture if already issued.
e. Qualification Information (please follow the **link** PRDP Pangasinan SU Form Qualification Information.docx for the template)
TECHNICAL DOCUMENTS
f. Bid Security, in a form of **Bid Securing Declaration** (please follow the **link** PRDP Pangasinan SU Form Bid Securing Declaration.docxfor the template) *(prescribed template in the name of the Joint Venture)*
g. Project requirements, which shall include the following *(pooling of resources or combination among partners)*:
(i) List of Contractor's personnel to be assigned to the contract to be bid, **with their complete qualifications and experience data**, viz: a. **Project Manager** – Licensed Civil Engineer with minimum of five (5) years relevant work experience as Project Manager in Building Construction; b. **Two (2) Project Engineers** – Each should have a minimum of five (5) years' experience as a Licensed Civil/Agricultural Engineer with a minimum of two (2) projects handled in building construction as Project Engineer, each has a value of at least twenty percent (20%) of the Estimated Project Cost;

c. **Materials Engineer** – Licensed Civil Engineer duly accredited by DPWH following DPWH D.O. 98, S. of 2016 as Materials Engineer II *(as required under SCC Clause 6.5)*;

d. **Mechanical Engineer** - Licensed Mechanical Engineer with minimum of five (5) years' experience as a Licensed Mechanical Engineer with a minimum of two (2) projects handled in mechanical related works/projects as Mechanical Engineer, each has a value of at least twenty percent (20%) of the Mechanical Component of the EPC (PhP2,992,000.00) or equivalent value of at least PhP598,400.00;

e. **Electrical Engineer** - Licensed Electrical Engineer with minimum of five (5) years' experience as a Licensed Electrical Engineer with a minimum of two (2) projects handled in electrical related works/projects as Electrical Engineer, each has a value of at least twenty percent (20%) of the Electrical Component of the EPC (PhP10,929,000.00) or equivalent value of at least PhP2,185,800.00;

f. **Sanitary Engineer** - Licensed Sanitary Engineer with minimum of five (5) years' experience as a Licensed Sanitary Engineer and has at least two (2) projects handled in sanitary related works/projects as Sanitary Engineer, each has a value of at least twenty percent (20%) of the Sanitary Component of the EPC (PhP18,160,000.00) or equivalent value of at least PhP3,632,000.00;

Pass (if all the above documents are present)
Fail (if non-historical documents are absent, such as JV agreement, Bid Securing Declaration, Bid Form and Bill of Quantities)

Notwithstanding the BAC's declaration of non-responsiveness of the first bid envelope, the financial proposals contained in the second bid envelopes of all the bidders shall be read. The first and second envelopes shall not be returned to the bidders.
Foreign bidders may submit the equivalent documents, if any, issued by the country of the foreign bidder.

Envelope 2

FINANCIAL PROPOSAL

Bid price in approved **Bid form** (please follow the **link** PRDP Pangasinan SU Form Bid Form.docxfor the template), and

Bid prices in the **Bill of Quantities** (please follow the **link** bit.ly/bangushatcheryBOQ for the Bill of Quantities)

BID DATA SHEET
Clause 20.3 Each Bidder shall submit one (1) original and four (4) copies of the first and second components of its bid. An electronic copy of the bid should also be submitted in PDF file format in a flash drive. Should there be discrepancies, the original copy would prevail.

TABLE OF CONTENTS

Section I. Invitation to Bid

Republic of the Philippines
Philippine Rural Development Project Scale-Up
Invitation to Bid for the

Construction of Pangasinan Bangus Breeding and Hatchery

Identification No. PRDP-SU-IB-R001-PAN-003-000-000-2023-VCI
Loan No. 9577-PH

07 May 2024

1. The Government of the Philippines (GoP) has received a Loan from the World Bank towards the cost of Philippine Rural Development Project Scale Up and it intends to apply part of the proceeds of this Loan to payments under the contract for the **Construction of Pangasinan Bangus Breeding and Hatchery/ PRDP-SU-IB-R001-PAN-003-000-000-2023-VCI**.

2. The **Provincial Government of Pangasinan**, implementing partner of the Department of Agriculture, now invites bids for the **Construction of Pangasinan Bangus Breeding and Hatchery**. Completion of the Works is required by **783 calendar days**. Bidders should have completed, within the last ten (10) years, 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 in accordance with relevant procedures for open competitive bidding as specified in the IRR of RA 9184 (R.A. 9184), with some amendments, as stated in these bidding documents and is open to all bidders from eligible source countries as defined in the applicable procurement regulations of the World Bank. The contract shall be awarded to the Lowest Calculated Responsive Bidder (LCRB) who was determined as such during post-qualification. The Estimated Project Cost for this project is **Two Hundred Thirty-Eight Million, Nine Hundred Ninety-Two Thousand Pesos (PhP238,992,000.00)**.

4. Interested bidders may obtain further information from the Bids and Awards Committee of the Provincial Government of Pangasinan and inspect the Bidding Documents at the address given below and also at the PRDP Regional Project Coordination Office 1 at DA RFO 1, Aguila Road, Sevilla, San Fernando City, La Union and at the PRDP Project Support Office North Luzon A Cluster with address at Sto. Niño City of San Fernando, Pampanga and at the National Project Coordination Office (NPCO) with address at Elliptical Road, Diliman, Quezon City from **8:00 a.m. to 5:00 p.m.,** Mondays to Fridays.

5. A complete set of Bidding Documents may be purchased by interested Bidders starting **7 May 2024** from the Bids and Awards Committee of the Provincial Government of Pangasinan with address below, from PRDP RPCO 1 or PRDP PSO North Luzon A Cluster and upon payment or depositing to the Provincial Government of Pangasinan – LBP Lingayen

Branch Acct# 2422-1000-51 a non-refundable fee for the bidding documents in the amount of **Ten Thousand Pesos (PhP10,000.00) not later than the submission of their bids**. The LGU Treasurer's official receipt, the bank teller's validated deposit slip or printed receipt from digital payment serves as the proof of payment.

Digital payment shall mean payment using the likes of PayMaya, IAccess, Smart Money, GCash, Coins.ph and other means of digital payment.

Bidding Documents may also be downloaded free of charge from the website of the Philippine Government Electronic Procurement System (PhilGEPS) and the PRDP website (prdp.da.gov.ph). For Detailed Engineering Design (DED), Drawings and Plans, please follow this link https://drive.google.com/file/d/1YxS0qAIsIYkqIK_AeeGgnI4CL0mlTVlR/view?usp=drive_link

As part of the transparency measures being instituted by the Department of Agriculture (DA) the bidders can virtually visit the site of the above-described subproject at **prdp.da.gov.ph** where geotagged base photographs are viewable. The DA, however, requires that all potential contractors who will be awarded contracts under the project shall have undergone geotagging training provided by the PRDP Project Support Office.

6. The Provincial Government of Pangasinan will hold a Pre-Bid Conference on **May 23, 2024 at 10:00 a.m.** at the **Multi-Purpose Hall, PESO Building, East Alvear St., Lingayen, Pangasinan,** with invitation link as follows https://us02web.zoom.us/j/89583008487?pwd=ZGhxU3RvaFZwNmdUZ2dqOGFhUTZIUT09 , which shall be open to all interested parties.

7. Bids must be duly received by the BAC Secretariat at the address below on or before **June 6, 2024 at 10:00 a.m.** All bids must be accompanied by a **Bid Securing Declaration.**

8. Bids will be opened on **June 6, 2024 at 10:00 a.m.** at the **Multi-Purpose Hall, PESO Building, East Alvear St., Lingayen, Pangasinan, with invitation** with invitation link https://us02web.zoom.us/j/84524409981?pwd=MEtoNnA4MzRLUjNDSDA3RGlWWXFqQT09 which shall be open to all interested parties. Bids will be opened in the presence of the bidders' representatives who choose to attend at the address below. Late bids shall not be accepted.

9. The Provincial Government of Pangasinan reserves the right to accept or reject any bid, to annul the bidding process, and to reject all bids at any time prior to contract award, without thereby incurring any liability to the affected bidder or bidders.

10. For further information, please refer to:

RHODYN LUCHINVAR O. ORO
BAC Secretariat Head
Bids and Awards Committee
Provincial Government of Pangasinan
Tel. no.: 0756327840
Email Address: bacpangasinan@yahoo.com

MELICIO F. PATAGUE II
BAC Chairperson

Section II. Instruction to Bidders

TABLE OF CONTENTS

A. General

11. Scope of Bid

1.1. The Procuring Entity named in the BDS, invites bids for the construction of Works, as described in Section VI Specifications.

1.2. The name, identification, and number of lots specific to this bidding are provided in the BDS. The contracting strategy and basis of evaluation of lots is described in **ITB** Clause 27.

1.3. The successful Bidder will be expected to complete the Works by the intended completion date specified in SCC **Clause 1.17**.

12. Source of Funds

The Procuring Entity has a budget or received funds from the Funding Source named in the BDS, and in the amount indicated in the BDS. It intends to apply part of the funds received for the Project, as defined in the BDS, to cover eligible payments under the Contract for the Works.

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

3.1. Unless otherwise specified in the **BDS**, the Procuring Entity, as well as bidders and contractors, shall observe the highest standard of ethics during the procurement and execution of the contract. In pursuance of this policy, the Funding Source:

(a) defines, for purposes of this provision, the terms set forth below as follows:

(i) "corrupt practice" means behavior on the part of officials in the public or private sectors by which they improperly and unlawfully enrich themselves, others, or induce others to do so, by misusing the position in which they are placed, and includes the offering, giving, receiving, or soliciting of anything of value to influence the action of any such official in the procurement process or in contract execution; entering, on behalf of the Procuring Entity, into any contract or transaction manifestly and grossly disadvantageous to the same, whether or not the public officer profited or will profit thereby, and similar acts as provided in Republic Act 3019;

(ii) "fraudulent practice" means a misrepresentation of facts in order to influence a procurement process or the execution of a contract to the detriment of the Procuring Entity, and includes collusive practices among Bidders (prior to or after Bid submission) designed to establish bid prices at artificial, non-competitive levels and to deprive the Procuring Entity of the benefits of free and open competition;

(iii) "collusive practices" means a scheme or arrangement between two or more Bidders, with or without the knowledge of the Procuring Entity, designed to establish bid prices at artificial, non-competitive levels; and

(iv) "coercive practices" means harming or threatening to harm, directly or indirectly, persons, or their property to influence their participation in a procurement process, or affect the execution of a contract;

(v) "obstructive practice" is

(aa) deliberately destroying, falsifying, altering or concealing of evidence material to an administrative proceedings or investigation or making false statements to investigators in order to materially impede an administrative proceedings or investigation of the Procuring Entity or any foreign government/foreign or international financing institution into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the administrative proceedings or investigation or from pursuing such proceedings or investigation; or

(bb) acts intended to materially impede the exercise of the inspection and audit rights of the Procuring Entity or any foreign government/foreign or international financing institution herein.

(b) will reject a proposal for award if it determines that the Bidder recommended for award has engaged in corrupt or fraudulent practices in competing for the Contract; and

(c) will declare a firm ineligible, either indefinitely or for a stated period of time, to be awarded Contract funded by the Funding Source if it at any time determines that the firm has engaged in corrupt or fraudulent practices in competing or, or in executing, a Contract funded by the Funding Source.

3.2. Further, the Procuring Entity will seek to impose the maximum civil, administrative, and/or criminal penalties available under the applicable laws on individuals and organizations deemed to be involved in any of the practices mentioned in **ITB** Clause 3.1(a).

3.3. Furthermore, the Funding Source and the Procuring Entity reserve the right to inspect and audit records and accounts of a contractor in the bidding for and performance of a contract themselves or through independent auditors as reflected in the **GCC** Clause 34.

14. **Conflict of Interest**

4.1. All Bidders found to have conflicting interests shall be disqualified to participate in the procurement at hand, without prejudice to the imposition of appropriate administrative, civil, and criminal sanctions. A Bidder may be considered to have conflicting interests with another Bidder in any of the events described in paragraphs (a) through (c) and a general conflict of interest in any of the circumstances set out in paragraphs (d) through (g) below:

(a) A Bidder has controlling shareholders in common with another Bidder;

(b) A Bidder receives or has received any direct or indirect subsidy from any other Bidder;

(c) A Bidder has the same legal representative as that of another Bidder for purposes of this Bid;

(d) A Bidder has a relationship, directly or through third parties, that puts them in a position to have access to information about or influence on the bid of another Bidder or influence the decisions of the Procuring Entity regarding this bidding process;

(e) A Bidder submits more than one bid in this bidding process. However, this does not limit the participation of subcontractors in more than one bid;

(f) A Bidder who participated as a consultant in the preparation of the design or technical specifications of the goods and related services that are the subject of the bid; or

(g) A Bidder who lends, or temporarily seconds, its personnel to firms or organizations which are engaged in consulting services for the preparation related to procurement for or implementation of the project, if the personnel would be involved in any capacity on the same project.

4.2. In accordance with Section 47 of the IRR of RA 9184, all Bidding Documents shall be accompanied by a sworn affidavit of the Bidder that it is not related to the Head of the Procuring Entity (HoPE), members of the Bids and Awards Committee (BAC), members of the Technical Working Group (TWG), members of the BAC Secretariat, the head of the Project Management Office (PMO) or the end-user unit, and the project consultants, by consanguinity or affinity up to the third civil degree. On the part of the Bidder, this Clause shall apply to the following persons:

(a) If the Bidder is an individual or a sole proprietorship, to the Bidder himself;

(b) If the Bidder is a partnership, to all its officers and members;

(c) If the Bidder is a corporation, to all its officers, directors, and controlling stockholders;

(d) If the Bidder is a cooperative, to all its officers, directors, and controlling shareholders or members; and

(e) If the Bidder is a joint venture (JV), the provisions of items (a), (b), (c) or (d) of this Clause shall correspondingly apply to each of the members of the said JV, as may be appropriate.

Relationship of the nature described above or failure to comply with this Clause will result in the automatic disqualification of a Bidder.

15. **Eligible Bidders**

5.1. Unless otherwise indicated in the **BDS**, the following persons shall be eligible to participate in this Bidding:

(a) Duly licensed Filipino citizens/sole proprietorships;

(b) Partnerships duly organized under the laws of the Philippines and of which at least seventy five percent (75%) of the interest belongs to citizens of the Philippines;

(c) Corporations duly organized under the laws of the Philippines, and of which at least seventy five percent (75%) of the outstanding capital stock belongs to citizens of the Philippines;

(d) Cooperatives duly organized under the laws of the Philippines.

(e) Persons/entities forming themselves into a JV, i.e., a group of two (2) or more persons/entities that intend to be jointly and severally responsible or liable for a particular contract: Provided, however, that, in accordance with Letter of Instructions No. 630, Filipino ownership or interest of the joint venture concerned shall be at least seventy five percent (75%): Provided, further, that joint ventures in which Filipino ownership or interest is less than seventy five percent (75%) may be eligible where the structures to be built require the application of techniques and/or technologies which are not adequately possessed by a person/entity meeting the seventy five percent (75%) Filipino ownership requirement: Provided, finally, that in the latter case, Filipino ownership or interest shall not be less than twenty five percent (25%). For this purpose, Filipino ownership or interest shall be based on the contributions of each of the members of the joint venture as specified in their JVA.

5.2. The Procuring Entity may also invite foreign bidders when provided for under any Treaty or International or Executive Agreement as specified in the BDS.

5.3. Government owned or controlled corporations (GOCCs) may be eligible to participate only if they can establish that they (a) are legally and financially

autonomous, (b) operate under commercial law, and (c) are not attached agencies of the Procuring Entity.

5.4. (a) 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 Philippine Statistics Authority (PSA) consumer price index. However, contractors under Small A and Small B categories without similar experience on the contract to be bid may be allowed to bid if the cost of such contract is not more than the Allowable Range of Contract Cost (ARCC) of their registration based on the guidelines as prescribed by the PCAB.

(b) 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 BDS.

For this purpose, contracts similar to the Project shall be those described in the BDS.

5.5. The Bidder must submit a computation of its Net Financial Contracting Capacity (NFCC), which must be at least equal to the ABC to be bid, calculated as follows:

NFCC = [(Current assets minus current liabilities) (15)] minus the value of all outstanding or uncompleted portions of the projects under ongoing contracts, including awarded contracts yet to be started coinciding with the contract for this Project.

The values of the domestic bidder's current assets and current liabilities shall be based on the latest Audited Financial Statements (AFS) submitted to the BIR.

For purposes of computing the foreign bidders' NFCC, the value of the current assets and current liabilities shall be based on their audited financial statements prepared in accordance with international financial reporting standards.

16. **Bidder's Responsibilities**

6.1. The Bidder or its duly authorized representative shall submit a sworn statement in the form prescribed in Section IX Bidding Forms as required in **ITB** Clause 12.1(b)(ii.3).

6.2. The Bidder is responsible for the following:

(a) Having taken steps to carefully examine all of the Bidding Documents;

(b) Having acknowledged all conditions, local or otherwise, affecting the implementation of the contract;

(c) Having made an estimate of the facilities available and needed for the contract to be bid, if any;

(d) Having complied with its responsibility to inquire or secure Supplemental/Bid Bulletin/s as provided under **ITB** Clause 10.4.

(e) Ensuring that it is not "blacklisted" or barred from bidding by the GoP or any of its agencies, offices, corporations, or LGUs, including foreign government/foreign or international financing institution whose blacklisting rules have been recognized by the GPPB;

(f) Ensuring that 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;

(g) Authorizing the HoPE or its duly authorized representative/s to verify all the documents submitted;

(h) Ensuring that the signatory 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, accompanied by the duly notarized Special Power of Attorney, Board/Partnership Resolution, or Secretary's Certificate, whichever is applicable;

(i) Complying with the disclosure provision under Section 47 of RA 9184 and its IRR in relation to other provisions of RA 3019;

(j) Complying with existing labor laws and standards, in the case of procurement of services. Moreover, bidder undertakes to:

(i) Ensure the entitlement of workers to wages, hours of work, safety and health and other prevailing conditions of work as established by national laws, rules and regulations; or collective bargaining agreement; or arbitration award, if and when applicable.

In case there is a finding by the Procuring Entity or the DOLE of underpayment or non-payment of workers' wage and wage-related benefits, bidder agrees that the performance security or portion of the contract amount shall be withheld in favor of the complaining workers pursuant to appropriate provisions of Republic Act No. 9184 without prejudice to the institution of appropriate actions under the Labor Code, as amended, and other social legislations.

(ii) Comply with occupational safety and health standards and to correct deficiencies, if any.

In case of imminent danger, injury or death of the worker, bidder undertakes to suspend contract implementation pending clearance to proceed from the DOLE Regional Office and to comply with Work Stoppage Order; and

(iii) Inform the workers of their conditions of work, labor clauses under the contract specifying wages, hours of work and other benefits

under prevailing national laws, rules and regulations; or collective bargaining agreement; or arbitration award, if and when applicable, through posting in two (2) conspicuous places in the establishment's premises; and

(k) Ensuring that it 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;

Failure to observe any of the above responsibilities shall be at the risk of the Bidder concerned.

6.3. The Bidder, by the act of submitting its bid, shall be deemed to have inspected the site, determined the general characteristics of the contract works and the conditions for this Project and examine all instructions, forms, terms, and project requirements in the Bidding Documents.

6.4. It shall be the sole responsibility of the prospective bidder to determine and to satisfy itself by such means as it considers necessary or desirable as to all matters pertaining to this Project, including: (a) the location and the nature of the contract, project, or 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.

6.5. The Procuring Entity shall not assume any responsibility regarding erroneous interpretations or conclusions by the prospective or eligible bidder out of the data furnished by the procuring entity. However, the Procuring Entity shall ensure that all information in the Bidding Documents, including supplemental/bid bulletins issued are correct and consistent.

6.6. Before submitting their bids, the Bidders are deemed to have become familiar with all existing laws, decrees, ordinances, acts and regulations of the Philippines which may affect the contract in any way.

6.7. The Bidder shall bear all costs associated with the preparation and submission of his bid, and the Procuring Entity will in no case be responsible or liable for those costs, regardless of the conduct or outcome of the bidding process.

6.8. The Bidder should note that the Procuring Entity will accept bids only from those that have paid the applicable fee for the Bidding Documents at the office indicated in the Invitation to Bid.

17. **Origin of Goods and Services**

There is no restriction on the origin of Goods, or Contracting of Works or Services other than those prohibited by a decision of the United Nations Security Council taken under Chapter VII of the Charter of the United Nations.

18. **Subcontracts**

8.1. Unless otherwise specified in the BDS, the Bidder may subcontract portions of the Works to an extent as may be approved by the Procuring Entity and stated in the BDS. However, subcontracting of any portion shall not relieve the Bidder from any liability or obligation that may arise from the contract for this Project.

8.2. Subcontractors must submit the documentary requirements under **ITB** Clause 12 and comply with the eligibility criteria specified in the BDS. In the event that any subcontractor is found by the Procuring Entity to be ineligible, the subcontracting of such portion of the Works shall be disallowed.

8.3. The Bidder may identify the subcontractor to whom a portion of the Works will be subcontracted at any stage of the bidding process or during contract implementation. If the Bidder opts to disclose the name of the subcontractor during bid submission, the Bidder shall include the required documents as part of the technical component of its bid.

B. Contents of Bidding Documents

19. **Pre-Bid Conference**

9.1. (a) If so specified in the BDS, a pre-bid conference shall be held at the venue and on the date indicated therein, to clarify and address the Bidders' questions on the technical and financial components of this Project.

(b) The pre-bid conference shall be held at least twelve (12) calendar days before the deadline for the submission of and receipt of bids, but not earlier than seven (7) calendar days from the posting of the Invitation to Bid/Bidding Documents in the PhilGEPS website. If the Procuring Entity determines that, by reason of the method, nature, or complexity of the contract to be bid, or when international participation will be more advantageous to the GoP, a longer period for the preparation of bids is necessary, the pre-bid conference shall be held at least thirty (30) calendar days before the deadline for the submission and receipt of bids, as specified in the **BDS**.

9.2. Bidders are encouraged to attend the pre-bid conference to ensure that they fully understand the Procuring Entity's requirements. Non-attendance of the Bidder will in no way prejudice its bid; however, the Bidder is expected to know the changes and/or amendments to the Bidding Documents as recorded in the minutes of the pre-bid conference and the Supplemental/Bid Bulletin. The minutes of the pre-bid conference shall be recorded and prepared not later than five (5) calendar days after the pre-bid conference. The minutes shall be made available to prospective bidders not later than five (5) days upon written request.

9.3. Decisions of the BAC amending any provision of the bidding documents shall be issued in writing through a Supplemental/Bid Bulletin at least seven (7) calendar days before the deadline for the submission and receipt of bids.

110. Clarification and Amendment of Bidding Documents

10.1. Prospective bidders may request for clarification(s) on and/or interpretation of any part of the Bidding Documents. Such a request must be in writing and submitted to the Procuring Entity at the address indicated in the BDS at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

10.2. The BAC shall respond to the said request by issuing a Supplemental/Bid Bulletin, to be made available to all those who have properly secured the Bidding Documents, at least seven (7) calendar days before the deadline for the submission and receipt of Bids.

10.3. Supplemental/Bid Bulletins may also be issued upon the Procuring Entity's initiative for purposes of clarifying or modifying any provision of the Bidding Documents not later than seven (7) calendar days before the deadline for the submission and receipt of Bids. Any modification to the Bidding Documents shall be identified as an amendment.

10.4. Any Supplemental/Bid Bulletin issued by the BAC shall also be posted in the PhilGEPS and the website of the Procuring Entity concerned, if available, and at any conspicuous place in the premises of the Procuring Entity concerned. It shall be the responsibility of all Bidders who have properly secured the Bidding Documents to inquire and secure Supplemental/Bid Bulletins that may be issued by the BAC. However, Bidders who have submitted bids before the issuance of the Supplemental/Bid Bulletin must be informed and allowed to modify or withdraw their bids in accordance with **ITB** Clause 23.

C. Preparation of Bids

111. Language of Bids

The eligibility requirements or statements, the bids, and all other documents to be submitted to the BAC must be in English. If the eligibility requirements or statements, the bids, and all other documents submitted to the BAC are in foreign language other than English, it must be accompanied by a translation of the documents in English. The documents shall be translated by the relevant foreign government agency, the foreign government agency authorized to translate documents, or a registered translator in the foreign bidder's country; and 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. The English translation shall govern, for purposes of interpretation of the bid.

112. Documents Comprising the Bid: Eligibility and Technical Components

12.1. Unless otherwise indicated in the **BDS**, the first envelope shall contain the following eligibility and technical documents:

(a) Eligibility Documents –

Class "A" Documents

(i) PhilGEPS Certificate of Registration and Membership in accordance with Section 8.5.2 of the IRR, except for foreign bidders participating in the procurement by a Philippine Foreign Service Office or Post, which shall submit their eligibility documents under Section 23.1 of the IRR, provided, that the winning bidder shall register with the PhilGEPS in accordance with Section 37.1.4 of the IRR;

(ii) Statement 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

(iii) Statement of the Bidder's SLCC similar to the contract to be bid, in accordance with ITB Clause 5.4.

The two statements required shall indicate for each contract the following:

(ii.1) name of the contract;

(ii.2) date of the contract;

(ii.3) contract duration;

(ii.4) owner's name and address;

(ii.5) nature of work;

(ii.6) contractor's role (whether sole contractor, subcontractor, or partner in a JV) and percentage of participation;

(ii.7) total contract value at award;

(ii.8) date of completion or estimated completion time;

(ii.9) total contract value at completion, if applicable;

(ii.10) percentages of planned and actual accomplishments, if applicable; and

(ii.11) value of outstanding works, if applicable.

The statement of the Bidder's SLCC shall be supported by the Notice of Award and/or Notice to Proceed, Project Owner's Certificate of Final Acceptance issued by the Owner other than the Contractor or the Constructors Performance Evaluation System (CPES) Final Rating, which must be at least satisfactory. In case of contracts with the private sector, an equivalent document shall be submitted;

(iv) Unless otherwise provided in the BDS, a valid special PCAB License in case of joint ventures, and registration for the type and cost of the contract for this Project; and

(v) NFCC computation in accordance with ITB Clause 5.5.

Class "B" Documents

(vi) If applicable, Joint Venture Agreement (JVA) in accordance with RA 4566.

(b) Technical Documents –

(i) Bid security in accordance with **ITB** Clause 18. If the Bidder opts to submit the bid security in the form of:

(i.1) a bank draft/guarantee or an irrevocable letter of credit issued by a foreign bank, it shall be accompanied by a confirmation from a Universal or Commercial Bank; or

(i.2) a surety bond accompanied by a certification coming from the Insurance Commission that the surety or insurance company is authorized to issue such instruments.

(ii) Project Requirements, which shall include the following:

(ii.1) Organizational chart for the contract to be bid;

(ii.2) List of contractor's 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. These personnel must meet the required minimum years of experience set in the **BDS**; and

(ii.3) 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, which must meet the minimum requirements for the contract set in the **BDS**; and

(iii) Sworn statement in accordance with Section 25.3 of the IRR of RA 9184 and using the form prescribed in Section IX Bidding Forms.

113. **Documents Comprising the Bid: Financial Component**

13.1. Unless otherwise stated in the BDS, the financial component of the bid shall contain the following:

(a) Financial Bid Form, which includes bid prices and the bill of quantities, in accordance with **ITB** Clauses 15.1 and 15.3; and

(b) Any other document related to the financial component of the bid as stated in the BDS.

13.2. (a) Unless otherwise stated in the BDS**,** all Bids that exceed the ABC shall not be accepted.

(b) Unless otherwise indicated in the BDS, for foreign-funded procurement, a ceiling may be applied to bid prices provided the following conditions are met:

(i) Bidding Documents are obtainable free of charge on a freely accessible website. If payment of Bidding Documents is required by the procuring entity, payment could be made upon the submission of bids.

(ii) The procuring entity has procedures in place to ensure that the ABC is based on recent estimates made by the engineer or the responsible unit of the procuring entity and that the estimates are based on adequate detailed engineering (in the case of infrastructure projects) and reflect the quality, supervision and risk and inflationary factors, as well as prevailing market prices, associated with the types of works or goods to be procured.

(iii) The procuring entity has trained cost estimators on estimating prices and analyzing bid variances. In the case of infrastructure projects, the procuring entity must also have trained quantity surveyors.

(iv) The procuring entity has established a system to monitor and report bid prices relative to ABC and engineer's/procuring entity's estimate.

(v) The procuring entity has established a monitoring and evaluation system for contract implementation to provide a feedback on actual total costs of goods and works.

114. **Alternative Bids**

14.1. Alternative Bids shall be rejected. For this purpose, alternative bid is an offer made by a Bidder in addition or as a substitute to its original bid which may be included as part of its original bid or submitted separately therewith for purposes of bidding. A bid with options is considered an alternative bid regardless of whether said bid proposal is contained in a single envelope or submitted in two (2) or more separate bid envelopes.

14.2. 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.

14.3. Each Bidder shall submit only one Bid, either individually or as a partner in a JV. A Bidder who submits or participates in more than one bid (other than as a subcontractor if a subcontractor is permitted to participate in more than one bid) will cause all the proposals with the Bidder's participation to be disqualified. This

shall be without prejudice to any applicable criminal, civil and administrative penalties that may be imposed upon the persons and entities concerned.

115. **Bid Prices**

15.1. The contract shall be for the whole Works, as described in **ITB** Clause 1.1, based on the priced Bill of Quantities submitted by the Bidder.

15.2. The Bidder shall fill in rates and prices for all items of the Works described in the Bill of Quantities. Bids not addressing or providing all of the required items in the Bidding Documents including, where applicable, Bill of Quantities, shall be considered non-responsive and, thus, automatically disqualified. In this regard, where a required item is provided, but no price is indicated, the same shall be considered as non-responsive, but specifying a zero (0) or a dash (-) for the said item would mean that it is being offered for free to the Government, except those required by law or regulations to be provided for.

15.3. All duties, taxes, and other levies payable by the Contractor under the Contract, or for any other cause, prior to the deadline for submission of bids, shall be included in the rates, prices, and total bid price submitted by the Bidder.

15.4. All bid prices for the given scope of work in the contract as awarded shall be considered as fixed prices, and therefore not subject to price escalation during contract implementation, except under extraordinary circumstances as specified in GCC Clause 48. Upon the recommendation of the Procuring Entity, price escalation may be allowed in extraordinary circumstances as may be determined by the National Economic and Development Authority in accordance with the Civil Code of the Philippines, and upon approval by the GPPB. Furthermore, in cases where the cost of the awarded contract is affected by any applicable new laws, ordinances, regulations, or other acts of the GoP, promulgated after the date of bid opening, a contract price adjustment shall be made or appropriate relief shall be applied on a no loss-no gain basis.

116. **Bid Currencies**

16.1. All bid prices shall be quoted in Philippine Pesos unless otherwise provided in the BDS. However, for purposes of bid evaluation, bids denominated in foreign currencies shall be converted to Philippine currency based on the exchange rate prevailing on the day of the Bid Opening.

16.2. If so allowed in accordance with **ITB** Clause 16.1, the Procuring Entity for purposes of bid evaluation and comparing the bid prices will convert the amounts in various currencies in which the bid price is expressed to Philippine Pesos at the exchange rate as published in the *Bangko Sentral ng Pilipinas* (BSP) reference rate bulletin on the day of the bid opening.

16.3. Unless otherwise specified in the **BDS**, payment of the contract price shall be made in Philippine Pesos.

117. **Bid Validity**

17.1. Bids shall remain valid for the period specified in the BDS which shall not exceed one hundred twenty (120) calendar days from the date of the opening of bids.

17.2. In exceptional circumstances, prior to the expiration of the bid validity period, the Procuring Entity may request Bidders to extend the period of validity of their bids. The request and the responses shall be made in writing. The bid security described in **ITB** Clause 18 should also be extended corresponding to the extension of the bid validity period at the least. A Bidder may refuse the request without forfeiting its bid security, but his bid shall no longer be considered for further evaluation and award. A Bidder granting the request shall not be required or permitted to modify its bid.

118. **Bid Security**

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

Form of Bid Security	Amount of Bid Security (Not less than the Percentage of the ABC)
(a) Cash or cashier's/manager's check issued by a Universal or Commercial Bank.	Two percent (2%)
(b) Bank draft/guarantee or irrevocable letter of credit issued by a Universal or Commercial Bank: Provided, however, that it shall be confirmed or authenticated by a Universal or Commercial Bank, if issued by a foreign bank.	
(c) Surety bond callable upon demand issued by a surety or insurance company duly certified by the Insurance Commission as authorized to issue such security; and/or	Five percent (5%)
(d) Bid Securing Declaration	

The Bid Securing Declaration mentioned above is an undertaking which states, among others, that the Bidder shall enter into contract with the procuring entity and furnish the performance security required under ITB Clause 32.2, within ten (10) calendar days from receipt of the Notice of Award, and commits to pay the corresponding amount as fine, and be suspended for a period of time from being qualified to participate in any government procurement activity in the event it violates any of the conditions stated therein as provided in the guidelines issued by the GPPB.

18.2. The bid security should be valid for the period specified in the BDS. Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

18.3. No bid securities shall be returned to Bidders after the opening of bids and before contract signing, except to those that failed or declared as post-disqualified, upon submission of a written waiver of their right to file a request for reconsideration and/or protest, or lapse of the reglementary period without having filed a request for reconsideration or protest. Without prejudice on its forfeiture, Bid Securities shall be returned only after the Bidder with the Lowest Calculated Responsive Bid (LCRB) has signed the contract and furnished the Performance Security, but in no case later than the expiration of the Bid Security validity period indicated in ITB **Clause 18.2**.

18.4. Upon signing and execution of the contract, pursuant to **ITB** Clause 31, and the posting of the performance security, pursuant to **ITB** Clause 32, the successful Bidder's Bid Security will be discharged, but in no case later than the Bid Security validity period as indicated in ITB **Clause 18.2**.

18.5. The bid security may be forfeited:

(a) if a Bidder:

(i) withdraws its bid during the period of bid validity specified in **ITB** Clause 17;

(ii) does not accept the correction of errors pursuant to **ITB** Clause 27.3(b);

(iii) has a finding against the veracity of the required documents submitted in accordance with ITB Clause 28.2;

(iv) submission of eligibility requirements containing false information or falsified documents;

(v) submission of bids that contain false information or falsified documents, or the concealment of such information in the bids in order to influence the outcome of eligibility screening or any other stage of the public bidding;

(vi) allowing the use of one's name, or using the name of another for purposes of public bidding;

(vii) withdrawal of a bid, or refusal to accept an award, or enter into contract with the Government without justifiable cause, after the Bidder had been adjudged as having submitted the LCRB;

(viii) refusal or failure to post the required performance security within the prescribed time;

(ix) refusal to clarify or validate in writing its bid during post-qualification within a period of seven (7) calendar days from receipt of the request for clarification;

(x) any documented attempt by a Bidder to unduly influence the outcome of the bidding in his favor;

(xi) failure of the potential joint venture partners to enter into the joint venture after the bid is declared successful; or

(xii) all other acts that tend to defeat the purpose of the competitive bidding, such as habitually withdrawing from bidding, submitting late Bids or patently insufficient bid, for at least three (3) times within a year, except for valid reasons.

(b) if the successful Bidder:

(i) fails to sign the contract in accordance with **ITB** Clause 31;

(ii) fails to furnish performance security in accordance with **ITB** Clause 32.

119. **Format and Signing of Bids**

19.1 Bidders shall submit their bids through their duly authorized representative using the appropriate forms provided in Section IX in the Bidding Forms on or before the deadline specified in the **ITB** Clause 21 in two (2) separate sealed bid envelopes, and which shall be submitted simultaneously. The first shall contain the technical component of the bid, including the eligibility requirements under **ITB** Clause 12.1, and the second shall contain the financial component of the bid. This shall also be observed for each lot in the case of lot procurement.

19.2 Forms as mentioned in **ITB** Clause 19.1 must be completed without any alterations to their format, and no substitute form shall be accepted. All blank spaces shall be filled in with the information requested.

19.3 The Bidder shall prepare and submit an original of the first and second envelopes as described in **ITB** Clauses 12 and 13. In addition, the Bidder shall submit copies of the first and second envelopes. In the event of any discrepancy between the original and the copies, the original shall prevail.

19.4 Each and every page of the Bid Form, including the Bill of Quantities, under Section IX hereof, shall be signed by the duly authorized representative/s of the Bidder. Failure to do so shall be a ground for the rejection of the bid.

19.5 Any interlineations, erasures, or overwriting shall be valid only if they are signed or initialed by the duly authorized representative/s of the Bidder.

120. **Sealing and Marking of Bids**

20.1. Bidders shall enclose their original eligibility and technical documents described in **ITB** Clause 12, in one sealed envelope marked "ORIGINAL - TECHNICAL COMPONENT," and the original of their financial component in another sealed envelope marked "ORIGINAL - FINANCIAL COMPONENT," sealing them all in an outer envelope marked "ORIGINAL BID."

20.2. Each copy of the first and second envelopes shall be similarly sealed duly marking the inner envelopes as "COPY NO. ___ - TECHNICAL COMPONENT" and "COPY NO. ___ – FINANCIAL COMPONENT" and the outer envelope as

"COPY NO. ___," respectively. These envelopes containing the original and the copies shall then be enclosed in one single envelope.

20.3. The original and the number of copies of the bid as indicated in the BDS shall be typed or written in ink and shall be signed by the Bidder or its duly authorized representative/s.

20.4. All envelopes shall:

(a) contain the name of the contract to be bid in capital letters;

(b) bear the name and address of the Bidder in capital letters;

(c) be addressed to the Procuring Entity's BAC in accordance with **ITB** Clause 20.1;

(d) bear the specific identification of this bidding process indicated in the **ITB** Clause 1.2; and

(e) bear a warning "DO NOT OPEN BEFORE…" the date and time for the opening of bids, in accordance with **ITB** Clause 21.

20.5. Bid envelopes that are not properly sealed and marked, as required in the bidding documents, shall not be rejected, but the Bidder or its duly authorized representative shall acknowledge such condition of the bid as submitted. The BAC or the Procuring Entity shall assume no responsibility for the misplacement of the contents of the improperly sealed or marked bid, or for its premature opening.

D. Submission and Opening of Bids

121. Deadline for Submission of Bids

Bids must be received by the Procuring Entity's BAC at the address and on or before the date and time indicated in the BDS.

122. Late Bids

Any bid submitted after the deadline for submission and receipt of bids prescribed by the Procuring Entity, pursuant to **ITB** Clause 21, shall be declared "Late" and shall not be accepted by the Procuring Entity. The BAC shall record in the minutes of Bid Submission and Opening, the Bidder's name, its representative and the time the late bid was submitted.

123. Modification and Withdrawal of Bids

23.1. The Bidder may modify its bid after it has been submitted; provided that the modification is received by the Procuring Entity prior to the deadline prescribed for submission and receipt of bids. The Bidder shall not be allowed to retrieve its original bid, but shall be allowed to submit another bid equally sealed and properly identified in accordance with Clause 20, linked to its original bid marked as "TECHNICAL MODIFICATION" or "FINANCIAL MODIFICATION" and

stamped "received" by the BAC. Bid modifications received after the applicable deadline shall not be considered and shall be returned to the Bidder unopened.

23.2. A Bidder may, through a Letter of Withdrawal, withdraw its bid after it has been submitted, for valid and justifiable reason; provided that the Letter of Withdrawal is received by the Procuring Entity prior to the deadline prescribed for submission and receipt of bids. The Letter of Withdrawal must be executed by the authorized representative of the Bidder identified in the Omnibus Sworn Statement, a copy of which should be attached to the letter.

23.3. Bids requested to be withdrawn in accordance with **ITB** Clause 23.1 shall be returned unopened to the Bidders. A Bidder, who has acquired the bidding documents may also express its intention not to participate in the bidding through a letter which should reach and be stamped by the BAC before the deadline for submission and receipt of bids. A Bidder that withdraws its bid shall not be permitted to submit another bid, directly or indirectly, for the same contract.

23.4. No bid may be modified after the deadline for submission of bids. No bid may be withdrawn in the interval between the deadline for submission of bids and the expiration of the period of bid validity specified by the Bidder on the Financial Bid Form. Withdrawal of a bid during this interval shall result in the forfeiture of the Bidder's bid security, pursuant to **ITB** Clause 18.5, and the imposition of administrative, civil, and criminal sanctions as prescribed by RA 9184 and its IRR.

124. Opening and Preliminary Examination of Bids

24.1. The BAC shall open the Bids in public, immediately after the deadline for the submission and receipt of bids in public, as specified in the BDS. In case the Bids cannot be opened as scheduled due to justifiable reasons, the BAC shall take custody of the Bids submitted and reschedule the opening of Bids on the next working day or at the soonest possible time through the issuance of a Notice of Postponement to be posted in the PhilGEPS website and the website of the Procuring Entity concerned.

24.2. Unless otherwise specified in the BDS, the BAC shall open the first bid envelopes and determine each Bidder's compliance with the documents prescribed in ITB Clause 12, using a non-discretionary "pass/fail" criterion. If a Bidder submits the required document, it shall be rated "passed" for that particular requirement. In this regard, bids that fail to include any requirement or are incomplete or patently insufficient shall be considered as "failed". Otherwise, the BAC shall rate the said first bid envelope as "passed".

24.3. Unless otherwise specified in the **BDS**, immediately after determining compliance with the requirements in the first envelope, the BAC shall forthwith open the second bid envelope of each remaining eligible Bidder whose first bid envelope was rated "passed." The second envelope of each complying Bidder shall be opened within the same day. In case one or more of the requirements in the second envelope of a particular bid is missing, incomplete or patently insufficient, and/or if the submitted total bid price exceeds the ABC unless otherwise provided in ITB Clause 13.2, the BAC shall rate the bid concerned as "failed." Only bids that are determined to contain all the bid requirements for both components shall

be rated "passed" and shall immediately be considered for evaluation and comparison.

24.4. Letters of Withdrawal shall be read out and recorded during bid opening, and the envelope containing the corresponding withdrawn bid shall be returned to the Bidder unopened.

24.5. All members of the BAC who are present during bid opening shall initial every page of the original copies of all bids received and opened.

24.6. In the case of an eligible foreign bidder as described in **ITB** Clause 5, the following Class "A" Documents may be substituted with the appropriate equivalent documents, if any, issued by the country of the foreign bidder concerned, which shall likewise be uploaded and maintained in the PhilGEPS in accordance with Section 8.5.2 of the IRR.:

a) Registration certificate from the Securities and Exchange Commission (SEC), Department of Trade and Industry (DTI) for sole proprietorship, or CDA for cooperatives;

b) Mayor's/Business permit issued by the local government where the principal place of business of the Bidder is located; and

c) Audited Financial Statements showing, among others, the prospective Bidder's total and current assets and liabilities stamped "received" by the Bureau of Internal Revenue or its duly accredited and authorized institutions, for the preceding calendar year which should not be earlier than two years from the date of bid submission.

24.7. Each partner of a joint venture agreement shall likewise submit the document required in **ITB** Clause 12.1(a)(i). Submission of documents required under **ITB** Clauses 12.1(a)(ii) to 12.1(a)(iv) by any of the joint venture partners constitutes compliance.

24.8. The Procuring Entity shall prepare the minutes of the proceedings of the bid opening that shall include, as a minimum: (a) names of Bidders, their bid price (per lot, if applicable, and/or including discount, if any), bid security, findings of preliminary examination, and whether there is a withdrawal or modification; and (b) attendance sheet. The BAC members shall sign the abstract of bids as read.

24.8. The Bidders or their duly authorized representatives may attend the opening of bids. The BAC shall ensure the integrity, security, and confidentiality of all submitted bids. The Abstract of Bids as read and the minutes of the Bid Opening shall be made available to the public upon written request and payment of a specified fee to recover cost of materials.

24.9 To ensure transparency and accurate representation of the bid submission, the BAC Secretariat shall notify in writing all Bidders whose bids it has received through its PhilGEPS-registered physical address or official e-mail address. The notice shall be issued within seven (7) calendar days from the date of the bid opening.

E. Evaluation and Comparison of Bids

125. Process to be Confidential

25.1. Members of the BAC, including its staff and personnel, as well as its Secretariat and TWG, are prohibited from making or accepting any kind of communication with any Bidder regarding the evaluation of their bids until the issuance of the Notice of Award, unless otherwise allowed in the case of **ITB** Clause 26.

25.2. Any effort by a Bidder to influence the Procuring Entity in the Procuring Entity's decision in respect of bid evaluation, bid comparison or contract award will result in the rejection of the Bidder's bid.

126. Clarification of Bids

To assist in the evaluation, comparison and post-qualification of the bids, the Procuring Entity may ask in writing any Bidder for a clarification of its bid. All responses to requests for clarification shall be in writing. Any clarification submitted by a Bidder in respect to its bid and that is not in response to a request by the Procuring Entity shall not be considered

127. Detailed Evaluation and Comparison of Bids

27.1. The Procuring Entity will undertake the detailed evaluation and comparison of Bids which have passed the opening and preliminary examination of Bids, pursuant to **ITB** Clause 24, in order to determine the Lowest Calculated Bid.

27.2. The Lowest Calculated Bid shall be determined in two steps:

(a) The detailed evaluation of the financial component of the bids, to establish the correct calculated prices of the bids; and

(b) The ranking of the total bid prices as so calculated from the lowest to highest. The bid with the lowest price shall be identified as the Lowest Calculated Bid.

27.3. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all bids rated "passed," using non-discretionary "pass/fail" criterion. The BAC shall consider the following in the evaluation of bids:

(a) Completeness of the bid. Unless the **BDS** allows partial bids, bids not addressing or providing all of the required items in the Schedule of Requirements including, where applicable, bill of quantities, shall be considered non-responsive and, thus, automatically disqualified. In this regard, where a required item is provided, but no price is indicated, the same shall be considered as non-responsive, but specifying a zero (0) or a dash (-) for the said item would mean that it is being offered for free to the Procuring Entity, except those required by law or regulations to be provided for; and

(b) Arithmetical corrections. Consider computational errors and omissions to enable proper comparison of all eligible bids. It may also consider bid modifications. Any adjustment shall be calculated in monetary terms to determine the calculated prices.

27.4. Based on the detailed evaluation of bids, those that comply with the above-mentioned requirements shall be ranked in the ascending order of their total calculated bid prices, as evaluated and corrected for computational errors, discounts and other modifications, to identify the Lowest Calculated Bid. Total calculated bid prices, as evaluated and corrected for computational errors, discounts and other modifications, which exceed the ABC shall not be considered, unless otherwise indicated in the BDS.

27.5. The Procuring Entity's evaluation of bids shall be based on the bid price quoted in the Bid Form, which includes the Bill of Quantities.

27.6. Bids shall be evaluated on an equal footing to ensure fair competition. For this purpose, all Bidders shall be required to include in their bids the cost of all taxes, such as, but not limited to, value added tax (VAT), income tax, local taxes, and other fiscal levies and duties which shall be itemized in the bid form and reflected in the detailed estimates. Such bids, including said taxes, shall be the basis for bid evaluation and comparison.

27.7. If so indicated pursuant to **ITB** Clause 1.2. Bids are being invited for individual lots or for any combination thereof, provided that all Bids and combinations of Bids 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 prices quoted shall correspond to all of the requirements specified for each lot. Bid Security as required by **ITB** Clause 18 shall be submitted for each contract (lot) separately. The basis for evaluation of lots is specified in **BDS** Clause 27.3.

128. **Post Qualification**

28.1. The BAC shall determine to its satisfaction whether the Bidder that is evaluated as having submitted the Lowest Calculated Bid complies with and is responsive to all the requirements and conditions specified in **ITB** Clauses 5, 12, and 13.

28.2. 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**.

Failure to submit any of the post-qualification requirements on time, or a finding against the veracity thereof, shall disqualify the Bidder for award. Provided in the event that a finding against the veracity of any of the documents submitted is made, it shall cause the forfeiture of the bid security in accordance with Section 69 of the IRR of RA 9184.

28.3. The determination shall be based upon an examination of the documentary evidence of the Bidder's qualifications submitted pursuant to **ITB** Clauses 12 and 13, as well as other information as the Procuring Entity deems necessary and appropriate, using a non-discretionary "pass/fail" criterion, which shall be completed within a period of twelve (12) calendar days.

28.4. If the BAC determines that the Bidder with the Lowest Calculated Bid passes all the criteria for post-qualification, it shall declare the said bid as the LCRB, and recommend to the HoPE the award of contract to the said Bidder at its submitted price or its calculated bid price, whichever is lower, subject to **ITB** Clause 30.3.

28.5. A negative determination shall result in rejection of the Bidder's bid, in which event the Procuring Entity shall proceed to the next Lowest Calculated Bid, with a fresh period to make a similar determination of that Bidder's capabilities to perform satisfactorily. If the second Bidder, however, fails the post qualification, the procedure for post qualification shall be repeated for the Bidder with the next Lowest Calculated Bid, and so on until the LCRB is determined for recommendation of contract award.

28.6. Within a period not exceeding fifteen (15) calendar days from the determination by the BAC of the LCRB and the recommendation to award the contract, the HoPE or his duly authorized representative shall approve or disapprove the said recommendation.

28.7. In the event of disapproval, which shall be based on valid, reasonable, and justifiable grounds as provided for under Section 41 of the IRR of RA 9184, the HoPE shall notify the BAC and the Bidder in writing of such decision and the grounds for it. When applicable, the BAC shall conduct a post-qualification of the Bidder with the next Lowest Calculated Bid. A request for reconsideration may be filed by the Bidder with the HoPE in accordance with Section 37.1.3 of the IRR of RA 9184.

129. **Reservation Clause**

29.1. Notwithstanding the eligibility or post-qualification of a Bidder, the Procuring Entity concerned reserves the right to review its qualifications at any stage of the procurement process if it has reasonable grounds to believe that a misrepresentation has been made by the said Bidder, or that there has been a change in the Bidder's capability to undertake the project from the time it submitted its eligibility requirements. Should such review uncover any misrepresentation made in the eligibility and bidding requirements, statements or documents, or any changes in the situation of the Bidder which will affect its capability to undertake the project so that it fails the preset eligibility or bid evaluation criteria, the Procuring Entity shall consider the said Bidder as ineligible and shall disqualify it from submitting a bid or from obtaining an award or contract.

29.2. Based on the following grounds, the Procuring Entity reserves the right to reject any and all Bids, declare a Failure of Bidding at any time prior to the contract award, or not to award the contract, without thereby incurring any liability, and make no assurance that a contract shall be entered into as a result of the bidding:

(a) If there is *prima facie* evidence of collusion between appropriate public officers or employees of the Procuring Entity, or between the BAC and any of the Bidders, or if the collusion is between or among the Bidders themselves, or between a Bidder and a third party, including any act which restricts, suppresses or nullifies or tends to restrict, suppress or nullify competition;

(b) If the Procuring Entity's BAC is found to have failed in following the prescribed bidding procedures; or

(c) For any justifiable and reasonable ground where the award of the contract will not redound to the benefit of the GOP as follows:

(i) If the physical and economic conditions have significantly changed so as to render the project no longer economically, financially or technically feasible as determined by the HoPE;

(ii) If the project is no longer necessary as determined by the HoPE; and

(iii) If the source of funds for the project has been withheld or reduced through no fault of the Procuring Entity.

29.3. In addition, the Procuring Entity may likewise declare a failure of bidding when:

(a) No bids are received;

(b) All prospective Bidders are declared ineligible;

(c) All bids fail to comply with all the bid requirements, fail post-qualification; or

(d) The Bidder with the LCRB refuses, without justifiable cause, to accept the award of contract, and no award is made in accordance with Section 40 of the IRR of RA 9184.

F. Award of Contract

130. Contract Award

30.1. Subject to **ITB** Clause 28, the HoPE or its duly authorized representative shall award the contract to the Bidder whose bid has been determined to be the LCRB.

30.2. Prior to the expiration of the period of bid validity, the Procuring Entity shall notify the successful Bidder in writing that its bid has been accepted, through a Notice of Award duly received by the Bidder or its representative personally or by registered mail or electronically, receipt of which must be confirmed in writing within two (2) days by the Bidder with the LCRB and submitted personally or sent by registered mail or electronically to the Procuring Entity.

30.3. Notwithstanding the issuance of the Notice of Award, award of contract shall be subject to the following conditions:

(a) Submission of the following documents within ten (10) calendar days from receipt of the Notice of Award:

(i) In the case of procurement by a Philippine Foreign Service Office or Post, the PhilGEPS Registration Number of the winning foreign Bidder; or

(ii) Valid PCAB license and registration for the type and cost of the contract to be bid for foreign bidders when the Treaty or International or Executive Agreement expressly allows submission of the PCAB license and registration for the type and cost of the contract to be bid as a pre-condition to the Award;

(b) Posting of the performance security in accordance with **ITB** Clause 32;

(c) Signing of the contract as provided in **ITB** Clause 31; and

(d) Approval by higher authority, if required, as provided in Section 37.3 of the IRR of RA 9184.

131. **Signing of the Contract**

31.1. At the same time as the Procuring Entity notifies the successful Bidder that its bid has been accepted, the Procuring Entity shall send the Contract Form to the Bidder, which Contract has been provided in the Bidding Documents, incorporating therein all agreements between the parties.

31.2. Within ten (10) calendar days from receipt of the Notice of Award, the successful Bidder shall post the required performance security, sign and date the contract and return it to the Procuring Entity.

31.3. The Procuring Entity shall enter into contract with the successful Bidder within the same ten (10) calendar day period provided that all the documentary requirements are complied with.

31.4. The following documents shall form part of the contract:

(a) Contract Agreement;

(b) Bidding Documents;

(c) Winning Bidder's bid, including the Technical and Financial Proposals, and all other documents/statements submitted (*e.g.*, Bidder's response to request for clarifications on the bid), including corrections to the bid, if any, resulting from the Procuring Entity's bid evaluation;

(d) Performance Security;

(e) Notice of Award of Contract; and

(f) Other contract documents that may be required by existing laws and/or specified in the BDS.

132. **Performance Security**

32.1. To guarantee the faithful performance by the winning Bidder of its obligations under the contract, it shall post a performance security within a maximum period of ten (10) calendar days from the receipt of the Notice of Award from the Procuring Entity and in no case later than the signing of the contract.

32.2. The Performance Security shall be denominated in Philippine Pesos and posted in favor of the Procuring Entity in an amount not less than the percentage of the total contract price in accordance with the following schedule:

Form of Performance Security	Amount of Performance Security (Not less than the Percentage of the Total Contract Price)
(a) Cash or cashier's/manager's check issued by a Universal or Commercial Bank.	Ten percent (10%)
(b) Bank draft/guarantee or irrevocable letter of credit issued by a Universal or Commercial Bank: Provided, however, that it shall be confirmed or authenticated by a Universal or Commercial Bank, if issued by a foreign bank.	
(c) Surety bond callable on demand issued by a surety or insurance company duly certified by the Insurance Commission as authorized to issue such security.	Thirty percent (30%)

32.3. Failure of the successful Bidder to comply with the above-mentioned requirement shall constitute sufficient ground for the annulment of the award and forfeiture of the bid security, in which event the Procuring Entity shall have a fresh period to initiate and complete the post qualification of the second Lowest Calculated Bid. The procedure shall be repeated until LCRB is identified and selected for recommendation of contract award. However if no Bidder passed post-qualification, the BAC shall declare the bidding a failure and conduct a re-bidding with re-advertisement, if necessary.

133. **Notice to Proceed**

Within seven (7) calendar days from the date of approval of the Contract by the appropriate government approving authority, the Procuring Entity shall issue the Notice to Proceed (NTP) together with a copy or copies of the approved contract to the successful Bidder. All notices called for by the terms of the contract shall be effective only at the time of receipt thereof by the successful Bidder.

134. **Protest Mechanism**

Decision of the procuring entity at any stage of the procurement process may be questioned in accordance with Sections 55 of the IRR of RA 9184.

Section III. Bid Data Sheet

ITB Clause	
1.1	The Procuring Entity is **Provincial Government of Pangasinan** The name of the Contract is **Construction of Pangasinan Bangus Breeding and Hatchery** The identification number of the Contract is **PRDP-SU-IB-R001-PAN-003-000-000-2023-VCI**
2	The Funding Source is the World Bank through **Loan No. 9577-PH** in the amount of **US$600,000,000.00.** The name of the Project is **Philippine Rural Development Project Scale-Up**. Payments by the Foreign Funding Source will be made only at the request of the PROCURING ENTITY and upon approval by the Funding Source in accordance with the terms and conditions of the Loan Agreement between the PROCURING ENTITY and the Funding Source. (hereunder called the "Loan Agreement"). The Payments will be subject in all respect to the terms and conditions of the Loan Agreement and the applicable law. No party other than the PROCURING ENTITY shall derive any rights from the Loan Agreement or have any claim to the funds.
3.1	The World Bank's Anti-Corruption Guidelines requires Borrowers (including beneficiaries of Bank-financed activity), as well as Bidders, Suppliers, Contractors and their agents (whether declared or not), sub-contractors, sub-consultants, service providers or suppliers and any personnel thereof, observe the highest standard of ethics during the procurement and execution of Bank-financed contracts. Any action to influence the procurement process or contract execution for undue advantage is improper. In pursuance of this policy, the Bank: (a) defines, for the purposes of this provision, the terms set forth below as follows: (i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party. Another party refers to a public official acting in relation to the procurement process or contract execution. Public official includes World Bank staff and employees of other organizations taking or reviewing procurement decisions; (ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation. The term "party" refers to a public official; the terms "benefit" and "obligations" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution; (iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or

	the property of the party to improperly influence the actions of a party. The term "party" refers to a participant in the procurement process or contract execution; (iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party. The term "parties" refers to participants in the procurement process (including public officials) attempting either themselves, or through another person or entity not participating in the procurement or selection process, to simulate competition or establish bid prices at artificial, noncompetitive levels, or are privy to each other's bid prices or other conditions; (v) "obstructive practice" is (aa) deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or (bb) acts intended to materially impede the exercise of the Bank's inspection and audit rights provided for under paragraph (e) below. (b) will reject a proposal for award if it determines that the Bidder recommended for award, or any of its personnel, or its agents, or its sub-consultants, sub-contractors, service providers, suppliers and/or their employees, has, directly or indirectly, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract in question (c) will declare mis-procurement and cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Borrower or of a recipient of any part of the proceeds of the financing engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices during the procurement or the implementation of the contract in question, without the Borrower having taken timely and appropriate action satisfactory to Bank to address such practices when they occur, including by failing to inform the Bank in a timely manner at the time they knew of the practices; (d) will sanction a firm or an individual, at any time, in accordance with the prevailing Bank's sanctions procedures, including by publicly declaring such firm or individual ineligible, either indefinitely or for a stated period of time: (i) to be awarded a Bank-financed contract; and (ii) to be a nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding document) is one which has either been (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that allow the bidder to meet the qualification requirements for the particular bid; or (ii)

	appointed by the Borrower. A firm or individual may be declared ineligible to be awarded a Bank financed contract upon (i) completion of the Bank's sanctions proceedings as per its sanctions procedures, including, inter alia, cross debarment as agreed with other International Financial Institutions, including Multilateral Development Banks, and through the application of the World Bank Group corporate administrative procurement sanctions procedures for fraud and corruption; and (ii) as a result of temporary suspension or early temporary suspension in connection with an ongoing sanctions proceeding. See footnote 14 and paragraph 8 of Appendix 1 of the World Bank Guidelines for Procurement of Goods, Works, and Non-Consulting Services; (e) will require that a clause be included in bidding documents and in contracts financed by a Bank loan or grant, requiring bidders, suppliers and contractors, and their subcontractors, agents, personnel, consultants, service providers, or suppliers to permit Bank to inspect all accounts and records and other documents relating to the submission of bids and contract performance, and to have them audited by auditors appointed by Bank.
5.1	The Financing Agreement provides that procurement shall follow the Bank's Procurement Regulations and Section 3.21 thereof permits the participation of firms from all countries except for those mentioned in Section 3.23 thereof. last
5.2	Foreign bidders may participate in this Project as provided for in the financing agreement which provides that procurement shall follow the Bank's Procurement Regulations and Section 3.21 thereof permits the participation of firms from all countries except for those mentioned in Section 3.23 thereof.
5.4	To be considered eligible and qualified, a Bidder must have: - A successful experience as prime contractor in the construction of at least one (1) work of a nature and complexity equivalent to the Works generally within the ten (10) years (to comply with this requirement, single works cited should be at least fifty percent (50%) of value of estimated contract cost of Works under bid in the amount of **One Hundred Nineteen Million Four Hundred Ninety-Six Thousand Pesos (PhP119,496,000.00)**, such being verifiable from Certificate of Completion; and - An average annual turnover of Construction Income for the last three (3) years equal or greater than one hundred percent (100%) of the estimated value of the contract to be bid as evidenced by the audited financial statements for the last three (3) years stamped "received" by the BIR [with supporting Income Tax Return stamped "received" by BIR or its duly accredited and authorized institutions or eBIR Tax Return Receipt Confirmation

	(if submitted through eBIR), and eFPS/validated bank deposit slip payment], in the amount of **Two Hundred Thirty-Eight Million, Nine Hundred Ninety-Two Thousand Pesos (PhP238,992,000.00).** **In case of Joint Venture, either one of the partners must have:** - A successful experience as prime contractor in the construction of at least one (1) work of a nature and complexity equivalent to the Works generally within the last ten (10) years of 50% of the estimated project cost of Works under bid amounting to **One Hundred Nineteen Million, Four Hundred Ninety-Six Thousand Pesos (PhP119,496,000.00)** such being verifiable from Certificate of Completion, and the rest of the partner with 25% of the estimated project cost of Works under bid amounting to **Fifty-Nine Million, Seven Hundred Forty-Eight Thousand Pesos(PhP59,748,000.00);** and - An average annual turnover of Construction Income for the last three (3) years of at least equal to one hundred (100%) of the estimated project cost of Works under bid as evidenced by the audited financial statements for the last three (3) years stamped "received" by the BIR [with supporting Income Tax Return stamped "received" by BIR or its duly accredited and authorized institutions or eBIR Tax Return Receipt Confirmation (if submitted through eBIR), and eFPS/validated bank deposit slip payment], in the amount of **Two Hundred Thirty-Eight Million, Nine Hundred Ninety-Two Thousand Pesos (PhP238,992,000.00)** and at least equal to 50% of the estimated project cost of Works under bid for the rest of the partner amounting to **One Hundred Nineteen Million Four Hundred Ninety-Six Thousand Pesos (PhP119,496,000.00).** For this purpose, similar contracts shall refer **to Building Construction Project**
5.5	Not mandatory.
8.1	Subcontracting is allowed. There is no restriction on the involvement of general sub-contractors in the areas of manual and semi-skilled labor or construction materials provided that the contractor undertakes not less than fifty percent (50%) of the contracted works with its own resources.
8.2	To be considered eligible and qualified a subcontractor must have a successful experience as contractor in the construction of at least one (1)

	work of a nature and complexity equivalent to the scope of works to be subcontracted, generally during the last five (5) years.
9.1	The Date, Time and Venue of the Pre-Bid Conference is: **May 23, 2024; 10:00AM** **Multi-Purpose Hall, PESO Building, East Alvear St., Lingayen, Pangasinan** with invitation link: https://us02web.zoom.us/j/89583008487?pwd=ZGhxU3RvaFZwNmdUZ2dqOGFhUTZIUT09
10.1	The Procuring Entity's address is: **BAC Conference Room, 2nd flr. Malong Building, Capitol Compound, Lingayen, Pangasinan**
10.4	No further instructions.
12.1	During Bid opening, if the first bid envelope lacks any of the following requirements that are historical information, these can be clarified following Section II, ITB Clause 26. If the first bid envelope lacks the Bid Securing Declaration, the bid shall be declared non-responsive. The first envelope shall contain the following eligibility and technical documents: **a. Eligibility Requirements** i. Registration Certification of the Company (from SEC or DTI or CDA); ii. Statement of the bidder's Single Largest Completed Contract (SLCC) similar to the contract to be bid and Average Annual Turnover, as specified in ITB Clause 5.4; iii. Audited Financial Statements for the last three (3) years; iv. In case of Joint Venture, a duly notarized Joint Venture agreement and a copy of the duly accomplished application form for Special License of the Joint Venture filed with the PCAB, or a copy of the Special License of the Joint Venture if already issued. **b. Technical Documents** v. Project Requirements, to include: (v.1) List of contractor's personnel **(one (1) Project Manager, (2) Project Engineers, one (1) Materials Engineer, one (1) Mechanical Engineer, one (1) Electrical Engineer, and one (1) Sanitary Engineer)** to be assigned to the contract to be bid, with their complete qualifications and experience data; and (v.2) List of contractor's major equipment units which are owned and are supported by Certified True Copy from the Original of proof of ownership such as, without limitation, Deed of Sale, Official Receipt/Certificate of Registration, Sales Invoice, Charge Invoice or Delivery Receipt, which must meet the

	minimum requirement for the contract set in the BDS 12.1(b)(iii.3) vi. Bid Securing Declaration as required in ITB 18; Foreign bidders may submit the equivalent documents, if any, issued by the country of the foreign bidder.
12.1(a)(iii)	Foreign bidders may submit their valid 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 for this Project as a pre-condition for award as provided in the Financing Agreement, and ITB Nos. 12.1(b)(ii.2) and 12.1(b)(iii.3)

12.1(b)(ii.2)	The minimum work experience requirements for key personnel are the following:

Key Personnel	General Experience	Relevant Experience
1. Project Manager (ME)	Licensed Civil Engineer	Minimum of five (5) years relevant work experience as Project Manager in building construction.
2. Two (2) Project Engineers (PE)	Minimum of five (5) years' experience as a Licensed Civil/ Agricultural Engineer	Each should have a minimum of two (2) projects handled in building construction as Project Engineer, each has a value of at least twenty percent (20%) of the Estimated Project Cost;
3. Materials Engineer (ME)	Licensed Civil Engineer	duly accredited by DPWH as Materials Engineer II following DPWH D.O. 98, S. of 2016
4. Mechanical Engineer	minimum of five (5) years' experience as a Licensed Mechanical Engineer	Licensed Mechanical Engineer with a minimum two (2) projects handled in mechanical related works/projects as Mechanical Engineer, each has a value of at least twenty percent (20%) of the Mechanical Component of the EPC (PhP2,992,000.00) or equivalent value of at least PhP598,400.00;
5. Electrical Engineer	minimum of five (5) years' experience as a Licensed Electrical Engineer	Licensed Electrical Engineer with a minimum of two (2) projects handled in electrical related works/projects as Electrical Engineer, each has a value of at least twenty percent (20%) of the Electrical Component of the EPC (PhP10,929,000.00) or equivalent value of at least PhP2,185,800.00;

	6. Sanitary Engineer	minimum of five (5) years' experience as a Licensed Sanitary Engineer	Licensed Sanitary Engineer with at least two (2) projects handled in sanitary related works/projects as Sanitary Engineer, each has a value of at least twenty percent (20%) of the Sanitary Component of the EPC (PhP18,160,000.00) or equivalent value of at least PhP3,632,000.00;

<table>
<tr><td>12.1(b)(iii.3)</td><td colspan="3">Minimum Required Equipment<table>
<tr><th>Particulars</th><th>Owned</th><th>Leased</th></tr>
<tr><td>1. Payloader (1.5 Cu.m.)</td><td></td><td>1</td></tr>
<tr><td>2. Road Grader (GD705-A4)</td><td></td><td>1</td></tr>
<tr><td>3. Backhoe (0.80 cu.m)</td><td>2</td><td>2</td></tr>
<tr><td>4. Barge</td><td></td><td>1</td></tr>
<tr><td>5. Amphibious Backhoe</td><td></td><td>1</td></tr>
<tr><td>6. Amphibious Crane</td><td></td><td>1</td></tr>
<tr><td>7. Bulldozer (D65a-8)</td><td></td><td>1</td></tr>
<tr><td>8. Boat w/ Machine</td><td></td><td>1</td></tr>
<tr><td>9. Vibratory Roller (SD100DC)</td><td>1</td><td></td></tr>
<tr><td>10. Batching Plant (30 cu.m.)</td><td></td><td>1</td></tr>
<tr><td>Total</td><td>3</td><td>10</td></tr>
</table></td></tr>
<tr><td>13.1</td><td colspan="3">No further instruction.</td></tr>
<tr><td>13.2 (a) & (b)</td><td colspan="3">There is no ceiling for Financial Proposals.</td></tr>
<tr><td>14.2</td><td colspan="3">No further instructions.</td></tr>
<tr><td>15.4</td><td colspan="3">No further instruction.</td></tr>
<tr><td>16.1</td><td colspan="3">The bid prices shall be quoted in Philippine Pesos.</td></tr>
<tr><td>16.3</td><td colspan="3">No further instructions.</td></tr>
<tr><td>17.1</td><td colspan="3">Bids will be valid until ninety (90) calendar days from the bid opening date.</td></tr>
<tr><td>18.1</td><td colspan="3">The bid security shall be in the form of a Bid Securing Declaration</td></tr>
<tr><td>18.2</td><td colspan="3">The bid security shall be valid until one hundred twenty (120) calendar days from the date set for Bid opening date.</td></tr>
<tr><td>19.2</td><td colspan="3">Substance over the form is considered.</td></tr>
<tr><td>20.3</td><td colspan="3">Each Bidder shall submit:

- one (1) original, and
- four (4) copies of the first and second components of its bid.

- An electronic copy of the bid should also be submitted in PDF file format in a flash drive.

Should there be discrepancies, the original copy would prevail.</td></tr>
<tr><td>21</td><td colspan="3">The address for Submission of Bids is at the Multi-Purpose Hall, PESO Building, East Alvear St., Lingayen, Pangasinan

The deadline for Submission of Bids is June 6, 2024 at 10:00 AM</td></tr>
<tr><td>24.1</td><td colspan="3">The BAC shall open the bids in public on June 6, 2024 at 10:00 AM, at the Multi-Purpose Hall, PESO Building, East Alvear St., Lingayen, Pangasinan with invitation link as follows https://us02web.zoom.us/j/89583008487?pwd=ZGhxU3RvaFZwNmdUZ2dqOGFhUTZIUT0.</td></tr>
</table>

	The time for the bid opening shall be the same as the deadline for receipt of bids or promptly thereafter. Rescheduling the date of the opening of bids shall not be considered except for force majeure, such as natural calamities. In re-scheduling the opening of bids, the BAC shall issue a Notice of Postponement to be posted at the PhilGEPS and the Procuring Entity's websites.
24.2	During Bid opening, if the first envelope lacks any of the requirements that are historical information, as listed in World Bank BDS 12.1, these can be clarified following Section II, ITB Clause 26. If the first bid envelope lacks the Bid Securing Declaration, the bid shall be declared non-responsive but the documents shall be kept by the Procuring Entity.
24.3	The financial proposals in the second envelope of all the bidders shall be read for record purposes. The first and second envelopes shall not be returned to the bidders.
27.4	No financial ceiling
28.2	None
28.4	The Financing Agreement provides that procurement shall follow the Bank's Procurement Regulations and Annex X 2.3 (i) thereof provides that the amount of the award of contract to the bidder with the Lowest Calculated Responsive Bid (LCRB) shall be at its adjusted Bid price.
31.4(f)	The other document required are: 1) Construction schedule 2) S-Curve 3) Manpower schedule 4) Construction methods 5) Equipment Utilization schedule 6) Construction Safety and Health Program approved by the Department of Labor and Employment; and 7) PERT/CPM.
32.2	In times of declaration of state of emergency/calamity, to allow submission of the following (until revoke/lifted) the following documents: 1. Performance Securing Declaration (PSD) in lieu of a performance security to guarantee the winning bidder's faithful performance of obligations under the contract, subject to the following: a. Similar to the PSD used in Framework Agreement, such declaration shall state, among others, that the winning bidder shall be blacklisted from being qualified to participate in any government procurement activity for one (1) year, in case of first offense or two

	(2) years, if with prior similar offense, in the event it violates any of the conditions stated in the contract. a. An unnotarized PSD may be accepted, subject to submission of a notarized PSD before payment, unless the same is replaced with a performance security in the prescribed form, as stated below; and b. The end-user may require the winning bidder to replace the submitted PSD with a performance security in any of the prescribed forms under Section 39.2 of the 2016 revised IRR of RA No. 9184 upon lifting of the State of Calamity.

Section IV. General Conditions of Contract

TABLE OF CONTENTS

11. Definitions

For purposes of this Clause, boldface type is used to identify defined terms.

1.1. The **Arbiter** is the person appointed jointly by the Procuring Entity and the Contractor to resolve disputes in the first instance, as provided for in **GCC** Clause 21.

1.2. **Bill of Quantities** refers to a list of the specific items of the Work and their corresponding unit prices, lump sums, and/or provisional sums.

1.3. The **Completion Date** is the date of completion of the Works as certified by the Procuring Entity's Representative, in accordance with **GCC** Clause 49.

1.4. The **Contract** is the contract between the Procuring Entity and the Contractor to execute, complete, and maintain the Works.

1.5 The **Contract Effectivity Date** is the date of signing of the Contract. However, the contractor shall commence execution of the Works on the Start Date as defined in GCC Clause 1.28.

1.6 The **Contract Price** is the price stated in the Notice of Award and thereafter to be paid by the Procuring Entity to the Contractor for the execution of the Works in accordance with this Contract

1.7 **Contract Time Extension** is the allowable period for the Contractor to complete the Works in addition to the original Completion Date stated in this Contract.

1.8 The **Contractor** is the juridical entity whose proposal has been accepted by the Procuring Entity and to whom the Contract to execute the Work was awarded.

1.9 The **Contractor's Bid** is the signed offer or proposal submitted by the Contractor to the Procuring Entity in response to the Bidding Documents.

1.10 **Days** are calendar days; months are calendar months.

1.11 **Dayworks** are varied work inputs subject to payment on a time basis for the Contractor's employees and Equipment, in addition to payments for associated Materials and Plant.

1.12 A **Defect** is any part of the Works not completed in accordance with the Contract.

1.13 The **Defects Liability Certificate** is the certificate issued by Procuring Entity's Representative upon correction of defects by the Contractor.

1.14 The **Defects Liability Period** is the one year period between contract completion and final acceptance within which the Contractor assumes the responsibility to undertake the repair of any damage to the Works at his own expense.

1.15 **Drawings** are graphical presentations of the Works. They include all supplementary details, shop drawings, calculations, and other information provided or approved for the execution of this Contract.

1.16 **Equipment** refers to all facilities, supplies, appliances, materials or things required for the execution and completion of the Work provided by the Contractor and which shall not form or are not intended to form part of the Permanent Works.

1.17 The **Intended Completion Date** refers to the date specified in the SCC when the Contractor is expected to have completed the Works. The Intended Completion Date may be revised only by the Procuring Entity's Representative by issuing an extension of time or an acceleration order.

1.18 **Materials** are all supplies, including consumables, used by the Contractor for incorporation in the Works.

1.19 The **Notice to Proceed** is a written notice issued by the Procuring Entity or the Procuring Entity's Representative to the Contractor requiring the latter to begin the commencement of the work not later than a specified or determinable date.

1.20 **Permanent Works** are all permanent structures and all other project features and facilities required to be constructed and completed in accordance with this Contract which shall be delivered to the Procuring Entity and which shall remain at the Site after the removal of all Temporary Works.

1.21 **Plant** refers to the machinery, apparatus, and the like intended to form an integral part of the Permanent Works.

1.22 The **Procuring Entity** is the party who employs the Contractor to carry out the Works stated in the SCC.

1.23 The **Procuring Entity's Representative** refers to the Head of the Procuring Entity or his duly authorized representative, identified in the SCC**,** who shall be responsible for supervising the execution of the Works and administering this Contract.

1.24 The **Site** is the place provided by the Procuring Entity where the Works shall be executed and any other place or places which may be designated in the SCC, or notified to the Contractor by the Procuring Entity's Representative as forming part of the Site.

1.25 **Site Investigation Reports** are those that were included in the Bidding Documents and are factual and interpretive reports about the surface and subsurface conditions at the Site.

1.26 **Slippage** is a delay in work execution occurring when actual accomplishment falls below the target as measured by the difference between the scheduled and actual accomplishment of the Work by the Contractor as established from the work schedule. This is actually described as a percentage of the whole Works.

1.27 **Specifications** means the description of Works to be done and the qualities of materials to be used, the equipment to be installed and the mode of construction.

1.28 The **Start Date**, as specified in the SCC, is the date when the Contractor is obliged to commence execution of the Works. It does not necessarily coincide with any of the Site Possession Dates.

1.29 A **Subcontractor** is any person or organization to whom a part of the Works has been subcontracted by the Contractor, as allowed by the Procuring Entity, but not any assignee of such person.

1.30 **Temporary Works** are works designed, constructed, installed, and removed by the Contractor that are needed for construction or installation of the Permanent Works.

1.31 **Work(s)** refer to the Permanent Works and Temporary Works to be executed by the Contractor in accordance with this Contract, including (i) the furnishing of all labor, materials, equipment and others incidental, necessary or convenient to the complete execution of the Works; (ii) the passing of any tests before acceptance by the Procuring Entity's Representative; (iii) and the carrying out of all duties and obligations of the Contractor imposed by this Contract as described in the SCC.

12. Interpretation

2.1. In interpreting the Conditions of Contract, singular also means plural, male also means female or neuter, and the other way around. Headings have no significance. Words have their normal meaning under the language of this Contract unless specifically defined. The Procuring Entity's Representative will provide instructions clarifying queries about the Conditions of Contract.

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

2.3. The documents forming this Contract shall be interpreted in the following order of priority:

a) Contract Agreement;

b) Bid Data Sheet;

c) Instructions to Bidders;

d) Addenda to the Bidding Documents;

e) Special Conditions of Contract;

f) General Conditions of Contract;

g) Specifications;

h) Bill of Quantities; and

i) Drawings.

13. **Governing Language and Law**

3.1. This Contract has been executed in the English language, which shall be the binding and controlling language for all matters relating to the meaning or interpretation of this Contract. All correspondence and other documents pertaining to this Contract which are exchanged by the parties shall be written in English.

3.2. This Contract shall be interpreted in accordance with the laws of the Republic of the Philippines.

14. **Communications**

Communications between parties that are referred to in the Conditions shall be effective only when in writing. A notice shall be effective only when it is received by the concerned party.

15. **Possession of Site**

5.1. On the date specified in the SCC, the Procuring Entity shall grant the Contractor possession of so much of the Site as may be required to enable it to proceed with 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.

5.2. If possession of a portion is not given by the date stated in the **SCC** Clause 5.1, 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 shall be in accordance with **GCC** Clause 47.

5.3. The Contractor shall bear all costs and charges for special or temporary right-of-way required by it in connection with access to the Site. The Contractor shall also provide at his own cost any additional facilities outside the Site required by it for purposes of the Works.

5.4. The Contractor shall allow the Procuring Entity's Representative and any person authorized by the Procuring Entity's Representative access to the Site and to any place where work in connection with this Contract is being carried out or is intended to be carried out.

16. **The Contractor's Obligations**

6.1. The Contractor shall carry out the Works properly and in accordance with this Contract. The Contractor shall provide all supervision, labor, Materials, Plant and

Contractor's Equipment, which may be required. All Materials and Plant on Site shall be deemed to be the property of the Procuring Entity.

6.2. The Contractor shall commence execution of the Works on the Start Date and shall carry out the Works in accordance with the Program of Work submitted by the Contractor, as updated with the approval of the Procuring Entity's Representative, and complete them by the Intended Completion Date.

6.3. The Contractor shall be responsible for the safety of all activities on the Site.

6.4. The Contractor shall carry out all instructions of the Procuring Entity's Representative that comply with the applicable laws where the Site is located.

6.5. The Contractor shall employ the key personnel named in the Schedule of Key Personnel, as referred to in the SCC, 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.

6.6. If the Procuring Entity's Representative asks the Contractor to remove a member of the Contractor's staff or work force, for justifiable cause, the Contractor shall ensure that the person leaves the Site within seven (7) days and has no further connection with the Work in this Contract.

6.7. During Contract implementation, the Contractor and his subcontractors shall abide at all times by all labor laws, including child labor related enactments, and other relevant rules.

6.8. The Contractor shall submit to the Procuring Entity for consent the name and particulars of the person authorized to receive instructions on behalf of the Contractor.

6.9. The Contractor shall cooperate and share the Site with other contractors, public authorities, utilities, and the Procuring Entity between the dates given in the schedule of other contractors particularly when they shall require access to the Site. The Contractor shall also provide facilities and services for them during this period. The Procuring Entity may modify the schedule of other contractors, and shall notify the Contractor of any such modification thereto.

6.10. Should anything of historical or other interest or of significant value be unexpectedly discovered on the Site, it shall be the property of the Procuring Entity. The Contractor shall notify the Procuring Entity's Representative of such discoveries and carry out the Procuring Entity's Representative's instructions in dealing with them.

17. Performance Security

7.1. 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 Contractor shall furnish the performance security in any of the forms prescribed in **ITB** Clause 32.2.

7.2. The performance security posted in favor of the Procuring Entity shall be forfeited in the event it is established that the Contractor is in default in any of its obligations under the Contract.

7.3. The performance security shall remain valid until issuance by the Procuring Entity of the Certificate of Final Acceptance.

7.4. The performance security may be released by the Procuring Entity and returned to the Contractor after the issuance of the Certificate of Final Acceptance subject to the following conditions:

(a) There are no pending claims against the Contractor or the surety company filed by the Procuring Entity;

(b) The Contractor has no pending claims for labor and materials filed against it; and

(c) Other terms specified in the SCC.

7.5. The Contractor shall post an additional performance security following the amount and form specified in **ITB** Clause 32.2 to cover any cumulative increase of more than ten percent (10%) over the original value of the contract as a result of amendments to order or change orders, extra work orders and supplemental agreements, as the case may be. The Contractor shall cause the extension of the validity of the performance security to cover approved contract time extensions.

7.6. In case of a reduction in the contract value or for partially completed Works under the contract which are usable and accepted by the Procuring Entity the use of which, in the judgment of the implementing agency or the Procuring Entity, will not affect the structural integrity of the entire project, the Procuring Entity shall allow a proportional reduction in the original performance security, provided that any such reduction is more than ten percent (10%) and that the aggregate of such reductions is not more than fifty percent (50%) of the original performance security.

7.7. Unless otherwise indicated in the SCC, the Contractor, by entering into the Contract with the Procuring Entity, acknowledges the right of the Procuring Entity to institute action pursuant to Act 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.

18. **Subcontracting**

8.1. Unless otherwise indicated in the SCC**,** the Contractor cannot subcontract Works more than the percentage specified in **BDS** Clause 8.1.

8.2. Subcontracting of any portion of the Works does not relieve the Contractor of any liability or obligation under this Contract. The Contractor will be responsible for the acts, defaults, and negligence of any subcontractor, its agents, servants or workmen as fully as if these were the Contractor's own acts, defaults, or negligence, or those of its agents, servants or workmen.

8.3. If subcontracting is allowed. The contractor may identify its subcontractor during the contract implementation stage. Subcontractors disclosed and identified during the bidding may be changed during the implementation of this Contract. In either case, subcontractors must submit the documentary requirements under ITB Clause 12 and comply with the eligibility criteria specified in the **BDS**. In the event that any subcontractor is found by any Procuring Entity to be eligible, the subcontracting of such portions of the Works shall be disallowed.

19. Liquidated Damages

9.1. The Contractor shall pay liquidated damages to the Procuring Entity for each day that the Completion Date is later than the Intended Completion Date. The applicable liquidated damages is at least one-tenth (1/10) of a percent of the cost of the unperformed portion for every day of delay. The total amount of liquidated damages shall not exceed ten percent (10%) of the amount of the contract. The Procuring Entity may deduct liquidated damages from payments due to the Contractor. Payment of liquidated damages shall not affect the Contractor's liabilities. Once the cumulative amount of liquidated damages reaches ten percent (10%) of the amount of this Contract, the Procuring Entity may rescind or terminate this Contract, without prejudice to other courses of action and remedies available under the circumstances.

9.2. If the Intended Completion Date is extended after liquidated damages have been paid, the Engineer of the Procuring Entity shall correct any overpayment of liquidated damages by the Contractor by adjusting the next payment certificate.

110. 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.

111. The Procuring Entity, Licenses and Permits

The Procuring Entity shall, if requested by the Contractor, assist him in applying for permits, licenses or approvals, which are required for the Works.

112. Contractor's Risk and Warranty Security

12.1. The Contractor shall assume full responsibility for the Works from the time project construction commenced up to final acceptance by the Procuring Entity and shall be held responsible for any damage or destruction of the Works except those occasioned by *force majeure*. The Contractor shall be fully responsible for the safety, protection, security, and convenience of his personnel, third parties, and the public at large, as well as the Works, Equipment, installation, and the like to be affected by his construction work.

12.2. The defects liability period for infrastructure projects shall be one year from contract completion up to final acceptance by the Procuring Entity. During this period, the Contractor shall undertake the repair works, at his own expense, of any damage to the Works on account of the use of materials of inferior quality within ninety (90) days from the time the HoPE has issued an order to undertake repair. In case of failure or refusal to comply with this mandate, the Procuring

Entity shall undertake such repair works and shall be entitled to full reimbursement of expenses incurred therein upon demand.

12.3. Unless otherwise indicated in the SCC, in case the Contractor fails to comply with the preceding paragraph, 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.

12.4. After final acceptance of the Works by the Procuring Entity, the Contractor shall be held responsible for "Structural Defects," *i.e.,* major faults/flaws/deficiencies in one or more key structural elements of the project which may lead to structural failure of the completed elements or structure, or "Structural Failures," *i.e.,* where one or more key structural elements in an infrastructure facility fails or collapses, thereby rendering the facility or part thereof incapable of withstanding the design loads, and/or endangering the safety of the users or the general public:

(a) Contractor – Where Structural Defects/Failures arise due to faults attributable to improper construction, use of inferior quality/substandard materials, and any violation of the contract plans and specifications, the contractor shall be held liable;

(b) Consultants – Where Structural Defects/Failures arise due to faulty and/or inadequate design and specifications as well as construction supervision, then the consultant who prepared the design or undertook construction supervision for the project shall be held liable;

(c) Procuring Entity's Representatives/Project Manager/Construction Managers and Supervisors – The project owner's representative(s), project manager, construction manager, and supervisor(s) shall be held liable in cases where the Structural Defects/Failures are due to his/their willful intervention in altering the designs and other specifications; negligence or omission in not approving or acting on proposed changes to noted defects or deficiencies in the design and/or specifications; and the use of substandard construction materials in the project;

(d) Third Parties - Third Parties shall be held liable in cases where Structural Defects/Failures are caused by work undertaken by them such as leaking pipes, diggings or excavations, underground cables and electrical wires, underground tunnel, mining shaft and the like, in which case the applicable warranty to such structure should be levied to third parties for their construction or restoration works.

(e) Users - In cases where Structural Defects/Failures are due to abuse/misuse by the end user of the constructed facility and/or non–compliance by a user with the technical design limits and/or intended purpose of the same, then the user concerned shall be held liable.

12.5. The warranty against Structural Defects/Failures, except those occasioned on force majeure, shall cover the period specified in the SCC reckoned from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity.

12.6. The Contractor shall be required to put up a warranty security in the form of cash, bank guarantee, letter of credit, GSIS or surety bond callable on demand, in accordance with the following schedule:

Form of Warranty	Amount of Warranty Security Not less than the Percentage (%) of Total Contract Price
(a) Cash or letter of credit issued by Universal or Commercial bank: provided, however, that the letter of credit shall be confirmed or authenticated by a Universal or Commercial bank, if issued by a foreign bank	Five Percent (5%)
(b) Bank guarantee confirmed by Universal or Commercial bank: provided, however, that the letter of credit shall be confirmed or authenticated by a Universal or Commercial bank, if issued by a foreign bank	Ten Percent (10%)
(c) Surety bond callable on demand issued by GSIS or any surety or insurance company duly certified by the Insurance Commission	Thirty Percent (30%)

12.7. The warranty security shall be stated in Philippine Pesos and shall remain effective for one year from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity, and returned only after the lapse of said one year period.

12.8. In case of structural defects/failure occurring during the applicable warranty period provided in **GCC** Clause 12.5, the Procuring Entity shall undertake the necessary restoration or reconstruction works and shall be entitled to full reimbursement by the parties found to be liable for expenses incurred therein upon demand, without prejudice to the filing of appropriate administrative, civil, and/or criminal charges against the responsible persons as well as the forfeiture of the warranty security posted in favor of the Procuring Entity.

113. **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.

114. **Procuring Entity's Risk**

14.1. From the Start Date until the Certificate of Final Acceptance has been issued, the following are risks of the Procuring Entity:

(a) The risk of personal injury, death, or loss of or damage to property (excluding the Works, Plant, Materials, and Equipment), which are due to:

(i) any type of use or occupation of the Site authorized by the Procuring Entity after the official acceptance of the works; or

(ii) negligence, breach of statutory duty, or interference with any legal right by the Procuring Entity or by any person employed by or contracted to him except the Contractor.

(b) The risk of damage to the Works, Plant, Materials, and Equipment to the extent that it is due to a fault of the Procuring Entity or in the Procuring Entity's design, or due to war or radioactive contamination directly affecting the country where the Works are to be executed.

115. **Insurance**

15.1. The Contractor shall, under his name and at his own expense, obtain and maintain, for the duration of this Contract, the following insurance coverage:

(a) Contractor's All Risk Insurance;

(b) Transportation to the project Site of Equipment, Machinery, and Supplies owned by the Contractor;

(c) Personal injury or death of Contractor's employees; and

(d) Comprehensive insurance for third party liability to Contractor's direct or indirect act or omission causing damage to third persons.

15.2. The Contractor shall provide evidence to the Procuring Entity's Representative that the insurances required under this Contract have been effected and shall, within a reasonable time, provide copies of the insurance policies to the Procuring Entity's Representative. Such evidence and such policies shall be provided to the Procuring Entity's through the Procuring Entity's Representative.

15.3. The Contractor shall notify the insurers of changes in the nature, extent, or program for the execution of the Works and ensure the adequacy of the insurances at all times in accordance with the terms of this Contract and shall produce to the Procuring Entity's Representative the insurance policies in force including the receipts for payment of the current premiums.

The above insurance policies shall be obtained from any reputable insurance company approved by the Procuring Entity's Representative.

15.4. If the Contractor fails to obtain and keep in force the insurances referred to herein or any other insurance which he may be required to obtain under the terms of this Contract, the Procuring Entity may obtain and keep in force any such insurances and pay such premiums as may be necessary for the purpose. From time to time, the Procuring Entity may deduct the amount it shall pay for said premiums including twenty five percent (25%) therein from any monies due, or which may become due, to the Contractor, without prejudice to the Procuring Entity exercising its right to impose other sanctions against the Contractor pursuant to the provisions of this Contract.

15.5. In the event the Contractor fails to observe the above safeguards, the Procuring Entity may, at the Contractor's expense, take whatever measure is deemed necessary for its protection and that of the Contractor's personnel and third

parties, and/or order the interruption of dangerous Works. In addition, the Procuring Entity may refuse to make the payments under **GCC** Clause 40 until the Contractor complies with this Clause.

15.6. The Contractor shall immediately replace the insurance policy obtained as required in this Contract, without need of the Procuring Entity's demand, with a new policy issued by a new insurance company acceptable to the Procuring Entity for any of the following grounds:

(a) The issuer of the insurance policy to be replaced has:

(i) become bankrupt;

(ii) been placed under receivership or under a management committee;

(iii) been sued for suspension of payment; or

(iv) been suspended by the Insurance Commission and its license to engage in business or its authority to issue insurance policies canceled; or

(v) Where reasonable grounds exist that the insurer may not be able, fully and promptly, to fulfill its obligation under the insurance policy.

116. **Termination for Default of Contractor**

16.1. The Procuring Entity shall terminate this Contract for default when any of the following conditions attend its implementation:

(i) Due to the Contractor's fault and while the project is on-going, it has incurred negative slippage of fifteen percent (15%) or more in accordance with Presidential Decree 1870, regardless of whether or not previous warnings and notices have been issued for the Contractor to improve his performance;

(ii) Due to its own fault and after this Contract time has expired, the Contractor incurs delay in the completion of the Work after this Contract has expired; or

(iii) The Contractor:

(i) abandons the contract Works, refuses or fails to comply with a valid instruction of the Procuring Entity or fails to proceed expeditiously and without delay despite a written notice by the Procuring Entity;

(ii) does not actually have on the project Site the minimum essential equipment listed on the bid necessary to prosecute the Works in accordance with the approved Program of Work and equipment deployment schedule as required for the project;

(iii) does not execute the Works in accordance with this Contract or persistently or flagrantly neglects to carry out its obligations under this Contract;

(iv) neglects or refuses to remove materials or to perform a new Work that has been rejected as defective or unsuitable; or

(v) sub-lets any part of this Contract without approval by the Procuring Entity.

16.2. All materials on the Site, Plant, Works, including Equipment purchased and funded under the Contract shall be deemed to be the property of the Procuring Entity if this Contract is rescinded because of the Contractor's default.

117. **Termination for Default of Procuring Entity**

The Contractor may terminate this Contract with the Procuring Entity if the works are completely stopped for a continuous period of at least sixty (60) calendar days through no fault of its own, due to any of the following reasons:

(a) Failure of the Procuring Entity to deliver, within a reasonable time, supplies, materials, right-of-way, or other items it is obligated to furnish under the terms of this Contract; or

(b) The prosecution of the Work is disrupted by the adverse peace and order situation, as certified by the Armed Forces of the Philippines Provincial Commander and approved by the Secretary of National Defense.

118. **Termination for Other Causes**

18.1. The Procuring Entity may terminate this Contract, in whole or in part, at any time for its convenience. The HoPE may terminate this Contract for the convenience of the Procuring Entity if he has determined the existence of conditions that make Project Implementation economically, financially or technically impractical and/or unnecessary, such as, but not limited to, fortuitous event(s) or changes in law and National Government policies.

18.2. The Procuring Entity or the Contractor may terminate this Contract if the other party causes a fundamental breach of this Contract.

18.3. Fundamental breaches of Contract shall include, but shall not be limited to, the following:

(a) The Contractor stops work for twenty eight (28) days when no stoppage of work is shown on the current Program of Work and the stoppage has not been authorized by the Procuring Entity's Representative;

(b) The Procuring Entity's Representative instructs the Contractor to delay the progress of the Works, and the instruction is not withdrawn within twenty eight (28) days;

(c) The Procuring Entity shall terminate this Contract if the Contractor is declared bankrupt or insolvent as determined with finality by a court of competent jurisdiction. In this event, termination will be without compensation to the Contractor, provided that such termination will not prejudice or affect any right of action or remedy which has accrued

or will accrue thereafter to the Procuring Entity and/or the Contractor. In the case of the Contractor's insolvency, any Contractor's Equipment which the Procuring Entity instructs in the notice is to be used until the completion of the Works;

(d) A payment certified by the Procuring Entity's Representative is not paid by the Procuring Entity to the Contractor within eighty four (84) days from the date of the Procuring Entity's Representative's certificate;

(e) The Procuring Entity's Representative gives Notice that failure to correct a particular Defect is a fundamental breach of Contract and the Contractor fails to correct it within a reasonable period of time determined by the Procuring Entity's Representative;

(f) The Contractor does not maintain a Security, which is required;

(g) The Contractor has delayed the completion of the Works by the number of days for which the maximum amount of liquidated damages can be paid, as defined in the **GCC** Clause 9; and

(h) 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, the following:

(i) corrupt, fraudulent, collusive, coercive, and obstructive practices as defined in **ITB** Clause 3.1(a), unless otherwise specified in the SCC;

(ii) drawing up or using forged documents;

(iii) using adulterated materials, means or methods, or engaging in production contrary to rules of science or the trade; and

(iv) any other act analogous to the foregoing.

18.4. The Funding Source or the Procuring Entity, as appropriate, will seek to impose the maximum civil, administrative and/or criminal penalties available under the applicable law on individuals and organizations deemed to be involved with corrupt, fraudulent, or coercive practices.

18.5. When persons from either party to this Contract gives notice of a fundamental breach to the Procuring Entity's Representative in order to terminate the existing contract for a cause other than those listed under **GCC** Clause 18.3, the Procuring Entity's Representative shall decide whether the breach is fundamental or not.

18.6. If this Contract is terminated, the Contractor shall stop work immediately, make the Site safe and secure, and leave the Site as soon as reasonably possible.

119. **Procedures for Termination of Contracts**

19.1. The following provisions shall govern the procedures for the termination of this Contract:

(a) Upon receipt of a written report of acts or causes which may constitute ground(s) for termination as aforementioned, or upon its own initiative, the Procuring Entity shall, within a period of seven (7) calendar days, verify the existence of such ground(s) and cause the execution of a Verified Report, with all relevant evidence attached;

(b) Upon recommendation by the Procuring Entity, the HoPE shall terminate this Contract only by a written notice to the Contractor conveying the termination of this Contract. The notice shall state:

(i) that this Contract is being terminated for any of the ground(s) afore-mentioned, and a statement of the acts that constitute the ground(s) constituting the same;

(ii) the extent of termination, whether in whole or in part;

(iii) an instruction to the Contractor to show cause as to why this Contract should not be terminated; and

(iv) special instructions of the Procuring Entity, if any.

The Notice to Terminate shall be accompanied by a copy of the Verified Report;

(c) Within a period of seven (7) calendar days from receipt of the Notice of Termination, the Contractor shall submit to the HoPE a verified position paper stating why the contract should not be terminated. If the Contractor fails to show cause after the lapse of the seven (7) day period, either by inaction or by default, the HoPE shall issue an order terminating the contract;

(d) The Procuring Entity may, at any time before receipt of the Contractor's verified position paper described in item (c) above withdraw the Notice to Terminate if it is determined that certain items or works subject of the notice had been completed, delivered, or performed before the Contractor's receipt of the notice;

(e) Within a non-extendible period of ten (10) calendar days from receipt of the verified position paper, the HoPE shall decide whether or not to terminate this Contract. It shall serve a written notice to the Contractor of its decision and, unless otherwise provided in the said notice, this Contract is deemed terminated from receipt of the Contractor of the notice of decision. The termination shall only be based on the ground(s) stated in the Notice to Terminate; and

(f) The HoPE may create a Contract Termination Review Committee (CTRC) to assist him in the discharge of this function. All decisions recommended by the CTRC shall be subject to the approval of the HoPE.

19.2. Pursuant to Section 69(f) of RA 9184 and without prejudice to the imposition of additional administrative sanctions as the internal rules of the agency may provide and/or further criminal prosecution as provided by applicable laws, the procuring entity shall impose on contractors after the termination of the contract the penalty of suspension for one (1) year for the first offense, suspension for two

(2) years for the second offense from participating in the public bidding process, for violations committed during the contract implementation stage, which include but not limited to the following:

(a) Failure of the contractor, due solely to his fault or negligence, to mobilize and start work or performance within the specified period in the Notice to Proceed ("NTP");

(b) Failure by the contractor to fully and faithfully comply with its contractual obligations without valid cause, or failure by the contractor to comply with any written lawful instruction of the procuring entity or its representative(s) pursuant to the implementation of the contract. For the procurement of infrastructure projects or consultancy contracts, lawful instructions include but are not limited *to* the following:

(i) Employment of competent technical personnel, competent engineers and/or work supervisors;

(ii) Provision of warning signs and barricades in accordance with approved plans and specifications and contract provisions;

(iii) Stockpiling in proper places of all materials and removal from the project site of waste and excess materials**,** including broken pavement and excavated debris in accordance with approved plans and specifications and contract provisions;

(iv) Deployment of committed equipment, facilities, support staff and manpower; and

(v) Renewal of the effectiveness dates of the performance security after its expiration during the course of contract implementation.

(c) Assignment and subcontracting of the contract or any part thereof or substitution of key personnel named in the proposal without prior written approval by the procuring entity.

(d) Poor performance by the contractor or unsatisfactory quality and/or progress of work arising from his fault or negligence as reflected in the Constructor's Performance Evaluation System ("CPES") rating sheet. In the absence of the CPES rating sheet, the existing performance monitoring system of the procuring entity shall be applied. Any of the following acts by the Contractor shall be construed as poor performance:

(i) Negative slippage of 15% and above within the critical path of the project due entirely to the fault or negligence of the contractor; and

(ii) Quality of materials and workmanship not complying with the approved specifications arising from the contractor's fault or negligence.

(e) Willful or deliberate abandonment or non-performance of the project or contract by the contractor resulting in substantial breach thereof without lawful and/or just cause.

In addition to the penalty of suspension, the performance security posted by the contractor shall also be forfeited.

120. **Force Majeure, Release From Performance**

20.1. For purposes of this Contract the terms "*force majeure*" and "fortuitous event" may be used interchangeably. In this regard, a fortuitous event or *force majeure* shall be interpreted to mean an event which the Contractor could not have foreseen, or which though foreseen, was inevitable. It shall not include ordinary unfavorable weather conditions; and any other cause the effects of

which could have been avoided with the exercise of reasonable diligence by the Contractor.

20.2. If this Contract is discontinued by an outbreak of war or by any other event entirely outside the control of either the Procuring Entity or the Contractor, the Procuring Entity's Representative shall certify that this Contract has been discontinued. The Contractor shall make the Site safe and stop work as quickly as possible after receiving this certificate and shall be paid for all works carried out before receiving it and for any Work carried out afterwards to which a commitment was made.

20.3. If the event continues for a period of eighty-four (84) days, either party may then give notice of termination, which shall take effect twenty eight (28) days after the giving of the notice.

20.4. After termination, the Contractor shall be entitled to payment of the unpaid balance of the value of the Works executed and of the materials and Plant reasonably delivered to the Site, adjusted by the following:

(a) any sum to which the Contractor is entitled under **GCC** Clause 28;

(b) the cost of his suspension and demobilization;

(c) any sum to which the Procuring Entity is entitled.

20.5. The net balance due shall be paid or repaid within a reasonable time period from the time of the notice of termination.

121. **Resolution of Disputes**

21.1. If any dispute or difference of any kind whatsoever shall arise between the parties in connection with the implementation of the contract covered by the Act and this IRR, the parties shall make every effort to resolve such dispute or difference by mutual consultation.

21.2. If the Contractor believes that a decision taken by the Procuring Entity's Representative was either outside the authority given to the Procuring Entity's Representative by this Contract or that the decision was wrongly taken, the decision shall be referred to the Arbiter indicated in the SCC within fourteen (14) days of the notification of the Procuring Entity's Representative's decision.

21.3. Any and all disputes arising from the implementation of this Contract covered by the R.A. 9184 and its IRR shall be submitted to arbitration in the Philippines according to the provisions of Republic Act No. 876, otherwise known as the "

Arbitration Law" and Republic Act 9285, otherwise known as the "Alternative Dispute Resolution Act of 2004": *Provided, however*, That, disputes that are within the competence of the Construction Industry Arbitration Commission to resolve shall be referred thereto. The process of arbitration shall be incorporated as a provision in this Contract that will be executed pursuant to the provisions of the Act and its IRR: *Provided, further,*

That, by mutual agreement, the parties may agree in writing to resort to other alternative modes of dispute resolution.

122. **Suspension of Loan, Credit, Grant, or Appropriation**

In the event that the Funding Source suspends the Loan, Credit, Grant, or Appropriation to the Procuring Entity, from which part of the payments to the Contractor are being made:

(a) The Procuring Entity is obligated to notify the Contractor of such suspension within seven (7) days of having received the suspension notice.

(b) If the Contractor has not received sums due for work already done within forty five (45) days from the time the Contractor's claim for payment has been certified by the Procuring Entity's Representative, the Contractor may immediately issue a suspension of work notice in accordance with **GCC** Clause 45.2.

123. **Procuring Entity's Representative's Decisions**

23.1. Except where otherwise specifically stated, the Procuring Entity's Representative will decide contractual matters between the Procuring Entity and the Contractor in the role representing the Procuring Entity.

23.2. The Procuring Entity's Representative may delegate any of his duties and responsibilities to other people, except to the Arbiter, after notifying the Contractor, and may cancel any delegation after notifying the Contractor.

124. **Approval of Drawings and Temporary Works by the Procuring Entity's Representative**

24.1. All Drawings prepared by the Contractor for the execution of the Temporary Works, are subject to prior approval by the Procuring Entity's Representative before its use.

24.2. The Contractor shall be responsible for design of Temporary Works.

24.3. The Procuring Entity's Representative's approval shall not alter the Contractor's responsibility for design of the Temporary Works.

24.4. The Contractor shall obtain approval of third parties to the design of the Temporary Works, when required by the Procuring Entity.

125. **Acceleration and Delays Ordered by the Procuring Entity's Representative**

25.1. When the Procuring Entity wants the Contractor to finish before the Intended Completion Date, the Procuring Entity's Representative will obtain priced proposals for achieving the necessary acceleration from the Contractor. If the Procuring Entity accepts these proposals, the Intended Completion Date will be adjusted accordingly and confirmed by both the Procuring Entity and the Contractor.

25.2. If the Contractor's Financial Proposals for an acceleration are accepted by the Procuring Entity, they are incorporated in the Contract Price and treated as a Variation.

126. **Extension of the Intended Completion Date**

26.1. The Procuring Entity's Representative shall extend the Intended Completion Date if a Variation is issued which makes it impossible for the Intended Completion Date to be achieved by the Contractor without taking steps to accelerate the remaining work, which would cause the Contractor to incur additional costs. No payment shall be made for any event which may warrant the extension of the Intended Completion Date.

26.2. The Procuring Entity's Representative shall decide whether and by how much to extend the Intended Completion Date within twenty one (21) days of the Contractor asking the Procuring Entity's Representative for a decision thereto after fully submitting all supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

127. **Right to Vary**

27.1. The Procuring Entity's Representative with the prior approval of the Procuring Entity may instruct Variations, up to a maximum cumulative amount of ten percent (10%) of the original contract cost.

27.2. Variations shall be valued as follows:

(a) At a lump sum price agreed between the parties;

(b) where appropriate, at rates in this Contract;

(c) in the absence of appropriate rates, the rates in this Contract shall be used as the basis for valuation; or failing which

(d) at appropriate new rates, equal to or lower than current industry rates and to be agreed upon by both parties and approved by the HoPE.

128. **Contractor's Right to Claim**

If the Contractor incurs cost as a result of any of the events under **GCC** Clause 13, the Contractor shall be entitled to the amount of such cost. If as a result of any of the said events, it is necessary to change the Works, this shall be dealt with as a Variation.

129. **Dayworks**

29.1. Subject to **GCC** Clause 43 on Variation Order, 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.

29.2. All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Procuring Entity's Representative. Each completed form shall be verified and signed by the Procuring Entity's Representative within two days of the work being done.

29.3. The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms.

130. **Early Warning**

30.1. The Contractor shall warn the Procuring Entity's Representative at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works. The Procuring Entity's Representative may require the Contractor to provide an estimate of the expected effect of the future event or circumstance on the Contract Price and Completion Date. The estimate shall be provided by the Contractor as soon as reasonably possible.

30.2. The Contractor shall cooperate with the Procuring Entity's Representative in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Procuring Entity's Representative.

131. **Program of Work**

31.1. Within the time stated in the SCC, the Contractor shall submit to the Procuring Entity's Representative for approval a Program of Work showing the general methods, arrangements, order, and timing for all the activities in the Works.

31.2. An update of the Program of Work shall show the actual progress achieved on each activity and the effect of the progress achieved on the timing of the remaining work, including any changes to the sequence of the activities.

31.3. 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.

31.4. The Procuring Entity's Representative's approval of the Program of Work shall not alter the Contractor's obligations. The Contractor may revise the Program of Work and submit it to the Procuring Entity's Representative again at any time. A revised Program of Work shall show the effect of any approved Variations.

31.5. When the Program of Work is updated, the Contractor shall provide the Procuring Entity's Representative with an updated cash flow forecast. The cash flow forecast shall include different currencies, as defined in the Contract, converted as necessary using the Contract exchange rates.

31.6. All Variations shall be included in the updated Program of Work produced by the Contractor.

132. **Management Conferences**

32.1. Either the Procuring Entity's Representative or the Contractor may require the other to attend a Management Conference. The Management Conference shall review the plans for remaining work and deal with matters raised in accordance with the early warning procedure.

32.2. The Procuring Entity's Representative shall record the business of Management Conferences and provide copies of the record to those attending the Conference and to the Procuring Entity. The responsibility of the parties for actions to be taken shall be decided by the Procuring Entity's Representative either at the Management Conference or after the Management Conference and stated in writing to all who attended the Conference.

233. **Bill of Quantities**

33.1. The Bill of Quantities shall contain items of work for the construction, installation, testing, and commissioning of work to be done by the Contractor.

33.2. The Bill of Quantities is used to calculate the Contract Price. The Contractor is paid for the quantity of the work done at the rate in the Bill of Quantities for each item.

33.3. If the final quantity of any work done differs from the quantity in the Bill of Quantities for the particular item and is not more than twenty five percent (25%) of the original quantity, provided the aggregate changes for all items do not exceed ten percent (10%) of the Contract price, the Procuring Entity's Representative shall make the necessary adjustments to allow for the changes subject to applicable laws, rules, and regulations.

33.4. If requested by the Procuring Entity's Representative, the Contractor shall provide the Procuring Entity's Representative with a detailed cost breakdown of any rate in the Bill of Quantities.

234. **Instructions, Inspections and Audits**

34.1. The Procuring Entity's personnel shall at all reasonable times during construction of the Work be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of the construction.

34.2. If the Procuring Entity's Representative instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a defect and the test shows that it does, the Contractor shall pay for the test and any samples. If there is no defect, the test shall be a Compensation Event.

34.3. The Contractor shall permit the Funding Source named in the SCC to inspect the Contractor's accounts and records relating to the performance of the Contractor and to have them audited by auditors appointed by the Funding Source, if so required by the Funding Source.

235. **Identifying Defects**

The Procuring Entity's Representative shall check the Contractor's work and notify the Contractor of any defects that are found. Such checking shall not affect the Contractor's responsibilities. The Procuring Entity's Representative may instruct the Contractor to search to uncover defects and test any work that the Procuring Entity's Representative considers below standards and defective.

236. **Cost of Repairs**

Loss or damage to the Works or Materials to be incorporated in the Works between the Start Date and the end of the Defects Liability Periods shall be remedied by the Contractor at the Contractor's cost if the loss or damage arises from the Contractor's acts or omissions.

237. **Correction of Defects**

37.1. The Procuring Entity's Representative shall give notice to the Contractor of any defects before the end of the Defects Liability Period, which is One (1) year from project completion up to final acceptance by the Procuring Entity's Representative.

37.2. Every time notice of a defect is given, the Contractor shall correct the notified defect within the length of time specified in the Procuring Entity's Representative's notice.

37.3. The Contractor shall correct the defects which he notices himself before the end of the Defects Liability Period.

37.4. The Procuring Entity shall certify that all defects have been corrected. If the Procuring Entity considers that correction of a defect is not essential, he can request the Contractor to submit a quotation for the corresponding reduction in the Contract Price. If the Procuring Entity accepts the quotation, the corresponding change in the SCC is a Variation.

238. **Uncorrected Defects**

38.1. The Procuring Entity shall give the Contractor at least fourteen (14) days notice of his intention to use a third party to correct a Defect. If the Contractor does not correct the Defect himself within the period, the Procuring Entity may have the Defect corrected by the third party. The cost of the correction will be deducted from the Contract Price.

38.2. The use of a third party to correct defects that are uncorrected by the Contractor will in no way relieve the Contractor of its liabilities and warranties under the Contract.

239. **Advance Payment**

39.1. 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.

39.2. The advance payment shall be made only upon the submission to and acceptance by the Procuring Entity of an irrevocable standby letter of credit of equivalent value from a commercial bank, a bank guarantee or a surety bond callable on demand, issued by a surety or insurance company duly licensed by the Insurance Commission and confirmed by the Procuring Entity.

39.3. The advance payment shall be repaid by the Contractor by an amount equal to the percentage of the total contract price used for the advance payment.

39.4. The contractor may reduce his standby letter of credit or guarantee instrument by the amounts refunded by the Monthly Certificates in the advance payment.

39.5. The Procuring Entity will provide an Advance Payment on the Contract Price as stipulated in the Conditions of Contract, subject to the maximum amount stated in SCC Clause 1).

240. **Progress Payments**

40.1. The Contractor may submit a request for payment for Work accomplished. Such request 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.

40.2. The Procuring Entity shall deduct the following from the certified gross amounts to be paid to the contractor as progress payment:

(a) Cumulative value of the work previously certified and paid for.

(b) Portion of the advance payment to be recouped for the month.

(c) Retention money in accordance with the condition of contract.

(d) Amount to cover third party liabilities.

(e) Amount to cover uncorrected discovered defects in the works.

40.3. Payments shall be adjusted by deducting there from the amounts for advance payments and retention. The Procuring Entity shall pay the Contractor the amounts certified by the Procuring Entity's Representative within twenty-eight (28) days from the date each certificate was issued. No payment of interest for delayed payments and adjustments shall be made by the Procuring Entity.

40.4. The first progress payment may be paid by the Procuring Entity to the Contractor provided that at least five percent (5%) of the work has been accomplished as certified by the Procuring Entity's Representative.

40.5. Items of the Works for which a price of "0" (zero) has been entered will not be paid for by the Procuring Entity and shall be deemed covered by other rates and prices in the Contract.

241. **Payment Certificates**

41.1. The Contractor shall submit to the Procuring Entity's Representative monthly statements of the estimated value of the work executed less the cumulative amount certified previously.

41.2. The Procuring Entity's Representative shall check the Contractor's monthly statement and certify the amount to be paid to the Contractor.

41.3. The value of Work executed shall:

(a) be determined by the Procuring Entity's Representative;

(b) comprise the value of the quantities of the items in the Bill of Quantities completed; and

(c) include the valuations of approved variations.

41.4. The Procuring Entity's Representative may exclude any item certified in a previous certificate or reduce the proportion of any item previously certified in any certificate in the light of later information.

242. **Retention**

42.1. The Procuring Entity shall retain from each payment due to the Contractor an amount equal to a percentage thereof using the rate as specified in GCC Sub-Clause 42.2.

42.2. Progress payments are subject to retention of ten percent (10%), referred to as the "retention money." Such retention shall be based on the total amount due to the Contractor prior to any deduction and shall be retained from every progress payment until fifty percent (50%) of the value of Works, as determined by the Procuring Entity, are completed. If, after fifty percent (50%) completion, the Work is satisfactorily done and on schedule, no additional retention shall be made; otherwise, the ten percent (10%) retention shall again be imposed using the rate specified therefor.

42.3. The total "retention money" shall be due for release upon final acceptance of the Works. The Contractor may, however, request the substitution of the retention money for each progress billing with irrevocable standby letters of credit from a commercial bank, bank guarantees or surety bonds callable on demand, of amounts equivalent to the retention money substituted for and acceptable to the Procuring Entity, provided that the project is on schedule and is satisfactorily undertaken. Otherwise, the ten (10%) percent retention shall be made. Said irrevocable standby letters of credit, bank guarantees and/or surety bonds, to be posted in favor of the Government shall be valid for a duration to be determined by the concerned implementing office/agency or Procuring Entity and will answer for the purpose for which the ten (10%) percent retention is intended, *i.e.*, to cover uncorrected discovered defects and third party liabilities.

42.4. On completion of the whole Works, the Contractor may substitute retention money with an "on demand" Bank guarantee in a form acceptable to the Procuring Entity.

243. **Variation Orders**

43.1. Variation Orders may be issued by the Procuring Entity to cover any increase/decrease in quantities, including the introduction of new work items that are not included in the original contract or reclassification of work items that are either due to change of plans, design or alignment to suit actual field conditions resulting in disparity between the preconstruction plans used for purposes of bidding and the "as staked plans" or construction drawings prepared after a joint survey by the Contractor and the Procuring Entity after award of the contract, provided that the cumulative amount of the Variation Order does not exceed ten percent (10%) of the original project cost. The addition/deletion of Works should be within the general scope of the project as bid and awarded. The scope of works shall not be reduced so as to accommodate a positive Variation Order. A Variation Order may either be in the form of a Change Order or Extra Work Order.

43.2. A Change Order may be issued by the Procuring Entity to cover any increase/decrease in quantities of original Work items in the contract.

43.3. An Extra Work Order may be issued by the Procuring Entity to cover the introduction of new work necessary for the completion, improvement or protection of the project which were not included as items of Work in the original contract, such as, where there are subsurface or latent physical conditions at the site differing materially from those indicated in the contract, or where there are duly unknown physical conditions at the site of an unusual nature differing materially from those ordinarily encountered and generally recognized as inherent in the Work or character provided for in the contract.

43.4. Any cumulative Variation Order beyond ten percent (10%) shall be subject of another contract to be bid out if the works are separable from the original contract. In exceptional cases where it is urgently necessary to complete the original scope of work, the HoPE may authorize a positive Variation Order go beyond ten percent (10%) but not more than twenty percent (20%) of the original contract price, subject to the guidelines to be determined by the GPPB: *Provided, however,*

That appropriate sanctions shall be imposed on the designer, consultant or official responsible for the original detailed engineering design which failed to consider the Variation Order beyond ten percent (10%).

43.5. In claiming for any Variation Order, the Contractor shall, within seven (7) calendar days after such work has been commenced or after the circumstances leading to such condition(s) leading to the extra cost, and within twenty-eight (28) calendar days deliver a written communication giving full and detailed particulars of any extra cost in order that it may be investigated at that time. Failure to provide either of such notices in the time stipulated shall constitute a waiver by the contractor for any claim. The preparation and submission of Variation Orders are as follows:

(a) If the Procuring Entity's representative/Project Engineer believes that a Change Order or Extra Work Order should be issued, he shall prepare the proposed Order accompanied with the notices submitted by the Contractor, the plans therefore, his computations as to the quantities of the additional works involved per item indicating the specific stations where such works are needed, the date of his inspections and investigations thereon, and the log book thereof, and a detailed estimate of the unit cost of such items of work, together with his justifications for the need of such Change Order or Extra Work Order, and shall submit the same to the HoPE for approval.

(b) The HoPE or his duly authorized representative, upon receipt of the proposed Change Order or Extra Work Order shall immediately instruct the appropriate technical staff or office of the Procuring Entity to conduct an on-the-spot investigation to verify the need for the Work to be prosecuted and to review the proposed plan, and prices of the work involved.

(c) The technical staff or appropriate office of the Procuring Entity shall submit a report of their findings and recommendations, together with the supporting documents, to the Head of Procuring Entity or his duly authorized representative for consideration.

(d) The HoPE or his duly authorized representative, acting upon the recommendation of the technical staff or appropriate office, shall approve the Change Order or Extra Work Order after being satisfied that the same is justified, necessary, and in order.

(e) The timeframe for the processing of Variation Orders from the preparation up to the approval by the Procuring Entity concerned shall not exceed thirty (30) calendar days.

244. **Contract Completion**

Once the project reaches an accomplishment of ninety-five (95%) of the total contract amount, the Procuring Entity may create an inspectorate team to make preliminary inspection and submit a punch-list to the Contractor in preparation for the final turnover of the project. Said punch-list will contain, among others, the remaining Works, Work deficiencies for necessary corrections, and the specific duration/time to fully complete the project considering the approved remaining contract time. This, however, shall not preclude the claim of the Procuring Entity for liquidated damages.

245. **Suspension of Work**

45.1. The Procuring Entity shall have the authority to suspend the work wholly or partly by written order for such period as may be deemed necessary, due to *force majeure* or any fortuitous events or for failure on the part of the Contractor to correct bad conditions which are unsafe for workers or for the general public, to carry out valid orders given by the Procuring Entity or to perform any provisions of the contract, or due to adjustment of plans to suit field conditions as found necessary during construction. The Contractor shall immediately comply with such order to suspend the work wholly or partly.

45.2. The Contractor or its duly authorized representative shall have the right to suspend work operation on any or all projects/activities along the critical path of activities after fifteen (15) calendar days from date of receipt of written notice from the Contractor to the district engineer/regional director/consultant or equivalent official, as the case may be, due to the following:

(a) There exist right-of-way problems which prohibit the Contractor from performing work in accordance with the approved construction schedule.

(b) Requisite construction plans which must be owner-furnished are not issued to the contractor precluding any work called for by such plans.

(c) Peace and order conditions make it extremely dangerous, if not possible, to work. However, this condition must be certified in writing by the Philippine National Police (PNP) station which has responsibility over the affected area and confirmed by the Department of Interior and Local Government (DILG) Regional Director.

(d) There is failure on the part of the Procuring Entity to deliver government-furnished materials and equipment as stipulated in the contract.

(e) Delay in the payment of Contractor's claim for progress billing beyond forty-five (45) calendar days from the time the Contractor's claim has been certified to by the procuring entity's authorized representative that the documents are complete unless there are justifiable reasons thereof which shall be communicated in writing to the Contractor.

45.3. In case of total suspension, or suspension of activities along the critical path, which is not due to any fault of the Contractor, the elapsed time between the effectiveness of the order suspending operation and the order to resume work shall be allowed by the Contractor by adjusting the contract time accordingly.

246. **Payment on Termination**

46.1. If the Contract is terminated because of a fundamental breach of Contract by the Contractor, the Procuring Entity's Representative shall issue a certificate for the value of the work done and Materials ordered less advance payments received up to the date of the issue of the certificate and less the percentage to apply to the value of the work not completed, as indicated in the SCC. Additional Liquidated Damages shall not apply. If the total amount due to the Procuring Entity exceeds any payment due to the Contractor, the difference shall be a debt payable to the Procuring Entity.

46.2. If the Contract is terminated for the Procuring Entity's convenience or because of a fundamental breach of Contract by the Procuring Entity, the Procuring Entity's Representative shall issue a certificate for the value of the work done, Materials ordered, the reasonable cost of removal of Equipment, repatriation of the Contractor's personnel employed solely on the Works, and the Contractor's costs of protecting and securing the Works, and less advance payments received up to the date of the certificate.

46.3. The net balance due shall be paid or repaid within twenty-eight (28) days from the notice of termination.

46.4. If the Contractor has terminated the Contract under **GCC** Clauses 17 or 18, the Procuring Entity shall promptly return the Performance Security to the Contractor.

247. **Extension of Contract Time**

47.1. Should the amount of additional work of any kind or other special circumstances of any kind whatsoever occur such as to fairly entitle the contractor to an extension of contract time, the Procuring Entity shall determine the amount of such extension; provided that the Procuring Entity is not bound to take into account any claim for an extension of time unless the Contractor has, prior to the expiration of the contract time and within thirty (30) calendar days after such work has been commenced or after the circumstances leading to such claim have arisen, delivered to the Procuring Entity notices in order that it could have investigated them at that time. Failure to provide such notice shall constitute a waiver by the Contractor of any claim. Upon receipt of full and detailed particulars, the Procuring Entity shall examine the facts and extent of the delay and shall extend the contract time completing the contract work when, in the Procuring Entity's opinion, the findings of facts justify an extension.

47.2. No extension of contract time shall be granted to the Contractor due to (a) ordinary unfavorable weather conditions and (b) inexcusable failure or negligence of Contractor to provide the required equipment, supplies or materials.

47.3. Extension of contract time may be granted only when the affected activities fall within the critical path of the PERT/CPM network.

47.4. No extension of contract time shall be granted when the reason given to support the request for extension was already considered in the determination of the original contract time during the conduct of detailed engineering and in the preparation of the contract documents as agreed upon by the parties before contract perfection.

47.5. Extension of contract time shall be granted for rainy/unworkable days considered unfavorable for the prosecution of the works at the site, based on the actual conditions obtained at the site, in excess of the number of rainy/unworkable days pre-determined by the Procuring Entity in relation to the original contract time during the conduct of detailed engineering and in the preparation of the contract documents as agreed upon by the parties before contract perfection, and/or for equivalent period of delay due to major calamities such as exceptionally

destructive typhoons, floods and earthquakes, and epidemics, and for causes such as non-delivery on time of materials, working drawings, or written information to be furnished by the Procuring Entity, non-acquisition of permit to enter private properties or non-execution of deed of sale or donation within the right-of-way resulting in complete paralyzation of construction activities, and other meritorious causes as determined by the Procuring Entity's Representative and approved by the HoPE. Shortage of construction materials, general labor strikes, and peace and order problems that disrupt construction operations through no fault of the Contractor may be considered as additional grounds for extension of contract time provided they are publicly felt and certified by appropriate government agencies such as DTI, DOLE, DILG, and DND, among others. The written consent of bondsmen must be attached to any request of the Contractor for extension of contract time and submitted to the Procuring Entity for consideration and the validity of the Performance Security shall be correspondingly extended.

248. **Price Adjustment**

Except for extraordinary circumstances as determined by NEDA and approved by the GPPB, no price escalation shall be allowed. Nevertheless, in cases where the cost of the awarded contract is affected by any applicable new laws, ordinances, regulations, or other acts of the GoP, promulgated after the date of bid opening, a contract price adjustment shall be made or appropriate relief shall be applied on a no loss-no gain basis.

249. **Completion**

The Contractor shall request the Procuring Entity's Representative to issue a certificate of Completion of the Works, and the Procuring Entity's Representative will do so upon deciding that the work is completed.

250. **Taking Over**

The Procuring Entity shall take over the Site and the Works within seven (7) days from the date the Procuring Entity's Representative issues a certificate of Completion.

251. **Operating and Maintenance Manuals**

51.1. If "as built" Drawings and/or operating and maintenance manuals are required, the Contractor shall supply them by the dates stated in the SCC.

51.2. If the Contractor does not supply the Drawings and/or manuals by the dates stated in the SCC, or they do not receive the Procuring Entity's Representative's approval, the Procuring Entity's Representative shall withhold the amount stated in the SCC from payments due to the Contractor.

Section V. Special Conditions of Contract

GCC Clause	
1.17	The **Intended Completion Date** is **783 calendar days** from start date. Inclusive of **139 Sundays and holidays.**
1.22	The **Procuring Entity** is **Provincial Government of Pangasinan**
1.23	The **Procuring Entity's Representative** is: **HON. RAMON V. GUICO III** **Governor** **Provincial Government of Pangasinan**
1.24	The **Site** is located at **Brgy. Arnedo, Bolinao, Pangasinan**
1.28	The **Start Date** is ten (10) calendar days upon receipt of the Notice to Proceed (NTP).
1.31	The Work consist of: Provision/ Construction of Field Office for the Engineers; Provision of General Requirements: Construction Survey and Staking; Project Billboards/ Signboards; Occupational Safety & Health; Mobilization/ Demobilization; Site Development Works; Construction of Broodstock Tanks; Construction of Larval Rearing Tanks (120 Units); Construction of Algal Tanks (36 Units); Construction of Rotifer Tanks (24 Units); Construction of Conditioning Pond; Construction of Drainage and Treatment Canal; Construction of Administrative and Phycology Laboratory Building; Construction of Staff Quarters and Fish Feed Storage Building; Construction of Triplex Building; Construction of Two-Unit Pumphouse; Construction of Reinforced Concrete Box Culvert; Construction of Intake Tank and HDPE Pipe; Construction of Berthing Dock; Construction of Access Road; Construction of Perimeter Fence; Installation of Solar-Powered Lights.
2.2	Sectional completion is **not** allowed.
5.1	The **Procuring Entity** shall give possession of all parts of the Site to the Contractor upon issuance of NTP

6.5	The Contractor shall employ the following Key Personnel: as per BDS 12.1(b)(ii.2) a. ***Project Manager*** – *Licensed Civil Engineer with minimum of five (5) years relevant work experience as Project Manager in Building Construction;* b. ***Two (2) Project Engineers*** – *Each should have a minimum of five (5) years' experience as a Licensed Civil/Agricultural Engineer with a minimum of two (2) projects handled in building construction as Project Engineer, each has a value of at least twenty percent (20%) of the Estimated Project Cost;* c. ***Materials Engineer*** – *Licensed Civil Engineer duly accredited by DPWH following DPWH D.O. 98, S. of 2016 as Materials Engineer II (as required under SCC Clause 6.5);* d. ***Mechanical Engineer*** - *Licensed Mechanical Engineer with minimum of five (5) years' experience as a Licensed Mechanical Engineer with a minimum of two (2) projects handled in mechanical related works/projects as Mechanical Engineer, each has a value of at least twenty percent (20%) of the Mechanical Component of the EPC (PhP2,992,000.00) or equivalent value of at least PhP598,400.00;* e. ***Electrical Engineer*** - *Licensed Electrical Engineer with minimum of five (5) years' experience as a Licensed Electrical Engineer with a minimum of two (2) projects handled in electrical related works/projects as Electrical Engineer, each has a value of at least twenty percent (20%) of the Electrical Component of the EPC (PhP10,929,000.00) or equivalent value of at least Php2,185,800.00;* f. ***Sanitary Engineer*** - *Licensed Sanitary Engineer with minimum of five (5) years' experience as a Licensed Sanitary Engineer and has at least two (2) projects handled in sanitary related works/projects as Sanitary Engineer, each has a value of at least twenty percent (20%) of the Sanitary Component of the EPC (PhP18,160,000.00) or equivalent value of at least PhP3,632,000.00;*

7.4(c)	No further instructions.
7.7	No further instructions.
8.1	No further instructions.
10	None.
12.3	No further instructions.
12.5	Five (5) years.
13	"No additional provision" or if the contractor is a joint venture, "All partners to the joint venture shall be jointly and severally liable to the Procuring Entity".
18.3(h)(i)	The World Bank's Anti-Corruption Guidelines requires Borrowers (including beneficiaries of Bank-financed activity), as well as Bidders, Suppliers, Contractors and their agents (whether declared or not), sub-contractors, sub-consultants, service providers or suppliers and any personnel thereof, observe the highest standard of ethics during the procurement and execution of Bank-financed contracts. Any action to influence the procurement process or contract execution for undue advantage is improper. In pursuance of this policy, the Bank: (a) defines, for the purposes of this provision, the terms set forth below as follows: (i) "corrupt practice" means the offering, giving, receiving, or soliciting, directly or indirectly, anything of value to influence improperly the actions of another party. Another party refers to a public official acting in relation to the procurement process or contract execution. Public official includes World Bank staff and employees of other organizations taking or reviewing procurement decisions; (ii) "fraudulent practice" means any act or omission, including a misrepresentation, that knowingly or recklessly misleads, or attempts to mislead, a party to obtain a financial or other benefit or to avoid an obligation. The term "party" refers to a public official; the terms "benefit" and "obligations" relate to the procurement process or contract execution; and the "act or omission" is intended to influence the procurement process or contract execution; (iii) "coercive practice" means impairing or harming, or threatening to impair or harm, directly or indirectly, any party or the property of the party to improperly influence the actions of a party. The term "party" refers to a participant in the procurement process or contract execution; (iv) "collusive practice" means an arrangement between two or more parties designed to achieve an improper purpose, including influencing improperly the actions of another party.

	The term "parties" refers to participants in the procurement process (including public officials) attempting either themselves, or through another person or entity not participating in the procurement or selection process, to simulate competition or establish bid prices at artificial, noncompetitive levels, or are privy to each other's bid prices or other conditions; (v) "obstructive practice" is (aa) deliberately destroying, falsifying, altering, or concealing of evidence material to the investigation or making false statements to investigators in order to materially impede a Bank investigation into allegations of a corrupt, fraudulent, coercive or collusive practice; and/or threatening, harassing or intimidating any party to prevent it from disclosing its knowledge of matters relevant to the investigation or from pursuing the investigation, or (bb) acts intended to materially impede the exercise of the Bank's inspection and audit rights provided for under paragraph (e) below. (b) will reject a proposal for award if it determines that the Bidder recommended for award, or any of its personnel, or its agents, or its sub-consultants, sub-contractors, service providers, suppliers and/or their employees, has, directly or indirectly, engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices or other integrity violations in competing for the Contract in question (c) will declare mis-procurement and cancel the portion of the financing allocated to a contract if it determines at any time that representatives of the Borrower or of a recipient of any part of the proceeds of the financing engaged in corrupt, fraudulent, collusive, coercive, or obstructive practices during the procurement or the implementation of the contract in question, without the Borrower having taken timely and appropriate action satisfactory to Bank to address such practices when they occur, including by failing to inform the Bank in a timely manner at the time they knew of the practices; (d) will sanction a firm or an individual, at any time, in accordance with the prevailing Bank's sanctions procedures, including by publicly declaring such firm or individual ineligible, either indefinitely or for a stated period of time: (i) to be awarded a Bank-financed contract; and (ii) to be a nominated sub-contractor, consultant, manufacturer or supplier, or service provider (different names are used depending on the particular bidding document) is one which has either been (i) included by the bidder in its pre-qualification application or bid because it brings specific and critical experience and know-how that allow the bidder to meet the qualification requirements for the particular bid; or (ii) appointed by

	the Borrower. A firm or individual may be declared ineligible to be awarded a Bank financed contract upon (i) completion of the Bank's sanctions proceedings as per its sanctions procedures, including, inter alia, cross debarment as agreed with other International Financial Institutions, including Multilateral Development Banks, and through the application of the World Bank Group corporate administrative procurement sanctions procedures for fraud and corruption; and (ii) as a result of temporary suspension or early temporary suspension in connection with an ongoing sanctions proceeding. See footnote 14 and paragraph 8 of Appendix 1 of the World Bank Guidelines for Procurement of Goods, Works, and Non-Consulting Services; (e) will require that a clause be included in bidding documents and in contracts financed by a Bank loan or grant, requiring bidders, suppliers and contractors, and their subcontractors, agents, personnel, consultants, service providers, or suppliers to permit Bank to inspect all accounts and records and other documents relating to the submission of bids and contract performance, and to have them audited by auditors appointed by Bank.
21.2	The Arbiter is: Construction Industry Arbitration Commission, Manila
29.1	No dayworks are applicable to the contract.
31.1	The Contractor shall submit the Program of Work to the Procuring Entity's Representative within five (5) calendar days of delivery of the Notice of Award.
31.3	The period between Program of Work updates is *30* days. The amount to be withheld for late submission of an updated Program of Work is 1% of the progress billing.
34.1(a)	Upon instruction by the Procuring Entity, the contractor will arrange and shall shoulder cost for the materials and field testing. The materials and field test shall be conducted by DPWH or its accredited testing laboratories. For field density test (FDT), it shall be carried out through the following options: 1. By DPWH or its accredited testing laboratories as default; 2. By independent accredited Materials Engineer located within the province;

	3. By an accredited Materials Engineer of the Provincial Government; 4. By colleges and universities with testing laboratories; The conditions to affect the other options (2, 3 & 4) mentioned above are described below. Whoever conducts the test must prepare and attest to the veracity of the test report. The contracting parties are the signatory witnesses in the conduct of the FDTs. The FDTs shall be closely witnessed by the contractor, and PPMIU and Regional Project Coordination Office (RPCO) or Project Support Office (PSO). Options 2, 3 and 4 may be availed of by the contracting parties in the conduct of FDTs if DPWH facilities will not be available on a timely basis. 1. The options to be adopted by the contracting parties must be communicated properly to the DPWH regional office where the LGU is covered. The response of the DPWH would trigger the application of the three options. The concurrence of the Project will be based on the evidence of impending or actual delays in the conduct of FDTs through Option 1; 2. The engagement of accredited Materials Engineers for Options 2 and 3 will follow the limits of authority for ME1 and ME 2 by the Bureau of Research and Standards (BRS) of the Department of Public Works and Highways. The nomination of which will come from the LGU and to be concurred by the Regional Project Coordination Office. However, the test apparatuses to be utilized by the accredited Materials Engineer may either come from the LGU or the contractor. The test apparatuses shall be re-calibrated and tested in the presence of the RPCO or PSO engineers prior to actual use. The selection of colleges and universities to conduct the FDT must be supported with proof that indeed the laboratory technicians have conducted the same test within the last three years. Records of FDT reports taken from similar projects filed by the laboratory administrator will suffice as proof of capacity to engage the said college or university.
34.3	The Funding Source is the World Bank.
39.1	The amount of the advance payment is 15% of the Contract Price and to be recouped every progress billing.
39.2	Except for surety bond

40.1	No further instructions.
40.4	Progress payment shall be made monthly as per work accomplished.
41.5	The Contractor is obliged to submit to the Procuring Entity's Representatives the geotagged photos taken before, during and after construction of each item of work especially the embedded items, at the time that the claim for payment is made and the Statement of Work Accomplished (SWA) is executed.
51.1	The date by which "as built" drawings are required is 15-30 of days from Completion Date as defined under GCC 1.1.3.
51.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is 1% of the final contract amount.

Section VI. Specifications

TABLE OF CONTENTS

A - FACILITIES FOR THE ENGINEER

A.1 REQUIREMENTS

A.1.1 Field Office, Laboratories and Living Quarters

The Contractor shall construct field offices, laboratories and living quarters including all the necessary air conditioning, electricity, water drainage and security services for the use of the Engineer and his staff for 24 hours a day or provide the same on a rental basis until end of the 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 the 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 sites of the Engineer's Building/s and Recreational Facilities, first priority shall be on DPWH property lots, second is on 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 documents and shall be a requirement to support the issuance of the 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 arrangement 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 5km 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 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.

A.1.1.1 Furniture/Fixtures, Equipment, Appliance, Apparatus and Publications

The field offices, laboratories and living quarters shall have at least the floor area prescribed on the plans and shall contain the sufficient furniture/ fixtures, equipment, appliances, apparatus and publications specified in the Contract. Testing equipment supplied in accordance with the contract shall be located in testing laboratories as required by the Engineer. If the Contractor cannot provide or intends to supply an equivalent substitute, the Contractor shall secure the approval of the Engineer.

A.1.1.2 Operation and Maintenance

The Contractor shall be responsible for the maintenance and protection of all facilities to be provided during the duration of the Contract, including providing adequate stock of all expendable items, such as light bulbs, light tubes, laboratory equipment and supplies at all times to ensure proper and continuous functioning of all the Engineer's facilities. The Contractor shall also repair and/or replace items that become defective or damaged in any way. Should the Contractor fail to maintain, repair or replace any item when such is required or fail to supply the materials or things necessary within the time specified by the Engineer, the Engineer may deal with the matter himself in whatever manner he considers most appropriate and all cost thereby incurred by the Engineer shall be recoverable from the Contractor and may be deducted from any payment which is due or which may become due to the Contractor. In the absence of water supply system within the area, the Contractor shall construct and install a 3,000 L capacity pressurized or elevated water tank with a well pump or equivalent, to sufficiently supply the requirements of the Engineer's Facilities. As a stand-by source of electricity, a power generator of 220 V, 10,000 W minimum capacity shall be provided by the Contractor at the Engineer's Facilities.

All field offices, stores and testing laboratories shall be proficiently guarded at all times, regularly and properly cleaned, adequately supplied and maintained for the duration of the Contract. Any portable offices required in the Contract shall be dismantled, moved and erected from time to time as directed by the Engineer.

A.1.2 Vehicles

The Contractor shall provide within thirty (30) calendar days upon issuance of the Notice to Proceed (NTP), the vehicles listed in the Contract for the exclusive use of the Engineer. The vehicles shall be able to transport personnel or equipment, supplies, products and materials. A provision in the Contract shall be provided that when the project duration exceeds 24 months, the service vehicle being rented shall be turned over to the Government after the completion of the project while the operation and maintenance of the vehicles shall be the responsibility of the Contractor until it is being turned over. For pure rental, in no instance shall the cumulative rental payment exceed the total cost of the vehicle.

All vehicles shall comply in all respects with all relevant Philippine national or local laws,

statutes and regulations. The vehicle shall carry or be fitted with the accessories as may be prescribed by laws and have comprehensive insurance. The vehicles on delivery shall be new and shall be driven by a competent qualified and experienced driver who shall be under the direct order of the Engineer.

The Contractor shall maintain the vehicle in good running condition and shall be supplied with appropriate fuel and lubricants at all times. He shall provide equivalent substitute vehicles during any period when the specified vehicles are taken out for service for maintenance, repair or any other reason. Unless otherwise specified, the vehicle shall at the end of the contract become the property of the Government.

A.1.2.1 Pickup Type Service Vehicles

The pickup shall be a four-wheel compact truck with a low sided open cargo hauler, and a passenger cab (regular/single or extended/crew cab type) accommodating up ton6 passengers including the driver seat on split and/or bench seats with two (2) or four (4) side doors. The pickup shall be able to carry both passengers and cargoes. The engine displacement shall not exceed 2,500 L for gasoline and 3,000 L for diesel and/or shall not have an engine exceeding four (4) cylinders.

A.1.2.2 Passenger Van

The van shall be a large four-wheel enclosed vehicle intended for conveying passengers having four (4) doors (two side doors for the driver and front passenger, a passenger side sliding door and a tailgate). The van shall accommodate eight (8) to 15 passengers including the driver. The rear area shall be expandable for the equipment, supplies, products, materials, etc. The engine displacement shall not exceed 2,500 L for gasoline and 3,000 L for diesel and/or shall not have an engine exceeding four (4) cylinders.

A.1.2.3 Motorized Banca

The motorized banca shall be used for inland waters and limited off-shore and inter-island transportation and shall be made of wood hull with roof. The motorized banca shall have engine capacity not exceeding 30hp.

A.1.2.4 Motorized Boat/Seacraft

The motorized boat/seacraft shall be used for inland waters, off-shore and inter-island transportation and operations as specified in the Contract.

A.1.2.5 Mini Bus

The mini bus shall be used for mass transportation of personnel/staff. The minibus shall have the capacity to transport 26 to 34 passengers The engine displacement shall not exceed 4,500 L for diesel.

A.1.2.6 Motorcycle

The motorcycle shall have one (1) or two (2) riding saddles with two wheels and, if required in the Contract, a third wheel to support a sidecar.

A.1.3 Assistance to the Engineer

The Contractor shall at all times during the duration of the Contract provide for the use of the Engineer all equipment, instrument and apparatus, all information and records. Such equipment, instruments and apparatus shall include in the Contract.

The Contractor shall provide qualified and experienced office, survey and laboratory staff/personnel for the assistance to the Engineer. The personnel/staff appointed by the Contractor to manage the office, survey and laboratory shall be well experienced in the type of work to be undertaken and shall be subject to the approval and direct supervision of the Engineer. They shall work full time and shall be responsible to the Engineer for all works carried out. The Contractor, if requested by the Engineer, shall immediately replace assigned personnel/staff for reasons arising from misconduct and/or unsatisfactory performance.

A.1.4 Progress Reports

A.1.4.1 Progress Photographs

The Contractor shall provide record photographs taken as, when and where directed by the Engineer at intervals of not more than one month. The photographs shall be sufficient in number and location to record the exact progress of the Works. The Contractor shall provide one proof print of each photograph taken, and the negative and ten (10) copies, not less than 254 mm x 203 mm and printed on glossy paper, of any of the photographs by the Engineer. The photographs retained by the Engineer will become the property of the Government and the

Contractor shall supply approved albums to accommodate them. Two copies are to be signed by the Contractor, one of which will be signed by the Engineer and returned to the Contractor.

The Contractor, when taking photograph shall observe the following:

1. An indicator, such as scale, pole or similar item shall be placed thereon to signify or illustrate the relative dimension of the pictures.

2. Each picture shall be captioned and identified as to date, location (Global Positioning System, GPS), description of work in progress or completed operation or activity or presence of unusual features in accordance with the DPWH Infratrack Manual and Guidelines for Geotagging Civil Works Projects.

The Photographs selected by the Engineer, with copies furnished by the Contractor, shall be compiled in albums per month with electronic files on jpeg file type and shall be arranged in consecutive order. Each album shall show the date or month, Project name on the cover and shall contain a location map of the construction site.

A.1.4.2 Progress Videos: Documentary Videos

The Contractor shall submit Progress Videos together with the Progress Photographs each

month if required in the Contract. The Contractor shall provide the video recording equipment listed in the Contract.

Upon completion, the Contractor, if required in the Contract, shall coordinate with the Engineer and edit all videos into a 15 to 30-minute professional Documentary Video of the project including professional English audio commentary, an introduction, chapters and credits which tells the story of the project in video concentrating on the main events, the major technical aspects and any problems associated with the project and how they were overcome.

The Contractor shall include a time-lapse video in the monthly submissions if required in the Contract. All footage, progress videos and documentary shall be restored in one terabyte (1TB) hard drive/s located in the Engineer's office.

All video recording equipment including the hard drives shall be turned over to and become the property of the Government upon completion of the project. All footages, progress videos and the completed documentary video shall become the copyrighted property of the Government.

A.1.5 Communication Facility/Equipment

The Contractor shall provide and maintain communication facility/equipment not later than 30 calendar days after the Commencement of the Works. If the Contractor fails to provide within the time stipulated, the Engineer may deal with the matter himself in whatever manners he considers most appropriate and all cost thereby incurred by the Engineer shall be coverable from the Contractor and maybe deducted from any payment which is due or may become due to the Contractor.

The Contractor shall provide and maintain mobile phones of good quality, brand new, ready for use, complete with accessories including provision for prepaid loads for the exclusive use of the Engineer.

The two-way radio communication service, if required in the Contract, shall be a Type-Approved/Accepted Radio Communication Equipment by National Telecommunications Commission (NTC).

The telephone service, if required in the Contract, shall have adequate speed as specified in the Contract.

Unless otherwise specified, any communication equipment shall become the property of the Government at the end of the Contract.

A.2 Method of Measurement

1. Lump sum shall be used as unit of measurement for the provision of:

    a. Field Office building for the Engineer including pieces of furniture, appliances and equipment

    b. Laboratory building for the Engineer including pieces of furniture, appliances,

equipment, apparatus and publications

c. Living quarters for the Engineer including pieces of furniture, and appliances.

d. Survey equipment for the Engineer.

e. Documentary video

2. The quantities for the provision on rental basis of the field office, laboratory, and living quarters for the Engineer shall include Operation and Maintenance and shall be for the time the Engineer occupies the field office, laboratory, and living quarters, respectively. The unit of measurement is "month".

3. The quantities for the provision on rental basis of fixtures/ furniture, appliances is supplied thereof. The unit of measurement is "month".

4. No separate payment shall be made in respect to consumable materials as this is deemed to be included in the pay item for maintenance of the Engineer's facility.

5. The quantities for the provision of vehicles for the Engineer shall be the number of each type of vehicle supplied. The unit of measurement is "unit".

6. The quantities for the operation and maintenance of vehicle for the Engineer shall be for the time the Engineer is supplied with each vehicle prior to their finally becoming the property of the Government. The unit of measurement is "vehicle-month".

7. The quantities for the provision on rental basis of the vehicles shall be for the time the Engineer is supplied thereof until the end of the Contract. The unit of measurement is "vehicle-month".

8. The quantities for progress photographs shall be the electronic files, album and/or number of photographs per month selected and provided as progress photographs from the commencement of works until the end of the Contract. The unit of measurement is "month".

9. The quantities for the provision of video recording equipment (e.g. drone, digital camera, including digital storage) shall be the number of each type of equipment used. The unit of measurement is " set".

10. The quantities for the provision of progress videos shall include the provision of video record equipment if on a rental basis. The unit of measurement is "month".

11. The quantities for the provision of communication facility/equipment for the Engineer shall include the mobile phones, telephone, internet connection and two-way radio and shall be for the time the Engineer is supplied with such prior to their finally becoming the property of the Government or until the end of the contract. The unit of measurement is "lump-sum" or "month".

12. The quantities for operation and maintenance of communication facility/equipment for the

Engineer shall be shall be for the time the Engineer is supplied with such prior to their finally becoming the property of the Government or until the end of the Contract. The unit of measurement is “month”.

This item includes the purchase and delivery of the following fixtures, furnitures and appliances:

Heavy Duty Monoblock Tables (63”x36”) 6pcs.

Heavy Duty Monoblock Chairs 30 pcs.

Lockable 3 layer Steel Cabinet 2 sets

Working Table - (Size : 1.0mx2.4m wooden table) 1 set

Wooden Bench - (2.4m long wooden bench) 2 sets

Desktop Computer with Monitor and Complete Accesories 1 set

Specifications

- Graphic Card: Nvidia GeForce RTX 2070
- Graphic Card Memory: atleast 4Gb
- System Memory (RAM): atleast 16Gb or more
- Hard Drive: SATA3 SSD

Monitor Specifications:

- 24” Monitor; 144Hz Full HD (1920x1080)

Peripherals :

- A4 Tech Regular USB Keyboard and Mouse

Laptop 1 set

- 15” screen
- Atleast RYZEN 5 5600U or Equivalent

- GeForce MX450 GPU or Equivalent
- 16GB RAM (minimum)
- 512GB SSD Storage
- 90Hz Refresh Rate (Minimum)

Printer (Colored) A3 Size **1 set**

- A3 Photo ink tank printer
- Ultra Low-cost : Purpose-built, refillable ink tank
- Photo printer : 6 colour A3+printer
- Compact Design : Small footprints ideal for home use
- User-friendly : hassle-free with simple set up
- Print method : On demand inkjet (Piezoellectric)
- Max print resolution : 570x1440dpi (with variable size droplet technology)
- Minimum Ink Droplet Volume : 1.5pl
- Automatic duplex printing : No
- Print Direction : Bi-direction printing, uni-directional printing
- Nozzle configuration : 90 per colour (cyan, light cyan, magenta, light magenta, yellow, black)
- Draft. A4(black/colour): up to 15ppm
- Photo default : 10x15cm/4x6” - approx. 45sec per photo (boarderless)

Geotagging Device, Android, **4 sets**

- Smart Phone

- Qualcom Snapdragon 662
- Android v10
- Fast Charging
- 770 x 1600 pixels screen resolution

Outdoor Projector with accessories **1 set**

White Board with stand (4'x8') **2 pcs.**

White Board (2"x3") **4 pcs.**

Water Dispenser **1 set**

- Tower Type hot & cold water dispenser
- Three faucet water option : hot, normal & cold
- Double sealed doors
- Double safety device to prevent overheating
- High efficiency compressor cooling
- High power stainless steel hot water tank
- Hot water capacity : 4L/h
- Cold water capacity : 2L/h
- Rated power : 420W(hot), 120W(cold)
- Voltage : 220-240V
- Dimension - 41.7068L x 37.7952W x 114.1984H

2-burner gas stove with tank and content **1 set**

Kitchen Utensils **1 lot**

Air Condition Unit 2hp, Split Type, Wall Mounted **1 set**

- Standard Inverter : Digital Inverter Bopst
- Fast Cooling Mode
- Triple Protector Plus
- Durafin ™
- Quiet Mode
- Single User Mode
- R32 Refrigerant

A.3 Basis of Payment

The quantities determined as provided above shall be paid for at the appropriate Contract Unit Price, for each of the particular pay items shown in the Bill of Quantities which price and payment shall constitute full compensation for furnishing and maintaining such items

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
A.1.1 (8)	Provision of Field Office for the Engineer (Rental Basis)	Lump Sum
A.1.1 (11)	Provision of Furniture/Fixtures,Equipment & Appliances for the Field Office for the Engineer	Lump Sum

B. OTHER GENERAL REQUIREMENTS

B.5 PROJECT BILLBOARD / SIGNBOARD

B.5.1 General Requirements

The Contractor shall install two (2) Project Information Signs at/or near the beginning and the end of the project or upon 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 1220 mm x 2440 mm using 12.50 mm thick marine plywood tarpaulin of the same size posted on 5 mm marine plywood. 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 billboards shall also be installed at every 5 km interval. Name(s) and/or picture(s) of any personages should not appear 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.5.2 Method of Measurement

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

B.5.3 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

B.7 - OCCUPATIONAL SAFETY AND HEALTH

B.7.1 Description

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

B.7.2 Construction Safety and Health Program (CSHP)

Every construction project shall have a suitable 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 Construction Safety and Health Program.

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

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

B.7.3 Construction Safety and Health Personnel

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

1. Project Manager/Project Engineer

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

2. 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 a part-time or full-time safety man depending on the number of workers shall be complied in accordance with Rule 1033 of the

Occupational Safety and Health Standards (OSHS) and applicable provisions under Section 7.0, Safety Personnel of Department of Labor and Employment (DOLE) 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 with Section 8.0, Emergency Occupational Health Personnel and Facilities or DOLE D.O. 13, Series of 1998.

4. Safety Practitioner

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

B.7.4 Supervision, Control and Monitoring

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

B.7.5 Construction Safety and Health Training

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

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

B.7.6 Construction Safety and Health Reports

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

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

B.7.7 Personnel Protective Equipment (PPE) and Devices

The Contractor shall furnish his workers with protective equipment for eyes, face, hands and

feet, lifeline, safety belt/harness, protective shields and barriers whenever necessary by reason of the hazardous work process or environment, chemical or radiological or other mechanical irritants of hazards capable of causing injury or impairment in the function of any part of the body through absorption, inhalation or physical agent.

All PPE and Devices shall be in accordance with the requirements of the Occupational Safety and Health Standards (OSHS) and should pass the test conducted and/or standards set by the Occupational Safety and Health Center (OSHC).

For General Construction Work, the required basic PPEs for all workers shall be safety helmet, safety gloves and safety shoes. Specialty PPEs shall be provided to workers in addition to or in lieu of the corresponding basic PPE as the work or activity requires. Workers within the construction project site shall be required to wear the necessary PPE at all times. Moreover, all other persons who are either authorized or allowed to be at a construction site shall also wear appropriate PPEs.

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

B.7.8 Signages and Barricades

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

B.7.9 Facilities

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

1. Adequate supply of safe drinking water;

2. Adequate sanitary and washing facilities;

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

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

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

B.7.10 Costing

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

1. Personal Protective Equipment (PPE)

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

2. Clinical Materials and Equipment

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

3. Signages and Barricades

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

4. Facilities

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

5. Salaries

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

6. Safety and Health Training

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

B.7.11 Safety on Construction during Heavy Equipment Operation

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

1. Pre-Construction

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

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

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

2. During Construction

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

a. For mobilization or transport of heavy equipment, load restrictions, height and width clearances as imposed by the 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 trailers.

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

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

3. Post Operation and Post Construction

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

B.7.12 Violations and Penalties

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

B.7.13 Mode of Measurement

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

B.7.14 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 the Bill of Quantities. Such payment shall be full compensation for furnishing, maintaining and ensuring against loss of the equipment/tools.

Payment will be made under:

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

B.9 - MOBILIZATION/DEMOBILIZATION

B.9.1 General Requirements

Mobilization shall mean the transport to the project site of the Contractor's personnel, construction plant and equipment as stipulated in the proposal and Contract of the project while demobilization shall be their subsequent removal from the site after the completion of the project.

The Contractor shall secure approval of the Engineer should he opted to demobilize any of the major plant and/or equipment before the completion of the project.

B.9.2 Method of Measurement

Mobilization/demobilization shall be paid by lump sum.

B.9.3 Basis of Payment

The accepted quantities, measured as prescribed in Section B.9.2, 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 No.	Description	Unit of Measurement
B.9	Mobilization/Demobilization	Lump Sum

B.16 RECOGNITION PLATE/ PROJECT MARKER

B.16.1 General Requirements

In order to have a uniform and consistent design in all recognition plate/project markers and for the guidance and information of the citizenry about the completed infrastructure projects being undertaken by the Department, recognition plate/project markers shall be installed in all applicable project sites by the concerned implementing offices of the Department, respectively. Henceforth, the following shall be observed in the preparation and installation of the recognition plate/project markers.

1. The marker to be installed in all completed projects shall be made of2.4 mm thick brass plate, 450 mm x 600 mm in size with black sunk lettering. It shall include the name of project, location, personages and source of funds.

2. For building and similar projects, it shall be strategically located at the front wall of the structure.

3. For a two (2) lane bridge and similar projects, it shall be installed at the right wing wall of the bridge.

4. For a four (4) lane bridge with median of not less than 2 m and similar projects, it shall be installed at the median of the road.

B.16.2 Method of Measurement

Recognition plate/project marker shall be measured by each unit placed and installed at the proper locations.

B.16.3 Basis of Payment

The accepted quantities, measured as provided in Section B.16.2, 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.16	Recognition Plate/Project Marker	Lump Sum

C. SITE DEVELOPMENT WORK

SPL 1 - DEWATERING

Description

This Item shall consist of the necessary excavation for removal of all foundations of materials of whatever nature encountered including all obstructions of any nature that would interfere with the proper execution and Completion of the work.

Construction Requirements

General

The removal of said materials shall conform to the lines and grades shown on the approved Plans and Specifications. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris and such materials shall be removed from the site prior to performing any excavation. The Contractor shall furnish, place and maintain all supports and shoring that may be required for the sides of the excavation, and all pumping, ditching or other

approved measures for the removal or exclusion of water, including taking care of storm water and wastewater reaching the site of Work from any source so as to prevent damage to the work and adjoining property.

In excavation which workers may be required to enter, excavated or other materials shall be stockpiled temporarily at least 600 mm from the edge of the trench and shall comply with the prevailing laws and issues pertaining to safety requirements.

Excavations shall be dewatered and maintained so that the material is excavated in its natural state and construction of the foundations is completed in the dry condition. The bottom of the excavation shall be kept free from excessive moisture and free-flowing water.

Excavation beneath Proposed Structures

Excavation shall be carried to the grade of the bottom of the footing or slab. Unless otherwise specified in the Plans, the areas beneath proposed structures shall be over-excavated. After the

required excavation or Over-excavation has been completed, the exposed surface shall be scarified to the depth of 150mm.

Brought to optimum moisture content and shall be compacted to 100% of Maximum dry density.

Excavation beneath Areas to be Paved

Excavation under areas to be paved shall extend to the bottom of the aggregate base if such base is called for; otherwise, it shall extend to the bottom of paving. After the required excavation has been completed, the exposed surface shall be scarified, brought to optimum moisture content and compacted to 100% of maximum dry density.

Pipeline Trench Excavation/ Excavation for Foundation of Structure

Unless otherwise shown on the approved Plans and Specifications, excavation for pipeline shall be open-cut trenches.

The bottom of the trench, including any shoring, shall have a minimum width equal to the outside diameter of the pipe plus 300 mm and a maximum width equal to the outside diameter of the pipe plus 600 mm. The bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe.

The trench bottom shall be given a final trim using a string line for establishing grade, such that each pipe section when first laid will be wholly in contact with the ground or bedding along the extreme bottom of the pipe.

Rounding out the trench to form a cradle shall not be required. The maximum amount of open trench permitted at any one time and in one location shall be 100 m or the length necessary to accommodate the number of pipes installed in one day, whichever is greater.

Barricades and warning lights shall be provided and maintained for all trenches except at intersections and driveways in which case heavy steel plates, adequately braced bridging or other type of crossing capable of supporting Vehicular traffic shall be furnished.

Excavation in Lawn Areas

Where pipeline excavation occurs in lawn areas, the sod shall be carefully removed and stockpiled to preserve it for replanting. Excavated material shall be placed on the lawn provided a drop cloth or other suitable method is employed to protect the lawn from damage. The lawn shall not remain covered for more than 72 h. immediately after the installation and completion of backfilling, the sod shall be replanted in a manner So as to restore the lawn as near as possible to its original condition.

Rock Excavation

Rock excavation shall include removal and disposal of stones having a volume of 1 m3 or more in existing ledges, bedding deposits and unsatisfied masses that cannot be excavated without blasting or the used rippers

Excavation beneath Proposed Concrete Reservoir

After the reservoir area has been stripped of all vegetation and debris, as specified in 1600.2.1, lawn and top soil from the top 600 mm of excavated soil shall be removed and stockpiled for possible later use as fill or around the reservoir and for miscellaneous top soil. Excavation under the reservoir shall extend to the bottom of the drain dock layer. After such excavation had been

completed, the exposed surface shall be rolled with heavy equipment to provide a reasonably smooth surface for placement of drain dock.

Method of Measurement

The quantity to be paid for shall be the volume of the materials excavated in cubic meter calculated by multiplying the horizontal area of the bottom of the structure or open-cut trench by the average depth. The average depth shall be calculated from the finished surface of the grade shown on the drawing or the original ground level, whichever is the lowest.

Dewatering shall be paid for on a lump sum basis, and no separate measurement shall be made for this work.

Basis of Payment

Payment for all work under this Item shall be made at the Contract Unit Price per cubic meter for each earthwork which price and payment shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete all work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 102 - EXCAVATION

102.1 Description

This Item shall consist of roadway and drainage and borrow excavation and the disposal of material in accordance with this Specification and in conformity with the lines, grades and dimensions shown on the Plans or established by the Engineer.

Removal of Unsuitable Material

Dewatering; Stabilized the area of the conditioning pond to be used for diverting water from fish pond 1 and another remaining Part of fishpond 2.

Dredging; Excavation areas must be dredged to remove combined sticky water and muck before the excavation starts. The materials result of dredging must be removed and disposed off by the contractor to the designated areas as shown in the plan or approved by the Engineer

Excavation; Removal of Unsuitable Material;

All unsuitable materials shall be excavated to the depth necessary and conduct Field Density Test to check if it also meets a stable natural base, or in accordance with general notes and in conformity with lines, grades and dimensions shown in the plans established by the Engineer. When the excavation is finished the Engineer may require the Contractor to dispose of the unsuitable material in designated areas.

Roadway Excavation; Roadway excavation will include excavation and grading for roadways, parking areas, intersections, approaches, slope rounding, benching, waterways and ditches; removal of unsuitable material from the roadbed and beneath embankment areas; and excavating selected material found in the roadway as ordered by the Engineer for specific use in the improvement. Roadway excavation will be classified as “unclassified excavation”, “rock excavation”, “common excavation”, or “muck excavation” as indicated in the Bill of Quantities and hereinafter described.

(1) Unclassified Excavation. Unclassified excavation shall consist of the excavation and disposal of all materials regardless of its nature, not classified and included in the Bill of Quantities under other pay items.

2) Common Excavation. Common excavations shall consist of all excavation not included in the Bill of Quantities under “rock excavation” or other pay items.

3) Muck Excavation. Muck excavation shall consist of the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material regardless of moisture content.

102.1.2 Borrow Excavation

Borrow excavation shall consist of the excavation and utilization of approved material required for the construction of embankments or for other portions of the work, and shall be obtained from approved sources, in accordance with Clause 61 and the following:

(1) Borrow, Case 1

Borrow Case 1 will consist of material obtained from sources designated on the Plans or in the Special Provisions.

(2) Borrow, Case 2

Borrow Case 2 will consist of material obtained from sources provided by the Contractor.

The material shall meet the quality requirements determined by the Engineer unless otherwise provided in the contract

Construction Requirements:

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a pre-construction survey referred to the datum plane used in the approved Plan shall be untaken by the Contractor under control of the Engineer to serve as basis for the computation of the actual volume of the excavated materials. All excavations shall be finished to a reasonably smooth and uniform surface. No materials shall be wasted without authority of the Engineer.

Conservation of Topsoil Where provided for on the Plans or in the Special Provisions, suitable topsoil encountered in excavation and on areas where embankment is to be placed shall be removed to such extent and to such depth as the Engineer may direct. The removed topsoil shall be transported and deposited in storage piles at locations approved by the Engineer. The topsoil shall be completely removed to the required depth from any designated area prior to the beginning of regular excavation or embankment work in the area and shall be kept separate from other excavated materials for later use.

Utilization of Excavated Material

All suitable material removed from the excavation shall be used in the formation of the embankment, subgrade, shoulders, slopes, bedding, and backfill for structures, and for other purposes shown on the Plans or as directed.

The Engineer will designate as unsuitable those soils that cannot be properly compacted in embankments. All unsuitable material shall be disposed off as shown on the Plans or as directed without delay to the Contractor.

Only approved materials shall be used in the construction of embankments and backfills.

All excess material, including rock and boulders that cannot be used in embankments shall be disposed off as directed.

Material encountered in the excavation and determined by the Engineer as suitable for topping, road finishing, slope protection, or other purposes shall be conserved and utilized as directed by the Engineer.

Borrow material shall not be placed until after the readily accessible roadway excavation has been placed in the fill, unless otherwise permitted or directed by the Engineer. If the Contractor places moré borrow than is required and thereby causes a waste of excavation, the

amount of such waste will be deducted from the borrow volume.

102.2.4 Prewatering

Excavation areas and borrow pits may be prewatered before excavating the material. When prewatering is used, the areas to be excavated shall be moistened to the full depth, from the surface to the bottom of the excavation. The water shall be controlled so that the excavated material will contain the proper moisture to permit compaction to the specified density with the use of standard compacting equipment. Prewatering shall be supplemented where necessary, by truck watering units, to ensure that the embankment material contains the proper moisture at the time of compaction.

The Contractor shall provide drilling equipment capable of suitably checking the moisture penetration to the full depth of the excavation.

102.2.5 Presplitting

Unless otherwise provided in the Contract, rock excavation which requires drilling and shooting shall be presplit.

Presplitting to obtain faces in the rock and shale formations shall be performed by: (1) drilling holes at uniform intervals along the slope lines, (2) loading and stemming the holes with appropriate explosives and stemming material, and (3) detonating the holes simultaneously.

Prior to starting drilling operations for presplitting, the Contractor shall furnish the Engineer a plan outlining the position of all drill holes, depth of drilling, type of explosives to be used, loading pattern and sequence of firing. The drilling and blasting plan is for record purposes only and will not absolve the Contractor of his responsibility for using proper drilling and blasting procedures. Controlled blasting shall begin with a short test section of a length approved by the Engineer. The test section shall be presplit, production drilled and blasted and sufficient material excavated whereby the Engineer can determine if the Contractor's methods are satisfactory. The Engineer may order discontinuance of the presplitting when he determines that the materials encountered have become unsuitable for being presplit.

The holes shall be charged with explosives of the size, kind, strength, and at the spacing suitable for the formations being presplit, and with stemming material which passes a 9.5 mm (3/8 inch) standard sieve and which has the qualities for proper confinement of the explosives.

The finished presplit slope shall be reasonably uniform and free of loose rock. Variance from the true plane of the excavated backslope shall not exceed 300 mm (12 inches); however, localized irregularities or surface variations that do not constitute a safety hazard or an impairment to drainage courses or facilities will be permitted.

A maximum offset of 600 mm (24 inches) will be permitted for a construction working bench at the bottom of each lift for use in drilling the next lower presplitting pattern.

102.2.6 Excavation of Ditches, Gutters, etc.

All materials excavated from side ditches and gutters, channel changes, irrigation ditches, inlet and outlet ditches, toe ditchers, furrow ditches, and such other ditches as may be designated on the Plans or staked by the Engineer, shall be utilized as provided in Subsection 102.2.3.

Ditches shall conform to the slope, grade, and shape of the required cross-section, with no projections of roots, stumps, rock, or similar matter. The Contractor shall maintain and keep open and free from leaves, sticks, and other debris all ditches dug by him until final acceptance of the work.

Furrow ditches shall be formed by plowing a continuous furrow along the line staked by the Engineer. Methods other than plowing may be used if acceptable to the Engineer. The ditches shall be cleaned out by hand shovel work, by ditcher, or by some other suitable method, throwing all loose materials on the downhill side so that the bottom of the finished ditch shall be approximately 450 mm (18 inches) below the crest of the loose material piled on the downhill side. Hand finish will not be required, but the flow lines shall be in satisfactory shape to provide drainage without overflow.

102.2.7 Excavation of Roadbed Level

Rock shall be excavated to a depth of 150 mm (6 inches) below subgrade within the limits of the roadbed, and the excavation backfilled with material designated on the Plans or approved by the Engineer and compacted to the required density.

When excavation methods employed by the Contractor leave undrained pockets in the rock surface, the Contractor shall at his own expense, properly drain such depressions or when permitted by the Engineer fill the depressions with approved impermeable material.

Material below subgrade, other than solid rock shall be thoroughly scarified to a depth of 150 mm (6 inches) and the moisture content increased or reduced, as necessary, to bring the material throughout this 150 mm layer to the moisture content suitable for maximum compaction. This layer shall then be compacted in accordance with Subsection 104.3.3.

102.2.8 Borrow Areas

The Contractor shall notify the Engineer sufficiently in advance of opening any borrow areas so that cross-section elevations and measurements of the ground surface after stripping may be taken, and the borrow material can be tested before being used. Sufficient time for testing the borrow material shall be allowed.

All borrow areas shall be bladed and left in such shape as to permit accurate measurements after excavation has been completed. The Contractor shall not excavate beyond the dimensions and elevations established, and no material shall be removed prior to the staking out and cross-sectioning of the site. The finished borrow areas shall be approximately true to line and grade established and specified and shall be finished, as prescribed in Clause 61, Standard Specifications for Public Works and Highways, Volume 1. When necessary to remove fencing, the fencing shall be replaced in at least as good condition as it was originally.

The Contractor shall be responsible for the confinement of livestock when a portion of the fence is removed.

102.2.9 Removal of Unsuitable Material

Where the Plans show the top portion of the roadbed to be selected topping, all unsuitable materials shall be excavated to the depth necessary for replacement of the selected topping to the required compacted thickness.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable soil, the Engineer may require the Contractor to remove the unsuitable material and backfill to the finished graded section with approved material. The Contractor shall conduct his operations in such a way that the Engineer can take the necessary cross-sectional measurements before the backfill is placed.

The excavation of muck shall be handled in a manner that will not permit the entrapment of muck within the backfill. The material used for backfilling up to the ground line or water level, whichever is higher, shall be rock or other suitable granular material selected from the roadway excavation, if available. If not available, suitable material shall be obtained from other approved sources. Unsuitable material removed shall be disposed off in designated areas shown on the Plans or approved by the Engineer.

102.3 Method of Measurement

The cost of excavation of material which is incorporated in the Works or in other areas of fill shall be deemed to be included in the Items of Work where the material is used.

Measurement of Unsuitable or Surplus Material shall be the net volume in its original position.

For measurement purposes, surplus suitable material shall be calculated as the difference between the net volume of suitable material required to be used in embankment corrected by applying a shrinkage factor or a swell factor in case of rock excavation, determined by laboratory tests to get its original volume measurement, and the net volume of suitable material from excavation in the original position. Separate pay items shall be provided for surplus common, unclassified and rock material.

The Contractor shall be deemed to have included in the contract unit prices all costs of obtaining land for the disposal of unsuitable or surplus material.

102.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 102.3 shall be paid for at the contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the removal and disposal of excavated materials including all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
102 (1)	Excavation of Unsuitable Materials	Cubic Meter

ITEM 804 - EMBANKMENT

804.1 Description

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

804.2 Material Requirements

804.2.1 Suitable Material

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

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

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

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

Table 804.1 Grading Requirements

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

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

804.2.2. Unsuitable Material

Materials that are not acceptable for use are the following

1. Organic soils such as peat and muck.

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

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

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

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

804.3 Construction Requirements

804.3.1 General

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

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

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

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

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

804.3.2 Methods of Construction

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

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

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

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

Embankment of earth material shall be placed in horizontal layers not exceeding 200 mm, loose measurement, and shall be compacted as specified before the next layer is placed. However, a thicker layer may be placed if a vibratory roller with high compacting effort is used provided that density requirement is attained and as approved by the Engineer. Trial section to this effect must be conducted and approved by the Engineer. Effective spreading equipment shall be used on each lift to obtain uniform thickness as determined in the trial section prior to compaction. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, blading, discing, or other methods satisfactory to the Engineer.

Where embankment is to be constructed across low swampy ground that will not support the mass of trucks or other hauling equipment, the lower part of She fill may be constructed by dumping successive loads in a uniformly distributed layer of a thickness not greater than necessary to support the auling equipment while placing subsequent layers. Fill material shall be placed in a way it effectively displaces unsuitable material from within an 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 routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

804.3.3 Compaction

1. Compaction Trials

Before commencing the formation of embankments, the Contractor shall submit in writing to the Engineer for approval his proposals for the compaction of each type of fill material to be used in the works. The proposals shall include the relationship between the types of compaction equipment, the number of passes required and the method of adjusting moisture content. The Contractor shall carry out full scale compaction trials on areas not less than 10 m wide and 50 m long as required by the Engineer and using his proposed procedures 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.

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

2. Earth

The Contractor shall compact the material placed in all embankment layers and the material scarified to the designated depth below subgrade in cut sections, until a uniform density of not less than 95 mass percent of the maximum dry density determined by AASHTO T 99, Standard Method of Test for Moisture Density Relations of Soils Using a 2.5 kg Rammer and a 305 mm Drop - Method C, is attained, at a moisture content determined by Engineer to be suitable for such density.

The Engineer shall, during progress of the Work, make density tests of compacted material in accordance with AASHTO T 191, Standard Method of Test for Density of Soil In-Place by the Sand-Cone Method, AASHTO T 205, Soil- Field density test sets: Balloon density apparatus or other approved field density tests, including the use of properly calibrated nuclear testing devices. If, by such tests, the Engineer determines that the specified density and moisture conditions have not been attained, the Contractor shall perform additional work as may be necessary to attain the specified conditions.

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

3. Gravel 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.

4. Broken Concrete

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

5. Rock

Density requirements will not apply to portions of embankments constructed of materials which cannot be tested in accordance with approved methods Embankment materials containing rocks shall be deposited, spread and leveled the full width of the fill with sufficient earth or other fine material so deposited to fill the interstices to produce a dense compact embankment. In addition, one of the rollers, vibrators, or compactors shall compact the embankment full width with a minimum of three (3) complete passes for each layer of embankment.

804.3.4 Protection of Embankment During Construction

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

804.3.5 Protection of Structure

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

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

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

804.3.6 Rounding and Warping Slopes

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

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

804.3.7 Finishing Roadbed and Slopes

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

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

804.3.8 Serrated Slopes

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

804.3.9 Earth Berms

When called for in the Contract, permanent earth berms shall be constructed of well graded

materials with no rocks having a maximum diameter greater than 25% the height of the berm. When local material is not acceptable, acceptable material shall be imported, as directed by the Engineer.

Compacted Berm

Compacted berm construction shall consist of moistening or drying and placing material as necessary in locations shown on the drawings or as established by the Engineer. Material shall contain no roots, sod, or other deleterious materials Contractor shall take precaution to prevent material from escaping over the embankment slope. Shoulder surface beneath berm will be roughened to provide a bond between the berm and shoulder when completed.

The Contractor shall compact the material placed until at least 95 mass percent of the maximum density is obtained as determined by AASHTO T 99, Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5 kg Ramme and a 305 mm Drop - Method C. The cross-section of the finished compacted berm shall reasonably conform to the typical cross-section as shown on the Plans.

Uncompacted Berm

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

804.3.10 Visual Inspection

Prior to final acceptance, the inspector shall visually inspect the entire section of the compacted embankment. If visual inspection shows that the course is not uniform or that the test values may not be representative of the entire section additional tests may be performed and deficiencies shall be corrected by the Contractor.

Deficiencies identified by visual inspection, such as laminations, dimensional deficiencies, soft areas, etc. shall be corrected before the section will be accepted. The section must be accepted prior to the placement of the next lift.

804.3.11 Dust Control

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

804.3.12 Stockpiling

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

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

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

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

804.4 Method of Measurement

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

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

Material from excavation per Item 802, Excavation which is used in embankment and accepted by the Engineer will be paid under Embankment and such payment will be deemed to include the cost of excavating, hauling, stockpiling and all other costs incidental to the work.

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

804.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 804.4, Method of Measurement shall be paid at the Contract Unit Price for each of the Pay Items listed below that is included in the Bill of Quantities.

The payment shall continue full compensation for placing and compacting all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804	Embankment	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 805 - DREDGING

805.1 Description

This item shall consist of the excavation of seabeds, river beds, bottoms of creek or esteros, and other bodies of water for the purpose of deepening up to the required bottom elevation and grade lines including disposal in accordance with the Plans and this Specification or as directed by the Engineer.

805.2 Construction Requirements

805.2.1 Construction Survey and Reference Elevation

A construction survey shall be undertaken by the Contractor under the supervision of the Engineer to determine actual work to be used as basis for the computation of the actual volume of dredged materials.

1. In areas affected by tidal action (rise and fall of water level) such as seabed, estuary, coastal area, etc. All elevations shall be referred to the mean lower low water elevation (MLLW) elevation, elev. 0.00.

   Establishment of elev. 0.00 by actual tide activity observation and recording for a period of not less than one month, based on mean lower low water (MLLW) level shall be conducted by the Contractor and shall be the basis of all elevation computations.

2. In areas not affected by tidal action such as riverbed, floodway channel, creek or estero, etc. All elevations shall be referred to a bench mark (BM) of known coordinates and elevation based on mean sea level (MSL) established by the National Mapping and Resource Information Authority (NAMRIA).

The reference benchmark (BM) nearest to the project site shall be transferred to a convenient location within the project limit by running a close traverse and transferring the elevation at prescribed accuracy.

The bench marks are generally located at about 1 km. interval along national, provincial, and municipal roads, bench marks are referred to mean sea level (MSL) and shall be the vertical datum for dredging works in areas not affected by tidal activity.

Respective construction surveys shall be undertaken by the Contractor under the control of the designated/assigned Engineer to serve as basis for the computation of the actual volume of dredged materials.

The survey works shall include actual on-site bathymetric, topographic and hydrographic surveys in accordance with the survey requirements as called for on the Plans.

Slope stability analysis shall be undertaken prior to planning and designing.

In addition to surveys, in order to be able to establish the representative riverbed material gradation as well as soil parameters at the banks, soil investigation shall be conducted. Soil

investigation shall be in accordance with the requirements as called for in the DPWH Design Guidelines Criteria and Standards for Geological and Geotechnical Investigation, Volume 2C, 2015 Edition. Survey and Investigation for slope stability analysis while shallow borings (about 3 m to 5 m) are undertaken along the riverbed at a minimum of every 200 m intervals for the necessary determination of the representative riverbed material gradation for sediment transport analysis.

805.2.2 Equipment

The contractor shall furnish all the necessary dredging equipment to assure satisfactory prosecution of the work.

805.2.3 Execution of the Work

The dredging work shall be undertaken by the Contractor starting from the downstream section or within the limits indicated on the Plans and in accordance with the Specifications and approved work schedule.

805.2.4 Materials to be Dredged

All available data regarding the materials to be dredged are given in the soil investigation reports and as indicated in the boring logs on the plans. Materials to be dredged may range from muck, sandy loam to coral.

The Contractor may at his own initiative verify or check at his own expense all the data regarding the materials to be encountered. He shall not be entitled to any claim against the Government in case of incorrect interpretation of the borings or laboratory test results of the soil investigation.

805.2.5 Dredging Tolerances (Over Depth)

The dredging shall be executed according to the depths or elevations indicated on the Plans. No elevation higher than the indicated elevation shall be tolerated. An allowance of 300 mm shall be acceptable for over dredging, but in no case shall the entire dredging area be dredged to the allowable 300 mm tolerance. All quantities due to over dredging shall be at the Contractor’s expense.

In case of excessive over dredging (beyond the 300 mm tolerance) the Contractor shall on his account backfill the over dredged areas and/or take all necessary measures as approved by the Engineer to protect the stability of the nearby structures.

805.2.6 Dredging Slopes

All dredging slopes shall be to the specified gradient and within the limits specified on the Plans.

805.2.7 Dredging Limit

The dredging operation shall start at the downstream reaches moving towards the upstream

reaches as practicable as possible. The theoretical boundaries of dredging are shown on the Plans. The dredging shall be carried out to the specified depth with the permissible over dredging specified in the Subsection 805.2.5, Dredging Tolerances (Over depth).

No extraction, removal, and/or disposition of materials shall be allowed within a distance of one (1) km from the boundaries of reservoirs established for public water supply, archaeological and historical sites or of any public or private works or structures, unless prior clearance from the Government agency(ies) concerned or owner is obtained. No extraction, removal and/or disposition of materials shall likewise be allowed in offshore areas within 500 m distance from the coast to 200 m from the mean low tide.

The preferred degree of slopes between the original bottom and the indicated dredging level is 1 (vertical) to 4 (horizontal) for layers of clay and 1 to 6 for layers of sand and silty sand and 1 to 10 for layers of mud or silt.

805.2.8 Dredging Adjacent to Waterfront Structures

The maximum permissible over dredging is 300 mm. The Contractor shall be fully responsible for the safety of any permanent structures on the subject area.

The proposed dredging works shall be in accordance with the approved Plan and Specifications. The top edge of dredging works shall not be closer than 10 m from existing riverbanks and/or river structures such as dikes, revetment, spur dikes and other river training structures.

In case where a dredging proponent is concerned, any damage to the existing private and public utilities adjacent to the proposed dredging works, including the loss of lives, if any that may result shall be the sole responsibility of the dredging proponent. Such damages to the existing private and public utilities shall be reconstructed/repaired to its original form in accordance with the Standards and Specifications at the expense of the Contractor.

805.2.9 Dredging Adjacent to Structures

Dredging shall not be allowed near or under public or private buildings, cemeteries, archaeological and historic sites, bridges, highways, waterways, railroads, reservoirs, dams or other infrastructure projects, public or private works including plantations or valuable crops, except upon written consent from the Government Agency or private entity concerned.

805.2.10 Disposal of Spoils

All unsuitable dredged materials shall be dumped at the spoil area shown on the Plans or into the open sea as directed by the designated/assigned Project Engineer.

Good quality dredged material shall be dumped in reclaimed areas in accordance with Item 806, Reclamation. Excess quantities shall be deposited at areas as designated by the Engineer.

805.2.11 Articles of Value or Wreckage

Articles of value, wreckage or obstructions discovered on the site shall be reported by the

Contractor in writing to the Engineer who in turn shall consult with the proper agency/official concerned for their proper disposal.

805.3 Method of Measurement

The Engineer shall verify that the dredging between the pre and post dredging surveys, subjected to the condition of Subsection 805.2.5, Dredging Tolerances.

805.4 Basis of Payment

The cost of dredging shall be paid based on the computed volume of dredged materials multiplied by the Contract Unit Price for the particular Pay Item shown in the Bid Schedule, which price and payment shall constitute full compensation for dredging, handling and disposal including labor, equipment, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
805 (1)	Dredging	Cubic Meter

ITEM 1000 - TERMITE CONTROL WORK

1000.1 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.

1000.2 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 tunnels where termites are exterminated through Trophallaxis method (exchange or nourishment between termites while greeting each other upon meeting).

1000.3 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.

1000.3.1 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.

1. 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/1.m within the cordoned area.

2. Drenching

When soil shows 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/m².

1000.3.2 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.

1000.3.3 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/m² 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 the 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.

1000.3.4 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.

1000.3.5 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.

1000.3.6 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.

1000.3.7 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 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.

1000.3.8 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.

1000.4 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.

1000.5 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

ITEM 1100-CONDUITS, BOXES AND FITTING

1100.1 Description

This Item shall consist of furnishing and installation of the complete conduit work consisting of electrical conduits; conduit boxes; conduit fittings and other electrical materials in accordance with the Plans and this Specification.

1100.2 Material Requirements

All materials shall be of the approved type in accordance with the requirements of the Philippine

Electrical Code (PEC), Part I and bearing the Philippine Standard (PS) mark for locally manufactured and Import Commodity Clearance (ICC) certification marks duly issued by Bureau of Philippine Standards (BPS) for imported materials.

1100.2.1 Rigid Metal Conduit (RMC)

A threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed with its integral or associated coupling and appropriate fittings.

RMC shall be made of steel with protective coatings, aluminum, red brass or stainless steel.

Markings in each length of RMC shall be clearly and durably identified in every 3,000 mm as required in the Subsection 1.10.1.21 (A) of Articde 1.10, Requirements for Electrical Installations of PEC, Part I. Nonferrous conduit of corrosion-resistant material shall have suitable markings.

The standard length of RMC shall be 3,000 mm, including an attached coupling and each end shall be threaded. Longer or shorter lengths with or without coupling and threaded or unthreaded shall be permitted.

RMC shall have a minimum size of metric designator 16 (trade size 1/2) and a maximum size of metric designator 155 (trade size 6)

1100.2.2 Intermediate Metal Conduit (IMC)

A steel threadable raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding Conductor when installed with its integral or associated coupling and appropriate fittings.

IMC shall be made of either steel with protective coatings or stainless steel.

Markings in each length of IMC shall be clearly and durably marked at least every 1,500 mm with the letters IMC. Each length shall be marked as required in Subsection 1.10.1.21 of Article 1.10, Requirements for Electrical Installations of PEC, Part I.

The standard length of IMC shall be 3,000 mm, including an attached coupling, and each end shall be threaded. Longer or shorter lengths with or without coupling and threaded or unthreaded shall be permitted.

IMC shall have a minimum size of metric designator 16 (trade size 1/2) and a maximum size of metric designator 103 (trade size 4).

1100.2.3 Flexible Metal Conduit (FMC)

A raceway of circular cross section made of helically wound, formed, interlocked metal strip. Sizes of FMC shall comply with the requirements of subsection 3.48.2.11, Size of Article 3.48, Flexible Metal Conduit: Type FMC of PEC, Part I.

1100.2.4 Electrical Metallic Tubing (EMT)

An unthreaded thin-wall raceway of circular cross section designed for the physical protection and routing of conductors and cables and for use as an equipment grounding conductor when installed utilizing appropriate fittings. EMT İS generally made of steel (ferrous) with protective coatings or aluminum (nonferrous).

EMT shall be clearly and durably marked at least every 3,000 mm as required In the Subsection 1.10.1.21 (A) of Article 1.10, Requirements for Electrical Installations of PEC, Part I.

EMT shall have a minimum size of metric designator 16 (trade size) and a maximum size of metric designator 103 (trade size 4)

1100.2.5 Rigid Polyvinyl Chloride Conduit (PVC)

PVC Conduit shall be made of rigid (nonplasticized) polyvinyl chloride (PVC). PVC conduit and fittings shall be composed of suitable nonmetallic material that is resistant to moisture and chemical atmospheres. For use above ground, it shall also be flame retardant, resistant to impact and crushing, resistant to distortion from heat under conditions likely to be encountered in service, and resistant to low temperature and sunlight effects .Where intended for direct burial, without encasement in concrete, the material shall also be capable of withstanding

continued loading that is likely to be encountered after installation.

Markings in each length of PVC conduit shall be clearly and durably marked at least every 3,000 mm as required in the Subsection 1.10.1.21 (A) of Article 1.10 Requirements for Electrical Installations of PEC, Part I. The type of material shall also be included in the marking unless it is visually identifiable.

For conduit recognized for use aboveground, these markings shall be permanent. For conduit limited to underground use only, these markings shall be sufficiently durable to remain legible until the material is installed. Conduit shall be permitted to be surfaced marked to indicate special characteristics of the material.

The physical and mechanical properties of PVC conduit shall conform to the requirements of PNS 14:2005, Unplasticized Polyvinyl Chloride (uPVC) electrical conduit - Specification.

PVC shall have a minimum size of metric designator 16 (trade size 1/2) and a maximum size of metric designator 155 (trade size 6).

1100.2.6 Liquidtight Flexible Nonmetallic Conduit (LFNC)

A raceway of circular cross section of various types as follows:

1. A smooth seamless inner core and cover bonded together and having one or more reinforcement layers between the core and covers, designated as type LFNC-A.

2. A smooth inner surface with integral reinforcement within the conduit wall, designated as Type LFNC-B.

3. A Corrugated internal and external surface without integral reinforcement within the conduit wall, designated as LFNC-C.

LFNC-B as a prewired manufactured assembly shall be provided in continuous lengths capable of being shipped in na coil, reel, or carton without damage.

LFNC shall be marked at least in every 600 mm in accordance with Subsection 1.10.1.21 (A) of Article 1.10, Requirements for Electrical Installations of PEC, Part I. The marking shall include a type designation and the trade size. Conduit that is intended for outdoor use or direct burial shall be marked.

The type, size and quantity of conductors used in prewired manufactured assemblies shall be identified by means of a printed tag or label attached to each end of the manufactured as assembly and either the carton, coil or reel.

The enclosed conductors shall be marked in accordance with Subsection 3.10.3.17, Markings of Article 3.10, Conductors for General Wiring of PEC, Part I.

Sizes of LFNC shall comply with the requirements of subsection 3.56.2.11, Size of Article 3.56, Liquidtight Flexible Nonmetalic Conduit: Type LFNC of PEC, Part I.

1100.2.7 Weatherhead

Weatherhead is installed at the point of connection to service-drop connectors to protect the service raceways and service cables from exposure to weather or rain.

Weatherhead material shall be of the same material as conduit where it will be Connected.

1100.2.8 Conduit Boxes, Fittings and Accessories

Conduit boxes, fittings and accessories shall comply with the applicable requirements of Article 3.14- Outlet, Device, Pull and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures of PEC, Part I.

1100.3 Construction Requirements

All works throughout shall be executed satisfactorily by qualified electricians under the supervision of a duly Registered Electrical Engineer and Shall be in accordance with the requirements of PEC, Part I.

1100.3.1 Rigid Metal Conduit (RMC)

1100.3.1.1 Uses Permitted

1. Atmospheric Conditions and Occupancies

a. **Galvanized Steel and Stainless Steel RMC**. Galvanized steel and stainless steel RMC shall be permitted under all atmospheric conditions and occupancies.

b. **Red Brass RMC**. Red brass RMC shall be permitted to be installed for direct embedment and swimming pool applications.

c. **Aluminum RMC**. Aluminum RMC shall be permitted to be installed where approved for the environment. Rigid aluminum conduit encased in concrete or in direct contact with the earth shall be provided with approved supplementary corrosion protection.

d. **Ferrous Raceways and Fittings**. Ferrous raceways and fittings protected from corrosion solely by enamel shall be permitted only indoors and in occupancies not subject to severe corrosive influences.

2. Corrosive Environments

a. **Galvanized Steel, Stainless Steel and Red Brass RMC, Elbows, Couplings and Fittings**. Galvanized steel, stainless steel and red brass RMC, elbows, couplings and fittings shall be permitted to be installed in Concrete, in direct contact with the earth, or in areas subject to severe Corrosive influences where protected by corrosion protection approved for the condition.

b. **Supplementary Protection of Aluminum RMC**. Aluminum RMC shall be provided with approved supplementary Corrosion protection where encased in concrete or in

direct contact with the earth.

3. Cinder Fill

Galvanized steel, stainless steel and red brass RMC shall be permitted to be installed in or under cinder fill where subject to permanent moisture where protected on all sides by a layer of noncinder concrete not less than 50 mm thick: where the conduit is not less than 450 mm under the fill; or where protected by corrosion protection and judged suitable for the condition.

4. Wet Locations

All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or protected | by corrosion-resistant materials exposed to moisture.

1100.3.1.2 Dissimilar Metals

Where practicable, dissimilar metals in contact anywhere in the system shall be avoided to eliminate the possibility of galvanic action. Aluminum fittings and enclosures shall be permitted to be used with galvanized steel RMC, and galvanized steel fittings and enclosures shall be permitted to be used with aluminum RMC where not subject to severe corrosive influences.

Stainless steel RMC shall only be used with stainless steel fittings and approved accessories, outlet boxes, and enclosures.

1100.3.1.3 Number of Conductors

The number of conductors in a conduit and tubing shall not exceed the permitted percentage fill specified in table below.

Table 1100.1. Percent of Cross Section of Conduit and Tubing for Conductors

Number of Conductors and/or Cables	Cross-sectional Area (%)
1	53
2	31
Over 2	40

Notes

1. Table 1100.1 is based on Common conditions of proper cabling and alignment of conductors. where the length of the pull and the number of bends are within reasonable limits. It should be recognized that, for certain conditions, a larger size conduit or lesser conduit fill should be considered.

2. When pulling three (3) conductors or cables into a raceway, if the ratio of the inside diameter (raceway) to the outside diameter (conductor or cable) is between 2.8 and 3.2, jamming can

occur. While jamming can occur when pulling four (4) or more conductors into a raceway, the probability is very low.

3. Table 1100. 1 applies only to complete conduit or tubing systems and is not intended to apply to sections of conduit or tubing used to protect exposed wiring from physical damage.

Cables shall be permitted to be installed where such use is not prohibited by the respective cable articles of PEC, Part I.

The number of cables shall not exceed the allowable percentage fill specified in Table 1100.1.

1100.3.1.4 Bends

Bends of RMC shall be so made that the conduit will not be damaged and so that the internal diameter of the conduit will not be effectively reduced. The radius of the curve of any field bend to the centerline of the conduit shall not be less than indicated in Table 1100.2.

Table 1100.2. Radius of Conduit and Tubing Bends

Conduit or Tubing Size	One Shot and Full Shoe Benders	Other Bends
Raceway Size (mm)	(mm)	(mm)
15	100	100
20	115	125
25	145	150
32	180	200
40	210	250
50	240	300
65	265	375
80	325	450
90	375	525
100	400	600
125	600	750
150	750	900

There shall not be more than the equivalent of four (4) quarter bends (500 degrees total) between pull points, for example, conduit bodies and boxes.

1100.3.1.5 Reaming and Threading

All cut ends shall be reamed or otherwise finished to remove rough edges. Where conduit is threaded in the field, a standard cutting die with a one (1) in 16 taper (62.5mm per meter) shall be used.

100.3.1.6 Securing and Supporting

RMC shall be installed as a complete system in accordance with Subsection 301.18 Raceway Installations, of Article 3.0, General Requirements for Wiring Methods and Materials of PEC, Part I and shall be securely fastened in place and supported in accordance with the following:

1. Securely Fastened. RMC shall be secured in accordance with the following:

   a. RMC shall I be securely fastened within 0.90m of each outlet box, junction box, device box, cabinet, conduit body, or other conduit termination.

   b. Fastening shall be permitted to be increased to a distance of 1.50 m where structural members do not readily permit fastening within 0.90 m.

   c. Where approved, conduit shall not be required to be securely fastened within 0.90 m of the service head for above-the-roof termination of a mast.

2. Supports. RMC shall be supported in accordance with one of the following:

   a. Conduit shall be supported at intervals not exceeding 3.0 m.

   b. The distance between supports for straight runs of conduit shall be permitted in accordance with Table 1100.3, provided the conduit is made up with threaded couplings, and such supports prevent transmission of stresses to termination where conduit is deflected between supports.

Table 1100.3 Supports for Rigid Metal Conduit

Conduit size		**Maximum Distance Between Rigid Metal Conduit Supports**
Metric Designator	**Trade Size**	**(m)**
16-21	½ - ¾	3.0
27	1	3.6
35-41	1 ¼ - 1 ¼	4.2
53-63	2 – 2 ½	4.8
73 and larger	3 and larger	6.0

c. Exposed vertical risers from industrial machinery or fixed equipment shall be permitted to be supported at intervals not exceeding 6.0 m if the conduit is made up with threaded couplings,

the conduit is supported and securely fastened at the top and bottom of the riser and no other means of intermediate support are readily available.

d. Horizontal runs of RMC supported by openings through framing members at intervals not exceeding 3.0 m and securely fastened within 0.90 m of termination points shall be permitted.

1100.3.1.7 Couplings and Connectors

Threadless couplings and connectors used with conduit shall be made tight. Where embedded in masonry or concrete, they shall be the concrete tight type. Where installed in wet locations, they shall comply with Subsection 3.14.2.1, Damp or Wet Locations of Article 3.14, Outlet, Device, Pull Junction Boxes; Conduit Bodies; Fittings; and Handholes Enclosures of PEC, Part 1. Threadless couplings and connectors shall not be used on threaded conduit ends unless listed for the purpose.

Running threads shall not be used on conduit for connection at couplings.

1100.3.1.8 Locknut and Bushings

Where a conduit enters a box, fitting, or other enclosure, a locknut and bushing shall be provided to protect the wire from abrasion unless the design of the box, fitting, or enclosure is such as to afford equivalent protection.

1100.3.2 Intermediate Metal Conduit (IMC)

1100.3.2.1 Uses Permitted

1. All Atmospheric Conditions and Occupancies

Use of IMC shall be permitted under all atmospheric conditions and occupancies.

2. Corrosion Environments

IMC, elbows, couplings and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection approved for the condition.

3.Cinder fill

IMC shall be permitted to be installed in or under cinder fill where subject to permanent moisture where protected on all sides by a layer of noncinder concrete not less than 50 mm thick; where the conduit is less than 450 mm under the fill; or where protected by corrosion protection approved for the Condition.

4. Wet locations

All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or protected against corrosion by corrosion-resistant materials.

100.3.2.2 Dissimilar Metal

Where practicable, dissimilar metals in contact anywhere in the system shall be avoided I to eliminate the possibility of galvanic action.

Aluminum fittings and enclosures shall be permitted to be used with galvanized steel IMC where not subject to severe corrosive influences. Stainless steel IMC shall only be used with stainless steel fittings and approved accessories, outlet boxes, and enclosures.

100.3.2.3 Number of Conductors

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.2.4 Bends

It shall comply with the requirements of Subsection 1100.3.1.4, Bends.

1100.3.2.5 Reaming and Threading

It shall comply with the requirements of Subsection 1100.3.1.5, Reaming and Threading.

1100.3.2.6 Securing and Supporting

It shall comply with the requirements of Subsection 1100.3.1.6, Securing and Supporting.

1100.3.2.7 Couplings and Connectors

It shall comply with the requirements of Subsection 1100.3.17, Couplings and Connectors.

1100.3.2.8 Bushings

It shall comply with the requirements of Subsection 1100.3.18, Locknut and Bushings.

1100.3.3 Flexible Metal Conduit

1100.3.3.1 Uses Permitted

FMC shall be permitted to be used in exposed and concealed locations

1100.3.3.2 Uses Not Permitted

FMC shall not be used in the following:

1. In wet locations.

2. In hoistways , other than as permitted in Subsection 6.20.3.1(A) (1) Hoistways and Pits of Article 6.20, Elevators, Dumbwaiters, Escalators, Moving Walks, Platforms Lifts of PEC, Part I.

3. In storage battery rooms.

4. In any hazardous (classified) location except as permitted by other articles in the PEC, Part I.

5. Where exposed to materials having a deteriorating effect on the installed conductors, such as oil or gasoline.

6. Underground or embedded in poured concrete or aggregate.

7. Where subject to severely physical damage.

1100.3.3.3 Number of Conductors

The number of conductors shall not exceed that permitted by the percentage fill specified in Table 1100.1 or as permitted in Table 3.48.2.13, Maximum Number of Insulated Conductors in Metric Designator 12 (Trade Size) Flexible Metal Conduit of Article 3.48, Flexible Metal Conduit: Type FMC of PEC, Part I or for metric designator 12 (trade size 3/8).

Cable shall be permitted to be installed where such use is not prohibited by the respective cable articles of PEC, Part I. The numbers of cables shall not exceed the allowable percentage fill specified in Table 1100.1.

1100.3.3.4 Bends

Part I. The numbers of cables shall not exceed Bends in conduit shall be made so that the conduit is not damaged and the internal diameter of the conduit is not effectively reduced. Bends shall be permitted to be made manually without auxiliary equipment. The radius of the Curve to the centerline of any bend shall not be less than as shown in Table 1100.2 using the column "Other Bends".

There shall not be more than the equivalent of four (4) quarter bends (360 degrees total) between pull points, for example, conduit bodies and boxes.

1100.3.3.5 Trimming

All cut ends shall be trimmed and smoothened.

1100.3.3.6 Securing and Supporting

FMC shall be secured and supported in accordance with the requirements of Subsection 3.48.2.21, Securing and Supporting of Article 3.48, Flexible Metal Conduit: Type FMC of PEC, Part I.

1100.3.3.7 Couplings and Connectors

Angle connectors shall not be used for concealed raceway installations.

1100.3.4 Electrical Metallic Tubing (EMT)

1100.3.4.1 Uses Permitted

1. Exposed and Concealed. The use of EMT shall be permitted for both exposed and concealed work for the following:

a. In concrete, in direct contact with the earth or in areas subject to severe corrosive influences where installed in accordance with Subsection 1100.3.4.1 (b).

b. In dry, damp and wet locations.

c. In any hazardous (classified) location as permitted by other articles in the PEC, Part 1.

2. Corrosive Environments

a. Galvanized Steel and Stainless Steel EMT, Elbows and Fittings, Galvanized steel and stainless steel EMT, elbows and fittings shall be permitted to be installed in concrete, in direct contact with the earth, or in areas subject to severe corrosive influences where protected by corrosion protection and approved as suitable for the condition.

b. Supplementary Protection of Aluminum EMT. Aluminum EMT Shall be provided with approved supplementary corrosion protection where encased in concrete or in direct contact with the earth.

3. Cinder Fill

Galvanized steel and stainless steel EMT shall be permitted to be installed in cinder concrete or cinder fill where subject to permanent moisture where protected on all sides by a layer of non cinder concrete not less than 50 mm thick or when the tubing is installed at 450 mm under the fill.

4. Wet Locations

It shall comply with the requirements of Subsection 1100.3.1.1 (4), Wet Locations.

1100.3.4.2 Uses Not Permitted

EMT shall not, be used under the following conditions:

1. Where subject to severe physical damage.

2. Where protected from corrosion solely by enamel.

1100.3.4.3 Number of Conductors.

1100.3.4.4 Bends

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

It shall Comply the requirements of Subsection 1100.3.1.4, Bends.

1100.3.4.5 Reaming and Threading

All cut ends of EMT shall be reamed or otherwise finished to remove rough edges.

EMT shall not be threaded.

1100.3.4.6 Securing and Supporting

EMT Shall be securely fastened in place at least every 3.0 m. In addition, each EMT run between termination points shall be securely fastened within 0.90 m of each outlet box, junction box, device box, cabinet, conduit body, or other tubing termination except to the following conditions:

1. Fastening of unbroken lengths shall be permitted to be increased to a distance of 1.5 m where structural members do not readily permit fastening within 0.90 m.

2. For concealed work in finished buildings or prefinished wall panels where such Securing is impracticable, unbroken lengths (without coupling) of EMT shall be permitted to be fished.

3. Horizontal runs of EMT Supported by openings through framing members at intervals not greater than 3.0 m and securely fastened within 0.90 m of termination points shall be permitted.

1100.3.4.7 Couplings and Connectors

Couplings and connectors used with EMT shall be made up tight when embedded in masonry or concrete. Where installed in wet locations, they shall comply with Subsection 3.14.2.1, Damp or Wet Locations of Article 3.14,Outlet. Device, Pull, and Junction Boxes; Conduit Bodies; Fittings; and Handhole Enclosures of PEC, Part I.

1100.3.5 Rigid Polyvinyl Chloride Conduit

1100.3.5.1 Uses Permitted

The use of PVC conduit shall be permitted in accordance with the following:

1. Concealed. PVC conduit shall be permitted in walls, floors and ceilings.

2. Corrosive Influences. PVC conduit shall be permitted in location subject to severe corrosive influences as covered in Subsection 3.0.1.6, Protection against Corrosion and Deterioration of Article 3.0, General Requirements for Wiring Methods and Materials of PEC Part I.

3. Cinders. PVC conduit shall be permitted in cinder fill.

4. Wet Locations. PVC conduit shall be permitted in portions of dairies, laundries, canneries, or other wet locations, and in locations where walls are frequently washed, the entire conduit system, including boxes and fittings used therewith, shall be installed and equipped so as to prevent water from entering the conduit.

All supports, bolts, straps, screws, and so forth, shall be of corrosion-resistant materials or be protected against corrosion by approved corrosion-resistant materials.

5. Exposed. PVC conduit shall be permitted for exposed work. PVC conduit used exposed in areas of physical damage shall be identified for the use.

6. Underground Installations. For underground installations, PVC Shall be permitted for direct embedment and underground encased in concrete accordance with Subsections 3.0.1.5 and 3.0.2.20, Underground Installations of Article 3.0, General Requirements for Wiring Methods and Materials of PEC, Part I.

7. Support of Conduit Bodies. PVC conduit shall be permitted to support nonmetallic conduit bodies not larger than the largest trade size of an entering raceway. These Conduit bodies shall not support devices other than splicing devices as permitted by Subsection 1.10.1.14 (B), Mounting and Cooling of Subsection 33.14.2.2(C)(2), Conduit Bodies of Article 3.14, Outlet, Device, Equipment of Article 1.10, Requirements for Electrical Installations and Pull, and Junction boxes; Conduit Bodies; Fittings; and Handhole Enclosures of PEC, Part I.

8. Insulations Temperature Limitations. Conductors or cables rated at a temperature higher than the listed temperature rating of PVC conduit shall be permitted to be installed in PVC conduit, provided the conductors or cables are not operated at a temperature higher than the listed temperature rating of the PVC conduit.

1100.3.5.2 Uses Not Permitted

PVC Conduit shall not be used under the conditions specified in the following:

1. Hazardous (Classified) Locations. In any hazardous (classified) location, except as permitted by other articles of the PEC, Part I.

2 Support of Luminaires. For the support of luminaires or other equipment not described in Subsection 1100.3.5. 1 (7) Support of Conduit Bodies.

3. Physical Damage. Where subject to physical damage unless identified for Such use.

4. Ambient Temperatures. Where subject to ambient temperatures in excess of 50°C unless listed otherwise.

5. Theaters and Similar Locations. In theaters and similar locations, except as provided in Subsection 5.18.1.4, Wiring Methods of Article 5.18, Assembly Occupancies and Subsection 5.20.1.5, Wiring Methods of Article 5.20, Theaters, Audience Areas of Motion Picture and Television Studios, Performance Areas, and Similar Locations of PEC, Part I.

1100.3.5.3 Number of Conductors

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.5.4 Bends

It shall comply the requirements of Subsection 1100.3.1.4, Bends.

1100.3.5.5 Trimming

All cut ends shall be trimmed and smoothened.

1100.3.5.6 Securing and Supporting

PVC Conduit shall be installed as a complete system as provided in Subsection 3.0.1.18, Raceway Installations of Article 3.0, General Requirements for Wiring Methods and Materials of PEC, Part I and shall be fastened so that movement from thermal expansion or contraction is permitted. PVC conduit shall be securely fastened and supported in accordance with the following:

1. Securely Fastened. PVC conduit shall be securely fastened within 900 mm of each outlet box, junction box, device box, Conduit body, or other conduit termination. Conduit listed for securing at other than 900 mm shall be permitted to be installed in accordance with the listing.

2. Supports. PVC conduit shall be supported as required in Table 1100.4 listed for support at spacings other than as shown in Table 1100.4 shall be permitted to be installed in accordance with the listing.

Horizontal runs of PVC conduit supported by openings through framing members at intervals not exceeding those in Table 1100.4 and securely fastened within 900 mm of termination points shall be permitted.

Table 1100.4 Support of Rigid Polyvinyl Chloride Conduit (PVC)

Conduit size		**Maximum Spacing Between Supports**
Metric Designator	**Trade Size**	**(m)**
16 - 27	½ - 1	0.90
35 - 53	1 ¼ - 2	1.5
63- 78	22 ½ - 3	1.8
91 - 129	3 ½ - 5	2.1
155	6	2.4

1100.3.5.7 Expansion Fittings

Expansion fittings for PVC conduit shall be provided to compensate for thermal expansion and contraction where the length change, in accordance with Table 3.52.2.35, Expansion Characteristics of PVC Rigid Nonmetallic Conduit Coefficient toff Thermal Expansion = 6.084 x 10mm/mm/° C, of PEC, Part 1 is expected to be 6 mm or greater in a straight run between securely mounted items such as boxes, cabinets, elbows, or other conduit terminations.

1100.3.5.8 Locknut and Bushings

Where a conduit enters a box, fitting, or other enclosure, a bushing or PVC adapter shall be

provided to protect the wire from abrasion unless the box. fitting, or enclosures designs provides equivalent protection

1100.3.5.9 Joints

All joints between lengths of conduit, and between conduit and couplings. fittings, and boxes, shall be provided with PVC solvent and made by an approved method.

1100.3.6 Liquidtight Flexible Nonmetallic Conduit (LFNC)

1100.3.6.1 Uses Permitted

LFNC shall be permitted to be used in exposed or concealed locations for the following purposes:

1. Where flexibility is required for installation, operation or maintenance.

2. Where protection of the contained conductors is required from vapors, liquids or solids.

3. For outdoor locations where listed and marked as suitable for the purpose.

4.For direct embedment where listed and marked for the purpose.

5.Type LFNC-B shall be permitted to be installed in lengths longer than 1.8 m where secured in accordance Subsection 1100.3.6.7, Securing and Supporting.

6. Type LFNC-B as a listed manufactured prewired assembly, metric designator 16 through 27 (trade size 2 through 1) conduit.

7. For encasement in concrete where listed for direct embedment cand install in accordance with Subsection 1100.3.6.8, Couplings and Connectors.

1100.3.6.2 Uses Not Permitted

LFNC shall not be used as follows:

1. Where subject to severe physical damage.

2. Where any combination of ambient and conductor temperatures is in excess of that for which the LFNC is approved.

3. In lengths longer than 1.8 m, except as permitted by Subsection 1100.3.6.1 (5) or where a longer length is approved as essential for a required degree of flexibility.

4. In any hazardous (classified) location, except as permitted by other articles in PEC, Part I.

1100.3.6.3 Number of Conductors

It shall comply with the requirements of Subsection 1100.3.1.3, Number of Conductors.

1100.3.6.4 Bends

It shall comply with the requirements of Subsection 1100.3.3.4, Bends.

1100.3.6.5 Trimming

All cut ends of conduit shall be permitted inside and outside to remove rough edges.

1100.3.6.6 Securing and Supporting

LFNC shall be securely fastened and Supported in accordance with Subsection 3.56.2.21, Securing and Supporting of Article 3.56, Liquidtight Flexible Nonmetallic Conduit: Type LFNC of PEC, Part I.

1100.3.6.7 Couplings and Connectors

Only fittings listed for use with LFNC shall be used. Angle connectors shall not be used for concealed raceway installations. Straight LFNC fittings are permitted direct burial or encasement in concrete.

1100.3.7 Weatherhead

Weatherhead shall be installed in accordance with the PEC, Part I.

1100.3.8 Test and Guarantee

Upon completion of the electrical construction work, the Contractor shall provide all test equipment, materials and personnel for conducting the test and shall submit written copies of all test results to the Engineer.

The Contractor shall guarantee that the electrical installations are done in accordance with the approved Plans and Specifications.

The Contractor shall furnish a guaranty or warranty covering all labor and materials for period of 1 year from the date of the final acceptance of works and shall agree to repair all defects and any part of the work not satisfactory to the Engineer which may develop during the defects liability period arising from defective workmanship or materials at his Own expenses.

1100.4 Method of Measurement

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

100.5 Basis of Payment

All works performed and measured in Section 1100.4, Method of Measurement and as provided for in the Bill of Quantities shall be paid for at the Unit Bid or Contract Unit Price which payment shall constitute full compensation including labor, materials, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1100 (10)	Conduits, Boxes & Fittings (Conduit Works/Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

1101.1 Description

This Item shall consist of furnishing and installation of all wires and wiring devices consisting of electric wires and cables, wall switches, convenience receptacles, heavy duty receptacles and other devices in accordance with the approved Plans and this Specification.

1101.2 Material Requirements

1101.2.1 Wires and Cables

1101.2.1.1 Wires

All wires shall meet the requirements specified in the Philippine Electrical Code (PEC), Part 1 and PNS 35-1, Electric wires and cables-Thermoplastic-insulated copper wires and cables rated 600 volts - Part 1: General Specifications, and shall bear the Philippine Standard (PS) mark unless specified or indicated otherwise and shall be marked to indicate the following information:

1. The maximum rated voltage

2. The proper type letter or letters for the type of wire or cable as specified in the PEC Part 1

3. The manufacturer's name, trademark, or other distinctive marking by which the organization responsible for the product can be readily identified

4.The size in square millimeter or millimeter diameter

5.Cable assemblies where the neutral wire is smaller

The letters such as TW, THHN, THWN and THW represent the main insulation types of individual wires. These letters depict the following requirements:

1. T-Thermoplastic Insulation

2. H-Heat Resistance

3. HH-High Heat Resistance

4. W-Suitable for Wet locations

5. N-Thermoplastic Polyester, Tough and

6. X-Flame-Resistant Synthetic Polymer

7. Z-Modified ethylene tetrafluoroethylene

Conductors shall be insulated for 600 V and shall be aluminum, copper-clad aluminum, or copper unless otherwise specified. The minimum diameter size of conductors shall be 1.6 mm (2.0 mm2) for copper and 2.0 mm (3.5 mm) for aluminum or copper-clad aluminum conductors. Solid aluminum conductors of diameters 3.2 mm, 2.6 mm, and 2.0 mm shall be made of an AA-8000 series electrical grade aluminum alloy conductor material. Stranded aluminum conductors 8.0 mm² through 500 mm² marked as Type RHH, RHW, XHHW THW, THHW, THWN, THHN, service-entrance Type SE Style U and SE Style R shall be made of an AA-8000 series electrical grade aluminum alloy conductor material.

Ampacities for conductors shall be as specified in the PEC Part 1. Where bare or covered conductors are used with insulated conductors, their allowable ampacities shall be limited to those permitted for the adjacent insulated conductors.

1101.2.1.2 Cables

1. Armored Cables (Type AC)

Type AC shall have ready identification of the manufacturer by distinctive external markings on the cable sheath throughout its entire length.

Type AC cable shall have an armor of flexible metal tape and shall have an internal bonding strip of copper or aluminum in intimate contact with the armor for its entire length. Insulated conductors of type AC shall be of type listed in the PEC Part 1. In addition, the conductors shall have an overall moisture resistant fibrous covering and fire-retardant fibrous covering. For Type ACT, a moisture-resistant fibrous covering shall be required only on the individual conductors.

2. Flat Cable Assemblies (Type FC)

Flat cable assemblies shall consist of two, three, four, or five conductors. The conductors shall be 5.5 mm² (2.6 mm dia.) special stranded copper wires Type FC cable shall have the temperature rating durably marked on the surface at intervals not exceeding 600 mm.

3. Flat Conductor Cable (Type FCC)

Type FCC cable shall be clearly and durably marked on both sides at intervals of not more than 600 mm with the information required by the PEC Part 1. It shall consist of three (3), four (4), or five (5) flat copper conductors, one of which shall be an equipment grounding conductor. The insulating material of the cable shall be moisture resistant and flame retardant.

4. Integrated Gas Spacer Cable (Type IGS)

The conductors shall be solid aluminum rods, consisting of one to nineteen 13 mm diameter rods. The minimum conductor size shall be 125 mm², and the maximum size shall be 2375 mm². The insulation shall be dry kraft paper tapes and a pressurized sulfur hexafluoride gas (SF6), both approved for electrical use. The nominal gas pressure shall be 138 kPa gauge.

5. Medium Voltage Cable (Type MV)

Type MV cables shall have copper, aluminum, or copper-clad aluminum conductors and shall be marked as required by the PEC Part 1.

6. Metal-Clad Cable (Type MC)

The conductors for type MC shall be of copper, aluminum, or copper-clad aluminum, solid or stranded. The minimum conductor size shall be 0.75 mm² (1.0 mm dia.) copper and 3.5 mm² (2.0 mm dia.) aluminum or copper-clad aluminum. Metallic covering shall be one of the following types: smooth metallic sheath, corrugated metal sheath, interlocking metal tape armor. The metallic sheath or armor shall be used on single conductor type MC. Supplemental protection of an outer covering of corrosion-resistant material shall be permitted and shall be required where such protection is needed. The sheath shall not be used as current-carrying conductor.

7. Mineral-Insulated, Metal-Sheathed Cable (Type MI)

Type MI cable conductors shall be of solid copper, nickel, or nickel-coated copper with a resistance corresponding to standard mm² and mm dia. sizes. The conductor insulation in Type MI cable shall be a highly compressed refractory mineral that provides proper spacing for all conductors.

8. Non-metallic - Sheathed Cable (Types NM, NMC, and NMS)

The 600 volt insulated conductors shall be sizes 2.0 mm² (1.6 mm dia.) through 30 mm² copper conductors or sizes 3.5 mm² (2.0 mm dia.) through 2.0 mm aluminum or copper-clad aluminum conductors. The signaling and communication conductors shall comply with the PEC Part 1. The insulated power conductors shall be one of the types listed in the PEC Part I that are suitable for branch circuit wiring or one that is identified for use in these cables Conductor insulation shall be rated at 90°C.

The outer sheath of non-metallic-sheathed cable shall comply with the following:

a. Type NM The overall covering shall be flame retardant and moisture resistant.

b. Type NMC - The overall covering shall be flame retardant, moisture resistant, fungus resistant, and corrosion resistant.

c. Type NMS - The overall covering shall be flame retardant and moisture resistant. The sheath shall be applied so as to separate the power conductors from the communications and signaling conductors. The signaling conductors shall be permitted to be shielded. An optional outer

jacket shall be permitted.

9. Power and Control Tray Cable (Type TC)

A metallic sheath or armor shall not be permitted either under or over the nonmetallic jacket. Metallic shield(s) shall be permitted over groups of conductors, under the outer jacket, or both. The insulated conductors of Type TC tray cable shall be in sizes 0.75 mm² (1.0 mm dia.) through 500 m aluminum or copper-clad aluminum. Insulated conductors of sizes 2.0 mm (1.6 mm dia.) and larger copper and sizes 3.5 mm² (2.0 mm dia.) and larger aluminum or copper-clad aluminum shall be one of the types listed in the PEC Part 1 that is suitable for branch circuit and feeder circuits or one that is defined for such use.

The outer jacket for Type TC shall be a flame-retardant, nonmetallic material. There shall be no voltage marking on a Type TC cable employing thermocouple extension wire.

10. Service-Entrance Cable (Type SE and USE)

Cabled, single-conductor, Type USE constructions recognized for underground use shall be permitted to have a bare copper conductor cable with the assembly. Type USE single, parallel, or cabled conductor assemblies recognized for underground use shall be permitted to have a bare copper concentric conductor applied. These constructions shall not an outer overall covering. Type SE or USE cable containing two or more conductors shall be permitted to have one conductor uninsulated.

11. Underground Feeder and Branch-Circuit Cable (Type UF)

The conductors shall be sizes 2.0 mm (1.6 mm dia.) copper or 3.5 mm² 2 (2.0 mm dia.) aluminum or copper-clad aluminum through 100 mm². The conductors of Type UF shall be moisture-resistant type that is suitable for branch-circuit wiring or one that is identified for such use. Where installed as a substitute wiring method for NM cable, the conductor insulation shall be rated 90°C. The overall covering shall be flame retardant; moisture, fungus, and corrosion resistant; and suitable for direct burial in the earth.

1101.2.2 Switches

All switches shall conform to the requirements of the PEC Part 1. Switches shall be marked with the current voltage, and, if horsepower rated, the maximum rating for which they are designed. They shall be of the externally type mounted in an enclosure listed for the intended use.

Metal faceplates for switches shall be of ferrous metal not less than 0.75 mm in thickness or of non-ferrous metal not less than 1.00 mm in thickness. Faceplates of insulating material shall be non-combustible and not less than 0.25 mm in thickness, but they shall not be permitted to be less than 0.25 mm in thickness if formed or reinforced to provide adequate mechanical strength.

1101.2.3 Receptacles

All receptacles shall conform to the requirements of the PEC Part 1. Receptacles shall be listed and marked with the manufacturer's name or identification and voltage and ampere ratings. The rating for receptacles shall not be less the 15 A, 125 V, or 15 A, 250 V. Table 1101.1 shows the receptacle ratings of various size circuits.

Table 1101.1 Receptacle Rating for Various Size Circuits

Circuit Rating (Amperes, A)	Receptacle Rating (Amperes, A)
15	15 Not over
20	15 - 20
30	30
40	40 or 50
50	50

Metal faceplates for receptacles shall be of ferrous metal not less than 0.75mm in thickness or of non-ferrous metal not less than 1.00 mm in thickness Faceplates of insulating material shall be non-combustible and not less the 0.25 mm in thickness if formed or reinforced to provide adequate mechanic strength.

1101.3 Construction Requirement

Installation of electric wiring and wiring devices shall comply with the governing laws and applicable codes and standards such as the PEC Part 1 and Safety Standards.

1101.3.1 Installation

1101.3.1.1 Conductors

1. Conductors of the Same Circuit

All conductors of the same circuit and, where used, the grounded conductor and all equipment grounding conductors and bonding conductors shall be contained within the same raceway, auxiliary gutter, cable tray, cable bus assembly, trench, cable, or cord, unless otherwise permitted in accordance with the PEC 1.

a. Paralleled Installations

Conductors shall be permitted to be run in parallel in accordance with the provisions of the PEC Part 1. The requirement to ru2021/9/9 09:18 circuit conductors with the same raceway, auxiliary gutter, cable tray, trench, cable, or cord shall apply separately to each portion of the paralleled installation, and the equipment grounding conductors shall comply with the provisions of the PEC Part 1. Parallel runs in cable tray shall comply with the provisions of the PEC Part 1.

b. Grounding and Bonding Conductors

Equipment grounding conductors grounding conductors shall be permitted to be installed outside a raceway or cable assembly in accordance with the provisions of the PEC Part 1.

c. Non-ferrous Wiring Methods

Conductors in wiring methods with a nonmetallic or other nonmagnetic sheath, where run in different raceways, auxiliary gutters, cable trays, trenches, cables, or cords shall comply with the provisions of the PEC Part 1.

2. Conductors of Different Systems

Conductors of circuits rated 600 V, nominal or less, ac circuits, and dc circuits shall be permitted to occupy the same equipment wiring enclosure, cable, or e raceway. All conductors shall have an insulation rating equal to at least the maximum circuit voltage applied to any conductor within the enclosure, cable, or raceway.

Conductors of circuits over 600 V, nominal, shall not occupy the same equipment wiring enclosure, cable, or raceway with conductors of circuits rated 600 V, nominal, or less unless otherwise permitted in the PEC Part 1.

1101.3.1.2 Switches

Installation of switches shall conform to the requirements of the PEC Part 1. All switches and circuit breakers used as switches shall be located in an accessible place to facilitate operation. They shall be installed such that the center of the position is not more than 1980 mm above the floor or working platform. Sip of the operating handle of the switch or circuit breaker, when in its highest position, is not more than 1980 mm above the floor or working platform. Faceplates provided for snap switches mounted in boxes and other enclosures shall be installed so as to completely cover the opening and, where the switch is flush mounted, seat against the finished surface.

Metal enclosures for switches shall be grounded. Where nonmetallic enclosures are used with metal raceways or metal-armored cables, provision shall be made for grounding continuity. Snap switches, including dimmer and similar cont switches, shall be effectively grounded and shall provide a means to ground metal faceplates, whether or not a metal faceplate is installed. Snap switches shall be considered effectively grounded if either of the following conditions met:

1. The switch is mounted with metal screws to a metal box or to a nonmetal box with integral means for grounding devices.

2. An equipment grounding conductor or equipment bonding jumper connected to an equipment grounding termination of the snap switch.

1101.3.1.3 Receptacles

General installation requirements for receptacles shall be in accordance with the PEC Part 1.

Receptacle outlets shall be located in branch circuits in accordance with the PEC Part 1.

Receptacles shall be mounted in boxes or assemblies designed for the purpose and such boxes or assemblies shall be securely fastened in place unless otherwise permitted in the PEC Part 1.

Receptacles installed on 15- and 20-A branch circuits shall be of the grounding type, Grounding-type receptacles shall be installed only on circuits of the voltage class and current for which they are rated, except as provided in the PEC Par

Receptacles and cord connectors that have grounding contacts shall have these contacts effectively grounded. They shall be grounded by connection to the equipment grounding conductor of the circuit supplying the receptacle or co connector.The branch circuit wiring method shall include or provide equipment-grounding conductors to which the grounding contacts of the receptacle or cord connector are connected.

1101.3.2 Personnel Qualification

The installation of electrical wiring and devices shall be done by a certified installer under the supervision of an Electrical Engineer based on the guidelines of Republic Act No. 7920, New Electrical Engineering Law

1101.3.3 Locations

1101.3.3.1 Dry Locations

Insulated conductors and cables, receptacles, switches and other devices used in dry locations shall be any of the types identified in the PEC Part 1.

1101.3.3.2 Dry and Damp Locations

Insulated conductors and cables used in dry and damp locations shall be Types FER, FEPB, MTW, PFA, RHH, RHW-2, SA, THHN, THW, THW-2, THHW, THHW 2, THWN, THWN-2, TW, XHH, XHHW, XHHW-2, Z, or ZW.Receptacles installed outdoors in a location protected from the weather or in other damp locations shall have an enclosure for the receptacle that is weatherproof when the receptacle is covered (attachment plug cap not inserted and receptacle covers closed).

1101.3.3.3 Wet Locations

Insulated conductors and cables used in wet locations shall be Moisture impervious metal-sheathed, Types MTW, RHW, RHW-2, TW, THW, THW-2, THHW, THHW-2, THWN, THWN-2, Z, or ZW and Type for use in wet locations.Receptacles installed in wet locations shall have an enclosure that is weatherproof. Switches in a wet location or outside of a building shall be enclosed in a weatherproof enclosure or cabinet.

1101.3.3.4 Locations Exposed to Direct Sunlight

Insulated conductors or cables used where exposed to direct rays of the sun shall comply with one of the following:

1.Cables listed, or listed and marked, as being sunlight resistant.

2.Conductors listed, or listed and marked, as being sunlight resistant.

3.Covered with insulating material, such as tape or sleeving.

1101.4 Method of Measurement

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

1101.5 Basis of Payment

The quantity as determined in Section 1101.4, Method of Measurement shall be paid for at unit price stipulated in the Contract's Bill of Quantities. The payment shall constitute the full compensation for furnishing all the necessary materials, providing necessary equipment and tools in installing the wires and wire devices, labor cost and all the incidental expenses necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1101 (2)b6	Electrical wire, 22mm² TW/THHNTHWN², Stranded	Meter
1101 (2)b7	Electrical wire, 30mm² TW/THHNTHWN², Stranded	Meter
1101 (2)b9	Electrical wire, 50mm² TW/THHNTHWN², Stranded	Meter
1101 (2)b11	Electrical wire, 80mm² TW/THHNTHWN², Stranded	Meter
1101 (2)b14	Electrical wire, 150mm² TW/THHNTHWN², Stranded	Meter
1101 (2)b16	Electrical wire, 250mm² TW/THHNTHWN², Stranded	Meter
1101 (31)	Messenger Wire	Meter

ITEM 1111 - MISCELLANEOUS ELECTRICAL/CIVIL WORKS

1111.1 Description

This item shall consist of construction of pedestal poles, manhole, concrete encasement, handhole, wire trench, furnishing and installation of cable tray, mounting bolts/eye bolts, and spool insulator wire rack and shall conform to the alignment, grades, design, dimensions and details in accordance with the Plans and this Specifications.

1111.2 Material Requirements

1111.2.1 Reinforced Concrete Pedestal Pole and Encasement

Reinforced concrete, pedestal poles and encasement shall be in accordance with the applicable requirements of Item 900, Structural Concrete.

1111.2.2 Handhole and Manhole

Concrete for these structures shall meet the requirements of Item 900., Structural Concrete.Other materials to be used shall be in accordance with Section 3.14.2.16, Handhole Enclosures and Section 1.10.5, Manholes and Other Electric Enclosures Intended for Personnel Entry of the Philippine Electrical Code (PEC) Part 1.

1111.2.3 Cable Tray

Materials in Cable Tray shall be in accordance with the applicable requirements of Article 3.92, Cable Trays of the PEC, Part 1.

1111.2.4 Mounting Bolts/Eye Bolts

Mounting Bolts/Eye Bolts shall be hot-dip galvanized conforming to the requirements of ASTM A123, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products or as indicated in the approved Plans.

1111.2.5 Spool Insulator Secondary Rack

Insulator Post struts shall be rounded to ensure that the spool insulator will not be damaged while being strung.

All components of Secondary Rack shall be hot-dip galvanized conforming to the requirements of ASTM A123, Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1111.3 Construction Requirements

1111.3.1 Reinforced Concrete Pedestal, Pole and Encasement

Installation of reinforced concrete pedestal, pole and encasement shall be indicated in the-Plans.

1111.3.2 Handhole Enclosures

This enclosure shall have a size that allows personnel to only reach inside for the purpose of installing, operating, or maintaining equipment and/or wiring.

This shall also be installed so that the wiring contained in them can be rendered accessible without removing any part of the building or, in underground circuits, without excavating sidewalks, paving, earth or other substance that is to be used to establish the finished grade. Handhole installation shall be in accordance with the Approved Plans and meet the requirements of Section 3.14.2.16, Handhole Enclosures of the PEC, Part 1.

1111.3.3 Manholes and other Electric Enclosures

This enclosure shall allow personnel to enter with a purpose of having a sufficient size to provide safe work space about electric equipment with live parts that is likely to require examination, adjustment, servicing of maintenance. Manhole enclosure shall be in accordance with the Plans and meet the specifications made in the Section 1.10.5, Manholes and Other Electric Enclosures Intended for Personnel

1111.3.4 Cable Tray

Cable Tray shall be used to securely fasten or support cables and raceways. Installation of cable tray shall be in accordance with the Plans and applicable requirements in Article 3.92, Cable Tray of EPC, Part 1.

1111.3.5 Trench Excavation

Trench shall be excavated to the lines and grades or elevations shown on the plans or As-Staked Plans. It shall be sufficient size to permit the placing of wires of the full with and length shown on the Plans.

1111.4 Method of Measurement

When the Contract stipulates that payment will be made for the miscellaneous electrical and civil works on lump sum basis, set and each, the Pay Item shall include all materials and accessories needed in the work . Wire racks shall be ordered by set.

1111.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 1111.4 Methods of Measurement shall be paid for at the Contract Unit Price for each of the particular item listed below that is included in the Bill of Quantities, which price and payment shall be full compensation for furnishing and placing all materials and labor, equipment tools and incidentals as well as temporary works necessary to complete the work prescribed in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1111 (1)	Reinforced Concrete Electrical Pole with Complete Accessories	Set

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

1102.1 Description

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

1102.2 Material Requirements

All materials shall be brand new and shall be of the approved type. It shall conform to the applicable requirements of the Philippine Electrical Code Part and the products locally manufactured shall bear a Philippine Standard (PS) mark, while imported products shall bear Import Commodity Clearance (ICO certification marks duly issued by the Bureau of Philippine Standards (BPS).

1102.2.1 Power Load Center Unit Substation

The Contractor shall furnish and install an indoor-type Power Load Center Unit Substation at the location shown on the approved Plans.

It shall be metal-enclosed, dead front and shall consist of the following parts:

1102.2.1.1 High Voltage Primary Section:

High voltage primary incoming line section consisting of the following parts and related accessories:

1. One (1) air-filled interrupter Switch, Two (2)-position (open-close) installed in a suitable air-filled metal enclosure and shall have sufficient interrupting capacity to carry the electrical load.

It shall be provided with key interlock with the cubicle for the power fuses to prevent access to the fuses unless the switch is open.

2. Three (3)-power fuses mounted in separate compartments within the switch housing and accessible by a hinged door.

3. One (1) set of high voltage potheads or three (3)-conductor cables or three (3) single conductor cables.

4 Lightning arresters shall be installed at the high voltage cubicle with the proper neutral and grounding system.

Items (1) and (2) above could be substituted with a power circuit breaker with the correct rating and interrupting capacity.

1102.2.2 Transformer Section

The transformer section shall consist of a power transformer with ratings and capacities as shown on the plans. It shall be oil liquid-filled non-flammable or dry type and designed in accordance with the latest applicable standards.

The transformer shall be provided with four (4) approximately 2.5% rated KVA ups on the primary winding in most cases one (1) above and three (3) below rated primary voltage and shall be changed by means of externally gang-operated manual tap changer only when the transformer is de-energized. Tap changing under load is allowed, if necessary.

The following accessories shall be provided with the transformer, namely: drain valve, sampling device, filling connection, oil liquid level gauge, ground pad, top filter press connection, lifting lugs, diagrammatic nameplate, relief valve, thermometer and other necessary related accessories.

The high-voltage and low-voltage bushings and transition flange shall be properly coordinated for field connection to the incoming line section and low voltage switchboard section, respectively.

1102.2.2.1 Current Transformers

Current transformers shall be of the straight-through type with suitable ratio, output and class of accuracy for their function and shall comply with IEC 600-44, Instrument transformers. Measuring current transformers shall have accuracy of Class 1 and protective transformers shall have an accuracy of SP10.

Groups of current transformers used on three (3) phase systems shall have their secondary connections starred and earthed. When measuring line current value using a common meter with a selector switch, they shall be connected so that the current transformers shall be shorted out when not being used for indication. This shall be carried out in the selector switch by "make before break" contacts.

1102.2.2.2 Potential Transformers

Potential transformers shall conform to IEEE C57.13, IEEE Standard Requirements for Instrument Transformers for installation in metal-clad switchgear. Standard 120-volt secondary transformers shall be used. The transformer shall provide with burden, frequency, and accuracy as required. Indoor dry type two-winding construction for disconnecting potential transformers with integral fuse mountings and current-limiting fuses with primary and secondary voltage ratings as required.

1102.2.2.3 Distribution Transformer

A distribution transformer is a static device constructed with two or more windings used to transfer alternating current electric power by electromagnetic induction from one circuit to another at the same frequency but with different values of voltage and current. It is equipped with a lightning arrester, a weak link or protective-link expulsion-type fuse (installed under oil

in the transformer tank), a secondary circuit breaker, and a warning light. The transformer primary bushing conductor is connected to one phase of the three-phase primary circuit through a partial-range current-limiting fuse. The transformer tank is grounded and connected to the primary and secondary common-neutral ground wire. The self-protected transformer contains core and coils, a primary fuse mounted on the bottom of the primary bushing, a secondary terminal block, and a low voltage circuit breaker.

Pad-mounted transformers are used with underground systems. Three-phase pad-mounted transformers are used for commercial installations, and single-phase pad-mounted transformers are used for underground residential installations. Vault-type distribution transformers are installed for commercial customers where adequate space is not available for pad-mounted transformers. The vault-type transformer may be installed in a vault under a sidewalk or in a building. They are often used in underground electric network areas. Submersible single-phase distribution transformers are used in some underground systems installed in residential areas.

1102.2.3 Low-Voltage Switchboard Section

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

1. Switchboard HousingThe housing shall be fully type tested switchgear as duly certified by the Original Electrical Manufacturer.

2. Secondary Metering Section

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

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

3. Main Circuit Breaker

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

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

4. Feeder Circuit Breaker

There shall be as many feeder breakers as shown on the single line diagram, or schematic riser diagram or schedule of loads. The circuit breakers shall be Air Circuit Breaker (ACB) draw-out or fixed type, Molded Case Circuit Breaker (MCCB). The circuit breakers shall each have sufficient interrupting capacity and shall be manually operated complete with trip devices and

all necessary accessories to ensure safe and efficient operation. The number, ratings, capacities of the feeder branch circuit breakers shall be as shown on the approved Plans with short circuit and arc flash analysis.

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

5. Automatic Transfer Switch

Automatic transfer switches shall be open transition switches, four-pole, draw out construction, electrically operated, mechanically held open contact without integral overcurrent protection. Automatic transfer switches utilizing automatic or non-automatic molded case circuit breakers, insulated case circuit breakers, or power circuit breakers as switching mechanisms are not acceptable.

Automatic transfer switches shall be completely factory-assembled and wired such that only external circuit connections are required in the field.

Each automatic transfer switch shall be equipped with an integral bypass/isolation switch.

Automatic transfer switches Markings shall be in accordance with UL 1008, Transfer Switch Equipment.

Automatic transfer switches shall be tested in accordance with UL 1008. The contacts of the transfer switch shall not weld during the performance of withstanding and closing tests when used with the upstream overcurrent device and available fault current specified.

Enclose automatic transfer switches in wall or floor-mounted steel cabinets, with metal gauge not less than No. 14, in accordance with UL 508, Standard for Industrial Control Equipment, or in a switchboard assembly in accordance with UL 891, Switchboards, as shown on the Plans.

The enclosure shall be constructed so that personnel is protected from energized bypass-isolation components during automatic transfer switch maintenance.

Automatic transfer switch components shall be removable without disconnecting external source or load power conductors.

Cabinets shall be given a phosphate treatment, painted with rust-inhibiting primer, and finish-painted with the manufacturer's standard enamel or lacquer finish.

Actuated by an electrical operator.

Electrically and mechanically interlocked so that the main contact cannot be closed simultaneously in either normal or emergency position.

Normal and emergency main contacts shall be mechanically locked in position by the operating linkage upon completion of the transfer. Release of the locking mechanism shall be possible

only by normal operating action.

Contact transfer time shall not exceed six cycles. Operating mechanism components and mechanical interlocks shall be insulated or grounded.

1102.2.4 Low-Voltage Switchgear

The Contractor shall furnish and install a low-voltage fully type tested switchgear as duly certified by the Original Electrical Manufacturer at the location shown on the Plans.

The low-voltage switchgear shall consist of the switchgear housing, secondary metering, main breaker and feeder branch circuit breakers and all necessary accessories, completely wired, ready for service.

The equipment mounted in the Low voltage switchgear and controlgear assembly shall be fitted and wired in accordance with corresponding Manufacturer's instructions and recommendations. Minimizing the Low voltage switchgear and controlgear assembly size shall be taken into account. The equipment and circuits in the Low voltage switchgear and controlgear assembly shall be so arranged as to facilitate their operation and maintenance and at the same time to ensure the necessary degree of safety.

The equipment mounted within the assembly shall have a clearance of 100 mm minimum around the perimeter of the enclosure and 50 mm from the door.

All electrical equipment, bus bars, terminal blocks and covers of connections of Switching devices, mounted inside the assembly, shall be IP 20 or NEMA Type 1 (general use) protected at least.

1102.2.5 Grounding Systems

It shall conform to the applicable requirements of Item 1109, Grounding Systems.

1102.2.6 Panelboards and Cabinets

Panelboards shall be fully type tested panels as duly certified by the Original Electrical Manufacturer.

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

1102.2.7 Busbars

Four pole air insulated busbars of the uniform cross-sectional area throughout their length with a

continuous rating or dimensions not less than that indicated in the drawings shall be arranged

neatly.

The busbars and busbar connections between the busbar and various items of the switchgear shall be manufactured from copper.

All busbars shall be tinned, and continuous lengths without connections shall be insulated with heat shrink sleeves.

Busbars shall be mounted on non-hygroscopic, anti-tracking insulators strong enough to endure, without damage, forces set up by any thermal expansion within the bars under normal operating conditions and forces created by prospective fault currents.

Busbars shall be housed in separate compartments and these compartments shall not contain any wiring or apparatus other than that required for coupling to the busbars.

Access to busbars and busbar connections shall be gained only by the removal of a cover secured by bolts. Behind the covers, an insulating sheet with warning labels bearing the word "DANGER" in bold letters and the lighting symbol shall be provided so that final access can be gained only through removing this sheet secured by round head screws.

1102.2.8 Diesel-Generator Set Stationary 100-2500 Kw, With Auxiliaries

1. Provide and install each engine-generator set complete and very functional, with all necessary ancillary equipment to include: air filtration; starting system; generator controls, protection, and isolation; instrumentation; lubrication; fuel system; cooling system; and engine exhaust system. Each engine-generator set shall satisfy the requirements specified in the Engine Generator Parameter Schedule.

2. Each set shall consist of one engine, one generator, and one exciter mounted, assembled, and aligned on one base; and other necessary ancillary equipment which may be mounted separately. Sets having a capacity of 750 kW or smaller shall be assembled and attached to the base prior to shipping. Sets over 750 kW capacity may be shipped in sections. Each set component shall be environmentally suitable for the location shown and shall be the manufacturer's standard product offered in catalogs for commercial or industrial use. Any nonstandard products or components and the reason for their use shall be specifically identified. Each engine-generator-set shall provide power equal to the sum of Service Load plus the machine's efficiency loss and associated ancillary equipment loads. Rated output capacity shall also consider engine and/or generator oversizing required to meet requirements in paragraph Engine-Generator Parameter Schedule.

3. Transient Response

The engine-generator set governor and voltage regulator shall cause the engine-generator set to respond to the maximum step load changes such that output voltage and frequency recover to and stabilize within the operational bandwidth within the transient recovery time. The engine generator set shall respond to maximum step load changes such that the maximum voltage and frequency deviations from bandwidth are not exceeded.

4. Each engine-generator set specified for parallel operation shall be configured for automatic or manual parallel operation.

5. Each set shall be capable of parallel operation with a commercial power source on an infinite bus and with one or more sets on an isolated bus

6. Each engine-generator set specified for parallel operation shall be configure to manually load share or automatically load share with other sets by proportional loading. Proportional loading shall load each set to within 5% of its fair share. A set's fair share is its nameplate-rated capacity times the total load, divided by the sum of all nameplate-rated capacities of on-line sets. Load sharing shall incorporate both the real and reactive components of the load.

7. The engine-generator set enclosure shall be corrosion resistant and fully weather resistant. The enclosure shall contain all set components provide ventilation to permit operation at Service Load under secured conditions. Doors shall be provided for access to controls and equipment requiring periodic maintenance or adjustment. Removable panels shall be provided for access to components requiring periodic replacement. The enclosure shall be capable of being removed without disassembly of the engine-generator set or removal of components other than the exhaust system.

1102.2.9 Station Battery System

A station battery system shall be provided to include the battery, battery rack spacers, automatic battery charger and distribution panelboards with overcurrent protection, metering and relaying. Components shall be sized to withstand the seismic acceleration forces specified.

1102.2.9.1 Battery

The battery shall be lead-acid or nickel-cadmium, sized in accordance with IEEE 485, Lead Acid Batteries for Stationary Applications, and conform to the requirements of IEEE 484, IEEE Recommended Practice for Installation Design and Installation of Vented Lead-Acid Batteries for Stationary Applications, Valve regulated lead-acid batteries are not acceptable

1102.2.10 Motor Control

Motor Controllers shall conform to NEMA ICS 3, Industrial Control and Systems: Medium Voltage Controllers Rated 2001 to 7200 V AC and UL 508, Standard for Industrial Control Equipment. Controllers shall have thermal overload protection in each phase.

1102.2.10.1 Manual Motor Controllers

Full-voltage, manually operated manual motor controllers shall be provided for the control and protection of single-phase 60-hertz ac small wattage rating fractional-horsepower squirrel-cage induction motors.

Single-throw, single or double-pole, three-position controllers rated at not more than 750 W, rated 1 hp at 115 V and 230 V single phase shall be provided. Include a supporting base or body of electrical insulating material with enclosed switching mechanism, yoke, thermal

overload relay, and terminal connectors. Controllers shall clearly indicate operating condition: on, off, or tripped.

Toggle or key-operated type manual motor controllers shall be provided as indicated and arrange so that they are lockable with a padlock in the "OFF" position.

Recessed manual motor controllers shall be provided for single-speed, small wattage rating fractional-horsepower squirrel-cage induction motors that include a single controller and indicating light in a 100-millimeter square wall outlet box for flush-wiring devices with matching corrosion-resistant steel flush cover plate. Surface-mounted manual motor controllers shall be provided for single-speed, small wattage rating fractional-horsepower squirrel cage induction motors that include a single controller and indicating light in a NEMA 250, Type 1 General-purpose enclosure.

Recessed and surface-mounted manual motor controllers shall be provided for two-speed, small wattage rating fractional-horsepower squirrel-cage induction motors that include two controllers, two indicating lights, and a selector switch in a multiple-gang wall outlet box for flush-wiring devices with matching corrosion-resistant steel flush-cover plate. Surface-mounted manual motor controllers shall be provided for two-speed small wattage rating fractional horsepower squirrel-cage induction motors that include two controllers, two Indicating lights, and a selector switch in a NEMA 250, Type 1 General-purpose enclosure.

1102.2.10.2 Magnetic Motor Controllers

1. Full-Voltage Controllers

Magnetic motor controllers shall be provided for the control and protection of single and three-phase, 60-hertz, squirrel-cage induction motors with fa voltage, full magnetic devices in accordance with NEMA ICS 1, Industrial Control and Systems General Requirements, NEMA ICS 2, Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts, and Ut 508, Industrial Control Equipment.

Overcurrent protection includes three manual reset thermal overload devices, one in each pole of the controller. Thermal overload relays of the melting-alloy or bimetallic nonadjustable type with continuous current ratings and service limit current ratings and with a plus or minus 15% adjustment to compensate for ambient operating conditions.

An externally operable manual-reset button shall be provided to re-establish control power to the holding coil of the electromagnet. The Contractor sha ensure that after the controller has tripped from overload, resetting the motor overload device will not restart the motor.

2. High-Voltage Motor Controllers

High-voltage motor controllers shall be provided for the control and protection of squirrel-cage induction motors, wound-rotor induction motors, and synchronous machines rated 2.4 through 7.2 kilovolts, three-phase, that are NEMA ICS 2, Class E2, type as required.

Unless enclosed within a switchgear or unit-substation cubide, house high-voltage motor

controllers in floor-mounted structures of the NEMA type indicated, approximately 2.3 m high, 750 mm wide, and 750 mm deep, with suitable draw-out compartments. Include structural provisions for padlocking the doors.

The structure shall be subdivided into low-voltage control compartment with separate door, high-voltage control compartment with separate door, ac bus compartment, and cable-entrance compartment.

Isolate controller by externally operated draw-out stabs with shutter mechanism which also opens the secondary of the control-power transformer. Interlocks shall be provided to prevent inadvertent operation of the isolating mechanism under load, opening the medium-voltage compartment door without isolating the starter, and closing the line contactor with the door open. Include an isolating switch assembly.

For overload protection, include ambient-compensated thermal overload relays and hand reset in all three phases. Utilizing solid-state multifunction overload protection is acceptable when approved.

Fused type controllers shall be provided employing current-limiting power fuses of the interrupting rating indicated. Single-phase anti-trip protection shall be provided. Magnetic air-break line contactors rated not less than 5 kilovolts shall be provided on starters. Control circuit shall be provided with provisions for external testing of a 120-volt control circuit and a minimum of one (1) set of normally open and normally closed auxiliary contacts.

1102.2.11 Fuses

All switches and switchgear shall be provided with a complete set of fuses. Fuses shall be provided voltage rating of not less than the circuit voltage.

For ratings 30 A, 125 V or less, nonrenewable cartridge type fuses shall be provided. Renewable cartridge type fuses shall be provided for ratings above 30 A, 600 V or less with time-delay dual elements, except where otherwise indicated. It shall conform to NEMA FU

1, Low Voltage Cartridge Fuses, for fuses.

Special fuses shall be installed such as extra-high interrupting-capacity fuses, fuses for welding machines, and capacitor fuses where required. Plug fuses are not permitted.

Power fuses shall be provided on ac systems above 600 volts in accordance with NEMA SG 2, High Voltage Fuses.

Fuses shall be labeled showing UL class, interrupting rating, and time-delay characteristics, when applicable. Clearly, list fuse information on equipment drawings.

Porcelain fuse holders shall be provided when field-mounted in a cabinet or box. Do not use fuse holders made of such materials such as ebony asbestos, bakelite, or pressed fiber for field installation.

1102.2.12 Protective Relays

1102.2.12.1 Overcurrent Relays

Overcurrent relays shall conform to IEEE C37.90, IEEE Standard for Relays and Relay Systems Associated with Electric Power Apparatus. For protection against phase and ground faults provide a single-phase non-directional removable induction type overcurrent relays with built-in testing facilities designed for operation on the de or ac control circuit indicated.

Ground-fault overcurrent relays with short-time inverse time characteristics and with adjustable current tap range shall be provided as required.

Phase-fault overcurrent relays with varied inverse-time characteristics with adjustable current tap range shall be provided as required. Indicate instantaneous-trip attachments with an adjustable current range as required.

Trip unit shall employ a combination of discreet components and integrated circuits to provide the time-current protection functions required in a modem distribution system.

Complete system selective coordination by utilizing a combination of the following time-current curve-shaping adjustments: ampere setting; long-time delay; short-time pickup; short-time delay; instantaneous pickup; and ground fault.

Switchable or easily defeatable instantaneous and ground fault trips shall be provided.

Make all adjustments using non-removable, discrete step, highly reliable switching plugs for precise settings. Provide a sealable, transparent cover over the adjustments to prevent tampering.

Trip devices shall be furnished with three visual indicators to denote the automatic tripping mode of the breaker including overload; short circuit; and ground fault.

Make available for use a series of optional automatic trip relays for use with the trip unit to provide remote alarm and lockout circuits.

All trip units shall be with test jacks for in-service functional testing of the long time instantaneous and ground fault circuits using a small hand-held test kit.

1102.2.12.2 Directional Overcurrent Relays

Directional overcurrent relays shall conform to IEEE C37.90.

Single-phase induction type relays shall with adjustable time delay and instantaneous trip attachments for directional overcurrent and protection against reverse-power faults. Provide removable type relays with inverse-time directional and overcurrent units with built-in testing facilities.

1102.2.13 Apitong or Approved Equal Creosoted Wood Pole

It shall conform to the applicable requirements of ANSI 05.1, Wood Poles - Specifications and Dimensions.

1102.3 Construction Requirements

The Contractor shall install the Power Load Center Substation and Low-Voltage fully type tested Switchgear and Panelboards at the locations shown on the Plans.

The switchboards shall be of enclosed assembly design, suitable for indoor use in the form of free standing or wall mounting, self-contained, flush fronted cubicles sectionalized as necessary to facilitate easy transportation and erection. The assembly shall be Type Tested in accordance with IEC 61439. The main incoming unit, functional units of metered and unmetered supply, the metered and unmetered busbar sections shall be separately housed in their own cubicles.

Wall mounted switchboards shall be suitable for front access only and the maximum height shall be 2.0 m.

Floor mounted switchboards shall be suitable for front and back access.

The cubicle sections shall be constructed of electro-galvanized sheet steel frames of a minimum thickness of 2.0 mm and the panels shall be constructed from electro-galvanized sheet steel of a minimum thickness of 1.6 mm. It shall be able to withstand a fault level of 36 KA for one (1) second unless otherwise specified in the single-line-diagrams. The enclosures for the switchboards shall provide a degree of protection of IP 4X.

Each cubicle unit shall be incorporated with a removable cover with hidden hinges. The front cover shall have apertures for the protrusion of operating handles of circuit breakers.

The various units comprising a complete switchboard shall be grouped in a multi-tier arrangement including cabling and wiring chamber of ample dimensions to accommodate terminal boards, cable boxes and gland plates.

All external panels of the switchboard shall be treated with a coat of finishing paint, giving a total paint thickness of not less than 50 microns. All coats of paint shall be oven-baked and dried.

Installation of panelboards and enclosures shall be coordinated with cable a e and raceway installation work.

Enclosures shall be anchored firmly to walls and structural surfaces to ensure that they are permanently and mechanically secure.

Panelboard's circuit directory shall be filled out upon completion of installation work and it shall be typewritten or printed.

Bus bar shall be of high conductivity tinned copper, fully insulated, and installed in a segregated compartment completely shielded and isolated from other circuits with sheet metal. Barriers are to be provided between adjacent panels Bus bar shall be supported on non-hygroscopic material, braced and rated to withstand the short-circuit currents. They are to be drilled for future extensions at each end of the switchgear and insulated boots shall be fitted at

the ends of the bus bars. Heaters suitable for operating at 230V, 60Hz, AC shall be provided to prevent moisture condensation on bus bars, current transformers, feeder/bus bar spouts and inside the switchgear enclosure.

The switchgear shall be provided with all small wiring, terminal boards, fuses links, labels, cable sockets, foundation bolts test, and earth connections

The Contractor shall follow the manufacturer's instructions for receiving handling, storage, and installation of a unit substation.

1102.3.1 Inspection and Tests

The Contractor shall submit a proposal of preliminary Test and Inspection Plan. Each Low voltage switchgear and controlgear assembly shall be tested in accordance with IEC Standard 60439-1, Low-voltage switchgear and controlgear assemblies Part 1: Type-tested and partially type-tested assemblies.

1102.4 Method of Measurement

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

1102.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (10)	Pole Mounted Distribution Transformer with Complete Accessories	Lump Sum

SPL 2 - METERING REQUIREMENTS & ACCESSORY

Description

This item shall consist of the pertinent metering procedures, flowcharts, policies and standards. The standards set forth in this section shall be applicable for all metering facilities, such as devices and miscellaneous equipment, etc. of a metering installation among and between all Grid Users like the Network Service Provider, Metering Services Provider, the System Operator, Market Operator, Generators, Distributors, Suppliers, and Customers. It also describes certain electrical, dimensional and mechanical characteristics and designs and takes

into consideration certain safety features of current and inductively coupled voltage transformers of types generally used in the measurement of electricity associated with revenue metering.

General Requirements

This standard supplements the minimum requirements of the harmonized standards on the WESM Rules, PGC and PDC for the Grid and Distribution Metering Installations for the WESM. Any Metering Installation of a higher level accuracy or functionality than that by this standard may also be installed.

Location of the Metering Point

The location of the metering point shall adhere to the applicable provisions of the WESM Rules, the Philippine Grid Code (PGC), the Philippine Distribution Code (PDC), and other relevant issuances of the Energy Regulatory Commission (ERC) and the Department of Energy (DOE).

In accordance with the DOE Department Circular No. DC2016-05-0007, the market trading node, metering point and its metering installations shall be located at the connection point. In accordance with WESM Rules Clause 3.2.2.2 (e), the metering point and metering installations shall be located and installed within 500 meters from the connection point, as defined in the PGC and PDC.

For non-compliant metering point that is located more than 500 meters from the connection point, Site-Specific Loss Adjustment (SSLA) shall be applied to the meter data for the full distance from the connection point representing the energy produced or consumed by the Trading Participant at that metering point for determining the quantities to be settled in the WESM. If the metering point is located within 500 meters from the connection point, no Site-Specific Loss Adjustment (SSLA) shall be applied."

A. Material Requirements

A.1 Metering Installation

A.1.1 Applicability to Equipment

This standard applies to the following metering equipment, devices and accessories:

a. Meters;

b. Current transformer (CT);

c. Voltage transformer (VT);

d. Meter Enclosure;

e. Test Switch/Block;

f. Secondary Cabling for Metering;

g. Grounding System;

h. Rigid Conduit System in accordance with the Philippine Electrical Code (PEC);

i. Communication Link;

j. Facility to seal and secure the meter;

k. Other components for checking the voltage and current; and

l. Metering Perimeter.

The equipment is used for the settlement of Philippine WESM administered transactions. 2.3.2.

A.1.2 Applicability to Installation

This standard applies to metering installations in the WESM for administered transactions, as follows:

a. Connection to the grid;

b. Points of connection between distribution utilities;

c. Connection of registered Trading Participants embedded within the distribution utilities;

d. Any other locations as required by the WESM for settlement purposes

A.2 Meters

A.2.1 Requirements for Transmission Grid Revenue Meters

There shall be a main and alternate meter preferably of different meter model but are both compliant to the requirements of the prevailing PGC.

The meter shall also have a mass memory capable of recording the 5-minute required demand interval data for a period of at least 60 days and have communication capabilities for remote and manual data retrievals.

A.2.2 Requirements for Revenue Meters for Embedded Generators Registered as WESM Participants

For Embedded Generators registered as WESM Participants, the main meter shall adhere to the prevailing requirements of the PDC and shall be capable of recording 5-minute interval data. If there is an alternate meter, it shall also adhere to the requirements of the prevailing PDC Edition.

B. Construction Requirements

A.3 Instrument Transformers

A.3.1 General Requirements

Metering installations, if applicable, shall include instrument transformers.

A.3.2 Requirements for Transmission Grid Instrument Transformers

Instrument Transformers used for metering of transmission grid connections shall adhere to the requirements of the prevailing PGC.

A.3.3 Requirements for Embedded Generators Registered as WESM Participants

Instrument Transformers used for metering of Embedded Generators registered as WESM Participants shall adhere to the requirements of the prevailing PDC.

A.3.4 General Requirements for Grounding System

The installation shall be in accordance but not limited to the following provisions of the Philippine Electrical Code:

a. Electrical systems that are grounded shall be connected to earth in a manner that will limit the voltage imposed by lightning, line surges, or unintentional contact with higher voltages and that will stabilize the voltage to earth during normal operation.

b. Normally non-current carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected to earth so as to limit the voltage to ground on these materials.

c. Normally non-current carrying conductive materials enclosing electrical conductors or equipment, or forming part of such equipment, shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path. Metering Standards and Procedures Page 14 of 160

d. Normally non-current carrying conductive materials that are likely to become energized shall be connected together and to the electrical supply source in a manner that establishes an effective ground-fault current path.

e. Electrical equipment, wiring, and other electrically conductive material likely to become energized shall be installed in a manner that creates a low-impedance circuit facilitating the operation of the overcurrent device. It shall be capable of safely carrying the maximum ground fault-current likely to be imposed on it from any point on the wiring system where a ground fault occurs to the electrical supply source. The earth shall not be considered as an effective ground fault current path.

f. For voltage level 69kV and higher, the minimum size of copper conductor to be used for metering instrument transformer grounding shall be 100 mm2 .

g. For voltage lower than 69kV the minimum size of copper conductor to be used for metering

instrument transformer grounding shall be 60 mm2.

h. The minimum size of copper conductor to be used for the secondary circuits of instrument transformers shall be 3.5 mm2.

i. Connections to all bonded parts shall be made in accordance to Article 2.50.1.8 of the Philippine Electrical Code 2009 Part 1.

The installation shall likewise conform to the IEC or ANSI/IEEE C57.13-1983 IEEE Guide for Grounding of Instrument Transformer Secondary Circuits and Cases and IEEE Std. 80-2000 or IEEE Guide for Safety in AC Substation Grounding.

The ground resistance of the metering grounding system shall not be more than five (5) ohms.

A.4 Primary Connections

A.4.1 Location of Primary Terminals of Current Transformer

The primary terminals of each current transformer shall be located as close as practicable to the prescribed Connection Point.

Location of Primary Terminals of Voltage Transformer The primary terminals of each voltage transformer shall be located as close as practicable to the prescribed Connection Point.

A.4.2 Requirements of Primary Terminals

The primary terminals of each voltage transformer shall be:

a. at the same potential as the current transformer; and

b. as close as practicable to the primary terminals of the current transformer of the same phase.

Connection to Power System With respect to any physical separation of the points at which the voltage transformer and the current transformer of each phase are connected to the power system, the installation shall:

a. minimize the voltage drop between the voltage transformer and the current transformer; and

b. minimize the leakage of current between the voltage transformer and the current transformer

A.5 Primary Cable

A.5.1 Quality of Materials and Workmanship

The primary cable terminations connecting to the high-voltage terminals of an instrument transformer shall be in good quality and of accepted workmanship.

A.5.2 Location of Primary Connections

Primary connections of the instrument transformer shall be located such that operation of

power system equipment does not degrade the following elements:

a. accuracy of measurement;

b. data required for validation or settlement;

c. loss adjustment factors; and

d. Monitoring of metering equipment condition

A.6 Secondary Connections for Instrument Transformers

The requirements and applicability apply to all instrument transformers used in the Metering Installations of all metered Trading Participants of the WESM.

A.6.1Current Transformer

A.6.1.1. Size of Secondary Cabling

The secondary cabling between the current transformers and the meter test switch/block shall be of a sufficient size that the rated burden specified in Section 2.5.4.1 accuracy class is not exceeded when current, equivalent to the rated current, flows in the secondary winding.

A.6.2 Voltage Transformer

A.6.2.1 Size of Secondary Cabling

The secondary cabling between the voltage transformers and the meter test switch/block shall be of correct size such that the voltage drop in each phase shall not exceed 0.2 V.

A.6.3 Codes and Conditions

Instrument transformer secondary cabling and cabling accessories shall comply with the following codes and conditions:

The Philippine Electrical Code;

The meters shall be provided with dedicated current and voltage transformers used only for WESM metering installation, except as permitted in Section 2.5.2;

Current transformers may be supplied with more than one secondary core. However, no secondary core other than those intended for revenue meters may be provided;

Voltage transformers may be supplied with more than one secondary windings intended for the revenue meters and shall not be used for any other purpose;

Electrical connection to the instrument transformer secondary terminals shall not be outside of the meter box;

Cabling from the instrument transformers to the meter enclosure shall be routed in dedicated

conduit, and the route shall be visually traceable; and

Each secondary terminal of each instrument transformer shall be brought to the test block on a separate conductor.

Method of Measurement

The work under this Item shall be measured by either lump sum or set installed as indicated in the Plans.

Basis of Payment

Method of Measurement shall be paid for at the unit bid price which payment constitutes 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
SPL 2	Metering Requirements and Accessory	Lump Sum

D. BROODSTOCK TANKS (7 UNITS)

ITEM 803 - STRUCTURE EXCAVATION

803.1 Description

This item shall consist of the necessary excavation for foundation of buildings, culverts, underdrains, and other structures not otherwise provided for in the Specifications. Except as otherwise provided for pipe culverts, the backfilling of completed structures and the disposal of all excavated surplus materials, shall be in accordance with the plans and 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.

803.2 Construction Requirements

803.2.1 Clearing and Grubbing

Prior to starting excavation operations in any area, all necessary clearing and grubbing in that area shall have been performed in accordance with Item 800, Clearing and Grubbing.

803.2.2 Excavation

1. General, All Structures

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

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

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

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

2. Structures Other than Pipe Culverts

All rock or other hard foundation materials shall be cleaned of all loose materials, and cut to a firm surface, either level, stepped, or serrated as directed by the Engineer. All seams or crevices shall be cleaned and grouted. All loose and disintegrated rocks and thin strata shall be removed. When the footing is to rest on material other than rock, excavation to final grade shall not be made until just before the footing is to be placed. When the foundation material is soft or mucky or otherwise unsuitable, as determined by the Engineer, the Contractor shall remove the unsuitable material and backfill with approved granular material. This foundation fill shall be placed and compacted in 150 mm layers up to the foundation elevation.

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

3. Pipe Culverts

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

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

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

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

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

803.2.3 Utilization of Excavated Materials

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

803.2.4 Cofferdams

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

Cofferdams or cribs for foundation construction shall in general, be carried well below the bottoms of the footings and shall be well braced and as nearly watertight as practicable. In general, the interior dimensions of cofferdams shall be such as to give sufficient clearance for the construction of forms and the inspection of their exteriors, and to permit pumping outside of the forms. Cofferdams or cribs which are tilted or moved laterally during the process of sinking shall be righted or enlarged so as to provide the necessary clearance.

When conditions are encountered which, as determined by the Engineer, render it impracticable to dewater the foundation before placing the footing, the Engineer may require the construction of a concrete foundation seal of such dimensions as he may consider necessary, and of such thickness as to resist any possible uplift. The concrete for such a seal shall be placed as shown

on the Plans or directed by the Engineer. The foundation shall then be dewatered and the footing placed. When weighted cribs are employed and the mass is utilized to overcome partially the hydrostatic pressure acting against the bottom of the foundation seal, special anchorage such as dowels or keys shall be provided to transfer the entire mass of the crib to the foundation seal. When a foundation seal is placed under water, the cofferdams shall be vented or ported at low water level as directed.

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

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

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

803.2.5 Preservation of Channel

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

803.2.6 Trimming Works

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

803.2.6.1 Trimming and Finishing of Surfaces

Unless otherwise specified, all areas within the limits of clearing and outside the limits of earthworks shall be graded to an even surface which will drain freely and is suitable for the operation of tractor mounted mowers.

Batters in cut and fill shall be trimmed to shapes shown on drawings.Cut and fill batters shall be trimmed as specified in the Plans.

803.3 Method of Measurement

803.3.1 Structure Excavation

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

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

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

3. The volume outside of neat lines of underdrains as shown on the plans, and the outside the limits of foundation fill as ordered by the engineer.

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

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

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

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

8. The volume of excavation for footings ordered at a depth more than 1.5 m below the lowest elevation for such footings shown on the original contract plans, unless the Bill of Quantities contains a pay item for excavation ordered below the elevations shown on the plans for the individual footings.

803.3.2 Shoring, Cribbing, and Related Work

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

803.3.3 Trimming Works

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

803.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 803.3, Method of Measurement shall be paid at the Contract Unit Price for each of the particular pay items listed below that is included in the Bill of Quantities. The payment shall constitute full compensation for the removal and disposal of excavated materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item, except as follows:

1. Any excavation for footings ordered at a depth more than 1.5 m below the lowest elevation shown on the original contract plans shall be paid for as provided in the Part K of Volume I requirements and conditions of contract, unless a pay item for excavation ordered below plan elevation appears in the bill of quantities.

2. Concrete will be measured and paid for as provided under Item 900, Structural Concrete. The quantity of structural concrete to be paid for shall be the final quantity placed and accepted in the completed structure. No deduction shall be made for the volume occupied by pipe less than 100 mm in diameter or by reinforcing steel, anchors, conduits, weep holes or expansion joint materials.

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

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

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C of Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804	Embankment	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 902 - REINFORCING STEEL

902.1 Description

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

902.2 Material Requirements

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

Table 902.1 Reinforcing Steel Bars Requirements

Type of Reinforcing Steel	Specification
Deformed Billet Steel Bars for Concrete Reinforcement	AASHTO M 31M, Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement
	ASTM A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
	PNS 49, Philippine National Standard, Steel Bars for Concrete Reinforcement - Specification
Deformed Steel Wire for Concrete Reinforcement	AASHTO M 336M, Standard Specification for Steel wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement (ASTM A1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete)
Type of Reinforcing Steel	**Specification**
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	AASHTO M 54M, Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement (ASTM A184M,

Reinforcement	Standard Specification for Welded Deformed Steel Bar Mats for Concrete Reinforcement)
Welded Deformed Steel Wire Fabric or Concrete Reinforcement	AASHTO M 336M, Standard Specification for Steel Wire and Welded Wire, Plain and Deformed, for Concrete Reinforcement (ASTM 1064M, Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete)
Plastic Coated Dowel Bars	AASHTO M 254M, Standard Specification for Corrosion-Resistant Coated Dowel Bars Type A
Low Alloy Steel Deformed Bars for Concrete Reinforcement	ASTM A706M, Standard Specification for Deformed and Plain Low-Alloy Steel Bars for Concrete Reinforcement
Deformed Rail-Steel and Plain Bars for Concrete Reinforcement	ASTM A996M, Standard Specification for Rail-Steel and Axle-Steel Deformed Bars for Concrete Reinforcement

If reinforcing bars are to be welded, these ASTM specifications shall be supplemented by requirements ensuring 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 re-straightened during construction. Tie bars shall be deformed bars. Dowel Bars shall be plain round bars. They shall be free from burning or other deformation restricting slippage in the concrete. Before delivery to the site of the work, a minimum of 1⁄2 the length of each dowel bar shall be painted with one coat of approved lead or tar paint.

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

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

902.2.1 Wire Rope or Wire Cable

The wire rope or wire cable shall conform to the requirements of AASHTO M30, Standard Specification for Zinc-Coated Steel Wire Rope and Fittings for Highway Guardrail for the specified diameter and strength class.

902.2.2 Prestressing Reinforcing Steel

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

High-tensile wire: AASHTO M 204M, Standard Specification for Uncoated Stress-Relieved

Steel Wire for Prestressed Concrete ASTM A241M, 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 Specification for Low-Relaxation, Seven-Wire Steel Strand for Prestressed Concret

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

Physical Property	Requirement
Minimum Ultimate Tensile Strength	1000 Mpa followed by stress relieving
Minimum Yield Strength, measured by the 0.7% extension under load method	895.7 MPa
Minimum Modulus of Elasticity	25,000,000
Minimum Elongation in 20 bar diameters after rupture	4%
Diameter Tolerance	0.254 mm to 0.762 mm

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

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

High Strength alloy steel bars 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	1%
Reduction of Area at Rupture	25%

902.2.3 Epoxy Coated Reinforcing Steel Bars

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

902.2.3.1 Surface Preparation

The surface of the steel reinforcing bars to be coated shall be cleaned by abrasive blast cleaning to a near white metal. It is recommended that reinforcing steel bars and blast media be checked for contamination by any foreign materials and oil impurities prior to use. Blast media found to be salt contaminated should be rejected. Reinforcing steel bars and blast media found to be contaminated shall be rejected or washed and cleaned prior to heating through the use of methods suitable to remove the contamination.

Manufacturers shall be permitted to use a chemical wash or blast cleaned steel reinforcing bars surface, or both, to enhance coating adhesion. This pretreatment shall be applied after abrasive cleaning and before epoxy coating, in accordance with the written application instructions specified by the pretreatment manufacturer.

902.2.3.2 Coating Application

If pretreatment is used in the preparation of the surface, the powder coating shall be applied to the cleaned and pretreated steel reinforcing bar surface as soon as possible after surface treatments have been completed, and before visible oxidation of the surface occurs as discernible to a person with normal or corrected vision. In no case shall application of the coating be delayed more than 3 hours after cleaning.

The fusion-bonded epoxy powder coating shall be applied in accordance with the written recommendations of the manufacturer of the powder coating for initial surface temperature

range and post application curing requirements. During continuous operations, the temperature of the surface immediately prior to coating shall be measured using infrared guns or temperature indicating crayons, or both, at least once every 30 minutes. The Powder coating shall be applied by electrostatic spray or other suitable method.

902.2.3.3 Curing

Following powder application, the coating is allowed to cure at approximately 30 seconds during which time it hardens to a solid. In some plants, the curing is often followed by an air or water quench that quickly reduces the bar temperature to facilitate handling.

902.2.3.4 Requirements for Epoxy-Coated Reinforcing Steel Bars

1. Coating Thickness

For acceptance purposes, at least 90% of all recorded thickness measurements of the coating after curing shall be 175 um to 300 um. Thickness measurements below 125 um shall be considered cause for rejection. The upper thickness limit does not apply to repaired areas of damaged coating.A single recorded coated reinforcing steel bar thickness measurement is the average of three (3) individual gauge readings obtained between four (4) consecutive deformations. A minimum of five (5) recorded measurements shall be obtained approximately evenly spaced along each side of the test bar (a minimum of ten (10) recorded measurements per bar).

The coating thickness shall be measured on the body of a straight length of reinforcing steel bar between the deformations.

2. Coating Continuity

Holiday checks to determine the acceptability of the reinforcing steel bars prior to shipment shall be made at the manufacturer's plant with a 67.5 V, 80,000 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.

3. Coating Flexibility

a. The coating flexibility shall be evaluated by bending production coated reinforcing steel bars at a uniform rate around a mandrel of specified size within a maximum specified time as prescribed in the applicable requirements of bend test requirements of ASTM A775M, Standard Specification for Epoxy-Coated Steel Reinforcing Bars. The two (2) longitudinal ribs shall be placed in a plane perpendicular to the mandrel radius. The test specimen shall be between 20º C and 30º C.

b. No cracking or disbonding of the coating shall be visible to the unaided eye on the outside radius of the bent bar. Evidence of cracking or disbanding of the coating shall be considered cause for rejection of the coated reinforcing steel bars represented by the bend test sample.

c. Fracture or partial failure of the reinforcing steel bar, or cracking, or disbonding caused by imperfections in the bar surface visible after performing the bend test shall not be considered a flexibility failure of the coating, but shall require testing two (2) additional specimens. These two (2) specimens shall then meet the requirements of (b).

d. The requirements for coated reinforcing steel bars shall be met at the manufacturer's plant prior to shipment.

902.3 Construction Requirements

902.3.1 Order Lists

Before materials are ordered, all order lists and bending diagrams shall be furnished by the Contractor, for approval of the Engineer. The approval of order lists and bending diagrams by the Engineer shall in no way relieve the contractor of responsibility for the correctness of such lists and diagrams. Any expense incident to the revisions of materials furnished in accordance with such lists and diagrams to make them comply with the Plans shall be borne by the Contractor.

902.3.2 Protection of Material

1. Steel Reinforcement

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

2. Epoxy-Coated Reinforcing Steel Bars

a. Epoxy coated steel stored at the site shall be placed on timber sills suitably spaced so that no steel shall be laid upon or come in contact with the ground and elevated sufficiently to prevent sags in the bundles and from workers walking on the steel.

b. If rainy or exceptionally humid weather occurs or is anticipated, bars shall be stored under cover immediately upon delivery to site. Epoxy bars shall be covered with polyethylene or other materials to prevent exposure to direct sunlight.

c. Reinforcement steel bars shall be handled and stored in manner to prevent damage to bars

or the epoxy coating.

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

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

f. All bundling bands shall be padded or suitable banding shall be used to prevent damage to the coating. All bundles of coated reinforcing steel bars shall be lifted with a strong back, spreader bar, multiple supports, or a platform bridge to prevent bar to bar abrasion from sag in the bundles of coated reinforcing steel bars.

902.3.3 Bending

All reinforcing bars requiring bending shall be cold-bent to the shapes shown on the plans. Bars shall be bent around a circular pin having the following diameters (D) in relation to the nominal diameter of the bar (d) as shown in Table 902.5.

Table 902.5 Pin Diameter for Bending Bars

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

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

902.3.4 Placing and Fastening

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

Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports, so that it does not vary from the position indicated on the plans by more than 6 mm. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shapes and dimensions. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone 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.

902.3.5 Splicing

All reinforcement shall be furnished in the full lengths indicated on the Plans. Splicing of bars, except where shown on the Plans, will not be permitted without the written approval of the Engineer. Splices shall not 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 ⅓ the maximum size of coarse aggregate between the splice and the nearest adjacent bar. Welding of reinforcing steel shall be done only if detailed on the plans. Spiral reinforcement shall be spliced by lapping at least 1 ½ turns or by butt welding unless otherwise shown on the plans.

Splicing shall conform to the following requirements unless otherwise shown on the Plans.

1. Lap splices shall not be permitted for bars larger than 36 mm ∅.

2. For contact lap splices, minimum clear spacing between the contact lap splice and adjacent splices or bars shall be in accordance with the requirements below.

    a. For parallel non-prestressed reinforcement in a horizontal layer, clear spacing shall be at least the greatest of 50 mm, nominal diameter of bar (db) and (4/3) nominal maximum size of coarse aggregates (dagg).

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

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

    a. Lap splices of bars in the bundle shall be based on the lap splice length required for the individual bars within the bundle.

    b. Individual bar splices within a bundle shall not overlap.

    c. Entire bundles shall not be lap spliced.

902.3.6 Lapping of Bar Mat

Sheets of mesh or bar mat reinforcement shall overlap each other sufficiently to maintain a uniform strength and shall be securely fastened at the ends and edges. The overlap shall not be less than one (1) mesh in width.

902.3.7 Welding

Welding of reinforcing steel bars shall conform to American Welding Society, AWS D1 4M, Structural Welding Code - Reinforcing Steel.

For Steel Bars conforming to ASTM A706, 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 260º C.

After completion of welding on epoxy-coated bars, the damaged areas shall be repaired using patch materials conforming to ASTM A47M, Standard Specification for Ferritic Malleable Iron Castings.

902.4 Method of Measurement

The quantity of reinforcing steel to be paid for will be the final quantity placed and accepted for the completed structure as shown on the plans.

902.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 902.4, Method of Measurement shall be paid for at the Contract Unit Price for reinforcing 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) a	Reinforcing Steel Bar (Deformed) Grade 40	Kilograms

SPL 1 - DEWATERING WORKS

Description

This Item shall consist of the necessary excavation for removal of all foundations of materials of whatever nature encountered including all obstructions of any nature that would interfere with the proper execution and Completion of the work.

Construction Requirements

General

The removal of said materials shall conform to the lines and grades shown on the approved Plans and Specifications. Unless otherwise provided, the entire construction site shall be stripped of all vegetation and debris and such materials shall be removed from the site prior to performing any excavation.

The Contractor shall furnish, place and maintain all supports and shoring that may be required for the sides of the excavation, and all pumping, ditching or other

approved measures for the removal or exclusion of water, including taking care of storm water and wastewater reaching the site of Work from any source so as to prevent damage to the work and adjoining property.

In excavation which workers may be required to enter, excavated or other materials shall be stockpiled temporarily at least 600 mm from the edge of the trench and shall comply with the prevailing laws and issues pertaining to safety requirements.

Excavations shall be dewatered and maintained so that the material is excavated in its natural state and construction of the foundations is completed in the dry condition. The bottom of the excavation shall be kept free from excessive moisture and free-flowing water.

Excavation beneath Proposed Structures

Excavation shall be carried to the grade of the bottom of the footing or slab. Unless otherwise specified in the Plans, the areas beneath proposed structures shall be over-excavated. After the required excavation or Over-excavation has been completed, the exposed surface shall be scarified to the depth of 150mm.

Brought to optimum moisture content and shall be compacted to 100% of Maximum dry density.

Excavation beneath Areas to be Paved

Excavation under areas to be paved shall extend to the bottom of the aggregate base if such base is called for; otherwise, it shall extend to the bottom of paving. After the required excavation has been completed, the exposed surface shall be scarified, brought to optimum

moisture content and compacted to 100% of maximum dry density.

Pipeline Trench Excavation/ Excavation for Foundation of Structure

Unless otherwise shown on the approved Plans and Specifications, excavation for pipeline shall be open-cut trenches.

The bottom of the trench, including any shoring, shall have a minimum width equal to the outside diameter of the pipe plus 300 mm and a maximum width equal to the outside diameter of the pipe plus 600 mm. The bottom of the trench shall be excavated uniformly to the grade of the bottom of the pipe.

The trench bottom shall be given a final trim using a string line for establishing grade, such that each pipe section when first laid will be wholly in contact with the ground or bedding along the extreme bottom of the pipe.

Rounding out the trench to form a cradle shall not be required. The maximum amount of open trench permitted at any one time and in one location shall be 100 m or the length necessary to accommodate the number of pipes installed in one day, whichever is greater.

Barricades and warning lights shall be provided and maintained for all trenches except at intersections and driveways in which case heavy steel plates, adequately braced bridging or other type of crossing capable of supporting Vehicular traffic shall be furnished.

Excavation in Lawn Areas

Where pipeline excavation occurs in lawn areas, the sod shall be carefully removed and stockpiled to preserve it for replanting. Excavated material shall be placed on the lawn provided a drop cloth or other suitable method is employed to protect the lawn from damage.

The lawn shall not remain covered for more than 72 h. immediately after the installation and completion of backfilling, the sod shall be replanted in a manner So as to restore the lawn as near as possible to its original condition.

Rock Excavation

Rock excavation shall include removal and disposal of stones having a volume of 1 m3 or more in existing ledges, bedding deposits and unsatisfied masses that cannot be excavated without blasting or the used rippers

Excavation beneath Proposed Concrete Reservoir

After the reservoir area has been stripped of all vegetation and debris, as specified in 1600.2.1, lawn and top soil from the top 600 mm of excavated soil shall be removed and stockpiled for possible later use as fill or around the reservoir and for miscellaneous top soil. Excavation under the reservoir shall extend to the bottom of the drain dock layer. After such excavation had been

completed, the exposed surface shall be rolled with heavy equipment to provide a reasonably

smooth surface for placement of drain dock.

Method of Measurement

The quantity to be paid for shall be the volume of the materials excavated in cubic meter calculated by multiplying the horizontal area of the bottom of the structure or open-cut trench by the average depth. The average depth shall be calculated from the finished surface of the grade shown on the drawing or the original ground level, whichever is the lowest.

Dewatering shall be paid for on a lump sum basis, and no separate measurement shall be made for this work.

Basis of Payment

Payment for all work under this Item shall be made at the Contract Unit Price per cubic meter for each earthwork which price and payment shall be full compensation for furnishing all materials, labor, equipment, tools and incidentals necessary to complete all work.

Payment shall be made under

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 903 - FORMWORKS AND FALSEWORKS

903.1 Description

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

903.2 Material Requirements

Forms shall be constructed with metal or timber. Fir timber forms, it is important that the moisture content of the timber that will be used to make the formwork between 15% to 20%. Low Moisture content means the timber is very dry thus can absorb moisture from the wet concrete resulting in 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 timberworks though painting 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 fiberboard.

For metal forms, it is important that the metal used as sheathing should be free from rust and nonreactive to concrete or concrete containing calcium oxide. Plywood of lined forms will not be required for surfaces which are normally submerged or not ordinarily expose to view, Other types of forms, such as steel or unlined wooden forms, may be used for surfaces which are not

restricted to plywood or lined forms, and may be used as backing for form linings. Forms are required above all extended footings.

903.3 Construction Requirements

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 surface shall be 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 remain true to shape. For timber formworks plywood is used for sheathing 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 wet concrete will out on the formwork.

The design of formwork will specify the thickness of the plywood that will be incorporated in the project. All tie bars with bolts used in fastening forms should be countersunk to a depth similar to the required concrete covering and patched with cement mortar. The use of approved internal steel ties or steel or plastic spacers shall be permitted. The fabricated spacer blocks shall have an embedded No. 16 G.I Tie Wire with sufficient length to be attached to the reinforcing steel bars to hold the spacers in place after closure of forms and during pouring, Structural steel tubes used as support for forms shall have a minimum wall thickness of 4mm.

The design and construction of formworks and falseworks, shall be the responsibility of the Contractor and for the approval of the Engineer.

The Contractor shall employ competent professional engineering services to design forms to be approved by the Engineer and supervise the erection of all formworks needed for the completion of the project. All materials to be incorporated to the site shall be inspected and approved by the Engineer.

903.3.2 Fabrication and Erection

Formworks to be used shall conform to ACT 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 designated to withstand concrete pressures without bulging, spreading, or lifting of the forms. The forms shall produce finished surfaces that are free from offsets, 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 designated 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 the concrete columns shall be formed in a way that 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 a 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 screed or template. At horizontal construction joints 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 other points in order to facilitate cleaning and inspection prior to concrete placement. Unless otherwise shown on the drawing, 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 exposed surfaces and all steel forms shall be coated with non-staining form release agent which shall be applied just prior to replacement of steel reinforcement. After coating with industrial lubricants such as form oil , any surplus 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 of or screeds, excessive deflection of forms, or displacement of reinforcement occur during concrete placement, immediate corrective measures shall be taken to ensure acceptable lines and surface to required dimensions and across sections. If any forms bulge or show excessive deflection, in the opinion of the Engineer, the concrete shall be removed and the forms shall be rebuilt and strengthened.

903.3.2.1 Foundations for Formworks

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.

903.3.3 Safety

Forms must be strong sound (made of good quality and durable material in order to carry the full load and side pressure form 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 Formworks recommendations under Section 3.1 Safety Precautions in Construction and Section 3.2 Construction Practices and Workmanship, and local code requirements for formwork should be followed.

903.3.4 Delivery, Storage, Maintenance and Handling

Any formwork with steel components should be stored in a dry place.

Avoid direct sunlight on timber forms. Store form materials and accessories above ground with a minimum height of 100 mm on framework or blocking without twist or bend, and shall be covered with a suitable waterproof covering providing adequate air circulation and free form dirt.

Store and handle form coating to prevent contamination in accordance with manufacturers recommendation.

For maintenance of the forms, use stiff brush and clean water for cleaning of forms. Use scrapers only as a last resort for maintenance purposes. Keep forms well-oiled to prevent delamination of plywood or rusting of steel and always oil the edges.

903.3.5 Removal of Forms

Forms, falseworks and centering shall not be removed or disturbed until the concrete has attend sufficient strength to safely support all dead and the 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 % if Design Strength
Walls, column and vertical sides of beams	1 to 2	70%
Beam soffits (steel formwork props/shorting 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 over 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 arches Centering under girders, beam frames and arches spanning up 6.0 m	14	80%
Removal of Steel formwork props/shoring to beams and arches: Centering under girders, beam frames and arches spanning over 6.0 m	21	80%

Order and method of removing formwork:

1. Shuttering forming the vertical faces of walls, beams and columns sides shall be removed first as they bear no load but only retain the concrete.

2. Shuttering forming soffit of slabs shall be removed next.

3. Shuttering forming soffit of beams, girders or other heavily loaded shuttering shall be removed in the end.

Care shall be taken into consideration during the removal to avoid surface gouging, corner or edge breakage, or other damage to the concrete.

903.3.6 Quality Control and Inspection

Materials and components used for formworks shall be examined for damage or excessive deterioration before use. Reuse of forms shall be allowed only if found suitable after necessary repairs. In case of timber forms, the inspection shall not only cover physical damages but also signs of attacks by decay, rot or insect attack or the development of splits. Reuse of job-built forms shall be permitted only when specifically approved by the Engineer.The Engineer shall inspect the completed formwork, before carrying out any work, including fixing of reinforcing support.

903.4 Method of Measurement

Forms installed for cast-in-place concrete according 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 a lump sum basis. The Pay Item will include all materials and components used for furnishing, fabrication, installation, erection and removal forms. The quantity to be paid for shall be the square meters of formwork used and accepted by the Engineer or the Lump Sum bid price in the Contract.

903.5 Basis Payment

The quantity measured as prescribed above shall be paid for at the Contract Unit Price of lump sum price bid for the pay item listed below that is included in the Bill of Quantities. This unit price shall cover full compensation for all materials, labor, tools, equipment, and related services necessary for the design, construction and removal of formwork and falsework. Properly supported members as required until the concrete is cured, set and hardened is also part of the Contract Unit Price.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 900 - STRUCTURAL CONCRETE

900.1 Description

900.1.1 Scope

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

900.1.2 Classes and Uses of Concrete

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

The classes of concrete will generally be used as follows:

Class A All superstructures and substructures which include the important parts such as slabs, beams, girders, columns, arch ribs, box culverts, abutments, retaining walls, shear walls, pedestal and footings.

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

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

Class P- Prestressed concrete structures and members.

Seal - Concrete deposited in water

900.2 Material Requirement

900.2.1 Portland Cement

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

Table 900.1 Types of Cement

Type	Specification
Portland Cement	AASHTO M 85, Standard Specification for Portland Cement (ASTM C150, Standard Specification For Portland Cement)
Blended Hydraulic Cements	AASHTO M 240, Standard Specification for Portland Cement (ASTM C595, Standard Specification For Blended Hydraulic Cement)
Masonry Cement	ASTM C91, Standard Specification For Masonry Cement

900.2.2 Concrete Aggregates

Concrete aggregates shall conform to ASTM C33M, Standard Specification for Concrete Aggregates, and lightweight concrete aggregates shall conform to ASTM C330M, Standard Specification for Lightweight Aggregates except that aggregates failing to meet these specifications, but which have been shown by special test or actual service to produce concrete of adequate strength and durability may be used under Method 2 of Subsection 900.3.2, Methods of Determining the Proportions of Concrete, when authorized by the Engineer in writing.Except as permitted elsewhere in this Subsection, the maximum size of the aggregate shall be or not larger than 1/5 of the narrowest dimensions between sides of forms of the member for which the concrete is to be used nor larger than 3/4 of the minimum clear spacing between individual reinforcing bars or bundles of bars or pre-tensioning strands.

900.2.2.1 Fine Aggregates

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

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

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

Fine aggregates shall be free from injurious amounts of organic impurities. If subjected to the colorimetric test for organic impurities and a color darker than the standard is produced, it shall

be rejected.

However, when tested for the effect of organic impurities on strength of mortar by AASHTO T 71, Standard Method of Test for Organic Impurities in Fine Aggregate on Strength of Mortar (ASTM C87, Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar) the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95%.The fine aggregate shall be well-graded and shall conform to Table 900.2.

Table 900.2 Grading Requirements for Fine Aggregate

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

900.2.2.2 Coarse Aggregates

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

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

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

Coarse Aggregates shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96, Standard Method of Test for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine (ASTM C131, Standard Test Method for Resistance to Degradation of Small-Size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine).

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

Gradation shall conform to Table 900.3.

Table 900.3 Grading Requirements for Coarse Aggregate

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

900.2.2.3 Aggregate Tests

Samples of the fine and coarse aggregates to be used shall be selected by the Engineer for tests at least 30 days before the actual concreting operations shat begin. It shall be the responsibility of the Contractor to designate the source or sources of aggregates to give the Engineer sufficient time to obtain the necessary samples and submit them for testing.

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

900.2.3 Water

Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water which is drinkable may be used without test. Where the source of water is shallow, the intake shall be so enclosed as to exclude silt, mud, grass or other foreign materials.If it contains quantities of substance that discolor it or make it smell or taste unusual or objectionable, or cause suspicion, it shall not be used unless service records of concrete made with it (or other information) indicated that it is not deleterious to the quality, shall be subject to the acceptance criteria as shown in Table 900.4 and Table 900.5 or as designated by the Engineer.

Table 900.4 Acceptance Criteria for Water Supply

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

Table 900.5 Chemical Limitation for Water

Chemical Property	Limits (parts per million, ppm), max	Test Method
A. Chloride as $Cl^{(-1)}$		
1. Prestressed concrete	500	ASTM C114
2. Other reinforced concrete in moist environment 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

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

900.2.4 Metal Reinforcement

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

900.2.5 Admixtures

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

Chemical Admixtures, if used, shall conform to the requirements of ASTM C494M, Standard

Specification for Chemical Admixtures for Concrete or AASHTO M 194, Standard Specification for Chemical Admixtures for Concrete.

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

Chemical Admixture/s may be added to the concrete mix to produce some desired modifications to the properties of concrete if necessary, but not as partial replacement of cement. If specified, monofilament polypropylene synthetic fibrin fibers, which are used as admixture to prevent the formation of temperature/shrinkage cracks and increase impact resistance of concrete slabs shall be applied in the dosage rate recommended by its manufacturer.

900.2.6 Storage of Cement and Aggregates

All cement shall be stored immediately upon delivery at the site in a weatherproof building which will protect the cement from dampness. The floor shall be raised from the ground. The buildings shall be placed in locations approved by the Engineer.

Provisions for storage shall be ample, and the shipments of cement as received shall be separately stored in such a manner as to allow the earliest deliveries to be used first and to provide easy access for identification and inspection of each shipment. Storage buildings shall have capacity for storage of a sufficient quantity of cement to allow sampling at least 12 days before the cement is to be used. For a storage period of less than 60 days, stack the bags no higher than 14 layers, and for longer periods, no higher than seven (7) layers.

As an additional precaution the oldest cement shall be used first. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. Stored cement shall meet the test requirements at any time after storage when retest is ordered by the Engineer. At the time of use, all cement shall be free flowing and free of lumps.

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

In order to secure greater uniformity of concrete mix, the Engineer may require that the coarse aggregate be separated into two (2) or more sizes. Different sizes of aggregate shall be stored in separate bins or in separate stockpiles sufficiently removed from each other to prevent the material at the edges of the piles from becoming intermixed.

900.2.7 Curing Materials

Curing materials shall conform to the following requirements as specified;

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

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

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

900.2.8 Expansion Joint Materials

Expansion joint materials shall be:

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

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

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

900.3 Construction Requirements

The notation used in these regulations is defined as follows:

fc' = compressive strength of concrete

900.3.1 Concrete Quality

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

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

900.3.2 Methods of Determining the Proportions of Concrete

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

Method 1. Without preliminary test

Where preliminary test data on the materials to be used in the concrete have not been obtained, the water-cement ratio for a given strength of concrete shall not exceed the values shown in

Table 900.6.

When strengths in excess of 27.58 MPa are required or when lightweight aggregates or admixtures (other than those exclusively for the purpose of air entraining) are used, the required water-cement ratio shall be determined in accordance with Method 2.

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

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

Where previous data are not available.Concrete trial mixtures having proportions and consistency suitable for the work shall be made using at least three (3) different water cement ratios (or cement content in the case of lightweight aggregates) which will produce a range of strengths encompassing those required for the work.

For each water-cement ratio (or cement content) at least three (3) specimens for each age to be tested shall be made, cured and tested for strength in accordance with ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen and ASTM C192, Standard Practice for Making & Curing Concrete Test Specimens in the Laboratory.

The strength test shall be made at 7, 14 and 28 days at which the concrete is to receive load, as indicated on the Plans.

A graph shall be established showing the relationship between water-cement ratio (or cement content) and compressive strength.

The maximum permissible water-cement ratio for the concrete to be used in the structure shall be that shown by the curve to produce an average strength to satisfy the requirements of the strength test of concreteWhere different materials are to be used for different portions of the work, each combination shall be evaluated separately.

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

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

27.58	17.77	0.443	14.22	0.354

900.3.3 Concrete Proportions and Consistency

The proportions of aggregates to cement for any concrete shall be such as to produce a mixture which will work readily into the corners and angles of the form and around reinforcement with the method of placing employed on the work, but without permitting the materials to segregate or excess free water to collect on the surface.

The methods of measuring concrete materials shall be such that the proportions can be accurately controlled and easily checked at any time during the work.

900.3.4 Sampling and Testing of Structural Concrete

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

Samples from which compression test specimens are molded shall be secured in accordance with ASTM C172M, Standard Practice for Sampling Freshly Mixe Concrete.

Specimens made to check the adequacy of the proportions for strength of concrete or as a basis for acceptance of concrete shall be made and laboratory-cured in accordance with ASTM C31M, Standard Practice for Making and Curing Concrete Test Specimen in the Field.

Additional test specimens cured entirely under field conditions may required by the Engineer to check the adequacy of curing and protection of the concrete.

Strength tests shall be made in accordance with ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimen.

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

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

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

Making and curing of concrete compressive specimen in the field	AASHTO T 23, Standard Method of test for Making and Curing Concrete Test Specimens in the Field (ASTM C31, StZZZandard Practice for Making and Curing Concrete Test Specimens in The Field)
Compressive strength of molded concrete cylinders	AASHTO T 22, Standard Method of test for Test Method for Compressive Strength of Cylindrical Concrete Specimens (ASTM C39M, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens)

900.3.5 Proportioning and Strength of Structural Concrete

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

A change in the source of materials during the progress of work shall necessitate a new mix design.

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

Table 900.7 Composition and Strength of Concrete for Use in Structures

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

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

900.3.6 Consistency

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

900.3.7 Strength Test of Concrete

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

The age for strength tests shall be 28 days or, when specified in the Plan, the earlier age at which the concrete is to receive its full load or maximum stress. Additional test may be made at earlier ages to obtain advance information on the adequacy of strength development where age-strength relationships have been established for the materials and proportions used.

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

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

900.3.8 Batching

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

1. Portland Cement

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

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

2. Water

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

3.Aggregates

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

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

4. Bins and Scales

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

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

5. Batching

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

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

6. Admixtures

The Contractor shall follow an approved procedure for adding the specified amount of admixture to each batch and will be responsible for its uniform operation during the progress

of the work. He shall provide separate scales for the admixtures which are to be proportioned by weight, and accurate measures for those to be proportioned by volume. Admixtures shall be measured into the mixer with an accuracy of plus or minus 3%.

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

900.3.9 Mixing and Delivery

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

Volumetric measurement shall be used only if by weight batching plant is located more than 1 h travel from the project site.

Concrete mixing by chute is allowed provided that a weighing scales for determining the batch weight will be used.

For batch mixing at the construction site or at a central point, a batch mixer of an approved type shall be used. Mixer having a rated capacity of less than a one-bag batch shall not be used. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity as shown on the manufacturer's standard rating plate on the mixer except that an overload up to 10% above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided no spillage of concrete takes place. The batch shall be so charge into the drum that a portion of the water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 s of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 s for mixers having a capacity of 1.5 m^3 or less. For mixers having a capacity greater than 1.5 m^3, the mixing time shall not be less than 90 s. If timing starts, the instant skip reaches its maximum raised position, 4 s shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

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

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

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

Mixing Concrete: General

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

1. Mixing Concrete at Site

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

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

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

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

Cement shall be batched and charged into the mixer so that it will not result in loss of cement due to the effect of wind, or in accumulation of cement of surface of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

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

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

Mixers shall be operated with an automatic timing device that can be locked by the Engineer.

The time device and discharge mechanics shall be so interlocked that during normal operation no part of the batch will be charged until the specified mixing time has elapsed

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

2. Mixing Concrete at Central Plant

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

3. Mixing Concrete in Truck

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

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

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

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

4. Transporting and Delivery of Mixed Concrete

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

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

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

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

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

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

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

900.3.10 Handling and Placing Concrete: General

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

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

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

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

Concrete shall be placed so as to avoid segregation of the materials and the displacement of the reinforcement. The use of long troughs, chutes, and pipes for conveying concrete to the forms shall be permitted only on written authorization of the Engineer. The Engineer shall reject the use of the equipment for concrete transportation that will allow segregation, loss of

fine materials, or in any other way will have a deteriorating effect on the concrete quality.

Open troughs and chutes shall be of metal lined; where steep slopes are required, the chutes shall be equipped with baffles or be in short lengths tha reverse the direction of movement to avoid segregation.All chutes, troughs and pipes shall be kept clean and free from coatings of hardened concrete by thoroughly flushing with water after each run. Water used for flushing shall be discharged clear of the structure.

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

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

900.3.10.1 Placing Concrete by Pneumatic Means

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

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

900.3.10.2 Placing of Concrete by Pumping

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

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

900.3.10.3 Placing Concrete in Water

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

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

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

900.3.11 Consolidation of Concrete

The consolidation method should be compatible with the concrete mixture, placing conditions, and degree of air removal desired. When concrete comes down the chute and flows into forms it carries entrapped air. The entrapped air shall be removed to prevent voids in concrete. Poorly consolidated concrete will be weak, porous and poorly bonded to the reinforcement.

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

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

so great as to cause segregation, and vibrators shall not be used to transport concrete in the forms of troughs or chutes.

900.3.12 Concrete Surface Finishing: General

900.3.12.1 Float Finish

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

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

900.3.12.2 Trowel Finish

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

900.3.12.3 Concrete Rubbed Finish

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

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

900.3.13 Curing Concrete

900.3.12.1

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

1. Water Method

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

2. Curing Compound

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

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

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

Curing compound shall not be diluted or altered in any manner after manufacture. At the time of use, the compound shall be in a thoroughly mixed condition. If the compound has not been used within 120 days after the date of manufacture, the Engineer may require additional testing before the use to determine compliance to requirements.

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

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

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

3. Waterproof Membrane 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 asto provide a waterproof joint. The joint seams shall have a minimum lap of 100 mm.

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

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

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

4. Forms-in-Place Method

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

5. Steam Curing Method

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

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

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

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

d. Steam at jets shall be low pressure and in a saturated condition. Steam jets shall not impinge directly on the concrete, test cylinders, or forms. During application of the steam, the temperature rise within the enclosure shall not exceed 20°C per hour. The curing

temperature throughout the enclosure shall not exceed 65 °C and shall be maintained at a constant level for a sufficient time necessary to develop the required compressive strength. Control cylinders shall be covered to prevent moisture loss and shall be placed in a location where temperature of the enclosure will be the same as that of the concrete.

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

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

900.3.13.2

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

1. Curing Cast-In-Situ Concrete

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

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

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

2. Curing Pre-Cast Concrete (except piles)

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

3. Curing Pre-cast Concrete Piles

All newly placed concrete for pre-cast concrete piles, conventionally reinforced or prestressed shall be cured by the "Water Method" as described in Subsection 900.3.11, Curing Concrete, except that the concrete shall be kept under moisture for at least 14 days.

At the option of the Contractor, steam curing may be used in which case the steam curing provisions of Subsection 900.3.13(5), Steam Curing Method shall apply except that the concrete shall be kept wet for at least 7 days including the holding and steaming period.

900.3.14 Acceptance of Concrete

The strength of concrete shall be deemed acceptable if the average of three (3) consecutive

strength test results is equal to or exceed the specified strength and no individual test result falls below the specified strength by more than 15%.

Concrete deemed to be not acceptable using the above criteria may be rejected unless the Contractor can provide evidence, by means of core tests, that the quality of concrete represented by the failed test result is acceptable in place.

Three (3) cores shall be obtained from the affected area and cured and tested in accordance with AASHTO T 24, Standard Method of Test for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete (ASTM C42, Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.

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

900.4 Method of Measurement

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

900.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurements
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter

ITEM 1046 - MASONRY WORKS

1046.1 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.

1046.2 Materials Requirements

1046.2.1 Hydraulic Cement

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

4046.2.2 Aggregates

1046.2.2.1 Aggregates for Concrete Hollow Blocks and Louver Blocks

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

1046.2.2.2 Aggregates/ Pozzolan for Autoclaved Aerated Concrete (AAC) Blocks

Aggregates and pozzolan shall conform to the applicable requirements of ASTM C332, Standard Specification for Lightweight aggregates for Insulating Concrete and ASTM C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan in Concrete, respectively.

1046.2.3 Water

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

1046.2.4 Reinforcing Steel

1046.2.4.1 Reinforcing Steel for Concrete Hollow Blocks and Louver Blocks

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

1046.2.4.2 Reinforcing Steel for Autoclaved Aerated Concrete (AAC) Blocks

Dowels and tie bars shall conform to the applicable requirements of AASHTO M332M or ASTM A996M Standard Specification for Rail-Steel and Axie-Steel Deformed Bars for Concrete Reinforcement.

1046.2.5 Mortar for Concrete Hollow Blocks and Louver Blocks

Structural Concrete, mixed in the proportion of one (1) part cement to three (3) parts sand by volume, and sufficient water to obtain the required consistency.

1046.2.6 Quicklime for Autoclaved Aerated Concrete (AAC) Blocks

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

1046.2.7 Gypsum for Autoclaved Aerated Concrete (AAC) Blocks

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

1046.2.8 Aeration Agent for Autoclaved Aerated Concrete (AAC) Blocks

Aeration agent shall conform to manufacturer's specifications.

1046.2.9 Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Blocks

Thin-bed mortar shall conform to the applicable requirements of ASTM C1660, Standard Specification for Thin-bed Mortar for Autoclaved Aerated Concrete (AAC) Masonry.

1046.2.10 Backer Rod for Autoclaved Aerated Concrete (AAC) Blocks

Backer rod shall conform to the applicable requirements of ASTM D5249, Standard Specification for Backer Material use with Cold-and Hot-Applied Joint Sealants in Portland-Cement Concrete and Asphalt Joints.

1046.2.11 Concrete Hollow Blocks and Louver Blocks

Width, height and length of concrete hollow blocks and louver blocks shall be ± 3.20mm from the specified dimension as shown on the Plans.

1046.2.11.1 Load-Bearing Concrete Hollow Blocks

Load-bearing concrete hollow blocks shall conform to the physical requirements of the Tables 1046.1 and 1046.2 as prescribed on ASTM C90, Standard Specifications for Load-bearing Concrete Masonry Units.

Table 1046.1 Thickness of Face Shells and Webs

Nominal Width (W) of Units, mm	Minimum Face Shell Thickness (t_{fs}), mm	Minimum Web Thickness (tw)	
		Webs, mm	Equivalent Web Thickness, mm/linear m
76.2 and 102	19	19	136
152	25	25	188
203	32	25	188
254 and greater	32	29	209

Table 1046.2 Strength, Absorption, and Density Classification Requirements

Density Classification	Oven-Dry Density of Concrete, kg/m3	Maximum Water Absorption, kg/m3		Minimum Net Area Compressive Strength, MPa (Psi)	
	Average of 3 Units	Average of 3 Units	Individual Units	Average of 3 Units	Individual Units
Lightweight	Less than 1680	288	320	13.1 (1900)	11.7 (1700)
Medium Weight	1680 to less than 2000	240	272	13.1 (1900)	11.7 (1700)
Normal Weight	2000 or more	208	240	13.1 (1900)	11.7 (1700)

1046.2.11.2 Non-load bearing Concrete hollow blocks shall be clearly marked to prevent their use as load bearing units

1. Type I, Moisture-Controlled Units – Units shall conform to the requirements of Tables 1046.3, 1046.4 and 1046.5.

2. Type II, Non-Moisture-Controlled Units- Units designated as Type II shall conform to the requirements of Table 1046.4.

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%

1046.2.12 Autoclaved Aerated Concrete Blocks

Overall unit dimension (width, height or length) of autoclaved aerated concrete blocks shall not exceed 3 mm from the specified dimension shown on the Plans.

Non-load bearing Autoclave 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 Weigh Classification

Strength Class	Nominal Dry Bulk Density, kg/m3	Density Limits, kg/m3	
		Lower Limit >	Upper Limit <
AAC-4	500 600	450 550	550 650
AAC-5	600 700	550 650	650 750
AAC-6	600 700	550 650	650 750

Table 1046.7 Strength Requirements

Strength Class	Minimum Compressive Strength, MPa (Psi)
AAC-4	4.0 (580)
AAC-5	5.0 (725)

AAC-6	6.0 (870)

Table 1046.8 Average Drying Shrinkage Requirement

Strength Class	Average Drying Shrinkage
AAC-4	<0.02%
AAC-5	<0.02%
AAC-6	<0.02%

1046.2.13 Other Constituents for Concrete Hollow Blocks and Louver Blocks

Air-entraining agents, coloring pigments, integral water repellants, finely ground silica, and other constituents that are previously established as suitable for use in concrete masonry shall conform to applicable ASTM standards.

1046.2.14 Adobe Blocks

Adobe units shall have an average compressive strength of 2068 KPa when tested in accordance with ASTM C67, Standard Test Methods for Sampling and Testing Brick and Structural Clay. Five (5) samples shall be tested and individual units are not permitted to have a compressive strength of less than 1724 KPa

1046.2.15 Mortar for Adobe Blocks

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

1046.3 Construction Requirements

1046.3.1 Concrete Hollow Blocks and Louver Blocks

1046.3.1.1 Installation

1. All masonry work shall be laid true to line, level, plumb and neat in accordance with the Plans.

2. Units shall be cut accurately to fit all plumbing ducts, opening for electrical works, and all holes shall be neatly patched.

3. No construction support shall be attached to the wall except where specifically permitted by the Engineer.

4. Masonry units 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 2/12 hours of initial mixing.

1046.3.1.2 Reinforcement for Concrete Hollow Blocks

Reinforcement shall be done in accordance with the structural Plans as to size, spacing and other requirements of Section 902.3, Construction Requirements of Item 902, Reinforcing Steel.

Reinforcement shall be clean and free from loose, rust, scales and any coatings that will reduce bond.

1046.3.1.3 Sampling and Testing for Concrete Hollow Blocks and Louvers

Method of Sampling for Quality Test shall be as follows:

1. One (1) Quality Test for every 10,000 units of fraction thereof.

2. Six (6) specimens shall be submitted for one (1) quality test in which three (3) specimens for Compression Test and the remaining three (3) for Moisture Content and Water Absorption.

Units shall be tested in accordance with ASTM C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units and ASTM C426, Standard Test Method for Linear Drying Shrinkage of Concrete Masonry Units.

1046.3.1.4 Storage and Handling of Masonry Works

The blocks shall be stockpiled on planks or other supports free from contact with ground and covered. The blocks shall be handled with care and damaged units shall be rejected.

1046.3.2 Autoclaved Aerated Concrete (AAC) Blocks

1046.3.2.1 Installation

1. Reference lines shall be established based on the given Plan.

2. Layout adjustments or opening rectifications (plumbing ducts or opening for electrical

works) shall be made before laying masonry units.

3. The 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 2:11 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 the initial layer of masonry unit.

7. Laying of masonry units shall be continued until the lateral layer is complete before moving on to the next layer. Adhesive shall be applied at 5mm thick using a notched trowel on the required portions and maintaining 3mm to 5mm 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, 10mm 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 applying the adhesive. Ice or wood saw can be used for this matter.

11. When cutting of masonry units is necessary, it shall be downsized first before applying the adhesive. Ice or wood saw can be used for this matter.

12. Corner interlocking setup is recommended.

1046.3.2.2 Finish and Appearance

1. All units shall be sound and free of cracks or other defects that interfere the proper placement of the unit 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 5mm 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 not meet requirements of the above provisions.

1046..2.3 Sampling and Testing of AAC Blocks

Method of Sampling for Quality Test shall be as follows:

Two (2) Quality Test for every 10,000 units or a fraction thereof

Three (3) specimens shall be submitted for every one (1) quality test namely, Compression Test and Moisture Content & Bulk Density Determination

Units shall be tested in accordance with ASTM C1693, Standard Specifications for Autoclaved Aerated Concrete (AAC)

1046.4 Method of Measurement

The work to be paid for under this Item shall be number of square meters of masonry units that are satisfactorily completed and accepted.

1046.5 Basis of Payment

The accepted quantity, measure 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 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

1027.1 Description

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

1027.2 Material Requirements

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

1027.2.1 Cement

Portland cement shall conform to the requirements as defined in Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete.

1027.2.2 Hydrated Lime

Hydrated lime shall conform to the requirements as defined in Subsection 900.2.5, Admixtures of Item 900, Structural Concrete.

1027.2.3 Fine Aggregates

Fine aggregates shall be clean, washed river sand and free from dirt, clay, organic matter or other deleterious substances. Sand derived from crushed gravel or stone may be used with the Engineer's approval but in no case shall such sand be derived from stone unsuitable for use as coarse aggregates.

Fine aggregates shall conform to ASTM C897, Standard Specification for Aggregate for Job-Mixed Portland Cement-Based Plasters, Grading.

Table 1027.1 Grading of Fine Aggregates for Portland Cement-Based Plasters

Sieve size No.	% Retaining by Weight
4.75 mm	0
2.36 mm	0
1.18 mm	40
600 um	65
300 um	90
150 um	100
75 um	100

1027.2.4 Water

It shall conform to the Specification requirements defined in Subsection 900.2.3, Water of Item 900, Structural Concrete.

1027.3 Construction Requirements

1027.3.1 Surface Preparation

All plaster bases and accessories shall be free of deleterious amounts of rust, oil, or other foreign matter, which could cause bond failure or unsightly discoloration.

1. After removal of formworks reinforced concrete surfaces shall be roughened to improve adhesion of cement plaster.

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

3. Metal bases and accessories used to receive plaster shall be installed in conformance with ASTM C1063, Standard Specification for Installation of Lathing and Furring to Receive Interior and Exterior Portland Cement-Based Plaster, except as other specified. Non-metallic based used to receive plaster shall be installed in conformance with ASTM C1787, Standard Specification for Installation of Non-Metallic Plaster Bases Used with Portland Cement Based Plaster in Vertical Wall Application.

4. Surfaces of solid base to receive plaster, such as masonry, stone, cast in place or precast concrete shall be straight and true within 6 mm in 3 m and shall be free of form oil or other elements, which would interfere with bonding.

Conditions where the surfaces are out of tolerance shall be corrected prior to the application of the plaster.

Ferrous-containing form ties or other obstructions shall be removed or receded a minimum 3 mm below the surface of the solid base and treated with a corrosion-resistant coating.

Non-ferrous protuberances shall be permitted to be trimmed back even with the surface of the solid base.

1027.3.2 Plaster Proportions

All plaster shall be mixed and proportioned in accordance with the applicable requirements of ASTM C926, Standard Specification for Application of Portland Cement-Based Plaster.

The method of measuring materials for the finish shall be such that the specified proportions are controlled and accurately maintained.

The weights per cubic meter of the materials are considered to be as follows:

Table 1027.2 Measurement of Materials

Material	Weight, kg/m^3
Portland Cement	1505
Blended Cement	Weight printed on Bag
Masonry or Plastic Cement	Weight printed on Bag
Hydrated Lime	640
Sand, Damp, and Loose	1280 of dry sand

For purposes of this specification, a weight of 1,280 kg of oven-dried sand shall be used. This is, in most cases, equivalent to 0.028 m^3 of loose, damp sand.

Plaster mix used shall be designated and referenced to Table 1027.3.

Base coat proportions shall be as shown in Table 1027.4 for the mix specified from Table 1027.3.

Finish-coat proportions for job-mixed finish coats shall be as specified in Table 1027.5.

Table 1027.3 Plaster Bases - Permissible Mixes

Property Base	Mixes for Plaster Coats	
	First (Scratch)	Second (Brown)
Low absorption, such as dense, smooth clay tile, brick, or concrete	C CM or MS P	C, CL, M or CM CM, MS, or M P
High Absorption, such as concrete masonry, absorptive brick, or tile	CL M CM or MS P	CL M CM, MS, or M P
Metal plaster base	C CL CM or MS M CP P	C, CL, M, CM, or MS CL CM, MS, or M CP or P M CP or P P

Where specified, natural or synthetic fibers shall be free of contaminants and used only in the base coat(s). The quantities per batch shall be in accordance with the published directions of the fiber manufacturer.

Table 1027.4 Base-Coat Proportions, [A] Parts by Volume [B]

Plaster Mix Symbols	Cementitious Materials					Volume of Aggregate per Sum of Separate Volumes of Cementitious Materials	
	Portland Cement Blend	Plastic Cement	Masonry Cement		Lime		
			N	M or S		1st coat	2nd coat
C	1	-	-	-	0 – ¾	2 ½ - 4	3 - 5
CL	1	-	-	-	¾ - 1 ½	2 ½ - 4	3 - 5
M	-	-	1	-	-	2 ½ - 4	3 - 5
CM	1	-	1	-	-	2 ½ - 4	3 - 5
MS	-	-	-	1	-	2 ½ - 4	3 - 5
P	-	1	-	-	-	2 ½ - 4	3 - 5
CP	1	1	-	-	-	2 ½ - 4	3 - 5

Note:

[A] The mix proportions for plaster scratch and brown coats to receive ceramic tile shall be in accordance with the applicable requirements of ANSI A108.1 series applicable to Specified method of setting time.

[B] Variations of lime, sand, and perlite contents are allowed due to variation in local sands and insulation and weight requirements. A higher lime content will generally support a higher aggregate content without loss of workability. The workability of the plaster mix will govern the amounts of lime, sand or perlite

[C] The same or greater sand proportion shall be used in the second coat than is used in the first coat.

Table 1027.5 Finish Coat Proportion Parts by Volume

Plaster Mix Symbols	Cementitious Materials					Volume of Aggregate per Sum of Separate Volumes of Cementitious Materials
	Portland Cement Blend	Plastic Cement	Masonry Cement		Lime	
			N	M or S		
F	1	-	-	-	¾ – 1 ½	1 ½ - 3
FL	1	-	-	-	1 ½-2	1 ½ - 3

FM	-	-	1	-	-	1 ½ - 3
FCM	1	-	1	-	-	1 ½ - 3
FMS	-	-	-	1	-	1 ½ - 3
FP	-	1	-	-	-	1 ½ - 3

Note:

[A] Additional Portland cement is not required when Type S or M Masonry cement is used.

[B] In areas not subject to impact, perlite aggregate shall be permitted to be used over bas-coat plaster containing perlite aggregate.

1027.3.2.1 Mixing

All plaster shall be prepared in a mechanical mixer, using sufficient water to produce a workable consistency and uniform color.

Base-coat plasters that have stiffened because of evaporation of water shall be permitted to be tempered one time only to restore the required consistency. Plaster not used within 90 min from start of initial mixing shall be discarded. Finish-coat plaster shall not be tempered.

1027.3.3 Mixture

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

2. Finish coat shall be pure Portland cement properly graded conforming to the requirements of Subsection 900.2.1, Portland Cement of Item 900, Structural Concrete and mixed with water to approved consistency and plasticity.

1027.3.4 Application

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

2. Finish coat shall not be applied until after the brown coat has seasoned for 7 days and corrective measures had been done by the Contractor on surface that are defective. Just before the application of the finish coat, the brown coat surface shall be evenly moistened with potable water. Finish coat shall be floated first to a true and even surface, then troweled in a manner that will force the mixture to penetrate into the brown coat. Surfaces applied with finish coat shall then be smooth with sandpaper in a circular motion to remove trowel marks, checks and blemishes. All cement plaster finish shall be 10 mm thick minimum on vertical concrete and/or

masonry walls.

Wherever indicated on the Plans to be "Simulated Red Brick Finish," or "Decorative Stone" the Contractor shall render brick design or stone on plaster surface before brown coat had properly set and then allowed to dry. Cement plaster shall not be applied directly to:

1. Concrete or masonry surface that had been coated with bituminous compound and; 2. Surfaces that had been painted or previously plastered.

Provide a mock-up for evaluation of surface preparation techniques and application workmanship.

1027.3.5 Workmanship

Cement plaster finish shall be true to details and plumb and do not deviate more than plus or minus 3 mm in 3 m from a true plane in finished plaster surfaces, as measured by a 3 m straight-edge placed at any location on the surface. Finish surface shall have no visible junction marks where one (1) day's work adjoins the other.

Vertical and horizontal groove joints shall be 25 mm wide and 10 mm deep or as shown on the Plans.

1027.4 Method of Measurement

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

1027.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

ITEM 1016 - WATERPROOFING

1016.1 Description

This Item shall consist of furnishing all waterproofing materials, labor, tools, equipment and other facilities in undertaking the proper installation works required in accordance with the Plans and this Specification.

1016.2 Material Requirements

1016.2.1 Cement-base Waterproofing

1016.2.1.1 Cement-base Waterproofing Powder Mix

1. Cement-base waterproofing powder mix shall be cement-base, aggregate type, heavy duty, waterproof coating for reinforced concrete surface and masonry exposed to water. The aggregates are graded and sized so as to mesh perfectly and are selected for purity, hardness, strength and are non-metallic. When mixed with other ingredients, the mix shall be a free flowing waterproof coatings that possesses strength, durability and density.
2. Additive binders shall be of special formulation of acrylic polymers and modifiers in liquid form used as additives with cement-base powder mix that improves adhesion and mechanical properties.
3. Water shall be clean, clear and potable.
4. One(1) brand type of waterproofing material shall be used on the project.
5. Waterproofing materials shall be stored in weather-tight enclosure to avoid moisture damage and absorption.

1016.2.1.2 Hydrolithic Waterproofing Mix

1. Hydrolithic waterproofing mix shall be of heavy cement-based compatibility with reinforced concrete walls. It shall prevent built-up of water vapor which causes blistering, flaking and peeling of paint films.

2. Material shall thoroughly fill and seal pores and voids that it can be used against water pressure on the interior surface of walls below grade.

1016.2.2 Built-Up and Preformed Bituminous Membrane Waterproofing

Primer shall be of asphalt cold applied, free from water and other foreign matters, and shall conform to the specifications requirements defined in ASTM D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.Built-up membrane shall be made of smooth woven fibers that are impervious to acid, heat, dampness , and totting, It shall permit complete penetration of asphalt compound or bituminous coating in the woven glass fiber.Built membrane shall conform to the requirements of ASTM C981M, Standard Guide for Bituminous Membrane Waterproofing Systems for Building decks.Performed

membrane shall be self-sealing flexible cold applied bituminous sheets bonded to 0.15 mm thick polyethylene film.

1016.2.2.4 Mopping Materials

It shall conform to the requirements of ASTM D449M, Standard Specification for Asphalt Used in Dampproofing and Waterproofing:

1. Type I – A soft, adhesive, "self-healing" asphalt that flows easily under the mop and is suitable for use below grade under uniformly moderate temperature conditions both during the process of installation and during service.

2. Type II – A somewhat less susceptible asphalt that Type I, with good adhesive properties, and suitable for use above grade on vertical surfaces exposed to direct sunlight or temperatures above 50°C.

3. Type III – An asphalt less susceptible to temperature than Type II, with good adhesive properties, and suitable for use above grade on vertical surfaces exposed to direct sunlight or temperatures above 50°C

1016.2.3 Liquid Waterproofing

Liquid waterproofing alternate material shall be of elastomeric or other substances applied in liquid form and cured to an impervious membrane.

For long-term UV and weather resistance, a high performance synthetic rubber-based membrane type of liquid waterproofing is highly suggested to be used. For tiled finishes that is capable of accommodating expected structural movements, a waterborne flexible SBR waterproof membrane can be used. For waterproofing shower recesses, bathrooms, laundries, decks, balconies and rooftops, an elastomeric, one part, fiber reinforced, water based polyurethane membrane can be used.

1016.3 Construction Requirements

Roof decks, balconies, toilet and bathrooms, gutters, parapet walls and other areas indicated-on the Plans to be waterproofed shall first be rendered with cement-based waterproofing before any type of waterproofing is applied.

1016.3.1 Surface Preparation

Concrete surfaces to be applied with waterproofing shall be structurally sound, clean and free of dirt, loose mortar particles, paints, films, oil, protective coats, efflorescence laitance, etc.All defects shall be properly corrected and carefully formed to provide a smooth surface that is free of marks and properly cured prior to application works.

Inside corners where vertical and horizontal structure meet shall be provided with cants measuring 75 mm x 75 mm or rounded at corners with a minimum of 75 mm radius.

1. Concrete Slabs shall be properly graded to drain rainwater. Provide a minimum pitch of

1:100 to satisfactorily drain rainwater freely into the drainage lines, gutters and downspouts.

2. Drainage connections and weep holes shall be set to permit the free flow of water.

3. Any expansion and contraction joints shall be cleaned, primed, fitted with a backing rod and caulked with sealant.

4. Provide reglets of about 40 mm deep by 40 mm wide and 250 mm above floor finish along walls or parapets for the termination of the membrane.

5. Prepared surfaces shall be cured and kept wet by sprinkling with water at regular intervals for a period of at least 3 days and allow surface to actually set within 7 days.

6. Ensure that the prepared surface has completely set and all defects repaired.

7. When there is reasonable doubt as to the presence of moisture in the surface to be applied with a membrane, expose the same direct sunlight for another 2 days or heat all suspected areas using a blow torch.

1016.3.2 Preformed or Built-up Membrane

1016.3.2.1 Application Procedure

1. Prior to application of membrane concrete surfaces shall be sound and cured without the use of curing compound. Apply a coat of concrete neutralize to remove oil dirt and other thickness.

2. Apply asphalt primer at the rate of 4 L per 9 m² evenly by spraying or by paint brush.

3. Application shall be done in one direction strip and by overlapping each other to assure uniform thickness.

4. Allow the primer to dry until it is ready to receive the next coat of layer as specified in the manufacturing instructional manual.

5. As soon as primer coating is workable, lay a single layer of performed or built-up membrane smoothly free from irregularities and folds.

6. Lay preformed or built-up membrane conforming to the size and shape of the surface area to be covered.

7.Carefully lay side and end laps in order to assure an even thickness throughout the whole surface area to be covered.

8. When the whole surface area is completely covered, apply a single coast of asphalt primer at the rate of 11 L to 15 L per 9 m².

9. Meshes of treated woven glass fibers shall not be completely closed or sealed by the primer coat, but shall sufficiently open to allow successive moppings of the ply material to seep through.

10. Cover ply not more than the minimum amount of surfacing necessary to prevent sticking om ply.

11. After application, the surface shall not be uniformly smooth, free from irregularities and knots.

12. Repeat the procedure until five (5) piles have been satisfactorily installed or as the layers required are satisfied as specified in the Plans.

13. Where weather disturbances interrupt the work and expose the membrane to moisture, remove the layer exposed to moisture and repeat the procedure until completion of the process.

1016.3.2.2 Protective Coatings

1. Where laying of the built-up or performed membrane conforms to the number of piles required as shown on the Plans, lay a mixture or sand mastic in the proportion of one (1) part asphalt or bituminous material and four (4) parts coarse screened sand by volume using steel trowel at an average of 3 mm thick over the surface of the membrane.

2. Then at the rate of 4 L per 9 m², apply aluminum heat reflecting finish thoroughly over the dried sand mastic coating.

1016.3.2.3 Metal Cap Flashing

1. Provide cap flashing, gauge 24 plain G.I. as shown on the Plans.

2. Where cap flashing is connected to pre-formed lock in through-wall, from upper edge of cap flashing to engage in pre-formed lock. Mallet lock down tight to provide a spring action against base flashing.

3. At the rate of 4 L per 9 m², apply aluminum heat reflecting finish thoroughly over the dried sand mastic coating.

4. Where cap flashing is terminated in ranked joints or in prepared masonry or stone reglet, flashing shall be fastened with an edge every 350 mm and fill reglet on vertical surfaces, continuous with molten lead.

1016.3.3 Membrane Waterproofing Cement Topping

1. Provide Concrete cement topping of at least 50 mm thick on the membrane after 5 days where protective coatings have been applied.

2. Concrete cement topping shall be class “A” with 9 mm pea gravel and preferably provided with 2-way 6mm dia. Temperature steel bars.

1016.3.4 Liquid Waterproofing as Membrane

Before any coat of liquid waterproofing is applied, concrete cement surface shall conform to the requirement defined as Subsection 1016.3.1, Surface Preparation.

1016.3.4.1 Application

1. Prior to application of membrane concrete, surfaces shall be sound and cured without the use of curing compound. Apply a coat of concrete neutralizer to remove oil, dirt and other contaminants.

2. Apply a primer coat of elastomeric coating standard of the manufacturer at the rate of 1.33 L per 9.28m² over the surface area to be applied.

3. After the primer coat has dried, penetrating and sealing the concrete surface areas, apply 25 dry mils of coating at the rate of 4 L per 100 m ² for three (3) coatings on the same concrete surface areas coated with liquid waterproofing.

4. The concrete surface areas coated shall be allowed to dry in 24 h of relative humidity is 4.44℃.

5. Liquid waterproofing membrane shall be applied by paint brush, airless spray, notched trowel, squeegee or roller.

Preferably, each coat shall have 20 to 25 mil maximum thickness.

1016.3.4.2 Precaution

1. Liquid waterproofing membrane shall not be applied unless the ambient temperature is 4.44℃ or higher and shall not proceed during inclement weather conditions.

2. Extra care shall be observed by persons doing the application works especially those that have skin sensitiveness must wear gloves while applying the liquid waterproofing. The liquid water-proofing membrane compound is highly combustible.

1016.3.5 Protection of Membrane Waterproofing Surfaces in General

1. Concrete topping in situations where it is desirable to have a bond between membrane waterproofing and topped, slab it is recommended that the concrete topping be placed as the membrane dries, usually 48 h after final coat is applied.

2. If a band is not required, the membrane shall be protected with asphalt asbestos board or asphalt felt paper until such time as topping or concrete covering is applied. Prior to topping or placing of concrete covering, the membrane shall be inspected and initiate repair work where necessary.

3. Exposed membrane surfaces at concrete gutters and areas not frequently disturbed may be allowed.

4. Membrane waterproofing at the basement shall be covered and protected by installing tightly butted asphalt impregnated protection boards with a minimum thickness of 6 mm and preferably 12 mm on horizontal areas.

All projections and pipes shall be protected with asbestos cloth approximately 6 mm thick.

Install the Bituminous paving with extra care to avoid damage, lift or curl the underlying protection boards.

1016.4 Method Measurement

This item shall be measured in square meters for areas actually rendered with membrane waterproofing and number of packages for integrally waterproofed areas accepted to the satisfaction of the Engineer.

1016.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 1016.4. Method of Measurement shall be paid for at the Contract Unit Price for integral and membrane waterproofing work which price and payment shall be full compensation for furnishing and applying integral and membrane waterproofing materials including use of equipment and tools, labor and incidentals necessary to complete the work.

Payment shall be under:

Payment Item Number	Description	Unit of Measurement
1016	Waterproofing	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

1032.1 Description

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

1032.2 Material Requirements

1032.2.1 Paint Materials

Paint material shall conform to the requirements of the following Specifications:

Table 1032.1 Paint Material Specification Requirements

Material	PNS Code	Description	Application
Flat Latex Paint	PNS 139	Specification for Flat Latex Paint (white and light tints for exterior	Properly prepared plaster, masonry and primed wood

		and interior use)	and other architectural surfaces
Semi-gloss Latex Paint	PNS 463	Specification for Semi- Gloss Latex Paint (white and light tints for exterior and interior use)	Properly prepared plaster, masonry and primed wood and other architectural surfaces
Semi-gloss Enamel Paint	PNS 225	Specification for Alkyd- based Semi-Gloss Enamel Paint (white and light tints for exterior and interior use)	Properly prepared plaster, masonry and primed wood and other architectural surfaces
Enamel Paint	PNS 226	Specification for Alkyd based Gloss Enamel Paint (white and coloured for exterior and interior use)	Wood, metal and other architectural surfaces
Alkyd-based Metal Primer	PNS 366	Specification for Alkyd based Metal Primer	Ferrous metal
Epoxy Metal Primer	PNS 2113	Specification of Epoxy Metal Primer	Ferrous metal
Flatwall Enamel Paint	PNS 227	Specification for Alkyd based Flat Enamel Paint (white and light tints for exterior and interior use)	Wood
Gloss Latex Paint	PNS 462	Specification for Gloss Latex Paint (white and light tints for exterior and interior use)	Masonry
Water Based Gloss Roof Paint	PNS 612	Specification for Water Based Gloss Roof Paint	Concrete, metal, wood and other paintable roofing materials
Elastomeric Wall Coating	PNS 2116	Specification for Elastomeric Wall Coating	Plaster, masonry, other architectural surfaces
Epoxy Enamel	PNS 2118	Specification for Epoxy Enamel, white and coloured	Concrete, wood, metal and other architectural surfaces
Roof paint (water based, flat)	PNS 464	Specification for Roof paint (water-based, flat)	Paintable roofing materials
Roof paint (Portland Cement)	PNS 465	Specification for Roof paint (Portland Cement)	Paintable roofing materials

1032.2.2 Tinting Colors

Tinting colors shall be first grade quality, pigment ground in alkyd resin that disperses and mixes easily with paint to produce the color desired. Same brand of paint and tinting color shall be used to effect good paint body.

1032.2.3 Acry-colors

It shall be high strength tinting colors for water-based coatings that are specially formulated from the finest blend of pigments combined with pure acrylic latex vehicle that is easy to disperse, fast drying, odorless, and gives maximum color retention.

1032.2.4 Concrete Neutralizer]

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

1032.2.5 Silicon Water Repellant

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

1032.2.6 Patching Compound

Patching compound shall be fine powder type material like calciumine that can be mixed into paint that will produce a putty consistency, with oil base primers and paints to fill minor surface dents and imperfections.

1032.2.7 Varnish

Varnish shall be a homogeneous solution of resin, drying oil, drier and solvent. It shall be extremely durable, clear coating, highly resistant to wear and tear without cracking, peeling, whitening, spotting, etc. with minimum loss of gloss for a maximum period of time.

1032.2.8 Lacquer

Lacquer shall be any type of organic coating that dries rapidly and solely by evaporation of the solvent. Typical solvent are acetates, alcohols and ketones. Clear gloss lacquer shall be in accordance with the requirements of PNS 368, Specification for Clear Gloss Lacquer.

1032.2.9 Shellac

Shellac shall be a solution of refined lac resin in denatured alcohol. It dries up by evaporation of the alcohol. The resin is generally furnished in orange and bleached grades.

1032.2.10 Sanding Sealer

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

1032.2.11 Oil Wood Stain

Oil-based stain shall be a penetrating stain for interior doors, windows, trim and furniture. It rejuvenates and transforms interior timber.

Oil-based stain penetrates deeply and adds color without raising the grain. Oil-based stain is best used to rejuvenate old or used timber.

1032.2.12 Glazing Putty

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

1032.2.13 Natural Wood Paste Filler

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

1032.2.14 Schedule

Exterior

1. Plain cement plastered finish to be painted	- Three (3) coats acrylic base masonry paint
2. Concrete exposed aggregate and/or tool finish	- One (1) coat water repellant
3. Ferrous metal paint	- One (1) coat primer and two(2) coats enamel
4. Galvanized metal	- One (1) coat zinc chromate primer and two(2) coats Portland cement paint
5. Wood paint finish	- Three (3) coats oil based paint
6. Wood varnished finish	- Varnish water repellant

Interior

1. Plain cement plastered finish to be painted	- Two (2) coats acrylic base masonry paint
2. Concrete exposed aggregate and/or tool finish	- Clean surface

3. Ferrous metal paint	- One (1) coat primer and two(2) coats enamel
	4. Woodwork sea-mist - Three (3) coats of three (3) parts thinner and one (1) part lacquer
	5. Woodwork varnish - First coat of one(1) part sanding sealer to one(1) part - Solvent - Second coat of two-third (2/3) sanding sealer to one-third (1/3) solvent
6. Woodwork painted finish	- Three (3) coats oil base paint
	7. Ceiling boards textured finish - One (1) coat oil based paint, all to dry the patch surfaces unevenness and apply extured paint coat

1032.2.15 Containers and Markings

It shall be in accordance with the requirements of PNS 140, General Requirements for Packaging, Packing and Marking of Paints and Other Protective Coatings.

All paints, varnishes, and other related products shall be shipped in strong, substantial containers marked in prints distinctive color of the label or in letters clearly visible to the naked eye with the following information:

1. Type of Paint

2. Brand or Trademark

3. Name and address of manufacturer

4. Net Volume and/or mass in metric units

5. Directions for use

6. Safety precautions

7. Batch or lot number

Any package or container not so marked will not be accepted for use under this Specification.

1032.3 Construction Requirements

Prior to commencement of the painting, varnishing and related work, the surfaces to be applied

shall be examined in order not to jeopardize the quality and appearances of the painting, varnishing and related works.

1032.3.1 Surface Preparation

All surfaces shall be in proper condition to receive the finish. Woodworks shall be hand-sanded smooth and dusted clean.

All knot-holes pitch pockets or sappy portions shall be sealed with natural wood filler. Nail holes, cracks or defects shall be carefully puttied after the first coat, matching the color of paint.

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

Concrete and masonry surfaces shall be coated with concrete neutralizer and allowed to dry before any painting primer coat is applied.

When surface is dried, apply the first coating. Hairline cracks and unevenness shall be patched and sealed with approved putty or patching compound. After all defects are corrected apply the finish coats specified on the Plans (color scheme approved).

Metal shall be clean, dry and free from mill scale and rust. Remove all grease and oil from surfaces. Wash, unprimed galvanized metal with etching solution and allow it to dry. Where required to prime coat surface with Red Lead Primer same shall be approved by the Engineer.

In addition, the following shall be undertaken prior to painting, varnishing and ther related works:

I Voids, cracks, nick, and other wood imperfections will be repaired with proper patching material and finished flushed with surrounding surfaces.

2 Marred or damaged shop coats on metal shall be spot primed with appropriate metal primer.
3. Painting and varnishing works shall not be commenced when it is too hot or cold

4. Allow appropriate ventilation during application and drying period. 5. All hardware will be fitted and removed or protected prior to painting and varnishing works.

1032.3.2 Application

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

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

Paint is atomized by high pressure pumping rather than broken up by the large volume of air mixed with it. This procedure change the required properties of the paint.

1032.3.3 Mixing and Thinning

At the time of application paint shall show no sign of deterioration. Paint shall be thoroughly stirred, strained and kept at a uniform consistency during application. Paints of different manufacture shall not be mixed together.

When thinning is necessary, this may be done immediately prior to application in accordance with the manufacturer's directions, but not in excess of one (1) pint of suitable thinner per gallon of the paint.

1032.3.4 Storage

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

1032.3.5 Cleaning

All cloths and cotton waste which constitute fire hazards shall be placed in metal containers or destroyed at the end of daily works.

Upon completion of the work all staging, scaffolding and paint containers shall be removed. Paint drips, o or stains on adjacent surfaces shall be removed. Paint drips, oil, or stains on adjacent surfaces shall be removed and the entire job left clean and acceptable to the Engineer.

1032.3.6 Workmanship in General

1. All paints shall be evenly applied. Coats shall be of proper consistency and well brushed out so as to show a minimum of brush marks.

2. All coats shall be thoroughly dry before the succeeding coat is applied.

3. Where surfaces are not fully covered or cannot be satisfactorily finished in the number of coats specified, such preparatory coats and subsequent coats as may be required shall be applied to attain the desired evenness of surface without extra cost to the Owner.

4. Where surface is not in proper condition to receive the coat the Engineer shall be notified immediately. Work on the questioned portion(s) shall not start until clearance be proceed is ordered by the Engineer.

5. Hardware, lighting fixture and other similar items shall be removed of protected during the painting varnishing and related work operations and re installed after completion of the work.

1032.3.7 Procedure for Sea-Mist Finish

1. Depress wood grain by steel brush and sand surface lightly.

2. Apply sanding sealer.

3. Apply two (2) coats of industrial lacquer paint.

4. Spray last coat of industrial lacquer paint mixed with sanding sealer.

5. Apply wood paste filler thinned with turpentine or paint thinner into the wood surface.

6. Wipe off wood paste filler immediately.

7. Spray flat or gloss lacquer whichever is specified.

1032.3.8 Procedure for Varnish Finish

1. Sand surface thoroughly.

2. Apply putty on all cracks and other wood imperfections with wood paste filler.

3. Apply oil stain.

4. Apply lacquer sanding sealer.

5. Sand surface along the grain.

6. Spray three (3) coats of clear dead flat lacquer.

7. Polish surface coated using cloth pad.

8. Spray gloss lacquer or flat lacquer whichever is desired or specified.

1032.3.9 Procedure for Ducco Finish

1.Sand surface thoroughly.

2. Apply primer surface white or gray by brush or spray.

3. Apply lacquer spot putty in thin coat. Allow each coat to become thoroughly dry before applying next coat.

4. Apply primer surfaces and then allow to dry in 2 h before applying the next coat.

5. Apply a coat of flat tone semi-gloss enamel as per color scheme submitted and approved by the Engineer.

1032.4 Method of Measurement

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

1032.5 Basis of Payment

The accepted work shall be paid at the unit bid price, which price and payment constitute full compensation for furnishing and proper application of all materials, labor, equipment, tools

and other incidental necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)a	Painting Works, Masonry/Concrete	Square Meter
1032 (1)c	Painting Works, Steel	Square Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

1001.1 Description

This Item shall consist of furnishing all materials, equipment and labor for the complete installation of the storm drainage system which include all pipings, gutters, canals, catch basins, junction boxes, handholes, manholes and other appurtenant structures, and sewerage system which include all sanitary sewer piping and septic vault/tank where no public sewer exist, from the building to the point of discharge.

1001.2 Material Requirements

1001.2.1 Storm Drainage System

Materials for storm drainage system shall meet the requirements specified in the following Standard Specifications:

Material	Standard
Portland Cement	ASTM C150M, Standard Specification for Portland Cement
Fine and Coarse Aggregate	ASTM C33M, Standard Specification for Concrete Aggregates
Reinforcing Steel	ASTM A615M, Standard Specification for Reinforcing Steel
Non-reinforcing Concrete Pipes	AASHTO M 86/ASTM C14, Standard Specification for Nonreinforced Concrete Sewer, Storm Drain, and Culvert Pipe
Reinforced Concrete Pipes	ASTM C76/AASHTO M 170M, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe
Cast Iron Pipes (for conductors and downspouts)	ASTM A74,Standard Specification for Cast Iron Soil Pipe and Fittings
Galvanized Iron Pipes Schedule 40 (for	ASTM A53M, Standard Specification for Pipe, Steel. Black and Hot-Dipped, Zinc-Coated, Seamless

conductors and downspouts)	
Polyvinyl Chloride (PVC) (for conductors and downspouts)	ASTM D2729, Standard Specification for Poly(Vinw Chloride) (PVC) Sevwer Pipe and Fittings
	AASHTO M 278, Standard Specification for Class PS46 Poly(Vinyl Chloride) (PVC) Pipe
	AASHTO M 304, Standard Specification for Poly(Vinyi Chloride) (PVC) Profile Wall Drain Pipe and Fittings Based on Controlled Inside Diameter
	PNS 1950:2003, Plastic Piping Systems for Soil and waste Discharge (low and high temperature) inside buildings - Unplasticized Polyvinyl Chloride (PVC-U)
High Density Polyethylene Pipes (HDPE)	ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
	ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
	PNS ISO 4427, Polyethylene (PE) Pipes for Water Supply - Specifications

Where the covers for catch basins, junction boxes, manholes and canals for gratings are required, same shall be made of wrought iron and of the dimensions as shown on the Plans.

1001.2.2 Sewerage System

Materials for sewerage system shall meet the requirements specified in the following Standard Specifications:

Material	Standard
Cast Iron Pipes and Fittings	ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings
Pig Lead (for securing and sealing joints)	ASTM B29, Standard Specification for Refined Lead
PVC Pipes and Fittings (where called in Plans)	ASTM D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds
	PNS 1950:2003, Plastic Piping Systems for Soil and waste Discharge (low and high temperature) inside buildings - Unplasticized Polyvinyl Chloride (PVC-U)

Solvent Cement (for Securing PVC joints)	ASTM D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems
High Density Polyethylene Pipes (HDPE)	ASTM F714, Standard Specification for Polyethylene (PE) Plastic Pipe (DR-PR) Based on Outside Diameter
	ASTM F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe
	PNS ISO 4427, Polyethylene (PE) Pipes for Water Supply - Specifications

Where PVC pipes and fittings are used, joints shall be secured with rubber "0" ring or solvent cement, as the case may be.

Oakum for joints in bell and spigot pipes shall be made from hemp fiber, braided or twisted and oil-impregnated, free from lumps, dirt and extraneous matter.

1001.2.3 Structure Materials

All storm drainage structures such as manholes, inlets, junction boxes and catch basins shall be constructed of either brick, solid block or precast concrete.

1. Clay Brick shall be solid, rough, sound clay brick conforming to ASTM C32, Standard Specification for Sewer and Manhole Brick (Made from Clay or Shale). The brick shall be laid with full shove joints, filling up the joints with mortar. The thickness of the joints shall not exceed 9.53 mm.

2. Concrete Block or brick shall be solid and conforms to ASTM C139, Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes as to design and manufacture. The block or brick shall be. embedded in a mortar bed to form a 12.70 mm mortar joint.

3. Precast concrete manhole shall conform to ASTM C478, Standard Specification for Circular Precast Reinforced Concrete Manhole Sections. Fabricate precast concrete manhole to the sizes indicated on the Plans.

4. Concrete for drainage structures shall meet the applicable requirements of Item 900, Structural Concrete.

1001.2.4 Frames, Covers and Gratings

Metal units shall conform to the Plan dimensions and to the following specification requirements for the designated materials:

Material	Standard
Gray Iron Castings	ASTM A48M/AASHTO M 105, Standard Specification for

	Gray Iron Castings
Carbon Steel Castings for General Application that require up to 485 MPa minimum tensile strength.	ASTM A27M/AASHTO M 103M, Standard Specification for Steel Castings, Carbon, for General Application
Hot-Dip Galvanized Coatings on Iron and Steel Products	ASTM A123M/AASHTO M 111M, Standard specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
Reinforcing Steel	ASTM A615M, Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
	AASHTO M 31M, Standard Specification for Deformed and Plain Carbon and Low-Alloy Steel Bars for Concrete Reinforcement

Samples of the material in casting shall be taken during the casting of the units and shall be separate casting poured from the same material as the casting they represent.Metal gratings and covers which are to rest on frames shall bear on them evenly. They shall be assembled before shipment and so marked that the same pieces may be reassembled readily in the same position when installed. Inaccuracy of bearings shall be corrected by machining, if necessary. A frame and grating or Cover to be used with it shall constitute one (1) pair.All castings shall be uniformly coated with asphalt-based emulsion meeting the requirements of ASTM D1187, Standard Specification for Asphalt – Base Emulsion for Use in Protective Coating for Metal.

1001.2.5 Trench Drains and Downspouts

Trench drains and downspouts shall conform to the applicable requirements of ASTM A36M, Standard Specification for Carbon Structural Steel. Trench trough, overlap splice, anchors and downspout pipe shall be steel, galvanized after assembly of each trench section. Fabricate trench drain corners using mitered sections of trough, then weld. Trench drain trough and trench gate shall be as shown in the Plans.

Cast iron trench grates shall conform to ASTM A48M. Grates shall be cast iron unless indicated as cast aluminum in the Plans.Cast aluminum trench gates shall conform to ASTM B26M, Standard Specification for Aluminum-Alloy Sand Castings.

1001.2.6 Concrete Gutters and Canals

Concrete gutters and canals shall be constructed to the profile indicated on the Plans. Concrete materials and steel reinforcement shall comply with the applicable requirements of Item 900, Structural Concrete and Item 902,Reinforcing Steel.

Forms shall comply with the applicable requirements of Item 903, Formworks and Falseworks.

1001.2.7 Septic Tank

1. Materials used in constructing a septic tank shall be in accordance with the latest Unified Plumbing Code of the Philippines.

2. The minimum wall thickness of a steel septic tank shall be 2.77 mm and each Such tank shall be protected from corrosion both externally and internally by an approved bituminous coating or by other acceptable means.

3. Septic tanks Constructed of alternate materials shall be permitted to be approved by the Engineer in accordance with approved application standards. Wooden septic tanks shall be prohibited

Sizes, dimensions, reinforcing, structural calculations and such other pertinent data as required for septic tank shall | be indicated on the Plans.

1001.3 Construction Requirements

1001.3.1 Installation of Pipes

Under no circumstances shall pipes be laid under water and when trench condition or the weather is unsuitable for such work.

1. Bedding

Materials such as sand, sandy soil or any approved material shall be used provide a firm foundation of uniform density. The bedding shall have minimum thickness equivalent to 1/4 of the pipe's diameter.

2. Laying of Pipes

Proper facilities shall be provided for lowering and placing pipes into trenches in order to preclude damage. Laying of pipes shall start upgrade with the spigot end of bell-and-spigot pipe, or the tongue end of tongue-and-groove pipe, positioned towards the direction of the flow. The pipes shall be laid in accordance with the grades and alignments shown in the Plans.

The spigots or tongues shall be adjusted in bells or grooves to provide uniform space around joints to receive mortar. Blocking or wedging between spigot and bell or between tongue and groove to attain proper spacing Shall be allowed provided such blocking/wedging shall not interfere with the caulking and shall not affect the water tightness of the joint.

No building sewer or other drainage piping or part thereof, which is Constructed of materials other than those approved for use under or within a building, shall be installed under or within 610 mm of any building or structure, or part thereof, not less than 305 mm below the surface of the ground. The provisions of this subsection include structures such as porches and steps, whether covered or uncovered; breezeways; roofed porte-cocheres; roofed patios; carports; covered walks; covered driveways, and similar structures or appurtenances.

Septic tanks shall have not less than two Compartments or as shown on the Plans.

Warning tape shall be laid above main pipes. The tapes shall be flexible and Subject to the

Engineer's approval. Width of the tape should be at least 150 mm. The text on the tape shall be permanent ink bonded to resist prolonged chemical attack by corrosive acids and alkaline with message repeated at a maximum interval of 2 m. The tapes shall be laid 300 mm above the pipeline. The tape shall be continuous over pipelines and at joints there should be a minimum of 1 m over lapping.

3. Bell and Spigot Joint for Drain Pipe

The first pipe shall be properly bedded at the required grade. Just below the spigot of the first unit, a sufficient space shall be provided for engaging the bell end of the second pipe.

The spigot shall be carefully cleaned with a wet brush and the upper exterior portion applied with mortar to such a thickness as to bring the inner surfaces of the abutting pipes flush and even. The bell end of the second pipe shall be cleaned with a wet brush and uniformly matched with the spigot of the first pipe so that the sections are closely fitted. After the second pipe is laid, the remainder of the joint shall be fitted with mortar, and a bead shall be formed around the outside of the joints with sufficient amount of additional mortar. The inside of the joints shall be wiped and finished smooth. The mortar bead on the outside shall immediately be protected with a cover of wet burlap or wet earth for at least 3 days for curing.

4. Tongue and Groove Joint for Concrete Pipe

The first pipe shall be properly bedded. A shallow excavation shall be made underneath the joint and filled with mortar to provide a bed second pipe. The tongue end of the first pipe shall be carefully cleaned with wet brush and soft mortar applied around the upper half of the tongue. After cleaning and positioning the second pipe close to the first, mortar shall be applied around he lower half of the groove. With just sufficient thrust, the second pipe shall be brought in close contact with the first until mortar is squeezed out of the joint. Sufficient mortar shall be used to fill the joint and to form a bead on the outside.

5. Mortar for Joint

Mortar shall be a mixture of Portland cement, sand and water mixed in the proportion by volume of one (1) pat cement to two (2) parts of clean sand with just sufficient amount of water for plasticity.

6. Leaded Joints of Cast Iron Pipes

Joints of cast iron pipes shall be packed with braided or twisted oil- impregnated hemp or oakum, properly caulked around the joint. The packing shall be at least 20 mm below the rim of the hub or bell and this space be filled with molten pig lead in one (1) continuous pouring. The "ring" of pig lead formed around the joint shall be properly caulked by appropriate caulking tools to render the joints watertight.

1001.3.2 Concrete Structures

Concrete structures such as catch basins, canal gutters, junction boxes and manholes for the drainage system, and septic vault for sewerage system shall be constructed in accordance with

the Plans and Specifications on Concrete Work.

1001.3.3 Sewer Connections and Clean-Outs

1. The outlet of the septic vault shall be connected to the street drain or to other discharge point where sanitary sewer exists. Connection with the sanitary sewer shall not be made without the permission of the proper authorities, but shall be made in such a manner that any and all the service water, as well as house and other liquid wastes, will flow to the sanitary sewer. Provided that isolated faucets used exclusively for garden purpose may in the discretion of the proper authorities, be allowed not to flow into the sanitary sewer.

2. Clean-outs or rodding holes consisting of cast iron extensions with long Sweep elbow fittings shall be provided at the ends of the runs and at every change of directions. Clean-outs shall be capped with cast t brass ferrules with threads and screwed on removable brass plugs. Clean-outs extended outside the building and raised to the level of finished grade shall be terminate with the same cast brass ferrule with brass plug set in to a concrete slab shall be 150 mm thick and 300 mm square, finish flush with grade.

3. Additional building sewer cleanouts shall be installed at intervals not to exceed 30,480 mm in straight runs and for each aggregate horizontal change in direction exceeding 135 degrees. When a building sewer or a branch there of does not exceed 3,048 mm in length and is a straight-line projection from a building drain that is provided with a clean out, no cleanout will be required at its point of connection to the building drain.

1001.3.4 Septic Tank Construction

Septic tanks shall be constructed in accordance with the Plans and requirements of the latest Uniform Plumbing Code.

1001.3.5 Incidental Earthwork

Incidental earthwork for the storm drainage and sewerage systems, such as excavation and backfilling shall be undertaken in accordance with applicable requirements of Item 803, Structure Excavation.

1001.3.6 Inspection and Quality Control

Materials shall be inspected and accepted as to quality before same are installed. Piping installed in trenches shall first be inspected, tested and approved by the Engineer before these are covered or backfilled. All defects/leaks disclosed by the water test shall be remedied to the satisfaction of the Engineer and any extra cost shall be at the expense of the Contractor.

1001.3.6.1 Building Sewer Test

Building sewers shall be tested by plugging the end of the building sewer at its points of connection with the public sewer or private sewage disposal system and completely filling the building sewer with water from the lowest to the highest point thereof, or by approved equivalent low-pressure air test. Plastic drain, waste, and vent piping systems shall not be tested

by the air test method. The building sewer shall be water-tight at all points.

1001.3.6.2 Testing for Storm Drainage Systems

Except for outside leaders and I perforated or open-jointed drain tile, the piping of storm drain systems shall be tested upon completion of the rough piping installation by water or air, except that p plastic pipe shall not be tested with air, and proved tight.

The Engineer shall be permitted to require the removal of any cleanout plugs to ascertain whether the pressure has reached parts of the system. One of the following test methods shall be used:

1. Water Test

After piping has been installed, the water test shall be applied to the drainage system, either to the entire system or to sections. If the test is applied to the entire system, all openings in the piping shall be tightly closed except for the highest opening, and the system shall be filled with water to the point of overflow. If the system is tested in sections, each opening shall be tightly plugged except for the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 3,000 mm head of water. In testing successive sections, not less than the upper 3,000 mm of the next preceding section shall be tested so that no joint of pipe in the building (except the uppermost 3,000 mm of a roof drainage system which shall be filled with water to the flood level of the uppermost roof drain) shall have been submitted to a test of less than a 3,000 mm head of water. The water shall be kept in the system or in the portion under test for not less than 15 min before inspection starts. The system shall then be tight at all points.

2. Air Tes

The air test shall be made by attaching an air compressor testing apparatus to any suitable opening after closing other inlets and outlets to the system, forcing air into the system until there is a uniform gauge pressure of 34.5 kPa or sufficient pressure to balance a column of mercury 250 mm in height. This pressure shall be held without introduction of additional air for a period of not less than 15 min.

1001.4 Method of Measurement

Pipes, culverts, gutters, canals and gratings installed in place and accepted by the Engineer, shall be measured by the meter along their axes.

Catch basins, junction boxes, manholes and septic vault/tank shall be measured by the number of units or lump sum, completed and accepted by the Engineer.

Sewer Line works, Storm drainage and downspout and Pipes w/ Fittings connection shall be measured by lump sum, completed and accepted by the Engineer.

1001.5 Basis of Payment

The quantities as determined in Section 1001.4, Method of Measurement shall be paid at the

Contract Unit Price for each of the Items which shall constitute full compensation for all materials, labor, tools and equipment and all other incidentals necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a7	Pipe and Fittings, 100mm dia., PVC, Series 1000	Meter
1001 (1)a8	Pipe and Fittings, 150 mm dia., PVC, Series 1000	Meter

ITEM 1002 - PLUMBING

1002.1 Description

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

1002.2 Material Requirements

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

1002.2.1 Cast Iron Soil Pipes and Fittings

1. Pipes and fitting materials shall comply with the Specification requirements. whenever applicable, defined in ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings. The material description and standards of manufacture are herein described.

   a. Cast Iron - the casting shall be made of gray iron which shall be sound, free from cracks, sand holes and blow holes. They shall be uniformly low hardness that permits drilling and cutting by ordinary methods. Pipes and fittings shall be true to pattern and of Compact closed grained structure.

   b. Quality of Iron - the iron shall be made by the cupola, air furnace, electric furnace or other processes which shall be checked by regular chemical and physical control test. The resultant shall be gray iron of good quality

   c. Manufacture - the pipes shall be made with hub and spigot ends or hub ends only. All hubs for pipes and fittings shall be provided with held lead grooves and all spigot ends shall be made with beads or plain if machine cast centrifugally. Plugs shall be wrought or cast, machined to the dimensions required and shall be free from defect

d. Freedom from Defects- pipes and fittings shall be true, smooth and cylindrical, their inner and outer surfaces being as nearly concentric as practicable.

They shall be in all aspects, sound and good casting free from laps, pin holes or other imperfections and shall be neatly dressed and carefully fettled. The ends shall be finished reasonably square to their axes.

2. Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of the soil or waste or at right angles thereto and, except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

Clean-outs shall be made of heavy cast brass ferrule with counter sunk screw cover same diameter as the pipe except that they shall not be larger than 100 mm diameter.

Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or by extending flush with paving with approved materials and shall be adequately protected.

3. Caulking lead shall be of molten type peg lead conforming to specification requirements defined in ASTM B29, Standard Specification for Refined Lead.

4. Oakum shall be twisted or braided hemp or abaca fibers slightly impregnated with oil.

1002.2.2 Water Supply Pipes and Fittings

1. Pipes shall be galvanized iron pipe schedule 40 conforming to specification requirements defined in ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless with threaded connection. Under roads where necessary shall suitably protected as shown on the Plans.

Fittings shall be malleable iron Type II, galvanized iron conforming to specification requirements defined in ASTM A338, Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 345°C.Water pipe and fittings with a lead content which exceeds 8% shall be prohibited in piping systems used to convey potable water.

Where required for large diameter pipes (315 mm up to 800 mm) with elastomeric rubber sealed ring, the Oriented Polyvinyl Chloride (PVC-O) Cass 500 shall be in accordance with the applicable requirements defined in ISO 16422:2014, Pipes and Joints Made of Oriented Unplasticized Polyvinyl Chloride (PVC-O) for the Conveyance of Water under Pressure on ISO 1452:2009, Plastics Piping Systems for Water Supply and for Buried and Above-Ground Drainage and Sewerage Under Pressure – Unplasticized Poly(Vinyl Chloride) (PVC-U).

2. Valves

Valves for water supply shall be bronze body with threaded ends rated 21 kg/cm². All valves shall be gate valves unless otherwise specified. Gate valves shall have solid wedge body and discs conforming to specification requirements defined in ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings.Globe valves shall | have plug type discs S with ferrule threaded ends and bronze body. Valves up to and including 51 mm in size shall be

brass or other approved materials. Sizes exceeding 51 mm shall be permitted to have cast-iron or brass bodies.

3. Water Meter

Water meter when required to be furnished by the Contractor shall be of the type tested and approved by Metropolitan Waterworks and Sewerage System (MWSS) or Local Water Utilities Authority (LWUA) or any agency/ (es) accredited by both.

1002.2.3 Approved Alternate Pipes and Fittings

Pipes and fittings for sanitary and potable water lines as approved alternate shall be Unplasticized Polyvinyl Chloride Pipes and Fittings (uPVC).

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series) and PNS 65: 1993, Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply. Fittings shall be molded type and designed for solvent cement joint Connection for water lines and rubber O-ring seal joint for sanitary lines.

All materials shall bear Philippine Standards (PS) mark for locally manufactured and Import Commodity Clearance (ICC) marks duly issued by Bureau of Philippine Standards (BPS) for imported materials.

1002.2.3.1 Unplasticized Polyvinyl Chloride (uPVC)- Potable Water

1, Pipes and fittings for water lines and pressure lines shall conform to PNS 65: 1993: - Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.

2. Pines and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).

3. Maximum levels of toxic substances shall conform to Table 3 of PNS 65: - Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.

4. Pipes and fittings for water lines, sizes 20 mm to 63 mm shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.

5. Pipes and fittings for pressure lines, sizes 63 mm and larger shall be designed for manually-installed or machine-installed fixed seal gasket type jointing connection. Gaskets is to be made of Ethylene Propylene Diene Monomer (EPDM) rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced embedded in EPDM rubber gasket.

1002.2.3.2 Unplasticized Polyvinyl Chloride - Non-Potable Water(Sanitary and Sewer Line)

1. Pipes and fittings for sanitary lines shall conform to PNS 1950, Plastic piping systems for soil and waste discharge (Low & High temp.) inside buildings - Unplasticized Polyvinyl Chloride (PVC-U), conforming to specification requirements defined in ASTM D2729, Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings for pipes, and ASTM D3311, Standard Specification for Drain, Waste. and Vent (DWV) Plastic Fittings Patterns for fittings.

2. Pipes and fittings for sewer lines shall conform to Standard Dimension Ratio (SDR) 34 conforming to specification requirements defined in IS0 4435 Plastics Piping Systems for Non-Pressure Underground Drainage and Sewerage- Unplasticized Polyvinyl Chloride (uPVC).

3. Pipes and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass.

4. Pipes and fittings for sanitary and sewer lines, sizes 57 mm and larger shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems and/or machine-installed seal gasket type jointing connection. Gaskets is to be made of Engineered Natural Rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced NBR (Nitrile Butadiene Rubber).

1002.2.3.3 Chlorinated Polyvinyl Chloride (cPVC)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in ASTM 2846 (CTS) SDR 11, Standard Specification for Chlorinated Polyvinyl Chloride (cPVC) Plastic Hot and Cold- Water Distribution Systems, with the use of one-step cPVC solvent cement In jointing method.

Pipes and fittings shall be Heavy Metal-Free (HMF) as validated through Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES) method.

1002.2.3.4 High-Density Polyethylene (HDPE) Pipe

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in PNS-ISO 4427, Polyethylene (PE) Pipes and Fittings for Water Supply.

1002.2.3.5 Polypropylene Random/ Copolymer (PPR/ PPR-C)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in DIN 8077- Polypropylene (PP) Pipes-PP H, PP-B, PP-R, PP-RCT-Dimensions and DIN 8078 - Polypropylene (PP) Pipes- PP-H, PP-B, PP-R, PP-RCT - General Quality Requirements and Testing for pipes and DIN 19560/16962 - Pipes and Fittings made of Polypropylene (PP) for hot water resistant waste and soil discharge systems inside buildings/Pipe Joint assemblies and fittings for types 1 and 2 polypropylene (PP) pressure pipes, tees and branches produced by segment inserts and necking for butt welding; dimensions for fittings or ISO 15874- Plastic Piping Systems for Hot and Cold Water Installations-Polypropylene (PP).

100.2.2.3.6 Ductile Iron

Ductile Iron shall be designed conforming to specification requirements defined in ASTM A536:2014 Standard Specification for Ductile Iron Castings, ASTM A756 Standard Specification for Ductile Iron Gravity Sewer Pipe and ASTM A377 Standard Index of Specifications for Ductile-Iron Pressure Pipe.

1002.2.4 Septic Tank

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

1002.2.5 Plumbing Fixtures and Fittings

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

1. Water closet shall be vitreous China, free standing toilet combination, round front bottom outlet siphonic washdown bowl with extended rear self and closed coupled tank with cover complete with fittings and mounting accessories. Model make and color shall be submitted for approval prior to delivery at jobsite by the Engineer or unless otherwise specified on the Plans.

2. Plastic toilet bowl shall be a high quality polypropylene virgin material Composition, complete with integrated parts and other accessories or unless otherwise specified on the Plans.

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

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

1002.2.5.1 Prohibited Fixtures

Water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge shall be prohibited. Any water closet that might permit siphonage of the contents of the bowl back into the tank shall be prohibited. Drinking fountains shall not be installed in public toilet rooms.

Trough urinals and urinals with an invisible seal shall be prohibited. Non-Water urinals are an exception.

1002.2.6 Bathroom and Toilet Accessories

1. Shower head and fitting shall be movable, cone type with escutcheon arm complete with stainless steel shower valve and control lever, all exposed surface to be chromium finish.

2. Grab bars shall be made of tubular stainless steel pipe provided with safety grip and mounting flange.

3. Floor drains shall be made of stainless steel beehive type, measuring 100 mm by 100 mm, and provided with detachable stainless strainer, expanded metal lath type.

4. Toilet paper holder shall be vitreous China wall mounted. Color shall reconcile with the adjacent fixture and facing tiles.

5. Soap holder shall be vitreous China wall mounted. Color shall reconcile with the adjacent tile works.

6. Faucet(s) shall be made of stainless steel for interior use.

7. Hose-bib(s) shall be made of bronze cast finish.

1002.2.7 Special Plumbing Fixtures

1. Kitchen sink shall be made of stainless steel self-rimming, single compartment complete with supply fittings, strainer traps, dual control lever and other accessories or plastic made of a high quality polypropylene virgin material composition, with stainless steel strainer, lock-nut, rubber gasket and flexible connector unless otherwise specified on the Plans.

2. Laboratory sink shall be made of cast iron metal with white porcelain finish with single compartment, flat rim ledge, 762 mm x 533 mm complete with Supply fittings, strainer, trap and other accessories.

3. Scrub-up sink shall be made of cast iron metal with white porcelain finish measuring 610 mm x 610 mm Complete with supply fittings, strainer, trap and wall mounting accessories.

4. X-ray developing tank shall be made of cast iron white porcelain finish with three (3) compartment x-ray processing, drain plug, open standing drain, 19 mm IPS inlet spud complete with stand and mounting accessories.

5. Squat bowl(s) shall vitreous China, wash down squat bowl with integral foot treads, pail flush type or plastic made of a high quality polypropylene virgin material composition, complete with P-Trap fitting and its rubber gasket. Color, make and type to be approved by the Engineer.

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

1002.2.8 Roof Drains, Downspout, Overflow Pipe and Steel Grating

The Contractor shall provide, fir and/or install necessary drains with strainers, Where shown on the Plans. Each drain with strainer shall fit the size of the Corresponding downspout (or roof leader) over which it is to be installed and in Conformity with the following schedule:

1. Scupper drains (for balconies, parapet) shall be made of bronze base with flashing. Flange threaded outlet and Convex With integral fasting clamp bolted to flange.

2. Roof drains shall be made of bronze base semi-dome with large free area, flashing clamp and integral gravel stopper. To be used at roof decks, canopies, gutters, and elsewhere indicated on the Plans

3. Downspouts when encased in concrete, unless otherwise shown on the Plans shall be polyvinyl chloride (PVC). Whether indicated or specified to be cast iron or galvanized iron the same shall meet the specification requirement as herein described.

4. Overflow pipes shall be made of galvanized iron pipe measuring at least 13 mm diameter and spaced 200 mm on center.

5. Steel grating shall be made of wrought iron metals of design on shop drawings approved and surfaces to be located with shop finish.

1002.2.9 Fire Protection System

Firestop materials shall be installed in accordance with Uniform Plumbing Code of the Philippines, the National Building Code of the Philippines, Fire Code of the Philippines and the manufacturer's instructions.

1. Fire hose cabinets shall be locally available consisting of 38 mm diameter valve hose rack with nipple 30 mm rubber lined hose cable with standing pressure of 4,268 kg/cm2, nozzle 38 mm diameter brass, chromium plated.

Wet standpipes shall be located so that all portions of the buildings are within 6 m of a nozzle attached to 22 m of hose.

2. Fire standpipe system shall consist of risers and hose valves. Pipe shall be extra strong black iron. Valves to be high grade cast bronze mounted withstanding pressure of 79.40 kg/cm2, working pressure as indicated on the Plans.

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

4. Yard hydrant where shown on the Plans shall match the integrated Fire Department requirements. Outlet shall be single 63 mm diameter gate valves with chain connected caps.

5. Pipes and fittings for fire sprinkler piping system as approved alternate shall be made out of high grade Chlorinated Polyvinyl Chloride (CPVC) materials conforming to specification requirements defined in ASTM 1 F442 for pipes and ASTM F437, F438, F439 or F1970 for fittings.

6. For Steel pipe and fittings shall conforming to specification requirements defined in ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless, ASTM A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe and ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

7. Fire pumps where shown on the approved Plans shall conform to the Integrated Fire Department requirements, wherein the Fire Pump Motor shall be electric-driven and the overall system shall include an integrated Jockey Pump, Controller, and all the necessary accessories.

1002.2.10 Built-in Appliances

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

1002.3 Construction Requirements

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

For approved alternate pipes and fittings, installation work shall conform to the approved Plans or manufacturer's recommendation.

1002.3.1 Installation of Soil, Waste, Drain and Vent Pipes

1. All cast iron soil and drainage pipes shall be pitch 6 mm per 300 mm but in no case flatter than 3 mm per 300 mm.

2. Horizontal lines shall be supported by well secured length heavy strap hangers. Vertical lines shall be secured strongly by hooks to the building frame and a suitable brackets or chairs shall be provided at the floor from which they start.

3. All main vertical soil and waste stacks shall be extended full size to and above the roof line to act as vents, except otherwise indicated on the Plans.

4. Vent pipes in roof spaces shall be run as close as possible to underside of roof with horizontal piping pitched down to stacks without forming traps. Vertical vent pipes may be connected into one main vent riser above the highest vented fixtures.

5. Where an end or circuit vent pipe from any fixtures is connected to a vent line serving other fixtures, the connections shall be at least 1.20 m above the floor on which the fixtures are

located.

6. Horizontal waste line receiving the discharge from two or more fixtures shall be provided with end vents unless separate venting of fixtures is noted on the Plans.

7. All changes in pipe sizes on soil and waste lines shall be made with reducing fittings or recessed reducers. All changes in directions shall be made by appropriate use of 45 degrees wyes, half wyes, long sweep quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical and on the discharge from waste closets. Where it becomes necessary to use short radius fittings in other locations the approval of the Engineer shall be obtained prior to installation of the same.

8. All joints of cast iron pipes in bell and spigot shall be firmly packed with oakum or hemp and caulked with peg lead at least 25 mm deep.

9. Cleanouts at the bottom of each soil stack, waste stack, interior downspout and where else indicated shall be the same size as the pipe up to and including 102 mm, 152 mm, for larger pipes.

10. Cleanouts on floors shall be cast iron ferrule caulked into cast hub and fitted with cast brass Screw plug flush with floor. Cleanouts for threaded pipes shall be installed at the foot of soil, waste and drain stacks and on each building drain outside the building.

11. Vent pipe shall be flashed and made watertight at the roof with ferrule lead sheet. Flashing shall be turned down into pipes.

12. Each fixtures and place of equipment requiring connection to the drainage system except fixtures with continuous waste shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible. Traps installed on threaded pipe shall be recessed drainage pattern.

13. Overhead horizontal runs of pipes shall be hung with adjustable wrought it on pipe hanger spaced not over 3.04 m apart except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart and located near a hub.

1002.3.2 Water Pipes, Fittings and Connections.

All water piping inside the building and underground, 100 mm diameter and smaller shall be galvanized iron threaded pipe with malleable iron fittings, PVC-U, HDPE, PPR and ductile iron.

1. The water piping shall be extended to all fixtures, outlets, and equipment from the gate valves installed in the branch near the riser.

2. The cold water system shall be installed with a fall towards a main shutoff valve and drain. Ends of pipes and outlets shall be capped or plugged and left ready for future connections.

3. Mains and Branches

a. All pipes shall be cut accurately to measurements and shall be worked into place without

springing or forcing. Care shall be taken so as not to weaken the structural portions of the building.

b .All piping above the ground shall be run parallel with the lines of the building unless otherwise indicated on the Plans.

c. All service pipes, valves and fittings shall be kept at sufficient distance from other work to permit finished covering not less than 12.5 mm from such work or from finished covering on the different service.

d. No water piping shall be buried in floors, unless specifically indicated on the plans and approved by the Engineer.

e. Changes in pipes shall be made with reducing fittings.

4. Drain Cocks

Pipe drain indicated on the drawings shall consist of 12 mm globe valve with renewable disc and installed at low points on the cold water piping so that all piping shall slope 100 mm in 30.5 m.

5. Threaded Pipe Joints

All pipes shall be reamed before threading. All screw joints shall be made with graphite and oil or with an approved graphite compound applied to make threads only. Threads shall be full cut and not more than three (3) threads on the pipe shall remain exposed.

6. Expansion and Contraction Pipes

Accessible contraction-expansion joints shall be made whenever necessary. Horizontal runs of pipe over 15 m in length shall be anchored to the wall to the supporting structure about midway on the run to force expansion and Contraction equally toward the ends or as shown on the Plans.

7. Pipe Standpipe System

Fire standpipe system shall consist of risers and valve. Pipe shall be extra strong black iron. Valves to be underwriter's approval high grade cast bronze mounted.

8. Valves and Hose Bibs

a. Valves shall be provided on all supplied fixture as herein specified.

b. The cold water connections to the domestic hot water heater shall be provided with gate valves and the return circulation connection shall have a gate and a check valve.

c. All connection to domestic hot water heaters shall be equipped with unions between valve and tanks,.

d. Valve shall not be installed with its stem below the horizontal. All valves shall be gate valves unless otherwise indicated on the Plans.

e. Valves up to and including 50 mm diameter shall be threaded ends, rough bodies and finished trimmings, except those on chromium plated brass pipe.

f. Valves 63 mm in diameter and larger shall have iron bodies, brass mounted and shall have either screws or flange ends.

g. Hose bibs shall be made of brass with 12.5 inlet threads, hexagon shoulders and 19 mm male.

1002.3.3 Fixtures, Equipment and Fastenings

All fixtures and equipment shall be supported and fastened in a safe and satisfactory workmanship as practiced.

All fixtures, where required to be wall mounted on concrete or concrete hollow block wall, fasten with brass expansion bolts. Expansion bolts shall be 6 mm diameter with 20 mm threads to 25 mm into solid concrete, fitted with loose tubing or sleeves of proper length to acquire extreme rigidity.

Inserts shall be securely anchored and properly flushed into the walls. Inserts shall be concealed and rigid.

Bolts and nuts shall be horizontal and exposed. It shall be provided with washers and chromium plate finish.

1002.3.4 Pipe Hangers, Inserts and Supports

I. Pipe hangers shall be wrought iron or malleable iron pipe spaced not more than 3 mm apart for horizontal runs or pipe, except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart located near the hub.

2. Chains, straps perforated turn- -bucklers or other approved means of waste lines or individual toilet rooms to maintain stacks when spaced does adjustment except the turn-buckles may be omitted for hangers on soil or waste lines or individual toilet rooms to maintain stacks when spaced does not permit.

3. Trapeze hangers may be used in lieu of separate hangers on pipe running parallel to and close to each other.

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

Insert may be permitted adjustment of the bolts in one horizontal direction and shall be installed before pouring of concrete.

5. Wrought iron clamps or collars to support vertical runs of pipe shall be spaced not more than 6 mm apart as indicated on the Plans.

1002.3.5 Plates and Flashing

1. Plates to cover exposed pipes passing through floor finished walls or ceilingd shall be fitted with chromium plated cast brass plates or chromium plated cast iron or steel plates on ferrous pipes.

2. Plates shall be large enough to cover and close the hole around the area where pipes pass. It shall be properly installed to insure permanence.

3. Roof areas penetrated by vent pipes shall be rendered watertight by lead sheet flashing and counter flashing. It shall extend at least 150 mm above the pipe and 300 mm along the roof.

1002.3.6 Protection and Cleaning

1. During installation of fixtures and accessories and until final acceptance, protect items with strippable plastic or other approved means to maintain fixtures in perfect conditions.

2. All exposed metal surfaces shall be cleaned and polished upon completion.

3. Upon completion, thoroughly clean all fixtures and accessories to leave the work in polished condition.

1002.3.7 Inspection, Warranty Test and Disinfection

All pipes, fittings, traps, fixtures, appurtenances and equipment of the plumbing and drainage system shall be approved by the Engineer and inspected both by the Engineer and the Contractor's duly designated representative (Licensed Master Plumber or Sanitary Engineer) to insure compliance with all requirements of all Codes and Regulations referred to in this Specification.

1002.3.7.1 Drainage System Test

1. The entire drainage and venting system shall have all necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent above the roof.

2. The system shall hold this water for a full 30 min during which time there shall be no drop greater than 102 mm.

3. Where only a portion of the system is to be tested, the test shall be conducted in the same manner as described to the entire system except that a vertical stack 3 m highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure or water pump may be used to supply the required pressure.

4. If and when the Engineer decides that an additional test is needed, such as an air to smoke test on the drainage system, the Contractor shall perform Such test without any additional cost.

1002.3.7.2 Water Test on System

1. Upon completion of the rough-in and before connecting fixtures the entire cold water piping

system shall be tested at a hydrostatic pressure 1 ½ times the expected working pressure in the system during operation and remained tight and leak-proofed.

2. Where piping system is to be concealed the piping system shall be separately in manner similar to that described for the entire system and in presence of the Engineer or his duly designated representative.

3. The water test shall be applied to the drainage and vent systems either in entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow, If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 3 m head of water.

In testing successive sections at least the upper 3 m height of the preceding section previously tested shall be tested again so that no joint or pipe in the building (except the uppermost 3 m of the system) shall have been submitted to a test of not less than 3 m head of water. The water shall be kept in pipe system or in the portion under test, for at least 15 min before inspection starts. The system shall be tight at all joints.

1002.3.7.3 Defective Work

1. The entire water distribution system shall be thoroughly flushed and treated with chlorine before it is operated for public use.

2. Disinfection materials shall be liquid chlorine or hypochlorite and shall be introduced in a manner approved as practiced or approved by the Engineer into the water distribution system.

3. After a contact period of not less than 16 h, the heavenly chlorinated water shall be flushed from the system with potable water.

4. Valves for the water distribution system shall be opened and closed several times during the 16h chlorination treatment is done.

1002.3.8 As-Built Drawings

Upon completion of the work, the Contractor shall submit two (2) sets of prints with all as-built changes shown on the drawings in a neat workmanship manner.

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

1002.4 Method of Measurement

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

Plumbing Fixtures shall be measured by set, piece, square meter and/or lump sum.

1002.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (3)e	PVC Pipes (blue) with Fittings, 50 mm dia.	Meter
1002 (3)h	PVC Pipes (blue) with Fittings, 100 mm dia.	Meter

ITEM 1047 - METAL STRUCTURES

1047.1 Description

This works shall consist of furnishing, fabricating, hauling, erecting, welding and painting of metal structure and accessories constructed in accordance with the Plans and this Specifications.

1047.2 Material Requirements

1047.2.1 Classes of Structural Steels

1047.2.1.1 Built-Up Shapes

Built-up shapes are defined as structural steel sections made up of steel plates with thickness ranging from 5 mm to 45mm welded together to from 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 S5, Charpy V-Notch Impact Test and ASTM A673M, Standard Specification for Sampling Procedure for Impact Testing of Structural Steel.

1047.2.1.2 Cold Formed Plate Shapes

Cold formed plate shapes are made from steel plates with thickness ranging from 6mm to 20mm formed by cold rolling or by press brake bending into the desired shape. It shall conform to ASTM A36M.

1047.2.1.3 Cold-Formed Light Gage Shapes

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

1047.2.1.4 Rolled Steel Shapes

Rolled Steel shapes are structural steel sections produced by passing red 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.

1047.2.1.5 Metal Decks

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

1047.2.2 Structural Steel Materials

1047.2.2.1 General

For hot-rolled Structural shapes, plates and bars, such tests shall be made in accordance in ASTM A6M; for sheets, such tests shall be made in accordance with ASTM A568M, Standard Specification for Steel, Sheet, Carbon, Structural, and High-Strength, Low-Alloy, Hot-Rolled and Cold-Rolled, General Requirements; for tubing and pipe, such tests shall be made in accordance with the requirements of the applicable ASTM standards listed for those product forms.

Structural Steel shall be furnished according to the following applicable ASTM specifications:

1047.2.2.2 Hot-Rolled Structural Shapes

Hot-rolled structural shapes shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTM A36M	Standard Specification for Carbon Steel
ASTM A529M	Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality
ASTM A572M	Standard Specification for High-Strength Low-Alloy Colombium-Vanadium Structural Steel
ASTM A588M	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50 ks(345Mpa) Minimum Yield Point, with Atmospheric Corrosion Resistance

ASTM A709M	Standard Specification for Structural Steel for Bridges
ASTM A913M	Standard Specification for Strength Low-Alloy Steel Shapes of Structural Quality, Produced by Quenching and Self-Tempering Process (QST)
ASTM A992M	Standard Specification for Structural Steel Shapes

1047.2.2.3 Structural Tubing

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

Designation	Title
ASTM A500M	Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A501M	Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
ASTM A618M	Standard Specification for Hot-Formed Welded and Seamless High-Strength Low-Alloy Structural Tubing
ASTM A847M	Standard Specification for Cold-Formed Welded and Seamless High-Strength, Low-Alloy Structural Tubing with Improved Atmospheric Corrosion Resistance

1047.2.2.4 Steel 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.

1047.2.2.5 Steel Plates

Steel plates shall conform to the following specifications or as indicated in the Plans:

Designation	Title
ASTM A36M	Standard Specification for Carbon Structural Steel
ASTM A242M	Standard Specification for High-Strength Low-Alloy Structural Steel
ASTM A283M	Standard Specification for Low and Intermediate Tensile Strength Carbon Steel Plates
ASTM A514M	Standard Specification for High-Yield Strength, Quenched and Tempered Alloy Steel Plate, Suitable for Welding
ASTM A529M	Standard Specification for High-Strength Carbon-Manganese Steel of

	Structural Quality
ASTM A572M	Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A588M	Standard Specification for High-Strength Low-Alloy Structural Steel, up to 50ksi (345Mpa) Minimum Yield Point, with Atmospheric Corrosion Resistance
ASTM A709M	Standard Specification for Structural Steel for Bridges
ASTM A1011M	Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra- High Strength

1047.2.2.6 Steel Bars

Steel bars shall conform to the following 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

1047.2.2.7 Steel Sheets

Steek 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

1047.2.3 Steel Casting and Forgings

Cast steel shall conform to ASTM A216M, Standard Specification for Steel Castings, Carbon

Suitable for Fusion Welding, for High Temperature Service

1047.2.4 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
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

1047.2.5 Anchor Rods and Threaded Rods

Anchor road 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 Loy-Alloy Columbium-Vanadium Structural Steel
ASTM F1554	Standard Specification for Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength

1047.2.6 Consumables for Welding

Filler metals and fluxes shall conform to the following applicable specifications of American Welding Society or as indicated in the Plans:

Designation	Title
AWS A5.1M	Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding
AWS A5.5M	Specification for Low-Alloy Steel Electrodes for Shielded Metal Arc Welding
AWS A5.17M	Specification for Carbon Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.18M	Specification for Carbon Steel Electrodes and Rods for Gas Shielded Arc Welding
AWS A5.23M	Specification for /Low-Alloy Steel Electrodes and Fluxes for Submerged Arc Welding
AWS A5.25M	Specification for Carbon and Low-Alloy Steel Electrodes and Fluxes for Electroslag Welding
AWS A5.26M	Specification for Carbon and Low-Alloy Steel Electrodes for Electrogas Welding

AWS A5.32M	Welding Consumables – Gases and Gas Mixtures for Fusion Welding and Allied Processes
AWS A5.36M	Specification for Carbon and Low-Alloy Steel Flux Cored Electrodes for Flux Cored Arc Welding and Metal Cored Electrodes for Gas Metal Arc Welding

1047.2.7 Headed Stud Anchors

Steel stud shear connects 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 the ASTM A29M, Standard Specification for General Requirements for Steel Bars, Carbon and Alloy, Hot-Wrought.

1047.2.8 Turnbuckle

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

1047.2.9 Stainless Steel Flagpole Post

Unless otherwise specified, stainless steel for flagpole shall conform to the applicable requirements of ASTM A312M, Standard Specification for Seamless, Welded, and Heavily Cold Worked Austenitic Stainless Steel pipes and ASTM A554, Standard Specification for Welded Stainless Steel Mechanical Tubing.

1047.3 Construction Requirements

1047.3.1 Shop and Erection Drawings

Shop and erection drawings are permitted to be prepared in stages. Shop drawings shall be prepared in advance of fabrication and give complete information necessary for the fabrication of the component parts of the structure, including the location, type and size of welds and bolts. Erection drawings shall be prepared in advance of the erection and give information necessary for erection of the structure. Shop and erection drawings shall clearly distinguish between shop and field welds and bolts and shall clearly identify pretensioned and slip-critical high-strength bolted connections.

1047.3.2 Fabrication

1047.3.2.1 Cambering, Curving and Straightening

Local application of heat or mechanical means is permitted to be used to introduce or correct camber, curvature and straightness. The temperature of heated areas as measured by the

approved methods, shall not exceed 593 °C for ASTM A514M or as indicated in the Plans.

1047.3.2.2 Thermal Cutting

Thermally cut edges shall meet the requirements of AWS D1.1M clauses 5.14.5.2, 5.14.8.3 and 5.14.8.4 with the exception that thermally cut free 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 (NCSP), 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 copies shall be no greater than a surface roughness value of 50 um as defined in ASME B46.1 Surface Texture (Surface Roughness, Waviness, and Lay). For beam copes and weld access holes in which the curbed 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 the size and location.

1047.3.2.3 Planning of Edges

Planning or finishing of sheared or thermally cut edges of plates or shapes is not required unless specifically called for in the Contract documents or included in a stipulated edge preparation for welding.

1047.3.2.4 Welded Construction

The technique of welding, workmanship, appearance and quality of welds, and the methods used in correcting nonconforming work shall be in accordance with AWS D1.1M.

1047.3.2.5 Bolted Construction

Parts of bolted members shall be pinned or bolted and rigidly held together during assembly. Use of a drift pin in bolt holes during assembly shall not distort the metal or enlarge the holes. Poor matching of holes shall be cause for rejection.

Bolts shall comply with the provisions of the Research Council on Structural Connections (RCSC) Specification for Structural Joints using ASTM F3125M expect that thermally cut holes shall be permitted with a surface roughness profile not exceeding 25 um as define 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 6mm 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 of application of the load. The use of high-strength bolts shall conform to the requirements of the RCSC Specification for Structural Joints using STM F3125M.

1047.3.2.6 Dimensional Tolerances

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

1047.3.2.7 Finish of Column Bases

Column bases and base plates shall be finished in accordance with the following requirements:

1. Steel bearing plates 50 mm or less in thickness are permitted without milling, provided a satisfactory contact bearing is obtained. Steel bearing plates over 50 mm but not over 100 mm in thickness are permitted to be straightened by pressing, or if presses are not available, by milling for bearing surface (except as noted in subparagraph 2 and 3 of this section), to obtain a satisfactory contact bearing. Steel bearing plates over 100mm in thickness shall be milled for bearing surfaces (except as noted in subparagraph 2 and 3 of this section).

2. Bottom surfaces of bearing plates and column bases that are grouted to ensure full bearing contact on foundations need to be milled.

3. Top surfaces of bearing plates need not be milled when complete-joint penetration groove welds are provided between the column and bearing plate.

1047.3.2.8

Holes for anchor rods shall be permitted to be thermally cut in accordance with the provisions of Subsection 1047.3.2.2, Thermal Cutting.

1047.3.2.9 Drain in Holes

When water can collect inside Hollow Structural Sections (HSS) or box members, either during construction or during service, the member shall be sealed, provided with a drain hole at the base.

1047.3.2.10 Requirements of 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.

1047.3.3 Shop Painting

1047.3.3.1 General Requirements

Shop painting and surface preparation shall be in accordance with the provision of the AISC Code of Standard Practice for Steel Building and Bridges.

Shop paint is not required unless specified in the Contract Documents.

1047.3.3.2 Inaccessible Surfaces

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

10473.3.3 Contact Surfaces

Paint is permitted in bearing-type connections. For slip critical connections the faying surface requirements shall be in accordance with the RCSC Specification for Structural Joints Using ASTM F3125M.

1047.3.3.4 Finished Surfaces

Machine-finished surface 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.

1047.3.3.5 Surfaces Adjacent to Field Welds

Unless otherwise specified, surface within 50 mm of any filed weld location shall be free of materials that would prevent proper welding or produce objectionable fumes during welding

1047.3.4 Erection

1047.3.4.1 Alignment of Column Bases

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

1047.3.4.2 Bracing

The frame of steel skeleton buildings shall be carried up true and plumb within the limits

defines 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.

1047.3.4.3 Alignment

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

1047.3.4.4 Fit 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 pack out with non-tapered steel shims. Shims need not be other than mild steel, regardless of the grade of the main material.

1047.3.4.5 Field Welding

Shop paint of the surface adjacent to joints to be field welded shall be wire brushed to assure weld quality. Field welding of attachments to installed embeds in contact with concrete shall be done in such a manner as to avoid excessive thermal expansion of the embedment which could result in spalling or cracking of the concrete or excessive stress in the embedment anchors.

1047.3.4.6 Field Painting

Responsibility for touch-up painting, Cleaning and field paint shall be allocated in accordance with the accepted local practices, and this allocation shall be set forth explicitly in the design documents.

1047.3.4.7 Field Connections

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

1047.3.5 Quality Control

The Fabricator shall provide quality control procedures to the extent that the fabricator deems necessary to assure that the work performed is in accordance with his Specification. In addition to the fabricator's quality control procedures, material and workmanship at all time may be subject to inspection by the Engineer.

1047.3.5.1 Cooperation

As much as possible, the inspection by the Engineer shall be made at the fabricator's plant. The fabricator shall cooperate with the Engineer, permitting access for inspection to all places

where work is being done.

1047.3.5.2 Rejection

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

1047.3.5.3 Inspection and Testing of Welding

The inspection and testing of welding shall be performed in accordance with the provisions of AWS D1.1 except as modified in Section 510.2, Welds of National Structural Code of the Philippines, 2015. The process, extent and standards of acceptance shall be clearly defined in the Contract.

1047.3.5.4 Inspection 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.

1047.3.5.5 Identification of Steel

The fabricator shall be able to demonstrate by a written procedure and by actual practice a method of material identification, visible at least through the “fit-up” operation for the main structural elements of each shipping piece.

1047.4 Method of Measurement

The quantity of structural steel to be paid for shall be the number of kilograms or lump sum installed in place and accepted.The quantity of metal structure accessories to be paid for shall be the number of kilograms, pieces or lump sum installed in place and accepted.

1047.5 Basis of Payment

The accepted quantity, measure as prescribe 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 prescribe in this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (8)	Stainless Steel Pipe, Roof Framing	Lump Sum

SPL 3 - POLYETHYLENE NET

Description

This item shall consist of furnishing and placing erosion control mats, roving, and cellular confinement systems installed at the locations designated for ditch and slope protection, and stabilization, in accordance with this specification and in conformity with the lines, grades, dimensions, and arrangements shown on the plans or as directed by the Engineer.

Materials Requirements

Erosion Control Mats

Erosion control mats shall conform to the specifications as shown below:

Type 1 - Straw mats, burlap fabric, jute mesh, and woven paper or sisal mesh netting

1. *Straw mats* - shall be clean agricultural straw made from oats, wheat, rye, or other grain crops that is free from weeds, mold, or other objectionable material and furnished in an air-dry condition suitable for placing with mulch blower equipment. Straw erosion control mat shall conform to Table 1 as shown below:

Table 1: Straw Erosion Control Mat

Material	Property	Specification
Straw	Moisture Content g/m2	240
Netting	Photodegradable netting 1.5 on one side 5 - 20 mm square mesh, kg/m2, min	1.5

(1) Moisture Content shall not exceed 20 percent
(2) Dimensions are approximate and may vary to meet manufacturer's standards.

2. Burlap fabric - shall have a standard weave and a mass of 145 ± 20 grams per square meter.

3. Jute mesh - shall have a uniform open plain weave fabricated from jute yarn that does not vary in thickness by more than half its normal diameter. Jute mesh shall conform to the following:

Mesh size 25 by 25 mm max
Mesh mass , ASTM D1776 0.5 kg/m2 ± 5%

4. Woven paper or sisal mesh netting - Mesh netting of woven paper or woven sisal twisted yarn shall conform to the following:

Mesh openings 3 to 6 mm

Shrinkage after wetting 20% max

Type 2 - Straw and coconut mats, excelsior blanket, or mulch blanket

1. Straw and coconut mats - a mat consisting of straw and undyed untreated biodegradable jute, coconut coir, and synthetic polypropylene fibers or other approved yarn woven into a plain weave mesh. Straw and coconut mats shall conform to Table 2 as shown below:

Table 2: Straw and Coconut Mat

Material	Property	Specifications
Straw 70%	Moisture Content, g/m2, min	240
Coconut 30%	Moisture Content, g/m2, min	240
Netting	Photodegradable netting on both side 16-25mm square mesh, kg/100 m2, min	1.5

(1) Moisture content shall not exceed 20 percent

(2) Dimensions are approximate and may vary to meet manufacturer's standards

2. Excelsior blanket - shall be of uniform thickness consisting of curled wood excelsior secured on the top side to a biodegradable, photodegradable extruded plastic mesh andshall have smolder resistant without the use of chemical additives.

Excelsior blanket shall conform to the following:

Excelsior fibers ~ 200 mm length 80% min.
Mesh size 25mm by 50mm
Blanket mass/area 0.53±0.05 kg/m2

3. Mulch blanket - shall be 3 to 13 mm thick blanket consisting of organic, biodegradable mulch such as straw, curled wood cellulose, coconut coir, or other material evenly distributed on one side of a photodegradable. polypropylene mesh having a minimum mass of 0.27 kg/m2

Type 3 - Coconut mat

Coconut mat - shall consist of undyed untreated biodegradable jute, coconut coir, and synthetic polypropylene fibers or other approved yarn woven into a plain weave mesh with approximately 16 to 25 mm2 openings.

Coconut mat shall conform to Table 3 as shown below:

Table 3: Coconut Mat

Material	Property	Specification

Coconut 100%	Moisture Content, g/m2	240
Netting	Photodegradable netting on both side 16-25mm square mesh, kg/100 m2, min	1.5

(1) Moisture content shall not exceed 20 percent

(2) Dimensions are approximate and may vary to meet manufacturer's standards.

Type 4 - Synthetic erosion control mats and meshes

1. Synthetic mat - A flexible mat produced by machine, consisting of polyolefin monofilament fibers positioned between 2 biaxially oriented nets.

Mechanically bind the nets together by parallel stitching with polyolefin thread to form a 3-dimensional web-like weave, highly resistant to environmental and chemical deterioration. Synthetic mat shall conform to Table 4 as shown below:

Table 4: Synthetic Erosion Control Mat

Property	Specifications	Test Method
Color	Green	Visual
Thickness mm, min.	6	ASTM D1777
Strength N/m min.	1590 x 525	ASTM D5035
Elongation (1), %, max	50	ASTM D5035
Porosity (2), %, min.	85	Calculated
Resiliency (3) , %, min.	80	ASTM D1777
Ultraviolet stability (4), %	80	ASTM D4355

(1) Values for both machine and cross-machine directions under dry or saturated conditions. Machine direction specimen for 50 mm strip test includes one machine direction polyolefin stitch line centered within its width and extending the full width length of the specimen.

(2) Calculation based upon mass, thickness, and specific gravity.

(3) The percentage of original thickness retained after 3 cycles of a 690 kilopascal load for 60 seconds followed by 60 seconds without load. Thickness measured 30 minutes after load removed.

(4) Tensile strength retained after 1000 hours in a Xenon ARC weatherometer.

2. Synthetic polypropylene mesh - A flexible woven geotextile mesh fabricated from polypropylene fibers that were spun in one direction. Synthetic polypropylene mesh shall conform to Table 5 as shown below:

Table 5: Synthetic Polypropylene Mesh

Property	Specifications	Test Methods
Color	Beige	Visual
Mass, g/m2 , min.	59	ASTM 05261
Tensile strength, N/m, min.	6700 x 3700	ASTM 05035
Elongation at break, %, max.	40	ASTM 05035
Mullen burst strength, kPa min.	515	ASTM 03786

3. Synthetic mulch control netting - A uniformly extruded, rectangular, plastic mesh netting with 50 by 50 mm nominal mesh openings and weighing at least 8 grams per square meter.

4. Organic mulch control netting - A leno weave mesh netting fabricated from 12.7 kg biodegradable cellulose fiber yarn having 5 twists per 25 mm.

Make the size of the mesh grid 13 to 25 mm^2. Finish the selvedge to prevent raveling or fraying.

Type 5 - Turf reinforcement mats

Turf reinforcement mats - A web of mechanically or melt bonded polymer netting, monofilaments, or fibers that are entangled to form a strong and dimensionally stable mat. Bonding methods include polymer welding, thermal or polymer fusion, or the placement of fibers between 2 high-strength, biaxially oriented nets mechanically bound together by parallel stitching with polyolefin thread and is resistant to biological, chemical, and ultraviolet degradation. Turf reinforcement mats shall conform to Table 6 as shown below:

Table 6: Synthetic Polypropylene Erosion Control Mat

Property	Specification	Test Method
Color	Black	Visual
Thickness, mm , min.	13	ASTM 01777
Tensile StrengthN/m, max.	1370x790	ASTM 05035
Elongation (1), %, max	50	ASTM 05035
Porosity (2) %, max.	90	Calculated
Resiliency (3), %, min.	80	ASTM 01777
Ultraviolet stability(4), %, min.	80	ASTM 04355
Functional Longevity	5 years	Observed

(1) Values for both machine and cross-machine directions under dry or saturated conditions using 50 mm strip method.

(2) Calculation based upon mass, thickness, and specific gravity.

(3) The percentage of original thickness retained after 3 cycles of a 690 kilopascal load for 60 seconds followed by 60 seconds without load. Thickness measured 30 minutes after load

removed.

(4) Tensile strength retained after 1000 hours in a Xenon ARC weatherometer.

Emulsified Asphalt

Emulsified asphalt shall conform to the applicable requirements of Item 304, Bituminous Surface Treatment.

Cellular Confinement Systems

A flexible honeycomb 3-dimensional structure fabricated from polyethylene that has been properly stabilized with carbon black and/or hindered amine light stabilizers.

Roving

Types of Roving

1. Fiber glass roving - Fiber glass roving shall be formed from continuous fibers drawn from molten glass, coated with a chrome-complex sizing compound, collected into strands and lightly bound together into roving without the use of clay, starch, or like deleterious substances.

   Roving shall be wind into a cylindrical package approximately 300 mm high so it can be continuously fed from the center of the package through an ejector driven by compressed air and expanded into a mat of glass fibers on the soil surface. Roving containing petroleum solvents or other agents known to be toxic to plant or animal life shall not be used. Fiber glass roving shall conform to the following:

Strands/rove, end count	56 to 64
Fibers/strand, end count	184 to 234
Fiber diameter (trade designation G), ASTM D578	0.009 to 0.013 mm
m/kg of rove, ASTM D578	340 to 600 m/kg
km/kg of strand, ASTM D578	26.2 to 2.82
Organic content, ASTM D578	1.65% max.

2. Polypropylene roving - Polypropylene roving shall be formed from continuous strands of fibrillated polypropylene yarn. Roving shall be winded into a cylindrical package so that it can be continuously fed from the outside of the package through an ejector driven by compressed air and expanded into a mat of polypropylene strands. The material shall not contain agents that are toxic to plant or animal life. Polypropylene roving shall conform to the following:

Tensile strength, ASTM D2256	15.6 N

Elongation at break, ASTM 02256	15.5%
Mass of strand, ASTM 01907	360 denier
Strands per rove, measured	24
UV stability, ASTM 04355	50% retained after 200 hours

Topsoil

Topsoil shall conform to the requirements of Item 608, Topsoil, of the DPVVH Standard Specifications, Volume II.

Turf Establishment

1. Agricultural limestone Agricultural limestone

Shall conform to the requirements of Item 609, Subsection 609.2.3, Ground Limestone, of the DPWH Standard Specifications, Volume II.

2. Fertilizers

Fertilizers shall conform to the requirements of Item 609, Subsection 609.2.2, Fertilizers, of the DPWH Standard Specifications, Volume II.

3. Mulch

Straw - shall be made from oats, wheat, rye, or other grain crops that is free from weeds, mold, or other objectionable material and in an air-dry condition suitable for placing with mulch blower equipment.

Hay - shall be made from herbaceous mowing, free from weeds, mold, or other objectionable material. Furnish hay in an air-dry condition suitable for placing with mulch blower equipment.

Wood fiber - shall be processed from wood chips that is as follows:

a. Colored with a green dye non-injurious to plant growth

b. Readily dispersible in water

c. Nontoxic to seed or other plant material

d. Free of growth or germination inhibiting substances

e. Free of weed seed

f. Air dried to an equilibrium moisture content of 12±3 percent .

g. Packaged in new labeled containers

h. Packaged in a condition appropriate for mixing in a homogeneous slurry suitable for application with power spray equipment

Grass straw cellulose fiber - shall be processed from grass straw fiber, as follows:

a. Colored with a green dye non-injurious to plant growth

b. Readily dispersible in water

c. Nontoxic to seed or other plant material

d. Free of growth or germination inhibiting substances

e. Free of weed seed

f. Air dried to a moisture content of 10±0.2 percent

g. Air dried to a uniform mass of 15 percent

h. Packaged in new containers labeled with the manufacturer's name and air-dry mass

i. Packaged in a condition appropriate for mixing in a homogeneous slurry suitable for' application with power spray equipment

Peat moss - shall be a granulated sphagnum peat moss conforming to the following:

Sticks, stones, and mineral matter	0%
Partially decomposed stems and leaves of sphagnum	75% min.
Color	brown
Textured from porous fibrous to spongy fibrous	
pH	3.5 to 7.5
Air-dried	

Mature compost - shall be a partially decomposed organic material, such as leaves, grass, shrubs, and yard trimmings, cured for 4 to 8 weeks. Maturity is indicated by temperature stability and soil-like odor. Also shall be friable, dark brown, weed-free, and pathogen-free mature compost conforming to the following:

Carbon/nitrogen ratio	25/1 to 35/1
Carbon/phosphorus ratio	120/1 to 240/1
pH	6.0 to 7.8
Water content	40% max.

Particle size

Seeding and sodding	12 mm max.
Erosion control	25 mm max.
Organic material	50% min.
Man-made inserts (plastic, glass, metal)	2% max.

Straw for hydroseeding - shall be clean agricultural straw milled to 25 mm or less in length. Dry the fibers to 10% moisture for compaction. Bale in heat-sealed plastic bags.

Bonded fiber matrix hydromulch - shall be a mixture of longwood fibers and bonding agent which when hydraulically applied and dried produce a matrix conforming to the following:

a. Does not dissolve or disperse when wetted.

b. Holds at least 1000 grams of water per 100 grams of dry matrix.

c. Has no germination or growth inhibiting factors.

d. Forms no water insensitive crust.

e. Contains material that is 100 percent biodegradable.

Construction Requirements

Erosion Control Mats (Type 1, 2, 3, 4, and 5)

Install erosion control mats according to the manufacturer's recommendations.

Install erosion control mats to soil surfaces which are at final grade, stable, firm, and free of rocks or other obstructions. Spread erosion control mats evenly and smoothly, without stretching, to ensure direct contact with the soil at all points. Unroll erosion control mats parallel to the drainage flow direction. Lap edges as recommended by the manufacturer. Place the upslope end in a 150 mm vertical slot. Backfill the slot and compact.

For swale or ditch installations, place up the side slopes to extend above anticipated flow line and construct intermediated 150 mm vertical check slots at 8 m intervals. Construct check slots perpendicular to flow direction. Staple erosion control mats as recommended by manufacturer. Drive all staples flush with the soil surface.

Repair damaged areas immediately. Restore the soil in damaged areas to finished grade, refertilize, and reseed.

Synthetic erosion control mats and meshes (Type 4) shall be installed after turf establishment is in place.

Turf establishment mats (Type 5) shall be installed before turf establishment is in place. After seeding, lightly brush or rake 15±5 mm of topsoil into the mat voids to fill the mat thickness.

Roving

Furnish a pneumatic ejector capable of applying roving at a rate of 0.9 kilograms per minute. Furnish an air compressor capable of supplying 1.1 cubic meters per minute at 620±70 kilopascals, complete with air hoses necessary for supplying air to areas not accessible to the compressor. Furnish an asphalt distributor with necessary hoses and a hand spray bar for slopes and other areas not accessible to the distributor.

Fiber Glass Roving

Spread fiber glass roving uniformly at the rate of O.16±O.03 kg/m2 to form a random mat of continuous glass fibers.

Polypropylene Roving

Spread polypropylene roving uniformly at the rate of O.08±O.03 kg/m2 to form a random mat of continuous polypropylene fibers.

Anchor the roving to the ground with a slow setting emulsified asphalt applied uniformly at a rate of 1.5±0.2 liters per square meter over the roving. Bury upslope end of the roving 300 mm deep.

Cellular Confinement Systems

Excavate to the depth of the cellular confinement systems, and smooth and compact the slope. Install the top of the system .flush or lower than the! adjacent slope. Expand the cellular confinement systems down the slope. Connect adjacent cellular confinement systems sections with hog rings or staples every other cell.

Anchor the system with stakes across the top at every other cell. Repeat the anchoring pattern in every tenth row and in the bottom row.

Backfill the system with topsoil. Hand-compact the topsoil within each cell. Apply permanent turf establishment.

Acceptance Requirements

Certification

The manufacturer shall file with the purchaser a certificate stating the name of the manufacturer, the chemical composition of the filaments or yarns, and other pertinent information so as to fully describe material (including mats, roving and other cellular confinement systems) for erosion control, ditch and slope protection, and stabilization. The manufacturer shall include in the certificate a guarantee stating that the material that is furnished meets the requirements of the specification. The certificate shall be attested to by a person having legal authority to bind the company. Either mismarking or misinterpretation by

the manufacturer shall be reason to discontinue acceptance under these specifications. Notice sent to the manufacturer by the purchaser regarding the discontinuance of acceptance will be considered to be notice to all wholesalers, jobbers, distributors, agents and other intermediaries handling the manufacturer's product.

The Engineer shall evaluate acceptance for the material for topsoil through visual inspection and comply with the requirements of Item 608, Topsoil.

The Engineer shall evaluate acceptance for turf establishment work through visual inspection and certification as prescribed in Subsection 512.4.1, Certification.

Quality Control

The manufacturer of the material is responsible for establishing and maintaining a quality control program so as to assure compliance with the requirements of this specification.

Shipment and Storage

During periods of shipment and storage, the material shall be protected from direct sunlight, ultraviolet rays, temperatures greater than 60De (140DF), mud, dust, and debris.To the extent possible, the material shall be maintained wrapped in a heavy-duty protective covering. Each shipping document shall include a notation certifying that the material is in accordance with the manufacturer's certificate and guarantee previously filed with the purchaser.

Product Marking

Label the material and its container with the manufacturer's name, material's type or trade name, lot number and quantity.

Method of Measurement

Erosion control mats, roving, and cellular confinement systems shall be measured by the number of square meters excluding overlaps. Topsoil will be measured and paid for as provided in Item 608,Topsoil. Turf establishment will be measured on the following applicable methods:Seeding and mulching will be measured by the number of square meters.

Fertilizer, dry method will be measured by the metric ton.

Basis of Payment

The quantities determined as provided above shall be paid for at the contract price per unit of measurement, respectively.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 3	Polyethylene Net	Square Meter

ITEM 624 - SOLAR POWERED LED FLOOD LIGHT (WATERPROOF)

624.1 Description

This Item shall consist of furnishing of materials, equipment, and labor for the installation Of roadway lighting which includes the luminaire, pole, concrete footing/foundation, power supply, and other necessary components, as shown on the Plans and as directed by the Engineer.

624.2 Material Requirements

All materials shall be brand new and shall be of the approved type. It shall conform with the requirements of the Philippine Electrical Cede (PEC) and the preducts locally manufactured shall bear a Philippine Standard (PS) mark, while imported products shall bear Import Commodity Clearance (ICC) certification marks duly issued by the Bureau of Philippine Standards (BPS).

The light emitted by the luminaire shall have color temperature in the range Of 2000 K -2500 K (warm white), 3000K -4500K (cool white) or 5500K -6500K (daylight). For primary roads, warm white shall be used.

624.2.1 Solar-Powered LED Roadway Lighting

The LED modules, solar photovoltaic (PV) modules, controllers, and battery pack can be replaced independently and shall each have warranty certificate issued by the manufacturer or by the distributor certified by the manufacturer indicating a minimum of six (6) years warranty period.

624.2.1.1 Light Emitting Diode (LED) Luminaire

Light Emitting Diode (LED) shall conform to the applicable requirements for LED Road Luminaires of the Roadway Lighting Guidelines of the Department of Energy, latest edition. The luminaire shall have no risk linked to infrared, blue-light and UV radiation in accordance with IEC/EN 62471. The LED housing assembly shall be suitable for outdoor use and shall be rated as IP65.

624.2.1.2 Battery

The battery shall be deep cycle, lithium-ion type. It shall have low maintenance requirements, long service life (minimum of three years), and excellent capacity performance even in high temperature.

The battery pack shall have heat insulation and temperature detection for charging and discharging protection.

624.2.1.3 Solar Photovoltaic Module

Photovoltaic (PV) modules shall be made of crystalline high power/efficiency cells and shall be used and must be warranted for output wattage, which must be greater than 90% after 10 years and less than 80% after 25 years. The PV modules shall be provided a protective device against Surges.

624.2.1.4 Charge Controller

The charge controller shall have automatic dusk-dawn circuit based on Solar Photovoltaic module as sensor for switching on/off the streetlight without manual intervention and as specified operation profile during project analysis. All this control shall keep the system operating at peak performance and increases the system's lifespan,

624.2.2 High Pressure Sodium (HPS) Luminaire

HPS luminaire, ballasts, controllers, and other necessary components can be replaced independently and shall each have warranty certificate issued by the manufacturer or by the distributor certified by the manufacturer indicating a minimum of six (6) years warranty period.

1. Luminaires shall be Type Ill and Medium semi-cutoff. Roadway shall be properly aimed and designed in such a way that it will not produce high discomfort: glare or low illumination to motorists and pedestrians.

2. Luminaires shall be designed for roadway lighting with built-in ballast for use with a high-pressure sodium lamp. The luminaires shall bear the UL label. All luminaires shall be mounted with a zero-degree tilt from horizontal.

3. The luminaire housing, both upper and lower, shall be die-cast aluminum jointed by an integrally cast pin hinge at the mounting and a one-hand latch at the door enclosing the lamp and/or ballast.

4. The lens shall be a clear, tempered, high-quality, heat-resistant glass with no aberrations and shall be secured in the supporting frame.

5. The reflector shall be of drawn aluminum and have a highly reflective surface. The reflector edge shall have an elastomer gasket which seats firmly against the lens door to seal the optical system. The optical system shall have a filter permitting it to breathe during lamp heat-up and cool-down.

6. Ballasts shall operate within the range of voltage-current characteristic parameters that are compatible with the lamp used. Ballasts shall be capable of lamp starting at ambient temperatures down to minus 29°C.

624.2.3 Pole

The pole shall be constructed of hot dip galvanized GI pipe of 3 mm minimum thickness, a minimum lower and upper diameter of 200 mm and 75mm diameter, and a pole surface of matte or dull finished grade in able to prevent glare. The pole should have the provision to hold the weatherproof lamp housing individually per case, the battery box at an appropriate height,

and as well as the Solar Photovoltaic panel, that shall be mounted on top of the pole.

Each Pole shall have an inspection door or hand hole and shall have a suitable gasketed screw cover. After the pole has been erected, sealed and fixed in the foundation block, a coat of finishing aluminum paint shall be applied. Pole shall be provided with galvanized steel anchor bolts threaded top end and with a hooked bent at an angle end at the bottom. Size of the anchor bolts shall be as indicated on the Plans.

Pole shaft shall comply with ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

Anchor bases shall be provided with hot-dipped, galvanized steel anchor bolts with double nuts and washers, threaded at the top end and bended at 90 degrees at the bottom end. Galvanized nuts, washer, and ornamental covers shall also be provided for anchor bolts. Galvanizing shall be in accordance with the requirements of ASTM A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware or AASHTO M 111M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, or ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

624.2.4 Electric Cables

The electric cable shall be twin core PVC insulated water and UV resistant copper cable of 1.5 mm minimum size.

624.2.5 Photo Electric Control/Timer Switch

Roadway lighting shall be provided with reliable photoelectric controls either internal or external to keep lights turned on/off automatically that conform to ANSI C136.10, Roadway and Arcs Lighting Equipment -Lacking Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeable and testing, latest revision or equivalent and it shall be located as indicated on the Plans.

The timer switch shall be for prompt time of power switching off and on at the real-time for main light and advertising space in a separate time setting.

624.2.6 Conduit

Metallic conduit shall be standard rigid steel, zinc coated or galvanized steel conduit conforming to UL 6, Electrical Rigid Metal -Conduit Steel.

Non-metallic conduit or for ground and underground use without concrete encasement shall be rigid Polyvinyl Chloride (PVC) conforming to UL 651, Schedule 40, 80 Type EB and A Rigid PVC Conduit and Fittings.

624.2.7 Conduit Bodies, Boxes and Fittings

All conduit bodies, boxes and fittings shall be made watertight, dust tight and galvanized steel conforming to UL 5148, Conduit, Tubing and Cable Fittings. The terminal box on the module shall be designed for long-term outdoor operation in harsh environments with an opening for

replacing the cable if necessary.

624.2.8 Roadway Lighting Pole Concrete Footing

Roadway lighting pole footing shall be Class A concrete conforming to the requirements of Item 405, Structural Concrete.

624.2.9 Electrical Conductors and Grounding

Entire system shall be grounded and bonded in accordance with the requirements of the latest edition of Philippines Electrical Code and shall conform to the applicable requirements of National Electrical Code of the Philippines Chapter 2, Use and Identification of Grounded Conductors.

Grounding wire shall be made of bare copper stranded, soft drawn wire and shall be installed in one continuous length without splice or joint. Ground rods shall be made of copper-clad steel of not less than 20 mm diameter x 3 in in length driven in full length into earth. The size of the ground rod and ground wells shall be as shown on the Plans and the resistance shall not be more than 5 ohms.

All conductors and grounding size shall not be less than the indicated sizes as shown on the Plans.

624.2.10 Programmable Logic Controller

Lighting system for tunnels shall be controlled and monitored by the Supervisory Control and Programmable Logic Controller (PLC). The PLC base unit power supply shall be 100-230VAC,I/0 16 nos., I/P; 8 nos. 24 VDC, Relay O/P; 8 nos., and shall have a program memory of 64000 steps RAM (internal). It shall also have all necessary accessories and operational manual

624.2,11 Lighting Control Panel/Panel board

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

Panel board cabinets shall be designed and fabricated for pole surface mounted. Enclosures shall be fabricated to be watertight, dust tight, temper proof, dead front suitable for outdoor installation, and shall conform to the applicable requirements of the National Electrical Manufacturers Association (NEMA) 250, Enclosures for Electrical Equipment (1000 V Maximum), Type 3R, lockable with padlocks.

The panel board cabinets shall be designed and fabricated for pole surface mounted and shall be given two coats of light gray color both interior and exterior cabinet.

Conduit entry shall be at the top and bottom. A directory holder shall be provided inside the panel and ground lug for ground wire connection. Nameplate of laminated plastic shall be attached by means of stainless-steel rivets or permanent adhesive showing panel board number.

624.2.12 Circuit Breakers

All circuit breakers shall be plug in and thermal magnetic type, manually or electrically operated as required with ratings and capacity as shown on the Plans and shall be in accordance with UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

All circuit breakers shall have inverse-time tripping characteristics on overload and instantaneous trip on short circuits. It shall have quick make or break toggle mechanism, trip-free operating handle, and shall be equipped with arc quenches. Each multi-pole breaker shall be designed to have a common trip so that an overload or short on one pole will automatically cause all poles Of the breakers to open.

624.2.13 Terminal Connector

Connectors for wiring shall be rated at least 600 volts and shall be of the following types:

For 5.5 mm2 and smaller conductors/cables: Rugged material, such as phenolic, shall be mounted end-to-end without spacing. The pressure type tin plate copper connectors shall have nonflammable and self-extinguishing insulation with temperature rating equal to that of the conductor insulation.

For 8.0 mm2 and above conductors/cables: Type of construction shall be one-piece and material shall be phenolic. Terminal configuration shall be done by binding screw terminals. Solderless type connector made of compact, high strength, high copper alloy, split-bolt, and free running threads and highly resistant to corrosion and cracking shall be used. Maximum pressure and assure/secure connection on all combinations of run and tap conductors shall be provided.

624.2.14 Emergency Lighting System

ln case of power failure, a minimum lighting illumination level shall be immediately available from designated emergency light fixtures as well as from emergency exit signaling which are both deriving electric power from UPS Battery as indicated on the Plans.

The minimum lighting shall be available for 30 min to cover the necessary margin of elapsed time in-between power supply interruption and back-up power operation.

624.2.15 Main Feeder Distribution System

The main feeder distribution system shall be composed of conduit, electrical conductors and light control or panel board conforming to the material requirements specified herein.

624.2.16 Underground Electrical Works

Underground electrical works shall conform to the material requirements of Item 633, Cable Duct System.

624.2.17 Corrosion Protection

Ferrous metal raceways, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, nipples, fittings, supports, and support hardware shall be permitted to be installed in concrete or in direct contact with soil. Corrosion protection shall be provided in areas subject to severe corrosive influences where made of material approved for the condition, or where provided with corrosion protection approved for the condition as indicated in the Plans or as approved by the Engineer.

624.2.18 System Protection

All roadway lighting systems shall be protected by an overcurrent device. The overcurrent device shall be size rated or setting not higher than the allowable ampacity of the conductor. The circuit breakers shall be of the thermal magnetic type having inverse-time tripping characteristics on overload and instantaneous trip on short circuits, shall be equipped with arc quenches, shall have quick-make and quick-break toggle mechanism, and shall have trip-free operating handles. Each multi-pole breaker shall have a common trip so that an overload on one pole will automatically cause all poles of the breakers to open.

624.2.19 Testing

A full type test for luminaire shall be in accordance with IEC 60598-2-3. For the humidity test, it shall be carried out at a relative humidity around 95% and at an ambient temperature of 28°C.

LEDs shall have test reports from IESNA LM80-08 and TM-21-11 qualified for relevant LED product testing.

624.3 Construction Requirements

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

624.3.1 Roadway Lighting Poles

All roadway lighting poles shall be constructed of cold rolled mild steel of a sufficient gauge having yield strength of not less than 248.2 Mpa and shall be followed with a prime coat of paint within 24 h. The prime coat of paint shall be compatible with the finish ccrat of paint.

Pole shall be threaded at the top end of the foundation and adjustment shall be provided for permanent vertical position with the bracket arm in proper position for luminaire location and size as shown on the Plans.

The pole shall be provided with a hand hole and grounding lug attachment at the elevation and a cable entry slot sized and located as shown on the plans. The slot shall be free of burrs and sharp edges.

624.3.2 Luminaire Assembly

Luminaire assembly shall be strongly constructed, weatherproof, hail proof, insect proof,

corrosion proof, solar (including ultra-violet) resistant, and vandal resistant. It shall be mounted horizontally on a mast arm and shall be mechanically clamped to a 48-60 mm nominal diameter metal pipe end of the mast arm and adjusted to the required position using a clamping plate with at least two (2) -9.5 mm minimum diameter hexagonal head clamping bolts if applicable. The luminaire shall pass the IEC 60598 vibration test. The luminaire housing shall bear a nameplate that identify it as to type, rating, manufactured date, manufacturer and catalog data.

624.3.3 Ballast

Ballasts shall be of the encapsulated or vacuum impregnated type, the process of vacuum impregnation shall be such that the interstices of the windings are completely filled with the

Impregnating material. Connections shall be brought out to a suitable brass screw terminal block mounted on the ballast housing. Terminal blocks with steel screws will not be acceptable.

624.3.4 Conduit

All electrical conduits and fittings shall be installed in their correct positions and locations as shown on the Plans. The conduits shall be directly embedded in earth, except under paved areas and roadways, the conduit shall be encased in concrete and end of conduits shall be plugged with patching compounds at all outlets, or boxes at the ends of conduits to keep the conduits dry. Trenches in which the PVC conduits are laid shall follow the alignment as indicated on the Plans. In trenches and sidewalks, the PVC conduit shall be laid on 10 cm sand bed and covered by a layer of sand, 20 cm on thick measured from the upper level of the bed. For trenches under paved areas the same procedures shall be followed except the concrete shall be used in the place of sand. After placing the concrete, the remaining part of the trench shall be backfilled up to the sub-grade level with soil compacted properly. Cables shall be installed in one length from point to point and no joints shall be permitted. Before the cables are pulled, the Contractor shall see to it that the conduits are continuous and clear of debris, stone, and sand. Sharp bends shall not be permitted. A minimum covering of 0.45 in under the pavement shall be required for the conduits under the roadway.

624.3.5 Conduit Boxes, Boxes and Fittings

Conduit boxes for pulling and splicing wires and outlet boxes shall be provided for installation of wiring devices and. As a rule, junction boxes or pull boxes in all runs greater than 30 in in length, for horizontal runs. For other lengths, boxes shall be provided as required for splicing or pulling. Pull boxes shall be installed in inconspicuous but accessible locations. Conduit boxes shall be installed plumb and securely fastened. They shall be set flush with the surface of the structure in which they are installed where conduits are run concealed.

All conduits shall be fitted with approved standard galvanized bushing and locknuts where they enter cabinets and conduit boxes. Junction and pull boxes of code gauge steel shall be provided as indicated on the Plans or as required to facilitate the pulling of wires and cables.

624.3.6 Roadway Lighting Pole Concrete Footing

The shape of Roadway lighting pole concrete footing shall be as shown on the Plans.

Excavation and backfill for foundation including disposal of surplus material shall be provided. Excavated holes for concrete footings shall be neat or properly formed and fi.ee from loose materials when the concrete is placed.

When placed, the concrete shall be wall consolidated to completely fill and devoid in the hole and around the pole when embedded. Concrete shall be moist wired and for not less than 4 days.

Anchor bolt circle dimensions shall be furnished and rigid template shall be used to center the anchor bolts in the foundation with exposed threaded ends, at least three (3) threads vertically positioned in concrete. Unless otherwise specified, the template shall be oriented so that the mast arm of the lighting standard is perpendicular to the centerline of the roadway. The top of the concrete foundation shall be constructed in level and only shims used to rake the lighting standard shall be permitted. Shims with break-away couplings shall not be permitted. Each foundation shall have an imprinted arrow/s on the top of the foundation to indicate the direction of the cable duct run.

624.3.7 Electrical Conductors and Grounding

All electrical conductors and grounding shall be furnished and installed by the Contractor with the sizes as indicated on the plans. All connection shall be mechanically and electrically sound and secured by insulating tape. Solderless connectors of approved type shall be used for making connections of power cables. The insulations in then shall be built up again to normal thickness with rubber and vinyl plastic tapes. Splices in conductors shall only be made at pull boxes, hand holes or cabinets. No kicks or abrasions in the insulation or protection covering shall be found in installed conductors.

All grounding system installation shall be executed in accordance with the Plans. Grounding system shall include ground rods and ground wire taps as shown in the approved design. The ground wire is connected to the top or side of the ground rod. The ground rod, ground wire connection is made by a thermo-weld process. The wire and ground rod are required to be free of oxidized materials, moisture, and other contaminants prior to inserting the wire and the ground rod into the properly sized mold. The welding material is required to sufficiently cover and secure the conductor to the rod. The completed connection is required to be nonporous. This connection includes a quick-disconnect type connector kit so that in the event of a pole knockdown the connection readily breaks without damage to the buried conductor.

624.3.8 Lighting Control Panel/Panel board

All panel boards shall be installed by the Contractor at the locations indicated on the Drawings. All panels shall be of dead front construction furnished with trims for surface mounting. Electrical components shall be completely wired and installed in the enclosure in proper position and ready for operation. Power cables shall enter the panel board enclosure through conduits. All branch circuit conduits shall enter the panel board from the bottom.

624.3.9 Circuit Breakers

Circuit breakers shall be mounted so that any individual branch breakers can be removed

without disturbing adjacent units or without loosening or removing supplement insulation.

624.3.10 Test and Guarantee

Upon completion of the electrical construction work, the Contractor shall provide all test equipment. The Contractor shall then submit copies of all test results to the Engineer.

After the installation of all cables, the Contractor shall test the insulation resistance of all feeders and connected equipment with a 600 V megger for grounds and short circuits. testing shall include measuring of insulation resistance. These measurements shall be recorded by feeder and branch circuit number indicating the resistance values between phases and ground.

All effective and calibrated apparatus, materials and labor required for conducting tests shall be supplied and made available by the Contractor.

The Contractor shall guarantee that the electrical installation is done and in accordance with the Plans and Specifications.

624.4 Method of Measurement

The work under this item shall be measured either by pieces, set or lump sum, actually placed and installed as shown on the Plans.

The quantity of roadway lighting and electrical works to be paid for shall be the number of lighting poles of single and double luminaires to include all conduits, luminaires, all wirings, panel board, nuts, washer, fasteners, conduit clamps, bolts, capacitors, coils and others including all necessary materials and accessories needed for moisture and fungus control, corrosion protections and all other incidentals needed to make the system operational and accepted to comply with the requirements of the latest edition of the Philippine Electrical Code, and any other ordinances including payment of necessary permits from local enforcing authorities.

The concrete footing will be measured and paid for as provided under Item 405, Structural Concrete. The quantity of structural concrete to be paid for shall be the final quantity placed and accepted in the completed structure.

Reinforcing steel bars will be measured and paid for as provided under Item 404, Reinforcing Steel. The quantity to be paid for shall be the final quantity placed and accepted in the completed footing.

624.5 Basis of Payment

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

Pay Item Number	Description	Unit of Measurement
624 (8)	Solar Powered LED Flood Light (WaterProof)	Each

SPL 4 - AERATOR PIPE

Description

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

Material Requirements

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

Cast Iron Soil Pipes and Fittings

1. Pipes and fitting materials shall comply with the Specification requirements. whenever applicable, defined in ASTM A74, Standard Specification for Cast Iron Soil Pipe and Fittings. The material description and standards of manufacture are herein described.

a. Cast Iron - the casting shall be made of gray iron which shall be sound, free from cracks, sand holes and blow holes. They shall be uniformly low hardness that permits drilling and cutting by ordinary methods. Pipes and fittings shall be true to pattern and of Compact closed grained structure.

b. Quality of Iron - the iron shall be made by the cupola, air furnace, electric furnace or other processes which shall be checked by regular chemical and physical control test. The resultant shall be gray iron of good quality.

c. Manufacture - the pipes shall be made with hub and spigot ends or hub ends only. All hubs for pipes and fittings shall be provided with held lead grooves and all spigot ends shall be made with beads or plain if machine cast centrifugally. Plugs shall be wrought or cast, machined to the dimensions required and shall be free from defect.

d. Freedom from Defects- pipes and fittings shall be true, smooth and cylindrical, their inner and outer surfaces being as nearly concentric as practicable. They shall be in all aspects, sound and good casting free from laps, pin holes or other imperfections and shall be neatly dressed and carefully fettled. The ends shall be finished reasonably square to their axes.

2.) Each cleanout shall be installed so that it opens to allow cleaning in the direction of flow of

the soil or waste or at right angles thereto and, except in the case of wye branch and end-of-line cleanouts, shall be installed vertically above the flow line of the pipe.

Clean-outs shall be made of heavy cast brass ferrule with countersunk screw cover the same diameter as the pipe except that they shall not be larger than 100 mm diameter.

Cleanouts installed under concrete or asphalt paving shall be made accessible by yard boxes or by extending flush with paving with approved materials and shall be adequately protected.

3. Caulking lead shall be of molten type peg lead conforming to specification requirements defined in ASTM B29, Standard Specification for Refined Lead.

4. Oakum shall be twisted or braided hemp or abaca fibers slightly impregnated with oil.

Water Supply Pipes and Fittings

1. Pipes shall be galvanized iron pipe schedule 40 conforming to specification requirements defined in ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc-Coated, Welded and Seamless with threaded connection. Under roads where necessary shall suitably be protected as shown on the Plans.

Fittings shall be malleable iron Type II, galvanized iron conforming to specification requirements defined in ASTM A338, Standard Specification for Malleable Iron Flanges, Pipe Fittings, and Valve Parts for Railroad, Marine, and Other Heavy Duty Service at Temperatures up to 345°C.

Water pipe and fittings with a lead content which exceeds 8% shall be prohibited in piping systems used to convey potable water.

Where required for large diameter pipes (315 mm up to 800 mm) with elastomeric rubber sealed ring, the Oriented Polyvinyl Chloride (PVC-O) Cass 500 shall be in accordance with the applicable requirements defined in ISO 16422:2014, Pipes and Joints Made of Oriented Unplasticized Polyvinyl Chloride (PVC-O) for the Conveyance of Water under Pressure on ISO 1452:2009, Plastics Piping Systems for Water Supply and for Buried and Above-Ground Drainage and Sewerage Under Pressure – Unplasticized Poly(Vinyl Chloride) (PVC-U)

2. Valves

Valves for water supply shall be bronze body with threaded ends rated 21 kg/cm². All valves shall be gate valves unless otherwise specified. Gate valves shall have solid wedge body and discs conforming to specification requirements defined in ASTM B62, Standard Specification for Composition Bronze or Ounce Metal Castings. Globe valves shall | have plug type discs S with ferrule threaded ends and bronze body. Valves up to and including 51 mm in size shall be brass or other approved materials. Sizes exceeding 51 mm shall be permitted to have cast-iron or brass bodies.

3. Water Meter

Water meter when required to be furnished by the Contractor shall be of the type tested and

approved by Metropolitan Waterworks and Sewerage System (MWSS) or Local Water Utilities Authority (LWUA) or any agency/ (es) accredited by both.

Approved Alternate Pipes and Fittings

Pipes and fittings for sanitary and potable water lines as approved alternate shall be Unplasticized Polyvinyl Chloride Pipes and Fittings (uPVC).

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series) and PNS 65: 1993, Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply. Fittings shall be molded type and designed for solvent cement joint Connection for water lines and rubber O-ring seal joint for sanitary lines.

All materials shall bear Philippine Standards (PS) mark for locally manufactured and Import Commodity Clearance (ICC) marks duly issued by Bureau of Philippine Standards (BPS) for imported materials.

Polyvinyl Chloride (uPVC)- Potable Water

1. Pipes and fittings for water lines and pressure lines shall conform to PNS 65: 1993: - Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.

2. Pines and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass conforming to specification requirements defined in ASTM D2241, Standard Specification for Polyvinyl Chloride (PVC) Pressure-Rated Pipe (SDR Series).

3. Maximum levels of toxic substances shall conform to Table 3 of PNS 65: - Unplasticized Polyvinyl Chloride (uPVC) Pipes for Potable Water Supply.

4. Pipes and fittings for water lines, sizes 20 mm to 63 mm shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems.

5. Pipes and fittings for pressure lines, sizes 63 mm and larger shall be designed for manually-installed or machine-installed fixed seal gasket type jointing connection. Gaskets is to be made of Ethylene Propylene Diene Monomer (EPDM) rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced embedded in EPDM rubber gasket.

Unplasticized Polyvinyl Chloride - Non-Potable Water (Sanitary and Sewer Line)

1. Pipes and fittings for sanitary lines shall conform to PNS 1950, Plastic piping systems for soil and waste discharge (Low & High temp.) inside buildings - Unplasticized Polyvinyl Chloride (PVC-U), conforming to specification requirements defined in ASTM D2729, Standard Specification for Polyvinyl Chloride (PVC) Sewer Pipe and Fittings for pipes, and ASTM D3311, Standard Specification for Drain, Waste. and Vent (DWV) Plastic Fittings Patterns for fittings.

2. Pipes and fittings for sewer lines shall conform to Standard Dimension Ratio (SDR) 34 conforming to specification requirements defined in IS0 4435 Plastics Piping Systems for Non-Pressure Underground Drainage and Sewerage- Unplasticized Polyvinyl Chloride (uPVC).

3. Pipes and fittings shall be made of materials in its natural state with a medium K-Value, K65 grade resin by mass.

4. Pipes and fittings for sanitary and sewer lines, sizes 57 mm and larger shall be designed for solvent cement jointing connection conforming to specification requirements defined in ASTM D2564, Standard Specification for Solvent Cements for Polyvinyl Chloride (PVC) Plastic Piping Systems and/or machine-installed seal gasket type jointing connection. Gaskets is to be made of Engineered Natural Rubber homogeneously bonded to stiff polypropylene (PP) ring or metal reinforced NBR (Nitrile Butadiene Rubber)

Chlorinated Polyvinyl Chloride (cPVC)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in ASTM 2846 (CTS) SDR 11, Standard Specification for Chlorinated Polyvinyl Chloride (cPVC) Plastic Hot and Cold- Water Distribution Systems, with the use of one-step cPVC solvent cement In jointing method. Pipes and fittings shall be Heavy Metal-Free (HMF) as validated through Inductively Coupled Plasma Optical Emission Spectrometry (ICPOES) method.

High-Density Polyethylene (HDPE) Pipe

Pipes and fittings shall be made of materials in its natural state conforming to specification requirements defined in PNS-ISO 4427, Polyethylene (PE) Pipes and Fittings for Water Supply.

Polypropylene Random/ Copolymer (PPR/ PPR-C)

Pipes and fittings for hot and cold water line shall be designed conforming to specification requirements defined in DIN 8077- Polypropylene (PP) Pipes-PP H, PP-B, PP-R, PP-RCT-Dimensions and DIN 8078 - Polypropylene (PP) Pipes- PP-H, PP-B, PP-R, PP-RCT - General Quality Requirements and Testing for pipes and DIN 19560/16962 - Pipes and Fittings made of Polypropylene (PP) for hot water resistant waste and soil discharge systems inside buildings/Pipe Joint assemblies and fittings for types 1 and 2 polypropylene (PP) pressure pipes, tees and branches produced by segment inserts and necking for butt welding; dimensions for fittings or ISO 15874- Plastic Piping Systems for Hot and Cold Water Installations-Polypropylene (PP).

Ductile Iron

Ductile Iron shall be designed conforming to specification requirements defined in ASTM A536:2014 Standard Specification for Ductile Iron Castings, ASTM A756 Standard Specification for Ductile Iron Gravity Sewer Pipe and ASTM A377 Standard Index of Specifications for Ductile-Iron Pressure Pipe.

Plumbing Fixtures and Fittings

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

1. Water closet shall be vitreous China, free standing toilet combination, round front bottom outlet siphonic washdown bowl with extended rear self and closed coupled tank with cover complete with fittings and mounting accessories. Model make and color shall be submitted for approval prior to delivery at jobsite by the Engineer or unless otherwise specified on the Plans.

2. Plastic toilet bowl shall be a high quality polypropylene virgin material Composition, complete with integrated parts and other accessories or unless otherwise specified on the Plans.

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

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

Prohibited Fixtures

Water closets having an invisible seal or an unventilated space or having walls which are not thoroughly washed at each discharge shall be prohibited. Any water closet that might permit siphonage of the contents of the bowl back into the tank shall be prohibited. Drinking fountains shall not be installed in public toilet rooms.

Fire Protection System

Firestop materials shall be installed in accordance with Uniform Plumbing Code of the Philippines, the National Building Code of the Philippines, Fire Code of the Philippines and the manufacturer's instructions.

1. Fire hose cabinets shall be locally available consisting of 38 mm diameter valve hose rack with nipple 30 mm rubber lined hose cable with standing pressure of 4,268 kg/cm2, nozzle 38 mm diameter brass, chromium plated. Wet standpipes shall be located so that all portions of the buildings are within 6 m of a nozzle attached to 22 m of hose.

2. Fire standpipe system shall consist of risers and hose valves. Pipe shall be extra strong black iron. Valves to be high grade cast bronze mounted withstanding pressure of 79.40 kg/cm2, working pressure as indicated on the Plans.

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

4. Yard hydrant where shown on the Plans shall match the integrated Fire Department requirements. Outlet shall be single 63 mm diameter gate valves with chain connected caps.

5. Pipes and fittings for fire sprinkler piping system as approved alternate shall be made out of high grade Chlorinated Polyvinyl Chloride (CPVC) materials conforming to specification requirements defined in ASTM 1 F442 for pipes and ASTM F437, F438, F439 or F1970 for fittings.

6. For Steel pipe and fittings shall conforming to specification requirements defined in ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot- Dipped, Zinc-Coated, Welded and Seamless, ASTM A135 – Standard Specification for Electric-Resistance-Welded Steel Pipe and ASTM A795 - Standard Specification for Black and Hot-Dipped Zinc-Coated (Galvanized) Welded and Seamless Steel Pipe for Fire Protection Use.

7. Fire pumps where shown on the approved Plans shall conform to the Integrated Fire Department requirements, wherein the Fire Pump Motor shall be electric-driven and the overall system shall include an integrated Jockey Pump, Controller, and all the necessary accessories.

Built-in Appliances

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

Construction Requirements

The Contractor before any installation work is started shall carefully examine the Plans and shall investigate actual structural and finishing work condition affecting all his work. Where actual condition necessitates a rearrangement of tne approved pipe layout, the Contractor shall prepare Plan(s) of the proposed pipe layout for approval by the Engineer. For approved alternate pipes and fittings, installation work shall conform to the approved Plans or manufacturer's recommendation.

Installation of Soil, Waste, Drain and Vent Pipes

1. All cast iron soil and drainage pipes shall be pitch 6 mm per 300 mm but in no case flatter than 3 mm per 300 mm.

2. Horizontal lines shall be supported by well secured length heavy strap hangers. Vertical lines shall be secured strongly by hooks to the building frame and a suitable brackets or chairs shall be provided at the floor from which they start.

3. All main vertical soil and waste stacks shall be extended full size to and above the roof line to act as vents, except otherwise indicated on the Plans.

4. Vent pipes in roof spaces shall be run as close as possible to underside of roof with horizontal piping pitched down to stacks without forming traps. Vertical vent pipes may be connected into one main vent riser above the highest vented fixtures.

5. Where an end or circuit vent pipe from any fixtures is connected to a vent line serving other fixtures, the connections shall be at least 1.20 m above the floor on which the fixtures are located.

6. Horizontal waste line receiving the discharge from two or more fixtures shall be provided with end vents unless separate venting of fixtures is noted on the Plans.

7. All changes in pipe sizes on soil and waste lines shall be made with reducing fittings or recessed reducers. All changes in directions shall be made by appropriate use of 45 degrees wyes, half wyes, long sweep quarter bends or elbows may be used in soil and waste lines where the change in direction of flow is from the horizontal to the vertical and on the discharge from waste closets. Where it becomes necessary to use short radius fittings in other locations the approval of the Engineer shall be obtained prior to installation of the same.

8. All joints of cast iron pipes in bell and spigot shall be firmly packed with oakum or hemp and caulked with peg lead at least 25 mm deep.

9. Cleanouts at the bottom of each soil stack, waste stack, interior downspout and where else indicated shall be the same size as the pipe up to and including 102 mm, 152 mm, for larger pipes.

10. Cleanouts on floors shall be cast iron ferrule caulked into cast hub and fitted with cast brass Screw plug flush with floor. Cleanouts for threaded pipes shall be installed at the foot of soil, waste and drain stacks and on each building drain outside the building.

11. Vent pipe shall be flashed and made watertight at the roof with ferrule lead sheet. Flashing shall be turned down into pipes.

12. Each fixtures and place of equipment requiring connection to the drainage system except fixtures with continuous waste shall be equipped with a trap. Each trap shall be placed as near to the fixture as possible. Traps installed on threaded pipe shall be recessed drainage pattern.

13. Overhead horizontal runs of pipes shall be hung with adjustable wrought it on pipe hanger spaced not over 3.04 m apart except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart and located near a hub.

Water Pipes, Fittings and Connections.

All water piping inside the building and underground, 100 mm diameter and smaller shall be galvanized iron threaded pipe with malleable iron fittings, PVC-U, HDPE, PPR and ductile iron.

1. The water piping shall be extended to all fixtures, outlets, and equipment from the gate valves installed in the branch near the riser.

2. The cold water system shall be installed with a fall towards a main shutoff valve and drain. Ends of pipes and outlets shall be capped or plugged and left ready for future connections.

3. Mains and Branches

a. All pipes shall be cut accurately to measurements and shall be worked into place without springing or forcing. Care shall be taken so as not to weaken the structural portions of the building.

b. All piping above the ground shall be run parallel with the lines of the building unless otherwise indicated on the Plans.

c. All service pipes, valves and fittings shall be kept at sufficient distance from other work to permit finished covering not less than 12.5 mm from such work or from finished covering on the different service.

d. No water piping shall be buried in floors, unless specifically indicated on the plans and approved by the Engineer.

e. Changes in pipes shall be made with reducing fittings.

4. Drain Cocks

Pipe drain indicated on the drawings shall consist of 12 mm globe valve with renewable disc and installed at low points on the cold water piping so that all piping shall slope 100 mm in 30.5 m.

5. Threaded Pipe Joints

All pipes shall be reamed before threading. All screw joints shall be made with graphite and oil or with an approved graphite compound applied to make threads only. Threads shall be full cut and not more than three (3) threads on the pipe shall remain exposed.

6. Expansion and Contraction Pipes

Accessible contraction-expansion joints shall be made whenever necessary. Horizontal runs of pipe over 15 m in length shall be anchored to the wall to the supporting structure about midway on the run to force expansion and Contraction equally toward the ends or as shown on the Plans.

7. Pipe Standpipe System

Fire standpipe system shall consist of risers and valve. Pipe shall be extra strong black iron. Valves to be underwriter's approval high grade cast bronze mounted.

8. Valves and Hose Bibs

a. Valves shall be provided on all supplied fixture as herein specified.

b. The cold water connections to the domestic hot water heater shall be provided with gate valves and the return circulation connection shall have a gate and a check valve

c. All connection to domestic hot water heaters shall be equipped with unions between valve and tanks,.

d. Valve shall not be installed with its stem below the horizontal. All valves shall be gate valves unless otherwise indicated on the Plans.

e. Valves up to and including 50 mm diameter shall be threaded ends, rough bodies and finished trimmings, except those on chromium plated brass pipe.

f. Valves 63 mm in diameter and larger shall have iron bodies, brass mounted and shall have either screws or flange ends.

g. Hose bibs shall be made of brass with 12.5 inlet threads, hexagon shoulders and 19 mm male.

Fixtures, Equipment and Fastenings

All fixtures and equipment shall be supported and fastened in a safe and satisfactory workmanship as practiced.

All fixtures, where required to be wall mounted on concrete or concrete hollow block wall, fasten with brass expansion bolts.

Expansion bolts shall be 6 mm diameter with 20 mm threads to 25 mm into solid concrete, fitted with loose tubing or sleeves of proper length to acquire extreme rigidity.

Inserts shall be securely anchored and properly flushed into the walls. Inserts shall be concealed and rigid. Bolts and nuts shall be horizontal and exposed. It shall be provided with washers and chromium plate finish.

Pipe Hangers, Inserts and Supports

1. Pipe hangers shall be wrought iron or malleable iron pipe spaced not more than 3 mm apart for horizontal runs or pipe, except hub and spigot soil pipe which shall have hanger spaced not over 1.50 m apart located near the hub.

2. Chains, straps perforated turn- -bucklers or other approved means of waste lines or individual toilet rooms to maintain stacks when spaced does adjustment except the turn-buckles may be omitted for hangers on soil or waste lines or individual toilet rooms to maintain stacks when spaced does not permit.

3. Trapeze hangers may be used in lieu of separate hangers on pipe running parallel to and close to each other.

4. Inserts shall be cast steel and shall be of type to receive a machine bolt or nut after installation. Insert may be permitted adjustment of the bolts in one horizontal direction and shall be installed before pouring of concrete.

5. Wrought iron clamps or collars to support vertical runs of pipe shall be spaced not more than 6 mm apart as indicated on the Plans.

Plates and Flashing

1. Plates to cover exposed pipes passing through floor finished walls or ceilingd shall be fitted with chromium plated cast brass plates or chromium plated cast iron or steel plates on ferrous pipes.

2. Plates shall be large enough to cover and close the hole around the area where pipes pass. It shall be properly installed to insure permanence.

3. Roof areas penetrated by vent pipes shall be rendered watertight by lead sheet flashing and counter flashing. It shall extend at least 150 mm above the pipe and 300 mm along the roof.

Protection and Cleaning

1. During installation of fixtures and accessories and until final acceptance, protect items with strippable plastic or other approved means to maintain fixtures in perfect conditions.

2. All exposed metal surfaces shall be cleaned and polished upon completion.

3. Upon completion, thoroughly clean all fixtures and accessories to leave the work in polished

Inspection, Warranty Test and Disinfection

All pipes, fittings, traps, fixtures, appurtenances and equipment of the plumbing and drainage system shall be approved by the Engineer and inspected both by the Engineer and the Contractor's duly designated representative (Licensed Master Plumber or Sanitary Engineer) to insure compliance with all requirements of all Codes and Regulations referred to in this Specification.

Drainage System Test

1. The entire drainage and venting system shall have all necessary openings which can be plugged to permit the entire system to be filled with water to the level of the highest stack vent above the roof.

2. The system shall hold this water for a full 30 min during which time there shall be no drop greater than 102 mm.

3. Where only a portion of the system is to be tested, the test shall be conducted in the same manner as described to the entire system except that a vertical stack 3 m highest horizontal line to be tested may be installed and filled with water to maintain sufficient pressure or water pump may be used to supply the required pressure.

4. If and when the Engineer decides that an additional test is needed, such as an air to smoke test on the drainage system, the Contractor shall perform Such test without any additional cost.

Water Test on System

1. Upon completion of the rough-in and before connecting fixtures the entire cold water piping system shall be tested at a hydrostatic pressure 1 ½ times the expected working pressure in the system during operation and remained tight and leak-proofed.

2. Where piping system is to be concealed the piping system shall be separately in manner similar to that described for the entire system and in presence of the Engineer or his duly designated representative.

3. The water test shall be applied to the drainage and vent systems either in entirety or in sections. If applied to the entire system, all openings in the piping shall be tightly closed, except the highest opening, and the system filled with water to the point of overflow, If the system is tested in sections, each opening shall be tightly plugged except the highest opening of the section under test, and each section shall be filled with water, but no section shall be tested with less than a 3 m head of water. In testing successive sections at least the upper 3 m height of the preceding section previously tested shall be tested again so that no joint or pipe in the building (except the uppermost 3 m of the system) shall have been submitted to a test of not less than 3 m head of water. The water shall be kept in pipe system or in the portion under test, for at least 15 min before inspection starts. The system shall be tight at all joints.

Defective Work

1. The entire water distribution system shall be thoroughly flushed and treated with chlorine before it is operated for public use.

2. Disinfection materials shall be liquid chlorine or hypochlorite and shall be introduced in a manner approved as practiced or approved by the Engineer into the water distribution system.

3. After a contact period of not less than 16 h, the heavenly chlorinated water shall be flushed from the system with potable water.

4. Valves for the water distribution system shall be opened and closed several times during the 16h chlorination treatment is done.

As-Built Drawings

Upon completion of the work, the Contractor shall submit two (2) sets of prints with all as-built changes shown on the drawings in a neat workmanship manner.Such prints shall show changes or actual installation and conditions of the plumbing system in comparison with the original drawings.

Method of Measurement

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

Fixtures shall be measured by set, piece, square meter and/or lump sum.

Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 4	Aerator Pipe	Meter

E. LARVAL REARING TANKS (120 UNITS) WITH CONICAL HATCHING TANKS

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804 (1)	Embankment from Structure Excavation	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a	Reinforcing Steel (Deformed) Grade 40	Kilogram

SPL 1 - DEWATERING WORKS

Refer to SPL 1, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D of Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 Days	Cubic Meter

ITEM 1047 - METAL STRUCTURES

Refer to Item 1047, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum
1047 (10)	Metal Structure Accessories	Lump Sum

ITEM 1014 - PRE-PAINTED METAL SHEETS

1014.1 Description

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

1014.2 Material Requirements

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

1014.2.1 Pre-Painted Roofing Sheets

Pre-painted roofing sheets shall be fabricated from cold rolled galvanized iron sheets specially tempered steel for extra strength and durability.

It shall conform to the material requirements defined in PNS 67: 1985.

Profile section in identifying the architectural molded rib to, be used are as follows:

Regular corrugated, Quad-rib, Tri-wave, Rib-wide, twin-rib, etc.

Desired color shall be subject to the approval of the Architect/Engineer.

Gutters, Valleys, Flashings Hip and Ridge roll shall be fabricated from gauge 24 (.600 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 and rivets.

G.I. straps are of .500 mm thick x 16 mm wide x 267 mm long (gauge 26 x 5/8" x 10-1/2") and standard rivets.

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/m²)
55% Aluminum Zinc	14 microns (50 g/m²)
Zinc-5% Aluminum	14 microns (95 g/m²)
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	0.46 - 0.54
0.60	0.55 - 0.64
0.70	0.65 - 0.74
0.80	0.75 - 0.86

Note: Nominal thickness refers to the Total Coated Thickness (TCT) and defined as the sum of the Base Metal Thickness (BMT) and coating thickness

1014.3 Construction Requirements

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

1014.3.1 Handling/Lifting/Positioning of Sheets

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

1014.3.2 Installation Procedure

The laying of the roofing panels should begin on the end of the building away from the prevailing wind so that the side-lap seams face away from the prevailing wind-driven rain thus providing additional security against water penetration. Start roofing installation by placing the first sheet in position with the downturned edge in line with other building elements and fastened to supports as recommended. Fasteners should have corrosion resistance at least 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 place 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 100mm for vertical walling. For panel lapping, requirements depend on the product installation guide of a specific type of pre-painted 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.

1014.3.3 Gutters, Valleys, Flashing ridge and Hip rolls

Gutters, valleys, flashing ridge and hip rolls shall be fastened where indicated on the Plans by self-tapping screws or galvanized iron straps and rivets.Always begin flashing installation from bottom and work up, so that flashing are lapped on top of the lower flashing. This will prevent moisture from leaking under the flashing and into structure.

1014.3.4 End Laps

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

1014.3.5 Anchorage/Fastening

Pre-painted 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 use self-drilling screw No. 12 by 35 mm long hexagonal head with neoprene washer shall be used. For steel support up to 5mm 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 la[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 5mm diameter.

1014.3.6 Cutting of Sheets

In cutting pre-painted steel roofing sheets and accessories to place the exposed color side down. Cutting shall be carried out on the ground and not over the top of other painted roofing products. Power cutting or drilling to be done or carried out on pre-painted products already installed or laid in position, the area around holes or cuts shall be masked to shield the paint from hot fillings.

1014.3.7 Storage and Protection

Pre-painted steel roofing, walling products and accessories should be delivered to the jobsite in strapped bundles. Sheets and/or bundles shall be neatly stacked in the ground and if left in the open it shall be protected by covering the stack materials with loose tarpaulin.Bundles should be stored above the ground at a slight angle, to prevent water or condensation build up between adjacent sheets. Removing installation debris and metal fines due to drilling and cutting from the sheet surface and avoiding exposure of insulation to the weather shall be practice at all times.

1014.4 Method of Measurement

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

1014.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1014 (1)b2	Pre-painted Metal Sheets, 0.6mm, Rib type, Long Span	Square Meter

ITEM 1013 - CORRUGATED ROOFING

1013.1 Description

This Item shall consist of furnishing all plant equipment, tools, materials and labor required to properly perform and complete the corrugated metal roofing, together with related accessories such as ridge/hip rolls, valleys, gutters and flashing, when called for on Plans all in conformity with his Specifications.

1013.2 Material Requirements

1013.2.1 Corrugated and Plain Galvanized Iron Sheets

Corrugated galvanized iron (G.I.) sheets, including plain G.I. sheets for roofing accessories, shall be cold-rolled meeting ASTM A 153 and with spelter coating of zinc of not less than 0.381 kg/m² (1.25 ounces/square foot), conforming to ASTM A 525 OR pns 67:1985. Unless otherwise specified or shown on Plans roofing sheets shall be gauge 26 (0.48 mm thick) and provided in long span sizes to minimize end laps. Sheets shall weigh not less than 3.74 kg/m² and shall be marked or stamped showing the gauge, size, amount of zinc coating, brand and name of manufacturer. Test specimens shall stand being bent through 180° flat on itself without fracture of the base metal and without flaking of the zinc coating.

1013.2.2 Corrugated Asphalt Sheets

All corrugated asphalt roofing materials shall be delivered at the jobsite with labels affixed indicating the quality (including cellulose fiber), make type and thickness. Each roof in position shall withstand up to 200 km/h of wind pressure.

1013.2.2.1 Packaging and Marking

Asphalt roofing products may be slipped in container or bill of lading on bulk shipment as agreed upon by the manufacturer and the purchaser where each shall be marked with the following information:

1. Name of manufacturer or seller
2. ASTM designation
3. Type of product
4. Flash point
5. Equiviscous temperature (EVT) for map and for mechanical spreader application

1013.2.2.2 Dimensions

Dimensions for each delivered corrugated asphalt roofing sheet shall conform to the Table 1013.1.

Table 1013.1 Dimensions for Corrugated Asphalt Roofing

Physical Property	Dimension (mm)
Width	930.00 - 970.00
Length	1990.00 - 2010.00
Thickness	2.60 - 3.30
Pitch	90.00 - 100.00
Corrugated Height	35.00 - 40.00
No. of Corrugations	9.00 - 11.00

1013.2.2.3 Bitumen Properties

The oxidized bitumen prepared from crude petroleum shall be homogenous and free of water in which each type shall conform to the physical properties prescribed in Table 1013.2. This covers (4) types of asphalt intended for use in built-up roof construction, bituminous vapor retarded, and some modified bitumen systems and for adhering insulation boards used in various types of roof systems.Sampling shall conform to the requirements of ASTM D140M, Standard Practice for Sampling Bituminous Materials.

Table 1013.2 Physical Requirements of Asphalt Roofing

Property	Test Method	Type I		Type II		Type III		Type IV	
		Min	Max	Min	Max	Min	Max	Min	Max
Softeningpoint, ºC***	ASTM D36	57	66	70	80	85	96	99	107
Flash point, ºC	ASTM D92	260	…	260	…	260	…	260	…
Penetration, units at 25ºC	ASTM D5	18	60	18	40	15	35	12	25
Ductilityat 25ºC,cm	ASTM D113	10.0	…	3.0	…	2.5	…	1.5	…
Solubility in trichloro-ethylene,%	ASTM D2042	99	…	99	…	99	…	99	…

Note:

**** In cases where a disagreement exists between the Engineer and the Contractor, ASTM D 36 shall be used as the referee method.*

ASTM D36M - Standard Test Method for Softening Point of Bitumen (Ring-and-Ball Apparatus)

ASTM D92 - Standard Test Method for Flash and Fire Points by Cleveland Open Cup Tester

ASTM D5M - Standard Test Method for Penetration of Bituminous Materials

ASTM D113 - Standard Test Method for Ductility of Asphalt Materials

ASTM D2042 - Standard Test Method for Solubility of Asphalt Materials in Trichloroethylene

1013.2.3 Strap Fasteners

Strap fasteners shall be gauge 26 G.I. sheet 25 mm wide and sufficiently long to bend around up to the opposite face of purlin, with corners chipped off at the riveting ends.

1013.2.4 Rivets, Washers and Burrs

Rivets and washers shall be galvanized mild iron. Rivets shall not be less than 5 mm in diameter and 10 mm in length. Washers shall not be less than 1.5 mm thick and 20 mm in outside diameter. Washer's inside diameter shall provide snug fir to the rivet.

1013.2.5 Soldering Lead

Soldering lead shall have a composition of 50 percent tin and 50 percent lead, conforming to ASTM B 32.

Rivets and burrs for lap joints of gutters, downspouts and flashing shall be copper not less than 3.175 mm in diameter (No. 8).

1013.2.6 Fabricated Metal Roofing Accessories

Ridge/hip rolls, valleys, flashing and counter flashings, gutters and downspouts, whenever required, shall be fabricated from plain G.I. sheets. Ridge/hip rolls, flashings and counter flashings shall be gauge 26. Valleys, gutters and downspouts shall be gauge 24 unless otherwise specified on Plans. Wire basket strainers shall be galvanized, gauge 24.

Roof ventilators, whenever required shall be fabricated from gauge 26 plain G.I. sheets and constructed to the dimensions and details shown on Plans.

1013.3 Construction Requirements

1013.3.1 Preparatory Work

Preparatory Work to the installation of the corrugated G.I. roofing, purlins should have been placed and spaced properly to fit the length of roofing sheets to be used such that the centerline of the purlins at end laps are 150 mm from the bottom line of end laps and intermediate purlins are place equidistantly. Top of purlins should be at the same plane.

1013.3.2 Installation of Corrugated Roofing Sheets

1013.3.2.1 General

Valleys, ridge/hip rolls and flashings when required, shall be installed before fastening the

roofing sheets with galvanized straps and rivets. One strap shall be riveted at each alternate corrugation at the gutter line, the ridge line and at end laps and the straps bent around and nailed to the purlins. Riveting at intermediate purlins between end laps shall be done at every fourth corrugation. Rivet shall be provided with a galvanized mild iron washer below and one (1) lead and one (1) galvanized iron washer above the sheet. Rivet shall be sufficiently long to permit forming a hemispherical head. Riveting shall be done such that the lead washer shall be compressed to provide a watertight fit around the rivet.

1013.3.2.2 Installation of Corrugated Metal Roofing

Installation of corrugated G.I. sheets with end laps shall start at the lower part of the roof and proceed towards the direction of monsoon wind with side laps of two-and-a-half (2-1/2) corrugations. End laps shall be 250 mm minimum. Each sheet shall be fastened temporarily by 1.83 mm diameter by 25 mm long galvanized flat head nails at valleys of corrugations covered by side or end laps.

Succeeding upper rows of corrugated G.I. sheets shall be installed in the same manner until the entire roof area is covered.

1013.3.2.23 Installation of Corrugated Metal Roofing

Installation of Corrugated asphalt sheets with end laps shall start at the lower part of the roof and proceed towards the direction of monsoon wind with side laps of at least one (1) corrugation. End laps shall be 200 mm minimum. Each sheet shall be fastened temporarily by 1.83 mm diameter by 25 mm long galvanized flat head nails at valleys of corrugations covered by side or end laps.

Sheets at first stage shall be hanged over at 70 mm maximum.

Succeeding upper rows of corrugated asphalt sheets shall be installed in the same manner until the entire roof area is covered.

1013.3.3 Installation of Roofing Accessories

1. Ridge and Hip Rolls

Ridge and hip rolls shall lap at least 250 mm over roofing sheets and, together, shall be riveted at every second corrugation.

2. Valleys

Valleys shall lap at least 450 mm each way under the roofing sheets and shall be secured to the framework with galvanized nails, such nails placed below the roofing sheets. Rivets along side of the valley shall be at every second corrugation.

3. Flashing

Flashing, of gauge 26 plain G.I. sheets, unless otherwise specified, shall be installed along intersections of roofs with concrete or masonry walls in accordance with details shown on

Plans. Flashing running parallel to sheet corrugation shall lap at least two corrugations with edge turned down. Flashing across sheet corrugation or at an angle thereto, shall lap at least 250 mm and the edge of flashing turned down at each corrugation. The vertical portion of flashing adjoining wall shall be at least 200 mm wide and provided with counter flashing.

4. Counter Flashing

Counter flashing sheets of gauge 24 plain GI shall be built into preformed wedge-shape groove of concrete or masonry wall. The edge to be built into wall groove shall have a 25 mm strip bent 45 degrees and shall be sealed in the groove with cement mortar or caulking compound.

5. Reglets

Reglets when required per plans in connection with counter flashing shall be fabricated products approved by the Engineer, complete with fittings. Reglets shall be located not less than 200 mm or more than 40 mm above roofing. Reglet plugs shall be spaced not more than 300 mm on centers. Open-type reglets shall be filled with fiber board or other suitable separator to prevent crushing of the slot during installation. The counter flashing shall be inserted into the full depth of reglet and the reglet lightly punched- every 300'mm to crimp the reglet and the counter flashing together.

6. Gutters

Gutters, from gauge 24 plain G.I. sheets, shall be fabricated to the shape and dimensions indicated on the Plans. The rear side of the gutter shall have a 12.5 mm strip bent 30 degrees and shall be not less than 12.5 mm higher than the opposite side. Gutter joints shall be flat seam folded in the direction of flow and soldered evenly. Otherwise, gutter joints shall be lapped at least 25 mm, fastened together with 3.175 mm diameter (No.8) copper rivets and burrs, and sealed by soldering along both exposed edges of lap.

Gutter shall be attached to fascia board or roof nailer with galvanized nails or screws spaced at not more than 900 mm on centers and at a point slightly higher than leading edge of gutter. As additional support, gutter shall have plain G.I. strap hangers 25 mm wide fastened to roof nailers by screw shank-type nails and riveted to the gutter':; leading edge. Strap hangers shall be spaced at not more than 900 mm on centers. When shown on Plans that gutter is not fixed to fascia board or purlin, gutter shall be supported by wrought iron (W.I.) hangers not less than 4.75 mm thick and 19 mm wide spaced at not more than 900 mm on centers. W.I. hanger shall be fabricated to fit configuration of the gutter and attached to fascia board or purlin with two (2) No.8 flat head wood screws.

Gutter shall be installed with a pitch of 1 in 100 slopes to downspout.

7. Downspouts

a. Downspouts

Unless specified otherwise, downspouts shall be plain G.I., thickness fabricated to the dimensions shown on the Plans and installed at indicated locations. Downspout shall be

secured to the wall with G.I. straps 25 mm wide, spaced at more than 1000 mm and anchored with concrete nails. Inlets of downspouts shall be fitted with gauge 14 wire basket strainers.

b. Unplasticized Polyvinyl Chloride Downspouts

When shown on Plans that downspout are other than G.I. sheets, downspouts shall be unplasticized polyvinyl chloride (UPVC) pipes and fittings with dimensions indicated and conforming with ASTM D 3033 and D 3034.

Joints shall be made with either solvent cement or rubber "O-rings" depending on the design of fitting for the joints. Rubber "O-rings" shall be neoprene type, heat and oil resistant, complying with ASTM F-477. Downspout shall be secured to adjoining wall with plain G.I. straps 25 mm wide and spaced at not more than 1000 mm.

8. Roof Ventilators

Roof ventilators, whenever shown on Plans shall be firmly secured to the roofing or roof structure by means of rivets, Roof ventilators installed on the roof at places other than the ridge shall be provided with adequate flashing around intersection with roofing to ensure watertight joints.

1013.3.4 Joints of G.I. Roofing Accessories

1. Soldered Joints

Joints made by lapping coupled with riveting shall be rendered watertight by soldering. All edges of uncoated sheet metal to be soldered shall be pretinned before soldering. Soldering shall be done slowly with well heated iron in order to thoroughly heat the seam and sweat the solder completely through the full length of the seam. Upon completion of soldering, acid shall be neutralized by washing thoroughly with water.

2. Non-soldered Joints

Non-soldered joints of G.I. gutters, downspouts and flashings shall be done by flat lock seams. Two adjoining edges of lock seam shall be bent 90°. One bent strip shall be at least 15 mm wide and the connecting piece shall have a bent strip twice in width which shall be bent down over the upturned narrower strip and pressed together. Once properly interlocked, the joint shall be flattened such that the edge of the wider strip be concealed.

1013.3.5 Roof Installation on Metal Purlins

Installation on metal purlins shall follow the same procedure as that on wood purlins, except that fastening shall be done with thread-cutting, zinc-coated steel screws, No. 12 by 50 mm. having hexagonal heads and provided with neoprene washers. Screw holes shall be drilled using 5 mm (13/64") diameter bit.

1013.3.6 Water Leak Test

The completed roofing shall be tested for water tightness at side and end laps at joints of roofing sheets with ridge/hips rolls, valleys and flashings by means of water spray system. The water-spray system shall have nozzle which will deliver water pressure of 2 kg/cm2 directly to

the joint being tested in such manner and for a duration directed by the Engineer. All defective works as determined by this test shall be remedied by the contractor at his expense and the test shall be repeated until the work is found satisfactory.

1013.4 Method of Measurement

Roofing sheets shall be measured and paid for on an area basis in square meters or part thereof, such roofing sheets including all laps, fasteners and rivets as installed complete and accepted.

Ridge/hip rolls, flashings, valleys, gutters and down-spouts shall be measured in linear meter of completed and accepted work; such measurement shall include necessary straps and fixings required for complete installation.

Roof ventilators shall be measured and paid for per unit completely installed and accepted.

1013.5 Basis of Payment

Payment for completely installed and accepted roofing sheets and required fabricated metal roofing accessories shall be based on actual measurement and the corresponding contract unit price thereof. Payment based on contract unit price shall constitute full compensation.

The different pay Items under roofing work shall be designated the following number, description and unit of measure:

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1013 (2)	Fabricated Metal Roofing Accessory, 0.6mm thick	Linear Meter

SPL 5 - 1.50 MM THK. FIBERGLASS SKYLIGHT ROOFING, GRADE A

Description

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

Fiberglass sheets/panels can be used for stage backdrops, wall partitions, skylight roofing,

canopies, car garage and walkways.

Material Requirements

Fiberglass Sheets/Panels

Fiberglass sheets shall be made up of fiberglass resin in accordance with the characteristics indicated on Table 1 and physical and structural properties indicated on Table 2 for applications requiring material which offers high light transmission, thermal insulation, light in weight yet strong, high shock resistance, flame retardance, great economy, vandal resistance and design flexibility. Profile section shall be indicated on the approved Plans. Desired color shall be subjected to the approval of the Architect/Engineer.

Fiberglass sheet/panel thickness shall correspond to the relative span available locally and shall be subjected to the approval of the Architect / Engineer.

Fastening hardware shall be of screws that are compatible with fiberglass sheeting. The choice of type and nature of screws shall be the responsibility of the Contractor installing the material and should be adapted with accordance to the type of supports being used.

Construction Requirements

Handling and Cleaning of Sheets

Sheets can be cleaned with warm soap and a soft sponge. This should be done regularly. Large areas shall be professionally washed by high-pressure water jet, possibly adding a mild compatible detergent end/or a steam jet. Take care not to scrape or scratch the sheet. Rinse thoroughly. Avoid dry cleaning.

Installation Procedure

Before any installation works commenced, the underside masking of the sheets/panels shall be removed.

Never step on the sheets between the purlins or in the middle of a framed glazing, In emergency step only on the line of purlins or of structural forming.

The Contractor shall ensure that the roof pitch is at a minimum of 50 (87 mm per 1000 mm), to provide correct water run-off. If a flatter pitch is required additional weatherproofing shall be required and shall be Subjected to the approval of the Architect/ Engineer.

Allow an overhang of 50 mm at the roof edge or gutter line, To avoid damage in high wind areas. do not exceed 50 mm. For roof laying start with the lower sheets first

The lengths of fiberglass sheets/panels should overlap 200 mm. Side overlaps differ for each other profile as indicated on the approved Plans.

Fiberglass sheets/panels can be bended without heating and should be bended along the rib channels in the direction of the slope.

Fastening and Spacings

Before drilling, make a small hole with a nail of bradawl to avoid drill travel. Holes should be approximately 3 mm larger than the stem of the fixing button to allow for expansion and should be positioned at least 40mm from the edge of the sheets.

Screens should be fastened depending on the profile indicated on the plans. An electric screwdriver with an adjustable clutch should be used to tighten the screws. Avoid over tightening which might include undue internal stresses, causing premature failure and buckling to the sheet.

The Contractor shall pay attention to insert the screws perpendicular to the material face, as inclined insertion could damage the sheet and/or result in leaks. Allow for expansion and contraction while still fixing firmly.

Sealing

The Contractor shall ensure the use of the proper type of sealing tape according to the glazing form used verifying that the prepared sheets are mounted correctly. In case of curved installation, where both open ends are situated at the bottom – apply the ventilated tape on both ends. Incorrect sealing will damage the sheets and void the warranty.

Cutting

Fiberglass sheets/panels shall be cut with standard wood or metal workshop equipment. Saw blades designed especially for plastic yield best results. A circular saw (fixed or portable, with small teeth suited for hardware), rotating at high speed band sew or a jig saw' (best for short, complex cuts) can all be used, taking care to advance the blade slowly. A hand and hacksaw may also be used for local cutting. Ensure that the sheet is properly supported before cutting.

Removing Protective Film

When masking, drilling and cutting has been completed, peel back approximately 50mm of film all round both faces. Premature removal of picture polyethylene film may result in damage to the sheet during handling. The protective polyethylene film should only be fully removed when installation is complete.

Storage and Protection

Sheets/panels shall be padded, packaged and flattened out in good condition during storage and transport. Store sheets on a flat surface in a well-protected area away from direct sunlight. Prevent moisture getting between stored sheets. Avoid chemicals, paint, adhesives and other synthetic materials that are not compatible with fiberglass sheeting. All sheets shall be shipped with protective polyethylene film.

Method of Measurement

The work done under this Item shall be measured in linear meter of covered or installed with fiberglass roofing and/ or walling and accepted to the satisfaction of the Engineer / Architect

Basis of Payment

The actual length of fiberglass roofing and/ or walling in linear meter, shall be paid for at the unit bid or contract unit price which payment shall constitute full compensation including labor, materials, tools and incidents necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 5	1.50mm thk. Fiberglass skylight roofing, grade A	Square Meter

ITEM 1016 - WATERPROOFING

Refer to Item 1016, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement
1016	Waterproofing	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)a	Painting Works, Masonry/Concrete	Square Meter
1032 (1)c	Painting Works, Steel	Square Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a6	Pipe and Fittings, 75 mm dia., PVC, Series 1000	Meter
1001 (1)a7	Pipe and Fittings, 100 mm dia., PVC, Series 1000	Meter

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (3)e	PVC Pipes (blue) with Fittings, 50mm. dia.	Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay ItemNumber	Description	Unit of Measurement
1001 (9)	Storm Drainage and Downspout	Lump Sum
1001 (5)a	Catch Basin, CHB	Each

ITEM 1100 - CONDUITS, BOXES AND FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1100 (10)	Conduits, Boxes & Fittings (Conduit Works/ Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1101 (2)b2	Electrical wire, 3.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b3	Electrical wire, 5.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b7	Electrical wire, 30mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b10	Electrical wire, 60mm² TW/THHN/THWN², Stranded	Meter

ITEM 1103 - LIGHTING FIXTURES

1103.1 Description

This Item shall consist of furnishing all lightning fixtures, accessories and fixings necessary for installation as shown on the Plans and in accordance with this Specification.

A light fixture or luminaire is an electrical device to create artificial light that serves as a tool to direct light using reflective and shielding materials.

1103.2 Material Requirements

1103.2.1 General

All fixtures shall be suitable for 220 V single phase 60 Hz power supply system. They shall be complete with accessories and fixings necessary for installation. Fixture housing, frame or canopy shall have a suitable cover for the fixture outlet box or fixture opening.

Wiring within the fixture and for connection to the branch circuit wiring shall not be less than 1.5mm2 or equivalent for 250 V application.

Insulation shall be silicon rubber for the lower temperature (fluorescent fixtures) and impregnated asbestos for the higher temperatures (incandescent fixtures).

All materials to be used for lighting fixtures shall be in accordance with the Plans and Specifications.

The fixtures shall be completely free from burrs and tool marks, and solder shall not be used as a mechanical fastening device on any part of the fixture.

The color rendering index (CRI) scale shall be used to compare the effect of a light source on the color appearance of its surrounding.

A scale of 0 to 100 defines the CRI. CRI shall not be less than 65. Under higher CRI sources, surface colors appear brighter, improving the aesthetics of the space.

Table 1103.1 Efficacy Ranges of Various Lamps

Lamp Type	Rated Power Ranges (watts)	Efficacy Ranges (lumens/watt)
Linear/Tubular Fluorescent Lamp		
Halophosphate	10 – 40	55 – 70
Triphosphor	14 -65	60 – 83
Compact Fluorescent Lamp CFL	3 – 125	41 – 65
Light Emitting Diode (LED)	3 – 100	80 – 95
Incandescent Lamp	10 – 100	10 – 25
Mercury Vapor Lamp	50 – 2000	40 – 63
Metal Halide Lamp	Up to 1000	75 – 95
Low Pressure Sodium Lamp	20 – 200	100 – 180
High Pressure Sodium Lamp	50 – 250	80 - 130

1103.2.1.1 Interior Lighting Fixtures

1. Linear Fluorescent Fixtures

   a. It shall be suitable for single or twin approximately 1.20 m of 40 watts alternatively 36 watts fluorescent tube as specified. It shall be complete with low loss heavy duty ballast(s), starter(s) and power factor improvement capacitor.

   b. It shall be decorative commercial or industrial type as specified. In case of industrial type, stove/vitreous enameled reflector shall be provided wherever specified. In case of decorative luminaire, Opal Acrylic diffuser/square polystyrene/vertical metal louvers shall be provided as specified.

   c. The fixture shall be surface or recessed mounted as indicated on the Plans. In some cases, single/twin tube fixtures for Offices/Commercial areas shall be decorative recessed

mounting type with specially designed aluminum bright anodized reflectors. It shall have a bat wing wide spread distribution light and high optical efficiency. The reflector shall have Matt anodized cross louvers to minimize glare.

d. Only single and/or two lamp ballast shall be used in any one fixture Ballast shall be completely enclosed inside sheet steel casing, and shall have a corrosion resistant finish. Ballast shall contain a thermosetting type compound not subject to softening or liquefying under any operating conditions or upon ballast failure. Under no condition shall the thermal device permit the enclosure temperature of the ballast to exceed 90°C. Make sure that the compound shall not support combustion.

e. All fluorescent fixtures shall be provided with white lamp holders while industrial type shall have turret type lamp holders.

f. Surface mounted fixtures longer than 600 mm shall have one (1) additional point of support besides the outlet box fixture stud when installed individually. Pendant individually mounted fixtures 1.2 m long and small-sized shall be provided with twin stem hangers. It shall have ball aligners or any similar device and having a provision of 25 mm (minimum) vertical adjustment.

g. Items with appropriate length to suspend fixtures are required mounting height as specified on the approved Plans.

h. Lamps shall be rapid or trigger start, bi-pin base and minimum approximate rated life of 20,000 hours.

2. Compact Fluorescent Fixtures

There are two (2) units specified under this type of fixture:

a. Integral units – Theses consist of a compact fluorescent lamp and ballast in self-contained units. Some integral units also include a reflector and/or glass enclosure.

b. Modular units – The modular type of retrofit compact fluorescent lamp is similar to the integral units, except that the lamp is replaceable.

Considerations before the Installation include:

a. Reflectors shall be clear, with integral white trim ring, unless noted otherwise. Open reflectors shall have a minimum 18 mm diameter.

b. Fixture installed outdoors and over food handling areas shall be lensed.

c. Fixtures installed in shower locations shall be provided with flush type plastic reflector with opal lens.

Special Application and Function

a. Teleconferencing areas shall have fixtures which match and are compatible with existing facility installations, including lamp type, lamp color, fixture and lens type, controls, and

minimum lighting levels for the vertical and horizontal planes.

b. Low voltage fixtures utilizing MR16 lamps shall be lensed.

c. “Clean-room” type fixtures for high purity areas and special laboratory functions shall be triple gasketed, with sealed cam latches.

d. Warning signs (In Use, Beam On, X-Ray in Use, etc.) shall be light emitting diode (LED) illuminated with housing and face color as specified.

e. Task lights shall be equipped with and integral rocker switch. Where two or more task lights are located in a room, a wall switch shall be installed at the entry door for control.

1103.2.1.2 Environmental Rooms and Exterior Lighting Fixtures

Enclosures shall be complete with gaskets to form weatherproof seal where no water can enter or accumulate in wiring compartments, lamp holders, or other electrical parts. It shall be provided with low temperature ballasts starting at 0 °C.

Garden and driveway lighting fixtures requirements:

1. It shall be suitable for mounting of GI poles 2 m to 3 m height. The fittings shall be waterproof, robust and shall have components which are not easily corroded.

2. The Connectors shall be easily accessible and suitable for a minimum 2 x 4 mm2 PVC aluminum conductor cables.

3. The appearance with the reflector/shade shall be pleasing and aesthetic.

4. The fittings shall be suitable for mounting GLS lamps/ MLL blended lamps/80W/125W/ High Power Micro Wave (HPMW) /70W High Pressure Sodium Vapor (HPSV).

1103.2.1.3 Return Air Troffer

1. The return air troffer where indicate on the Plans, shall have white enamel finish, 4 mm clear prismatic acrylic lens, and shall be recessed in inverted “T” bar ceiling.

2. It shall have the capacity to handle 20 CFM of return air through the side slots of the nominal 1.2 m long fixture (without return air attachment) with a total pressure drop from the rooms to the return air ceiling plenum not to exceed 1.27 mm.

1103.2.2 Emergency Exit Signs

1. Provide exit signs with red Light-Emitting Diode (LED) illumination.

2. Exit signs shall have covers that are composed of a black face and body, smooth red diffusion material, with 152mm high red letters on black background, directional arrows as indicated. Individual LED’s shall not be visible through the diffusion material.

3. Fixtures installed in the areas shall have minimum five (5) year warranty.

4. Exit signs shall be rated for auto-volt (100-240) with back-up power supply.

1103.2.3 Lamps

1. Pin-based compact fluorescent lamps shall be quad or triple tube, 13,18, 26 or 32 watt similar to NEMA lamp type CFQ13W/G24Q/835 or sizes shall be acceptable. Compact fluorescent lamps shall be 3,500K color temperature. Original equipment manufacturer lamps that are only available from a single manufacturer shall not be acceptable.

2. Linear fluorescent rapid or instant-start lamps shall be medium bi-pin with minimum CRI of 85. If different lamp manufacturers are submitted, no noticeable difference in color temperature shall be allowed and performance shall be equal to or better than the base lamp. T-8 fluorescent lamps shall have a color temperature of 4,100K and be specified in 610 mm, 915 mm and 1,220 mm lengths only. Linear 1.2 m lamps used in open fixtures in environments below 21°C. or in operation rooms, shall be full wattage type.

3. Metal halide High Intensity Discharge (HID) lamps shall be ceramic metal halide type, clear, unless noted otherwise, with mogul or medium bases. Acceptable medium base lamp sizes are 50, 100 and 150 watts. Double-ended lamps are not acceptable. Any base type other than medium or mogul shall be submitted for Engineer's review and approval in advance. Metal halide fixtures shall be lensed or utilize a lamp (PAR type) which does not require special arc tube protection.

4. Cold cathode, neon, T-5 and T-2 systems shall not be approved for use.

5. The use of LED, induction and fiber optic lighting systems for special applications shall be approved by the Engineer.

6. Lamps, including linear fluorescent, compact fluorescent and high intensity discharge, shall be low-mercury and shall pass all federal Toxicity Characteristic Leaching Procedure (TCLP) test requirements at the time of manufacture.

1103.2.4 Ballast

1103.2.4.1 Ballast for Fluorescent

1. High frequency (20 kHz or greater) electronic type.

2. Total Harmonic Distortion (THD) shall be less than 10%.

3. Power factor shall be greater than or equal to 95%.

4. Ballasts shall operate with 265 MA lamps.

5. Unless noted otherwise (such as dual switching, etc.), provide one ballast per fixture.

6. All ballasts shall be auto-volt rated.

7. Ballasts shall be Class P minimum thermally protected.

1103.2.4.2 Ballasts for Compact Fluorescent Lamps

1. All ballasts shall be of high-power factor and capable of independent switching, if two (2) ballasts are provided with a fixture.

2. Dimming ballasts shall be electronic and compatible for line voltage or control wire dimming systems as specified on the Plans.

3. Ballast shall be magnetic for 2-pin lamp application. Electronic ballasts for other applications shall be submitted for Engineer's approval in advance.

1103.2.4.3 Ballasts for High Intensity Discharge (HID) Lamps

1. HID ballas shall be of the lead-peak auto-transformer type of metal halide lamps. The ballast shall start and operate the lamp at ambient temperatures ranging from minus 7°C to 41°C. All ballasts shall have automatic thermal protection, and high power factor, minimum of 90%. Ballasts for interior applications shall be encased and potted, or be of the electronic type.

2. HID ballasts for M90, M130, M139 and M140 rated lamps shall be electronic-type.

1103.3 Constructions Requirements

1103.3.1 Locations

1. Wet and Damp Locations – It shall be installed in areas where no water can enter or accumulate in wiring compartments, lampholders, or other electrical parts and shall be marked with "Suitable for Wet Locations" based on the Philippine Electrical Code (PEC) Part 1.

2. Corrosive Locations – Ferrous metal shall be bonded and given a corrosion resistant phosphate treatment or other approve rust inhibiting prime coat before application of finish.

3. Fixtures in Indoor Sport, Mixed-use, and All-Purpose Facilities – Fixtures subject to physical damage, using mercury vapour or metal halide lamp, installed in playing and spectator seating areas of indoor sports, mixed-use or all-purpose facilities shall be of the type that protects lamps with a glass or plastic lens. Such fixtures shall be permitted to have additional guard.

4. Fixtures Near Combustible Material – Fixtures shall be installed, or equipped with shades or guards so that combustible material is not subjected to temperatures in excess of 90 °C in compliance with the hazardous are of PEC, Part 1.

5. Fixtures Over Combustible Material – Lampholders installed over highly combustible material shall be of the unswitched type. Unless an individual switch is provided for each luminaire (fixture), lampholdders shall be located at least 2,400 mm above the floor or shall be located or guarded so that the lamps cannot be readily removed or damaged.

6. Fixtures in Shows Windows – Chain-supported fixtures used in a show window shall be permitted to be externally wired. No other externally wired fixtures shall be allowed.

7. Fixtures in Clothes Closets – fixtures in clothes closets shall be permitted to be installed as follows:

a. Surface-mounted fluorescent or LED fixtures installed on the wall above the door or on the ceiling, provided there is a minimum clearance of 300 mm between the fixture and the nearest point of a storage space.

b. Surface-mounted fluorescent or LED fixtures installed on the wall above the door or on the ceiling, provided there is a minimum clearance of 150 mm between the fixture and the nearest point of a storage space.

c. Recessed fluorescent or LED fixtures with a completely enclosed lamp installed in the wall or the ceiling, provided there is a minimum clearance of 150 mm between the fixture and the nearest point of a storage space.

d. Recessed fluorescent or LED fixtures installed in the wall or the ceiling, provided there is a minimum clearance of 150 mm between the luminaire (fixture) and the nearest point of a storage space.

1103.3.2 Installation

1. Installation shall conform to the specifications of the PEC Part 1 and in accordance with the manufacturer's written instructions.

2. Building electrical system requirements shall be checked. Regardless of the catalog number prefixes and suffixes shown, fixtures shall be furnished with the proper trim, frames, supports hanger, ballasts, voltage rating, and other miscellaneous appurtenances to properly coordinate with the project conditions.

3. The type of ceilings to be installed shall be checked in each room and verify that the recessed lighting fixtures are proper for the type of ceiling to be installed before ordering fixtures. A frame compatible with the type of ceiling shall be provided in which the recessed lighting fixture is installed. The specified ceiling type shall be referred to the Architectural Room Finish Schedule.

4. Fixtures shall be securely attached to the ceiling-framing members by mechanical means. Clips identified for use with the type of ceiling framing members (s) and fixtures (s) shall also be permitted. Lighting fixtures shall be fastened in areas where there is no ceiling securely installed to the structure.

5. Immediately before final observation, all fixtures shall be cleaned, inside and out, including plastics and glassware, and all trim shall be adjusted to properly fit adjacent surface, broken or damaged parts and lamps shall be replaced, and all fixtures for electrical as well as mechanical operation shall be tested.

6. Installed fixtures shall be protected from damage during the remainder of the construction period.

7. When replacing an existing fixture, the old fixture shall be disconnected and removed.

8. Pendant fixtures within the same room shall be installed plumb and at a uniform height from the finished floor. Adjustment of heigh shall be made during installation as per Architect's instructions.

9. Flush mounted recessed fixtures shall be installed so as to completely eliminate light leakage within the fixture and between the fixture and adjacent finished surface. It shall be rigidly secured to as fixture stud in the outlet box. Extension pieces shall be installed where required to facilitate proper installation. Recessed fixtures shall be constructed so that all components are replaceable without removing housing from the ceiling.

10. Fixture shall be completely wired and constructed to comply with the regulations and standards of PEC, Part 1 for electrical lighting fixtures, unless otherwise specified.

1103.3.3 Wiring

Wiring of Fixtures shall comply with the existing standards of the PEC Part 1.

1. Lighting fixtures shall be connected to a typical metal conduit, junction box, and wire lighting grid system. MC (Metal-Clad Cable) and FMC (Flexible Metal Conduit), when permitted to be used, shall be properly concealed to prevent physical damage. Exposed MC and FMC installations shall not be acceptable.

2. Modular cabling, flexible whip assemblies, feed through wiring, 'daisy-chain' feeds, tandem wiring and other similar wiring methods shall not be acceptable for the lighting circuit distribution and wiring system.

1103.3.4 Testing

Upon completion of installation of interior lighting fixtures, and after circuitry has been energized, electrical energy shall be applied to demonstrate capability and compliance with requirements. When possible, malfunctioned units at the Project Site shall be rectified, then retested to demonstrate compliance; otherwise, defective items shall be removed and replaced with new units, and another test shall be conducted.

1103.3.5 Outlet Boxes, Canopies, and Pans

It shall be in accordance with the requirements of Item 1100, Conduits, Boxes and Fittings.

1103.3.6 Grounding and Bonding

Bonding and grounding shall be provided where necessary to ensure electrical continuity as well as the capacity to conduct safe installation. It shall be in accordance with the PEC Part 1.

1103.4 Method of Measurement

The work under this item shall be measured in lump sum placed and installed as shown on the Plans.

1103.5 Basis of Payment

The Accepted quantity, measure as prescribed in Section 1103.4, Method of Measurement shall be paid for at the contract unit price which payment shall constitute full compensation including labor, materials, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board with Main & Branch Breakers	Lump Sum

ITEM 1003 - CARPENTRY AND JOINERY WORKS

1003.1 Description

The work under this Item shall consist of furnishing all required materials, fabricated woodwork, tools, equipment and labor and performing all operations necessary for the satisfactory completion of all carpentry and joinery works in accordance with the Plans and this Specification.

1003.2 Material Requirements

1003.2.1 Lumber

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

Jambs, transoms, mullions, headers, sills, frames, and wood base shall be air dried and well-seasoned for at least 2 months before use.

1003.2.1.1 Grades of Lumber and Usage

1. Stress grade is seasoned, close-grained and high quality lumber of the specified species free from defects and suitable for sustaining heavy loads. Stress grade lumber shall be used for wooden structural members subject to heavy loads, and for sub-floor framing embedded or in contact with concrete or masonry.

2. Select grade lumber of the specified species 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 baseboards, trims, moldings, millwork, railings, stairs, cabinet work, shelving, 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.

1003.2.1.2 Lumber Species and Usage

Unless otherwise specified on the Plans, the following lumber species shall be used as indicated:

1. Yacal (stress grade) for structural members 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. Taguile (select grade) for door and windows, facia and baseboards, trims, moldings, 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, baseboards, trims, moldings, cabinet work, millwork, doors and windows when indicated as such as in the Plans.

6. Dao (selected grade) for stair railings, flooring boards, wall panels, baseboards, trims, moldings, cabinet work, millwork, doors and windows when indicated as such on the Plans.

1003.2.1.3 Moisture Content

Except otherwise specified, lumber shall be sun-dried, or kiln-dried. At the time of installation, the maximum moisture content, expressed as a percentage of the oven-dry wood, shall be as follows:

Rough Carpentry and Framing

a. Framing lumber 50.80 mm and less in thickness: 19%

b. Framing lumber over 50.80 mm thick: 25%

Interior millwork, finish and trim: 17%

1003.2.1.4 Substitution in Lumber Species

Any lumber equally good for the purpose intended may be substituted for the specified kind subject to the prior approval of the Engineer, provided the substitution shall be of an equal or better species acceptable to the Engineer. In case of substitution with a better species, no additional cost therefore shall be allowed to the Contractor.

1003.2.2 Plyboard

Plyboard shall be good grade and made of laminated wood strips of uniform width and thickness bounded together with water resistant resin glue. The laminated core shall be finished both faces with selected grade Tanguile or red Lauan veneers not less than 2 mm thick shall be free from defect such as split in veneer, buckling or warping.

1003.2.3 Plywood

Plywood shall conform to the requirements of PNS ISO 12465:2017 Plywood Specifications. Thickness of single layer laminae shall not be less than 2 mm. The Laminae shall be superimposed in layers with rains 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 resistance.

Sample for testing shall comply with the applicable requirements of PNS ISO

12466-1:2016 Plywood - Bonding Quality – Part 1: Test Methods and PNS ISO

12466-2:2016 Plywood - Bonding Quality – Part 2: Requirements

1003.2.4 Lawanit

Lawanit, when required per plan, shall be 6 mm thick, tempered or oil impregnated for moisture/water resistance. Texture of lawanit shall be subject to the approval of the Engineer.

1003.2.5 Materials other than Lumber

1003.2.5.1 Plastic Sheet

When required for countertops, Plastic sheets such as Formica shall not be less than 1.50 mm thick and shall have a hard, durable and glossy surface resistant to stain, abrasion and heat. Color and design shall be as selected from the manufacturer's standard and approved by the Engineer.

1003.2.5.2 Glue

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

Glue in powder form be in a sealed container and shall be without evidence of lumping or deterioration in quality.

1003.2.5.3 Fasteners

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

1. Nails of adequate size shall be steel wire, diamond-pointed, ribbed shank and bright finish.

2. Screws of adequate size shall be cadmium or brass plated steel with a 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 be provided with standard flat steel washers and hexagonal nuts. Threads shall conform to American coarse thread series. The threaded portion shall be long enough such that the nut can be tightened against the bolted members without any need for blocking. The bolt's threaded end shall be finished smooth for ease of engaging and turning of the nut.

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

1003.2.5.4 Fiber Cement Board

It shall comply with the applicable requirements of ASTM C1186, Standard Specification for Flat-Fiber Cement Sheets for exterior application and ASTM C1288, Standard Specification for Fiber-Cement Interior Substrate Sheets for interior application.

1003.2.5.5 Gypsum Board

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

1003.2.5.6 Pre-painted Metal Panel

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

1003.2.5.7 Aluminum Metal Cladding

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

1003.2.5.8 Polyvinyl Chloride (PVC)

Polyvinyl Chloride (PVC) shall be made from 100% virgin PVC and Class A fire rating in accordance with ASTM E84, Standard Test Method for Surface Burning Characteristics of Building Materials.

1003.2.5.9 Moulding

Mouldings may be made of steel, wood, PVC, concrete and precast concrete or as indicated on the Plans.It shall match the surface where it shall be built.

Sizes, dimensions, colors, finishes, locations and design details shall be specified on the approved Plans and in accordance with the manufacturer's recommendation.

1003.2.5.10 Modular Partition

Materials for modular partition shall be in accordance with the manufacturer's recommendation and approved by the Engineer. Sizes, dimensions, color, finishes, descriptions, locations, and framing details of modular partition shall be indicated on the approved Plans.

1003.3 Construction Requirements

1003.3.1 Quality Materials

All materials to be incorporated in the carpentry and joinery works shall be of the quality specified under Section 1003.2, Material Requirements.

Before incorporation in work, all materials shall have been inspected/accepted by the Engineer or his authorized representative.

1003.3.2 Storage and Protection of Materials

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

1003.3.3 Shop Drawings

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

1003.3.4 Rough Carpentry

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

1. Framing shall be stress grade or common grade lumber of the specie specified under Subsection 1003.2.1.2, Lumber Species and Usage.

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

3. Trusses and other roof framing shall be assembled, fitted and set to exact location and slope indicated on the Plans.

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

5. Structural members shall not be cut, bored or notched for the passage of conduits or pipes without prior approval of the Engineer. Members damaged by such cutting or boring shall be reinforced by means of specifically formed and approved steel plates or shapes, otherwise, damaged structural members shall be removed and replaced to the satisfaction of the Engineer.

6. Timber framing in contact with concrete masonry shall be treated with termite-proofing solution and after drying coated with bituminous paint.

1003.3.5 Finished Carpentry

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

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

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

3. Panels shall be fitted to allow for contraction or expansion and insure that the panels remain

in place without warping, splitting, and opening of joints.

4. Plyboard shall be as specified under Subsection 1003.2.2 unless otherwise indicated on the Plans.

5. Plywood shall be specified under Subsection 1003.2.3

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

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

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

1003.3.6 Fiber Cement Board

Examine, clean, and repair as necessary any substrate conditions that would be detrimental to proper installation. Do not begin installation until unacceptable conditions have been corrected.

Prior to commencing installation, verify governing dimensions of building and condition of substrate. If substrate preparation is the responsibility of another installer, notify the Engineer of unsatisfactory preparation before proceeding. Installation requirements shall be in accordance with the manufacturer’s instructions and drawing details approved by the Engineer.

a. Use trim details indicated on drawings.

b. Touch up all field cut edges before installing.

c. Pre-drill nail holes if necessary to prevent breakage.

Over wood studs without sheathing. Install building paper over studs prior to installing siding. Over wood and wood-composite sheathing. Fasten siding through sheathing into studs. For sheathing of 25 mm thickness or less, nail through sheathing into studs using correspondingly longer nails.Over Masonry Walls. Install furring strips of adequate thickness to accept full length of nails and spaced at 406 mm on center.Over Steel Studs. Minimum 20-gauge steel, 92 mm C-studs, size as indicated on drawings or as required by limiting span. Use 41 mm long, #8-18 x 9.50 mm HD self-tapping, corrosion-resistant ribbed bugle head screws. Attach a panel at each stud ensuring that at least three (3) screw threads penetrate the studs. After installation, seal of joints. Seal around all penetrations.For finish painting, follow the manufacturer's recommendation timeline for painting primed and unprimed products. Paint all exposed cut edges.

1003.3.7 Gypsum Board

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

1003.3.8 Aluminum Metal Cladding

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

1003.3.9 Prepainted Metal Panel

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

1003.3.10 Moulding

Moulding color finishes shall match the wall or the surface where it will be installed. Cutting details of molding and its installatio shall be in accordance with the manufacturer's instructions and detailed drawings approved by the Engineer.

1003.3.11 Modular Partition

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

1003.4 Method of Measurement

The quantity to be paid for will be measured as per individual item detailed in Section 1003.5, Basis of Payment for the complete Carpentry and Joinery as furnished on site and in accordance with these design standards, specifications and as accepted by the Engineer.

1003.5 Basis of Payment

The Items measured and determined as provided in Subsection 1003.4, Method of Measurement shall be paid for at the unit bid price which payment constitute full compensation of materials, labor, equipment, tools and incidentals necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (8)	Flooring, Wood	Board Foot

SPL 4 - AERATOR PIPE

Refer to SPL 4, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 4	Aerator Pipe	Meter

SPL 6 - AERATOR MACHINE

Description

This item contains information about the description and operation and safe usage of Aerator Machine (180W 540L/min RESUN Blower High Pressure Electric Turbo Air Blower Aquarium Seafood Air Compressor Koi Pond Air Aerator Pump)

Material Requirements:

Voltage	220 – 240V	**Power**	1W
Model A	GF-180C GF180C GF 180C Seafood pond koi pond blower	**Tube Caliber**	0.5cm
Origin	Mainland China	**Type**	Aqua
Power	180W		

Impeller adopts three-dimensional design

The impeller is designed with three-dimensional design, with a circular airflow channel that changes the section segmentation.

Product details are clear at a glance

Dedicated Motor,small starting torque, stable operation and low noise;

Environmental protection and energy saving, easy to operate;

Used in large, medium and small fish ponds and aquarium shops

Precision Mesh

Precision mesh entrance, effectively prevent large particles from entering, effectively avoiding gas pump blocking.

Porous Ventilation Device

The Porous ventilation device can be connected to many small tubes, which are connected to the oxygen in each fish tank.

A lot of air outlet

The air outlet is connected to a high quality-transparent trachea, which is more practical and delicate

Construction Requirements

The 180W 540L/min RESUN Blower High Pressure Electric Turbo Air Blower Aquarium Seafood Air Compressor Koi Pond Air Aerator Pump is the perfect choice for your air accessories needs. The unique, stylish design keeps noise to a minimum.

The air pump requires very little maintenance and offers an optimal air flow for your aquarium.

Air pump ornaments such as bubbly stones, underwater rack filters and action ornaments can be supplied with the right amount of air with this air pump. and vibration-free so that you are not constantly disturbed by an annoying hum when you are enjoying your aquarium in peace.

Air pump should be placed above the water level.

Method of Measurement

The quantity to be paid for will be measured as per individual item detailed in Basis of Payment for the Aeration Machine as furnished on site and in accordance with these design standards, specifications and as accepted by the Engineer.

Basis of Payment

The Items measured and determined as provided in Method of Measurement shall be paid for at the unit bid price which payment constitutes 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
SPL 6	Aerator Machine	Sets

SPL 7 - HATCHING TANK WITH FRAME & SUPPORT

Description

This Item shall contain the works and materials covered by their specification, along with all the attachments mentioned in the specification. The tenderer shall be responsible for adherence to all requirements stipulated herein.

Material Requirements

Essential components of a milkfish hatchery are pumps for air and seawater. Spare pumps should be provided in case of breakdown.

1. Seawater centrifugal pump (2 HP) for pumping pre-filtered seawater from the suction well to filter tank and reservoir.

2. Air blower (1.5 HP) provides aeration to all tanks.

3. Submersible pump (1/3 HP) for mass transfer of algae to rotifer tanks.

4. Freshwater pump (1/3 HP) draws freshwater from a shallow well for hatchery use.

5. Standby generator (5 KVA) should be available in case of power failure.

6. Stereomicroscope for estimating density of rotifer, egg, and larval samples.

7. Weighing scale (preferably top-loading type):

i) 1-kilogram capacity, 10-gram sensitivity - for weighing Artemia cysts.

ii) 10-kilogram capacity, 50-gram sensitivity - for weighing fertilizers.

Construction Requirements

Tanks

Milkfish hatchery needs larval rearing tanks, culture tanks for rotifer (Brachionus) and green algae (Chlorella), and hatching tanks for the brine shrimp (Artemia). A volume ratio of 1 ton larval rearing tank to 3 tons algal and rotifer tank is recommended. Tanks should be easily drained through a harvesting canal. A prawn hatchery operator may need only a slight modification, i.e.; addition of algal and rotifer culture tanks to come up with the recommended ratio of 1:3

1. Larval Rearing Tank

Circular (2-3-meter diameter) canvas or concrete tanks (3-5-ton ca[1]pacity) with an airstone at the center may be used. Tanks of smaller volumes are preferred for easy management. Larval rearing tanks should be placed under a shade to protect the larvae from the glare and heat of direct sunlight and to deter growth of diatoms that contribute to poor water quality.

2. Algal/Rotifer Tank

Square (3x3x 1 meter), rectangular (3.5x2.5x 1 meter) or circular (4- meter diameter) canvas or concrete tanks may be used for mass production of Chlorella and Brachionus. To maximize tank usage, tanks for algae are also used to culture rotifer.

3. Brine Shrimp Hatching Tank

A cylindro-conical plexiglass, transparent conical fiberglass, or plastic carbuoy may be used in hatching Artemia cysts. The capacity of the hatching container varies depending on the amount of Artemia to be hatched. A plastic carbuoy usually has a capacity of 10 liters.

4. Gravity Sand Filter

A wooden, fiberglass, or concrete sand filter box (1x1x1 meter) is positioned above the seawater storage tank. The filter medium is generally composed of layers of fine sand, coarse sand, gravel or coarse stones interspersed with charcoal, and shell or coral pieces (Fig. 3). Filtered seawater directly flows into the storage tank by gravity.

5. Seawater Storage Tank

A seawater tank with a capacity of at least 50% of the total volume of culture tanks is recommended. Storage tanks should be elevated so that filtered seawater can be distributed to all tanks by gravity flow.

6. Fiberglass Tanks 1-ton capacity (4 units) 500-liter capacity (4 units) 250-liter capacity (5 units) 100-liter capacity (3 units).

Method of Measurement

The quantity to be paid for will be measured as per individual item, Basis of Payment for the complete Hatching Tank with Frame and Support as furnished on site and in accordance with these design standards, specifications and as accepted by the Engineer.

Basis of Payment

Method of Measurement shall be paid for at the unit bid price which payment constitutes 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
SPL 7	Hatching Tank with Frame and Support	Units

F. ALGAL TANKS (36 UNITS) WITH CONICAL HATCHING TANKS

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Structure Broodstock Tanks (7 Units)

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804	Embankment	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a	Reinforcing Steel (Deformed) Grade 40	Kilogram

SPL 1 - DEWATERING WORKS

Refer to SPL 1, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter

ITEM 1047 - METAL STRUCTURES

Refer to Item 1047, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum
1047 (10)	Metal Structure Accessories	Lump Sum

ITEM 1013 - CORRUGATED METAL ROOFING

Refer to Item 1013, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1013 (2)	Fabricated Metal Roofing Accessory, 0.6mm thick	Linear Meter

SPL 5 - 1.5MM THK. FIBERGLASS SKYLIGHT ROOFING, GRADE A

Refer to SPL 5, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 5	1.5mm thk. Fiberglass skylight roofing, grade A	Square Meter

ITEM 1046 - MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement

1027 (1)	Cement Plaster Finish	Square Meter

ITEM 1016 - WATERPROOFING

Refer to Item 1016, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement
1016	Waterproofing	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)a	PaintingWorks, Masonry/Concrete	Square Meter
1032 (1)c	Painting Works, Steel	Square Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a6	Pipe and Fittings, 75 mm dia., PVC, Series 1000	Meter
1001 (1)a7	Pipe and Fittings, 100 mm dia., PVC, Series 1000	Meter

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (3)e	PVC Pipes (blue) with Fittings, 50 mm Diameter	Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (9)	Storm Drainage and Downspout	Lump Sum
1001 (5)a	Catch Basin, Concrete	Each

ITEM 1100-CONDUITS, BOXES AND FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1100 (10)	Conduits, Boxes & Fittings (Conduit Works/ Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Plan.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement

1101 (2)b2	Electrical wire, 3.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b3	Electrical wire, 5.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b6	Electrical wire, 22mm² TW/THHN/THWN², Stranded	Meter

ITEM 1103 - LIGHTING FIXTURES

Refer to Item 1103, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICE

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board with Main & Branch Breakers	Lump Sum

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (8)	Flooring, Wood	Board Foot

ITEM 1051 - RAILINGS

1051.1 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.

1051.2 Material Requirements

1051.2.1 Concrete

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

1051.2.2 Forms and Falseworks

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

1051.2.3 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.

1051.2.4 Hardware

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

1051.2.5 Masonry

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

1051.2.6 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.

1051.2.7 Reinforcing Steel

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

1051.2.8 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.

1051.2.9

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.

1051.2.10 Stainless Steel (Non-Ferrous Metal)

It shall conform to the requirements of ASTM A 276M, Standard Specification for Stainless Steel Bars and Shapes or as called for in the Plans.

1051.2.11 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 Glass Kind 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:

1. 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.

2. 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: 220 N	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: 220 N	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.

1051.2.12 Aluminum

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

1051.2.13 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.

1051.3 Constructions Requirements

1051.3.1 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.

1051.3.2 Concrete Railing

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

1051.3.2.1 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.

1051.3.2.2 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.

1051.3.3 Wooden Railing

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

1051.3.4 Masonry Railing

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

1051.3.5 Stone Railing

The maximum projection of stones beyond the pitch lines shall not be more than 50 mm.

1051.3.6 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.

1051.3.7 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.

1051.3.8 Glass Railing

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

1051.4 Method of Measurement

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

1051.5 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 (6)	Stainless Steel Railing	Meter

SPL 4 - AERATOR PIPE

Refer to SPL 4, Part D. Broodstock Tanks (7 Units).

Refer to 1001, Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 4	Aerator Pipe	Meter

SPL 6 - AERATOR MACHINE

Refer to SPL 6, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 6	Aerator Machine	Sets

SPL 7 - HATCHING TANK W/ FRAME & SUPPORT

Refer to SPL 7, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 7	Hatching Tank with Frame and Support	Units

G. ROTIFER TANK WITH HATCHERY TANK

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Structure Broodstock Tanks (7 Units)

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804	Embankment	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a1	Reinforcing Steel (Deformed), Grade 40	Kilogram

SPL 1 - DEWATERING

Refer to SPL 1, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 Days	Cubic Meter

ITEM 1047 - METAL STRUCTURES

Refer to Item 1047, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum
1047 (10)	Metal Structure Accessories	Lump Sum

SPL 5 - 1.50MM THK FIBERGLASS SKYLIGHT ROOFING, GRADE A

Refer to SPL 5, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 5	1.50 mm thk. Fiberglass, Skylight Roofing, Grade A	Square Meter

ITEM 1013 - CORRUGATED METAL ROOFING

Refer to Item 1013, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement

1013 (2)	Fabricated Metal Roofing Accessory, 0.6mm thick	Linear Meter

ITEM 1046 - MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

ITEM 1016 - WATERPROOFING

Refer to Item 1016, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement
1016	Waterproofing	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)a	Painting Works, Masonry/Concrete	Square Meter
1032 (1)c	Painting Works, Steel	Square Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a6	Pipe and Fittings, 75 mm dia., PVC, Series 1000	Meter
1001 (1)a7	Pipe and Fittings, 100 mm dia., PVC, Series 1000	Meter

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (3)e	PVC Pipes (blue) with Fittings, 50 mm dia.	Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (9)	Storm Drainage and Downspout	Lump Sum
1001 (5)b	Catch Basin, CHB	Each

ITEM 1100 - CONDUITS, BOXES AND FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1100 (10)	Conduits, Boxes & Fittings (Conduit Works/Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1101 (2)b2	Electrical wire, 3.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b3	Electrical wire, 5.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b6	Electrical wire, 22mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b5	Electrical wire, 14mm² TW/THHN/THWN², Stranded	Meter

ITEM 1103 - LIGHTING FIXTURES

Refer to Item 1103, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board w/ Main and Branch Breakers	Lump Sum

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (8)	Flooring, Wood	Board Foot

ITEM 1051 - RAILINGS

Refer to Item 1051, Part F. Algal Tanks (36 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1051 (6)	Stainless Steel Railing	Meter

SPL 4 - AERATOR PIPE

Refer to SPL 4, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 4	Aerator Pipe	Lump Sum

SPL 6 - AERATOR MACHINE

Refer to SPL 6, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 6	Aerator Machine	Set

SPL 7 - HATCHING TANK W/ FRAME & SUPPORT

Refer to SPL 7, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 7	Hatching Tank with Frame and Support	Units

H. CONDITIONING POND

803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 Units)

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804 (2)	Embankment from Borrow	Cubic Meter

ITEM 901 - LEAN CONCRETE

901.1 Description

This Item shall consist of furnishing 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.

901.2 Material Requirements

901.2.1 Portland Cement

Cement shall conform to the applicable requirements of Subsection 900.2, Portland Cement of Item 900, Structural Concrete.

901.2.2 Concrete Aggregates

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

901.2.2.1 Fine Aggregates

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

901.2.2.1 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	Mas Percent Passing
73.5 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

901.2.3 Water

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

901.2.4 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.

901.2.5 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.

901.2.6 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.

901.3 Construction Requirements

901.3.1 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.

901.3.2 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 bases 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

901.3.3 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.

901.3.3.1 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.

901.3.3.2 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.

901.3.4 Finishing

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

901.3.5 Curing

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

901.3.6 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.

901.4 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.

901.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 901.4, Method of Measurement shall be at the Contract Unit Price for each of the Pay Items 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:

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
901 (1)	Lean Concrete	Cubic Meter

ITEM 506 - STONE MASONRY

506.1 Description

This Item shall consist of stone masonry in minor structures, in headwalls for culverts, in retaining walls at the toes of slopes, and at other places called for on the Plans, constructed on the prepared foundation bed, in accordance with this Specification and in conformity with the

lines, grades, sections, and dimensions shown on the Plans or as ordered in writing by the Engineer.

506.2 Material Requirements

506.2.1 Stone

The stone shall be clean, hard, and durable and shall be subject to the Engineer's approval. Adobe stone shall not be used unless otherwise specified.

Sizes and Shapes – Unless other sizes are shown on the Plans, stones have a thickness of not less than 150 mm, and widths of not less than one and one-half times their respective thickness, and lengths of not less than one and one half times their respective widths. Each stone shall be of good shape and be free of depressions and projections that might weaken or prevent it from being properly bedded.

Dressing – The stone shall be dressed to remove any thin or weak portions. Face stones shall be dressed to provide bed and joint lines that do not vary more than 20 mm from the true lines and to ensure the meeting of bed and joint lines without the rounding of corners of the stones in excess of 30 mm in radius. Bed surfaces of the face stones shall be approximately normal to the face of the stones for about 80 mm and from this point may depart from a normal plane not to exceed 50 mm in 300 mm.

Finish for Exposed Faces – Face stones shall be pitched to the line along the beds and joints. The maximum projection of rock faces beyond the pitch lines shall not be more than 50 mm.

506.2.2 Mortar

Cement, fine aggregate, and water shall conform to the respective requirements for those materials as specified under Item 405, Structural Concrete, except as to the grading of fine aggregate which shall all pass the 2.36 mm (No. 8) sieve, not less than 15 nor more than 40 percent shall pass the 0.3 mm (No. 50) sieve, and not more than 10 percent shall pass the 0.15 mm (No.100) sieve.

The mortar for the masonry shall be composed of one part of Portland Cement and two parts of fine aggregate by volume and sufficient water to make the mortar of such consistency that it can be handled easily and spread with a trowel. Mortar shall be mixed only in those quantities required for immediate use. Unless an approved mortar mixing machine is used, the fine aggregate and cement shall be mixed dry in a tight box until the mixture assumes a uniform color, after which, water shall be added as the mixing continues until the mortar attains the proper consistency. Mortar that is not used within 90 minutes after the water has been added shall be discarded. Retempering of mortar will not be permitted.

506.3 ConstructionRequirement

1. Selection and Placing

When the masonry is to be placed on a prepared foundation bed, the bed shall be firm and

normal to, or in steps normal to, the face of the wall, and shall have been approved by the Engineer before any stone is placed.

Care shall be taken to prevent the bunching of small stone or stones of the same size. Large stones shall be used in the corners.

All stones shall be cleaned thoroughly and wetted immediately before being set, and the bed which is to receive them shall be cleaned and moistened before the mortar is spread. They shall be laid with their longest faces horizontal in full beds of mortar, and the joints shall be flushed with mortar.

The exposed faces of individual stones shall be parallel to the faces of the walls in which the stones are set.

The stones shall be so handled as not to jar displace the stones already set. Suitable equipment shall be provided for setting stones larger than those that can be handled by two men. The rolling or turning of stones on the walls will not be permitted. If a stone is loosened after the mortar has taken initial set, it shall be removed, the mortar cleaned off, and the stone relaid with fresh mortar.

2. Bed and Joints

Beds for face stones may vary from 20 mm to 50 mm in thickness. They shall not extend an unbroken line through more than 5 stones. Joints may vary from 20 mm to 50 mm in thickness. They shall not extend in an unbroken line through more than two stones. They may be at angles with the vertical from 0^0 to 45^0. Face stone shall bond at least 150 mm longitudinally and 50 mm vertically. At no place shall corners of four stones be adjacent to each other.

Cross beds for vertical faced walls shall be level, and for battered walls may vary from level to normal to the batter line of the face of the wall.

3. Headers

Headers shall be distributed uniformly throughout the walls of the structures so as to form at least one-fifth of the exposed faces. They shall be of such lengths as to extend from the front face of the wall into the backing of at least 300 mm. When a wall is 450 mm or less in thickness, the headers shall extend entirely from front to back face.

4. Backing

Backing shall be built mostly of large stones as shown in the approved Plans or as directed by the Engineer. The individual stones composing the backing and hearting shall be well bonded with the stones in the face wall and with each other. All openings and interstices in the backing shall be filled completely with mortar or with spalls surrounded completely by mortar.

5. Pointing

Both bed and vertical joints shall be finished as shown on the Plans or as directed by the Engineer. The mortar in joints on top of surface of masonry shall be crowned slightly at the

center of the masonry to provide drainage.

6. Coping

Copings, if called for, shall be finished as shown on the Plans. Where copings are not called for, the top of the wall shall be finished with stones wide enough to cover the top of the wall from 450 mm to 1000 mm in length, and of random heights, with a minimum height of 150 mm. Stone shall be laid in such a manner that the top course is an integral part of the wall. The tops of top course of stone shall be pitched to line, in both vertical and horizontal planes.

7. Weepholes

It shall conform to the requirements of Item 504, Riprap and Grouted Riprap under Subsection 504.3.4, Weepholes.

8. Cleaning Exposed Faces

Immediately after being laid, and while the mortar is fresh, all face stones shall be thoroughly cleaned of mortar stains and shall be kept clean until the work is completed.

9. Curing

In hot or dry weather, the masonry shall be satisfactorily protected from the sun and shall be kept wet for a period of at least three days after completion.

506.4 Method of Measurement

The quantity to be paid for shall be the number of cubic meters of stone masonry complete in place and accepted. Projections extending beyond the faces of the walls shall not be included. In computing the quantity for payment, the dimensions used shall be those shown on the Plans or ordered in writing by the Engineer. No deductions shall be made for weep holes, drain pipes or other openings of less than one square meter in area.

506.5 Basis of Payment

The quantity of masonry, determined as provided in Section 506.4, Method of Measurement, shall be paid for at the contract unit price per cubic meter for Stone Masonry, which price and payment shall be full compensation for furnishing and placing all materials, including mortar for masonry, for all necessary excavations, and for all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
506 (1)	Stone Masonry	Cubic Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

SPL 1 - DEWATERING

Refer to SPL 1, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

SPL 8 - SANDBAGGING

Description

This Item shall consist of a sack filled with sand, as designated in the Bid Schedule, constructed in accordance with this Specification and in conformity with the lines and grades shown on the Plans or established by the Engineer.

Material Requirements

Bagged sand shall be sound and durable and furnished in a well-balanced range of sizes meeting the requirements herein.

Sand obtained from excavation performed under this contract may be used.

Construction Requirements

Sufficient excavation shall be made to expose a foundation bed that is satisfactory to the Engineer. The sand shall be found on this bed and laid to the lines and dimensions required.

Sand shall be laid flat and securely placed with broken joint lines. The exposed face of the rock mass shall be reasonably uniform, with no projections of more than 150 mm, beyond the neat lines shown on the Plans or as directed by the Engineer. Backfill adjacent to the bagged sand shall be filled entirely with acceptable material coming from excavation items and compacted.

Method of Measurement

The quantity to be paid for will be the number of cubic meters of bagged sand measured in place, completed and accepted.

Basis of Payment

Method of Measurement**,** will be paid for at the contract price per cubic meter for Bagged sand, which price and payment shall constitute full compensation for furnishing, selecting, and transporting sands, for placing bagged sands by hand, for backfilling, and for all labor, equipment, tools and incidentals necessary to complete the Item including foundation excavation.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
SPL 8	Sand Bagging	Cubic Meter

I. DRAINAGE AND TREATMENT CANAL

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

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

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a	Reinforcing Steel (Deformed), Grade 40	Kilogram

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 Days	Cubic Meter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a6	Pipe and Fittings, 75 mm dia., PVC, Series 1000	Meter

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E of Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement

1003 (8)	Flooring, Wood	Board Foot

ITEM 503 - DRAINAGE STEEL GRATING WITH FRAME

503.1 Description

This item shall consist of furnishing all materials, tools, and equipment including labor required in undertaking the proper application of steel grating with frame as shown on the plans and in accordance with this specification.

503.2 Classes and Uses of Road Grates and Frames

Classes of grates that are commonly use in drainage work are sump, trench and box.

Sump grates shall be used to create a trafficable ground level entry area for surface rainwater to flow into the underground storm water drainage system. Sump grates shall be used in paved or grassed areas that are graded to direct the surface water to a single pit or to a series of pits. Sump grates shall be plain or hinged.

Trench grates shall be used to collect surface rainwater runoff from areas that cannot be graded to direct flow into a single pit.

Box grates or road drainage shall be used to transfer road surface storm water into an underground drainage system.

Normally used in conjunction with kerb entry, the addition of the grate significantly increases the hydraulic capacity of the inlet, particularly on steep slopes.

503.3 Strength Classifications and the Loading Conditions for Sump, Trench and Box grates

Class A – Test Load 10kN

For locations trafficked only by pedestrians, wheelchairs and cyclists – inaccessible to motor vehicles by virtue of barriers, narrow passages or stepped or unpaved approaches.

Class B – Test Load 80kN

For locations normally trafficked by pedestrians and slow moving passenger cars or light agricultural tractors. These locations include areas accessible to infrequent slow moving heavy trucks. Typical locations include footpaths, ground level and multistoried car parks, suburban driveways and back yards.

Class C – Test Load 150kN

For locations trafficked by slow moving fully laden trucks such as pedestrians, malls and

industrial or commercial areas.

Class D – Test Load 210kN

For locations trafficked by fast moving fully laden trucks and forklifts with wheel loads to 5.0T. This includes all public roads from residential to freeway.

Class E, F or G – Test Load 400kN, 600kN or 900kN

For locations subject to vehicles such as large forklifts, earthmoving or container handling equipment and aircraft. Typical locations include wharves, container storage areas, heavy industry or construction sites and domestic or international airports.

All loading conditions specified above are applicable to the three classes of grates depending on their specific uses and locations.

503.4 Materials Requirement

503.4.1 Steel Grating

The steel grating shall be made of fabricated mild steel provided with hot dip galvanized in accordance with ASTM A153/AASHTO M 232 for superior corrosion protection. Steel grating shall be machine-made grating comprised of steel flat bars standing on edge equispaced from each other. To prevent them from falling over and to provide restraint in buckling, a twisted cross rod (6mm) is forge-welded into the top of the flat bars.

503.4.2 Steel Frame

The steel frame clear openings of drainage grates shall be 15mm larger than nominal sizes of industry standard sized pits. These pits increase in size in increments of 150mm. This shall be done to allow frames to be placed over standard panel formwork and cast in while pouring the pit walls, to speeds up installation and ensure the frame is fully embedded in the concrete.

503.4.3 Drainage Grate Sizes

The drainage grates shall be identified by their internal clear opening dimensions of the frame. For square and rectangular grates, the normal convention shall be the width x length. Metal units shall conform to the approved plan dimensions and specifications requirement for the designated materials.

Grates shall consist of 25mm to 65mm x 3mm, 4.5mm or 5mm thick flat bars with length of not more than 6.1m spaced at 30mm o.c. with 6mm twisted rod spaced at 100mm o.c.. Angular frame (L 75mm x 75mm x 9mm thick) shall be coated with hot dipped galvanized for superior corrosion protection finish and extended life. If required, I-Beam support shall be provided in the grates in accordance with the approved plan. It shall also conform to the requirements of ASTM A 153 or its equivalents AASHTO M 232.

503.4.4 The metal unit shall conform to ASTM A 36 / AASHTO M 183

Dimension

Tolerances: Thickness = ± 0.20mm

Width = ± 0.80mm

Length = + 50mm/NIL mm

Straightness = 6mm in each 1.5m length

503.4.5 Joint Mortar

Unless otherwise indicated on the Plans, joint mortar shall be composed of one part Portland cement and two parts fine aggregate by volume to which hydrated lime has been added in an amount equal to 10 percent of the cement by weight. All materials for mortar shall meet the requirements of Item 405, Structural Concrete. Structural concrete used shall attain a minimum 28-day compressive strength of 20.682 MPa (3000 psi).

503.5 Construction Requirements

Concrete construction shall conform to the requirements for Item 405, Structural Concrete.

Metal gratings which are to rest on frames shall bear on them evenly. They shall be assembled before shipment and so marked that the same pieces may be reassembled readily in the same position when installed.

Inaccuracy of bearings shall be corrected by machining, if necessary. The steel grating and its corresponding frame shall constitute one pair.

When grade adjustment or existing drainage grates is specified, the frames and steel gratings shall be removed and the walls shall be reconstructed as required.

The cleaned frames shall be reset at the required elevation.

Upon completion, each drainage grates shall be cleaned of any accumulations of silt, debris, or foreign matter of any kind and shall be kept clear of such accumulation until final acceptance of the work.

Excavation and backfill shall be done in accordance with Item 102, Excavation.

503.6 Acceptance Requirement

A sufficient number of cylinders for concrete construction shall be cast from the concrete for each unit for compression tests at 7, 14 and 28 days, and to allow for at least 3 cylinders for each test.

If the strength requirement is met at 7 or 14 days, the units shall be certified for use 14 days from the date of casting. If the strength is not met at 28 days, all units made from that batch or load will be rejected.

The steel grating plants will be inspected periodically for compliance with specified manufacturing and fabricating methods and bars samples will be obtained for laboratory testing for compliance with material quality requirements.

All draining grates materials shall be subjected to inspection for acceptance as to condition at the latest practicable time the Engineer has the opportunity to check for compliance prior to or during incorporation of materials into the work.

503.7 Method of Measurement

The quantity to be measured and paid for will be the number of pairs of metal frames and gratings completed and accepted. Concrete and reinforcing steel (AASHTO M 31) will be measured and paid for under Item 405, Structural Concrete and Item 404, Reinforcing Steel, respectively.

Excavation and backfill will be measured and paid for as provided in Item 102, Excavation.

503.8 Basis of Payment

The accepted quantities, determined as provided in Section 503.7, Method of Measurement of the Pay Items in the Bill of Quantities will be paid for at the contract unit prices, which shall constitute full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the item.

Payment will be made under:

Pay Item No.	Description	Unit Of Measurement
503 (2)	Metal Frames and Grating	Kilogram

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks(7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)c	Painting Works, Steel	Square Meter

J. STAFF QUARTERS AND FISH FOOD STORAGE BUILDING

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
804 (2)	Embankment from Borrow	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a	Reinforcing Steel (Deformed) Grade 40	Kilogram

SPL 1 - DEWATERING

Refer to SPL 1, Part D Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)c	Structural Concrete, Class A 3000 psi, 28 days	Cubic Meter

ITEM 1047 - METAL STRUCTURES

Refer to Item 1047, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum
1047 (10)	Metal Structure Accessories	Lump Sum

ITEM 1014 - PRE-PAINTED METAL SHEET

Refer to Item 1014, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1014 (1)b2	Pre-painted Metal sheets above 0.6 mm, Rib Type, Long Span	Square Meter

ITEM 1013 - CORRUGATED METAL ROOFING

Refer to Item 1013, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1013 (2)	Fabricated metal roofing accessories	Linear Meter

ITEM 1046 - MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter
1046 (2)a2	CHB Non- Load-Bearing (including Reinforcing Steel), 150mm	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster finish	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 Units).

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

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (8)	Sewer Line Works	Lump Sum
1001 (9)	Storm Drainage and Downspout	Lump Sum
1001 (5)a	Catch Basin, Concrete	Each
1001 (11)	Septic Vault/Tank, Concrete/CHB	Lump Sum

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (4)	Plumbing Fixtures	Lump Sum
1002 (24)	Cold Water Lines	Lump Sum

ITEM 1100- CONDUIT, BOXES & FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1100 (10)	Conduit, Boxes & Fittings (Conduit Works/Conduits Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1101 (2)b2	Electrical Wire, 3.5mm², TW/THHN/THWN², Stranded	Meter
1101 (2)b6	Electrical Wire, 22mm², TW/THHN/THWN², Stranded	Meter
1101 (2)b8	Electrical Wire, 38mm², TW/THHN/THWN², Stranded	Meter
1101 (2)b9	Electrical Wire, 50mm², TW/THHN/THWN², Copper Wire	Meter

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT DEVICES

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board with Main & Branch Breakers	Lump Sum

ITEM 1103 - LIGHTING FIXTURES

Refer to Item 1103, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (1)e2	Ceiling, Metal Frame, Prepainted Metal Panel	Square Meter
1003 (1)e1	Ceiling, Metal Frame, Gypsum Board	Square Meter
1003 (15)b	Moulding, Concrete	Meter
1003 (22)	Modular Partition	Square Meter

ITEM 1021 - CEMENT FLOOR FINISH

1021.1 Description

This Item shall consist of furnishing all materials, labor, tools and equipment in undertaking cement floor finishing where shown on the Plans and in accordance with this Specification.

1021.2 Material Requirements

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

1021.2.1 Cement

Portland cement shall conform to the requirement of Item 700, Hydraulic Cement.

1021.2.2 Fine Aggregates

Fine aggregates shall be clean, washed, Sharp River sand and free from dirt, clay, organic matter or other deleterious substances. Sand derived from crushed gravel or stone may be used with the Engineer's approval but in no case shall such sand be derived from stone unsuitable for use as coarse aggregate.

1021.2.3 Coloring Material

The coloring material shall be red or green oxide powder of the quality capable of achieving the best staining power and homogeneity.

1021.2.4 Curing Compound

1021.2.4.1 Gloss-Imparting Waxes

Concrete waxes to impart gloss to concrete surfaces are available from various manufacturers. Some are curing compounds, for such use they should meet or exceed the water-retention requirements of ASTM C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

1021.2.4.1 Evaporation Reducers

Evaporation-reducing chemical can be sprayed on the plastic concrete one (!) or more times during the finishing operation to minimize plastic-shrinkage cracking when the evaporation rate is high. These products shall be used in accordance with the manufacturer’s suggestion as per approval of the Engineer. It shall never be used during the final troweling operations because they discolor the concrete surface.

1021.2.5 Metallic Floor Hardener (Premix)

Metallic floor hardener shall be a mixture of oil-free specially graded clean iron particles/ aggregates, mineral oxide pigment and Portland cement binder,premixed according to the

manufacturer’s instruction manual.The aggregates shall be free of nonferrous metals, oil, grease, and other impurities. The aggregate shall be graded from coarse to fine, will not less than 90% passing a 2.66mm sieve and less than 5% passing a 0.150 mm sieve or as per approval of the Engineer.

1021.2.6 Non-Metallic Floor Hardener

1. Powder type hardener shall be silica quartz aggregates, workability admixtures, mineral oxide pigments and Portland cement mixed according to the manufacturer's instruction manual.

2. Epoxy type topping hardener shall be a combination of epoxy resins filled with hard and natural emery or silica quartz aggregates, premixed according to the manufacturer's instruction manual.

1021.3 Construction Requirements

1021.3.1 Mixture

Concrete topping materials shall be measured accurately in accordance with the following:

1. Mortar topping shall be one (1) part Portland cement and three (3) parts fine aggregate by loose volume.

2. Finish topping shall be pure Portland cement properly graded conforming to the requirements of Item 700, Hydraulic Cement, mixed with water to approved consistency and plasticity. Where required to be colored cement floor finish, red or green oxide powder shall be premixed with Portland cement complying with finish topping requirements and the desired color intensity. Cement floor finish floor hardener shall be premixed as required and applied in accordance with the manufacturer's instruction manual.

1021.3.2 Preparation of Concrete Surface

Surface to receive mortar concrete topping shall be cleaned of all projections, dust, loose particles and other foreign matters. Examine the surface to determine soundness of concrete for polishing. Finish elevation shall be established over the areas shown on the Plans

Finish elevation shall be established over the areas indicated on the Plans.

1021.3.3 Finishing

Before any mortar concrete topping is applied, the prepared concrete base surface shall first be wetted and grouted with Portland cement.

a) Mortar topping of the thickness specified on the Plans, shall be spread over the prepared concrete base and shall be float finished using wood hand trowel. Batches of mortar topping shall be emplaced within one hour of mixing thereof.

b) As soon as the water sheen has disappeared the surface shall be lightly scratched with a stiff bristle broom

c) The finish topping mixture whether plain, colored, or with floor hardener shall be spread over the lightly scratched surface before final set taken place and hand troweled to produce a smooth surface.

d) The finished surface shall be free of trowel marks, have uniform texture and true to a plane within an allowable tolerance of 3 mm in 3.0 meters.

1021.3.3.1 Types of Concrete Floor Finish

1. Scratch Finish

Place, Consolidate, strike off, and level concrete, eliminating high spots and low spots. Roughen the surface with stiff brushes or rakes before the final set.

2. Floated Finish

Place, consolidate, strike off,and level concrete, eliminating high spots and low spots. Do not work concrete furtheruntil it is ready for floating. Begin floating with a hand float, a bladed power float equipped with float shoes, or a powered disk float when the bleed water sheen has disappeared and the surface has stiffened sufficiently to permit the operation.

3. Troweled Finish

Float concrete surface, then power-trowel the surface. Hand-trowel the surface smooth and free of trowel marks. Continue hand-troweling until a ringing sound is produce as the floor is troweled.

4. Broom or Belt Finish

Immediately after concrete has received a floated finish, give the concrete surface a coarse traverse scored texture by drawing a broom or burlap belt across the surface.

5. Dry-shake Finish

Blend metallic or mineral aggregate specified in Contract Documents with Portland cement in the proportions recommended by the aggregate manufacturer, or use bagged, premixed mineral specified ing Contract as recommended by the manufacturer. Float-finish the concrete surface. Apply approximately ⅔ of the blended material required for coverage to the surfaceby a method that ensures even coverage without segregation. Float-finish the surface after application of the first dry--shake. Apply the remaining dry-shake material at right angles to the first application and in locations necessary to provide the specified minimum thickness. Begin final floating and finishing immediately after application of the dry-shake.

After selected material is embedded by the two (2) floatings, complete operation with a broomed, floated, or troweled finish, as specified in the Contract Documents.

6. Nonslip Finish

Where a nonslip finish is required, give the surface a broom or belt finish ora a dry-shake

application of crushed aluminum oxide or other abrasive particles, as specified in the Contract Documents. Rate of application shall be not less than 1.2 kg/m².

7. Exposed-Aggregate Finish

Immediately after surface of the concrete has been leveled tamp the aggregate lightly to embed aggregate in the surface. Float the surface until the embedded stone is fully coated with mortar and the surface has been finished.

After the matrix ahas hardened sufficiently to prevent dislodgement of the aggregate, apply water carefully and brush the surface with a fine-bistled brush to expose the aggregate without dislodging it.

An acceptable chemical retarder sprayed on freshly floated concrete surface may be used to extend the working time for the exposure of aggregate

8. Non-skid Cement Floor Rough Finish with Groove Lines

Give the concrete surface a broom or belt finish across the surface with groove lines as shown on the Plans

1021.3.4 Application of Curing Compound

Immediately after the finishing operations have been completed, the entire concrete surface shall be sprayed uniformly with curing compound and before the set of the concrete has taken place, or if the pavement is cured initially.

1021.3.5 Protection of Finished Surface

Cement floor finished surface shall be covered with burlap or appropriate covering to avoid injurious action by sun, rain, flowing water and mechanical injury.

1021.3.6 Workmanship

Cement floor shall be finished level and true to fi.djoins the other. V-cut groove lines shall be provided where shown on the Plans or as directed by the Engineer.

1021.4 Method of Measurement

All cement floor finish shall be measured in square meters or part thereof tor work actually completed and accepted.

1021.5 Basis of Payment

The work actually completed and accepted as measured in square meters shall be paid for at the Unit Price or contract price which price constitute full compensation including labor, materials, tools and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1021 (1)a	Cement Floor Finish, Plain	Square Meter

ITEM 1018 - CERAMICS AND GRANITE TILES

1018.1 Description

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

1018.2 Material Requirements

1018.2.1 Ceramic tiles

Ceramic tiles are thin slabs made from clay and/or other organic raw material, generally used as coverings for floors and walls, usually shaped by extruding, pressing at room temperature but may be formed by other processes, then dried and subsequently fired at temperatures sufficient to develop the required properties.Ceramic tiles can be classified as glazed or unglazed.

All ceramic tiles shall be sound, durable, and free of spalls, cracks, open seams, pits, or other defects, which may impair its structural integrity or function. Table 1018.1 shows the required test methods for ceramic tiles.

Texture, finish and color shall be within the range of samples approved by the Engineer

Table 1018.1 Physical Test for Ceramic Tiles

Physical Property	Test Method	Description
Abrasion Resistance-Glazed	ASTM C1027	Standard Test Method for Determining Visible Abrasion Resistance of Glazed Ceramic Tile
	ISO 10545-7	
Abrasion Resistance-through body	ISO 10545-6	Ceramic Tiles- Part 6: Determination of Resistance to Deep Abrasion for Unglazed Tiles
Water Absorption	ASTM C373	Standard Test Methods for Determination of Water Absorption and Associated Properties by Vacuum Method for Pressed Ceramic Tiles and Glass Tiles and Boil Method for Extruded Ceramic Tiles and Non-tile Fired Ceramic Whiteware Products
	ISO 10545-3	Determination of Water Absorption, Apparent

		Porosity, Apparent Relative Density and Bulk Density
Chemical Resistance	ASTM C650	Standard Test Method for Resistance of Ceramic Tile to Chemical Substances
	ISO 10545-13	Determination of Chemical Resistance
Break Strength	ASTM C648	Standard Test Method for Breaking Strength of Ceramic Tile
	ISO 10545-4	Determination of Modulus Rupture and Breaking Strength
Stain Resistance	ASTM C1378	Standard Test Method for Determination of Resistance to Staining
	ISO 10545-14	Determination of resistance to stains

1018.2.1.1 Glazed Tiles and Trims

Glazed tiles' and trims shall have an impervious face of ceramic materials fused onto the body of the tiles and trims. The glazed surface may be clear white or colored depending on the color scheme approved by the Engineer. Standard glazes may be bright (glossy) semimatte (Less glossy) matte (dull) or crystalline (mottled and textured; good resistance to abrasion). Glazed tiles are used principally for walls; crystalline glazed tiles may be used for floors provided how8ver that these are used as light duty floors.

1018.2.1.2 Unglazed Tiles

Unglazed tiles shall be hard dense tile of homogeneous composition.Its color and characteristics are determined by the materials used in the body, the method of manufacture and the thermal treatment. It is used primarily for floors and walks.

1018.2.1.3 Trims

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

1018.2.2 Granite Tiles

Granite tiles shall conform to the applicable requirements of ASTM C615M, Standard Specification for Granite Dimension Stone, for material characteristics, physical requirements, and sampling for selection of granite.All granite shall be sound,durable, and free of spalls, cracks, open eams, pits, or other defects, which may impair its structural integrity or function. Color or other visual characteristics indigenous to the particular material and adequately demonstrated in the sampling or mock-up phases will be accepted provided they do not compromise the structural or durability capabilities of the material. Texture and finish shall be

within the range of samples approved by the Engineer. Table 1018.2 shows the required test methods for granite tiles.

Table 1018.2 Physical Tests for Granite Tiles

Physical Property	Test Method	Description
Absorption by weight	ASTM C97M	Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
Density	ASTM C97M	Standard Test Methods for Absorption and Bulk Specific Gravity of Dimension Stone
Compressive Strength	ASTM C170M	Standard Test Method for Compressive Strength of Dimension Stone
Modulus of Rupture	ASTM C99M	Standard Test Method for Modulus of Rupture of Dimension Stone
Abrasion Resistance	ASTM C241M	Standard Test Method for Abrasion Resistance of Stone Subjected to Foot traffic
	ASTM C1353	Standard Test Method for Abrasion Resistance of Dimension Stone Subjected to Foot Traffic Using a Rotary Platform Abraser
Flexural Strength	ASTM C880M	Standard Test Method for Flexural Strength of Dimension Stone

Finishes of Granite Tiles:

1. Polish - Highly reflective, mirror gloss finish; shows full color depth and crystal structure of the stone.

2. Hone - Smooth, satin surface without reflection; shows full color of the stone.

3. Thermal - Slip-resistant, rough-textured surface.

4. Sandblast - Highly slip resistant; slightly rough textured surface.

1018.2.3 Synthetic Granite Tiles

Synthetic granite tiles are manufactured solid surface that are made of man-made materials most often acrylic, polyester resins, marble dust and other pigment, all blended and heated together.

All synthetic granite tiles shall be sound, durable and free of spalls,cracks, open seams, pits, or other defects, which may impair its structural integrity or function. Texture, finish and color shall be within the range of samples approved by the Engineer.

1018.2.4 Accessories

Tile accessories such as round edge ceramic tiles, cove tiles, step treads and nosing to stairs, landings, and thresholds, skirting, skills, copings, and bath vents, shall match the composition, color and finish of the surrounding tiles.

1018.2.5 Mortar Materials

1018.2.5.1 Portland Cement

Portland Cement shall comply with the applicable requirements of AASHTO M 85, Standard Specification for Portland Cement (ASTM C150M).

1018.2.5.2 Sand

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

1018.2.5.3 Lime

It shall be hydrated lime with free unhydrated oxide and magnesium oxide content not to exceed 8% by weight.

1018.2.6 Grouting Materials

1018.2.6.1 Sound-Portland Cement Grout

Sand-Portland cement grout is used with ceramic mosaic, quarry and paver tiles on floors and walls. Damp curing is necessary.

And on-the-job mixture of one (1) part Portland Cement toone (1) part of sand shall be used for joints up to 4.23 mm wide; one (1) part cement and two (2) parts sand for joints up to 12.70 mm wide; and one (1) part cement and three (3) parts sand for joints over 12.70 mm wide. Up to ⅕ part lime may be added.

1018.2.6.2 Standard Cement Grout

Standard Cement Grout shall be factory prepared mixture of cement, graded sand, and other ingredients to produce a water-resistant, dense, uniformly colored material, meant for joints 3.18 mm width or greater.

1018.2.6.3 Standard Unsanded Cement Grout

It shall be a factory prepared mixture of cement and additive that provides water retentivity, meant for joints 3.18 mm wide or less.

1018.3 Construction Requirements

Tile work shall not be started until roughing-ins for plumbing, electrical and other trades have

been completed and tested. The work of all other trades shall be protected from damage.

1018.3.1 Setting Materials

1. Wall Tiling. A mix of one (1) part of cement and four (4) parts of sand backing of 10 mm thick shall be laid as base for wall tiling. The surface of backing shall be scratched in an approved manner, when completely set to form key. The surface of the backing shall be wetted before the tiling is applied and same shall be cured for 5 days before tiling starts. Tiles shall be fixed using the appropriate adhesive.

2. Floor Tiling, The Contractor shall either bed the tiles using cement/sand mortar with ratio of 1:3 and 20 mm thick or lay the tiles on screed using the appropriate adhesive.

1018.3.2 Substrates Preparation

1. With the installer present, substrates and areas where tiles are to be installed shall be examined, for compliance with requirements for installation tolerances and other conditions affecting performance of installed tile.

a. Substrates for setting tile shall be firm, dry, clean and free from oil or waxy films and curing compounds.

b. Installation of grounds, anchors, recessed frames, electrical and mechanical units of work, and similar items located in or behind the tile shall be completed before installation of tile.

2. Substrate Levels shall consider the following allowable variations:

a. For tiles with all legal edges shorter than 380 mm, maximum allowable variation is no more than 6 mm in 3 m and no more than 1.6 mm in 0.3 m from the required plane, when measured from the high points in the surface.

b. For tiles with atleast one (1) edge is 380 mm or longer, the maximum allowable variation is no more than 3 mm in 3 m and no more than 1.6 mm in 0.6 m from the required plane, when measured from the high points in the surface.

3. For thin set work, the variation can be no more than 1.6 mm in 1 m with no abrupt irregularities greater than 0.80 mm.

4. Concrete, masonry and plaster substrate shall be grinded or filled as required to comply with allowable variations. For fill and underlayment of concrete, masonry and plaster substrates, one (1) part Portland cement. Three (3) part sand and sufficient mortar admixture, if needed, shall be utilized to provide workable mortar mix.

5. Substrates and adjoining construction, and the conditions under which the work will be installed, shall be examined. Before proceeding with the work, all unsatisfactory condition detrimental to the proper completion of the work should be corrected.

11018.3.3 General Installation

11018.3.3.1 Floor

1. Installation of each material requirement shall be in accordance with the manufacturer's instructions.

2. Allowable

a. Floors: 3 mm in 2m in any direction $\pm$ 3 mm at any location; 0.8 mm offset at any location.

b. Joints: $\pm$ 0.8 mm joint with variation at any locations; 1.6 mm in 1 m deviation from plumb and true.

3. Tile work shall be laid out in pattern using field tile and trim shapes as shown on the Plans. Tile fields shall be centered on both directions in each space or on each wall area, and shall be adjusted to minimize the cutting. Uniform joint widths for ceramic tile and granite tile shall be used unless otherwise shown on the Plans or approved by the Engineer. Field tiles, not trim shapes, shall be cut unless otherwise shown on the Plans.

4. Tile works shall be extended into recesses and under equipment and fixtures in the space shown on the Plans or scheduled to receive tiles. A complete covering without interruptions shall be formed except for control and expansion joints as shown on the Plans and as required to comply with disruption of pattern or joint alignments.

5. Liquid Latex Mortar Thin-Set Installation: Liquid latex mortar for thin-set tile work shall be used, unless otherwise shown on the Plans.

6. Work shall be neatly terminated at obstructions, edges, and corners without disrupting pattern or joint alignments.

7. Intersections and return shall be accurately formed. Cutting the drilling of tile shall be performed without damaging visible surfaces. Edges of the abutting trim, finish or built-in items shall be carefully grind cut for straight aligned joints. Tiles shall be closely fit to electrical outlet, piping, fixtures, and other penetrations so that plates, collars, or covers overlap tile.

8. Joining Pattern: Unless otherwise shown on the Plans, tiles shall be laid in grind pattern. Joints when adjoining tiles on floor, base, walls, and trim of the same size shall be aligned. Tile work shall be laid out and tile fields shall be centered in both directions in each space or on each wall area. Tile work shall be adjusted to minimize tile cutting. Uniform joint widths shall be provided unless otherwise shown on the Plans.

9. Tile lining shall be laid out to next full tile beyond dimensions indicated.

10. Control joints or expansion joints shall be provided where shown, or required on the Plans, or by job condition for proper workmanship. Removable divider strip or proper width and depth of the tile and setting bed shall be installed. Strips shall be removed after grouting tiles and properly curing the work. Joint fillers and sealants shall be installed in control joints and expansion joints, of type as recommended by the tiling manufacture.

11. All floor tiling in water present are such as bathrooms, washing area, kitchens, pantries and

mechanical room shall be laid with a joint filling of approved polyurethane sealant.

12 For areas with ceramic tile flooring, a thick creamy slurry of neat white or tinted cement mixed with sufficient water shall be brushed over the floor until all joints are thoroughly filled. The surface of the floor shall be gently rubbed with a wood block to bring the surface to true planes. Excess slurry shall be removed, and the floor shall be rubbed with burlap to clean the tiles and finish of the joints to the satisfaction of the Engineer. Walking on tiles shall not be allowed for 5 days after laying and all completed tiled areas shall be protected to the satisfaction and approval of the Engineer.

1018.3.3.2 Wall

1. Cement and sand (1:4) mix backing 10 mm thick shall be laid as base for wall tiling. The surface of the backing shall be scratched in an approved manner when completely set to form key. The surface of the backing shall be well wetted before the tiling is applied and same shall be cured before tiling starts.

2. Allowable Variations in Finished Work:

a. Walls: 3 mm in 2 m in any direction; $\pm$ 3 mm at any location; 0.8 mm offset at any location

b. Joints: $\pm$ 0.8 mm joint with variation at any locations; 1.6 mm in 1 m deviation from plumb and tree

3. Wall tiles and fittings shall be set in cement and sand mortar (1:4) mix, 6 mm thick to a true vertical face with continuous horizontal and vertical joints. Joints shall be straight, level perpendicular and of even width not exceeding 1.5 mm. The vertical joints shall be maintained plumb for the entire true level and plane by tamping under a straight edge or rubber faced block. Misfits as well as damaged or defective tiles shall be removed and replaced by and at the Contractor's expense.

4. Tile adhesive for wall tiles shall not be used without the approval of the Engineer.

5. The external and internal angles and side angles of glazed wall tiling shall be formed with angles beads. Whereas top edges of tiles shall be formed with rounded edges tiles. Joints shall match the general tiling and special fittings shall be used.

6. After edges of tiles have been thoroughly wet, joints in glazed wall tiles and fittings shall be grouted with a plastic mix of neat white or colored cement immediately after a suitable area of tile has been laid.

7. The joints shall be tooled slightly concave and the excess mortar shall be cut off and wiped off with a damp cloth from the face tile before it sets hard.

8. All special purpose wall tiles such as skirting tiles, single round edge, adjacent round edge, external round edge and the like, shall be used in wall cladding, shall be submitted for approval prior to commencement to work.

9. All service points in wall tiling shall be drilled holes in the tiles if they are located in the

center of tiles.

1018.3.3.3 Countertop

1. Solid surfacing components shall be installed plumb, level, and true according to approved shop drawings and manufacturer's published installation instructions. Woodworking and specialized fabrication tools that are acceptable to the Engineer shall be used.

2. Joint seams shall be formed with specified seam adhesive. Seams shall be in locations as shown on approved shop drawings and acceptable to the Engineer. Excess adhesive shall be promptly removed.

3. A minimum radius of 13 mm shall be provided for countertop inside corners.

4. Gaps shall be filled between countertop and terminating substrates with appropriate sealant.

5. Rout sink cut-outs shall be in accordance to manufacturer's template. Solid surface cast sink units shall be installed to countertops with appropriate adhesive.

6. Backsplashes and end slashes shall be installed where indicated on drawings. Install countertops with appropriate adhesive.

7. Vanities: Front panels shall be secured to solid substrate with appropriate adhesive. A 5 mm gap shall be maintained between fixed and removable panels.

1018.3.4 Grouting and Pointing

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

2. Grouting mortar shall be applied over the tile by float or squeegee stroked diagonally across the joints. Excess mortar shall be removed with a wet sponge stroked diagonally or in a circular-motion after 12 min to 15 min. A barely damp or dry sponge shall be used to remove remaining haze while smoothing all grouted joints.

1018.3.5 Cleaning

1. Tile surfaces shall be cleaned thoroughly as possible upon completion of grouting.

2. All grout haze shall be removed using the appropriate cleaner.

3. Tiles shall be thoroughly rinsed with clean water before and after using chemical cleaners.

4. Surface of the tile shall be polished with soft cloth.

1018.3.6 Protection from Construction Dirt

1. A protective coat of neutral cleanser solution diluted with water in the proportion of 1:4 (1

L cleanser concentrate to 4 L of water) shall be applied.

2. In addition, tile flooring shall be covered with heavy-duty non-staining construction paper, taped in place. The protective paper shall not be torn or removed.

3. Just before final acceptance of the work, the protective paper shall be removed and the protective coat of neutral cleaner from tile surface shall be rinsed off.

1018.3.7 Quality Control

1. Each type and color of tile, mortar adhesive and grout shall be obtained from a single sourceto minimize variations in appearance and quality.

2. Before installation of tiles, mock-up shall be erected for each tile and finish required to verify selections made under sample submittals and to demonstrate aesthetic effects as well as qualities of material and execution. Mock-ups shall be built using materials indicated for final of work.

1018.3.8 Delivery, Storage and Handling

1. Packaged materials shall be delivered and stored in original containers with seals unbroken and labels intact until ready for installation.

2. Damage or contamination of materials by water, foreign matter and other causes that may affect its appearance and quality shall be prevented.

3. Tiles and setting materials shall be stored on elevated platforms, under cover and in dry location and protect from contamination, dampness, or overheating.

1018.4 Method of Measurement

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

1018.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1018 (1)	Glazed tiles and trims	Square Meter
1018 (2)	Unglazed tiles	Square Meter

ITEM 1004 - HARDWARE

1004.1 Description

This Item shall consist of furnishing and installing all building hardware required to: (1)ensure rigidity on joint/connections of different parts of the structure, and (2)equip in a satisfactory operating condition parts of the structure such as doors, windows, cabinets, lockers, drawers and other similar operating parts in accordance with the Plans and this Specification.

1004.2 Material Requirements

1004.2.1 Rough Hardware

All rough hardware such as nails, screws, lag screws, bolts, nuts, washer, metal fasteners, framing anchors, anchor bolts and other related fasteners required for carpentry work shall be first-class quality and locally available.

Rough hardware shall be of standard manufacture and shall be approved by recognized agency for the intended applications. Unless otherwise indicated hardware items shall be steel, and hot-dip galvanized after fabrication.

1004.2.2 Finishing Hardware

All finishing hardware consisting of locksets, latches, bolts and other devices, door closers, knobs, handles, hinges, ladder, grab bar and other similar hardware shall be first-class quality available locally and conforming with the following Specifications:

1004.2.2.1 Door Locksets

Door locks appropriate for particular functions shall be of durable construction preferably the product of a single reputable manufacturer for consistent quality and master keying.

Cylindrical lockset for swing wood door shall of sturdy Construction and knob design. The cylindrical case shall be made of steel, zinc Coated, and dichromate dip.bronze. The knobs, latch, strike and pin tumbler assembly shall be cast brass or bronze. The spring and spindle shall be steel, zinc coated. The pins and the key shall be nickel-silver. The latch, with a minimum throw of 16 mm, shall be retracted by knob from either side except when the outside knob is locked by key in the outside knob or by the turn/push button on the inside knob.

Mortise lock for swing door shall have cast bronze latch bolt with steel compression spring, cast bronze deadbolt with hardened steel inserts, wrought bronze or brass knobs heavy gauge and cold-formed steel operation levers. The pin tumbler cylindrical assembly shall be cast bronze or brass and fitted with five (5) Spring pressed nickel silver pins. Mortise lock used in conjunction with fire exit bolts shall have armored fronts.

Unit of monolock for swing door shall be factory assembled in one piece, with knobs and escutcheons attached, ready for installation. All parts of unit lock shall be non-ferrous metal.

Frame shall be one-piece cast bronze or extruded brass, and the front shall be flat for door 35 mm thick and beveled for door 45 mm thick, and latch bolt shall be pivoted swing type with minimum 26 mm throw. Cylinder shall be extruded brass with five (5) spring-pressed pins and keys shall be nickel silver.

Deadlock for sliding door shall be mortise or surface mounted type to suit a particular application.

Mortise type deadlock shall have cast bronze case, front, latch bolts, strike and cylinder. Operation of deadbolt shall be by drop handles from either side. When locked by key from outside, or by thumb knob from inside, drop handle will not operate the deadbolt.

Surface type deadlock shall have cast bronze case, strike and cylinder. Interlocking vertical bolt shall be hardened steel operated by key from outside and thumb turn from inside. Strike shall be angle type.

Deadlock for swinging door shall be tubular design with a mechanism made of heavy-gauge cold-roled steel, zinc coated and dischromated. Deadbolt, strike and pin tumbler cylinder shall be bronze. Deadbolt, with at least 25 mm throw, shall be operated by key from outside and by thumb from inside.

Lock for the door of emergency /fire exit (panic hardware) shall be cast bronze or brass and heavy duty, locking device coupled with a horizontal crossbar. Latch shall be operated by key from outside and by crossbar from inside. Locking device shall be surface or mortise type suitable for a particular application. Inactive leaf of double doors or emergency/fire exit shall be fitted with vertical rod actuated by crossbars, such vertical rod providing two (2) point locking, bottom and overhead.

Lock for drawers and cabinets shall be bronze or brass with latch operated by key through a pin-tumbler cylinder 22 mm in diameter. Backplate of the lock shall be provided with four (4) screw holes for mounting. Hasp lock, when required as indicated on the Plans shall be hinge hasp with an integral padlock. The hinge hasp shall be zinc coated wrought steel, 475 mm in width and 100 mm in length when closed. The integral padlock shall be pin tumbler type with solid or laminated zinc-coated wrought steel case with hardened steel shackle securely attached to the draw bolt.

1004.2.2.2 Door Closers

1. All door closer shall be made of materials as specified in the Plans provided with a key valve or cap valve for making the necessary adjustment.

2. The following table shall serve as a guide in determining door closer sizes:

Door Maximum Width (m)	Size of Closer
0.76	Size 2

0.90	Size 3
1.07	Size 4
1.20	Size 5
1.37	Size 6

Use large size where unusual conditions exist.

1004.2.2.3 Hinge

Hinge unless otherwise indicated on the Plaans shall be brass Coated wrought iron steel for interior doors and wrought bronze for exterior doors with non-rising loose steel pins with button tips and mounting screws of the same materials.

1004.2.2.4 Sliding Door Hardware

Sliding door hardware shall be a four – wheel ball bearing trolley on and overhead track. The Track is of rolled steel formed steel or extruded aluminum. Bearing is of plain steel balls or steel rollers. Wheels to be steel, brass, rubber or plastic as the case may be.

1004.2.2.5 Miscellaneous Hardware

1. Flush Bolt

Flush/extension flush type bolt shall be made of stainless steel with a proper length suitable to the door specified.

2. Barrel Bolt

Barrel bolts shall be of wrought steel brasS coated with an attachment of at least four (4) screws.

3. Door Pull and Push Plate

Door pull and push plate shall be made of stainless steel with concealed attachments.

4. Hook. Bumper and Silencer

Hook. bumper and silencer shall be made of extruded brass or bronze, dull chrome finish with at least two (2) screw attachments.

5. Furniture and Cabinets Hardware

Furniture and cabinet hardware like a piano hinge, invisible hinge, floor pivot hinge, cabinet

door catches, shall be made from extruded brass or bronze with dull chrome finish, of sizes and type suited for use.

1004.3 Construction Requirements

1004.3.1 Submittals:

The Contractor shall submit all necessary information to the Engineer prior to placing of order.

1. Manufacturer’s data such as catalog for every hardware item to be furnished, showing all finishes, sizes, catalog numbers and pictures, with all abbreviations fully explained shall be submitted as general information and reference.

2. Hardware templates for fabricated doors and windows shall be furnished to each fabricator to confirm that adequate provision will be done for proper installation of the hardware.

3. Operation and maintenance data shall be provided and submitted to the Engineer – showing all the hardware component part lists and maintenance instructions for each type supplied including the necessary wrenches of tools required.

1004.3.2 Packaging and Marking

Each article shall be individually packaged in the manufacturer's Commercial carton/container properly marked or labeled so as to be readily identified and delivered to the project site in the original manufacturer's container/package.All hardware shall be provided with fasteners necessary for the installation packed in the same container with the hardware.

1004.3.3 Delivery, Storage and Protection

It shall be delivered in original, unbroken packages, containers or bundles bearing the name of the manufacturer. Hardware shall be properly stored in a dry and secured place. It shall be protected from damage at all times prior to and after installation.

1004.3.4 Installation of Hardware

1. All hardware shall be installed in a neat workmanship manner following the manufacturer's instruction manual to fit details as indicated on the Plans.

2. Except as indicated or specified otherwise, fasteners furnished with the hardware shall be used to fasten hardware in place.

3. After installation works are completed, the hardware shall be protected from paints, stains, blemishes, and other damage until the work are properly turned over and accepted.

4. All hardware shall be properly checked and adjusted in the presence of the Engineer and all hinges, locks, catches, bolts, pulls, closers and other miscellaneous items shall operate properly.

5. After hardware are properly checked and adjusted keys shall be properly identified with key

tags and turned over to the Engineer.

1004.3.5 Keying

Locks shall be keyed in sets and subsets. Where locks are required by the owner to be keyed alike in one system furnish a total of four (4) keys for each set.

1004.4 Method of Measurement

All hardware actually installed shall be measured and determined by the number of pieces or units ready for service as provided in the Bill of Quantities accepted to the satisfaction of the Engineer.

1004.5 Basis of Payment

The Items measured and determined as provided in Subsection 1004.4, Method of Measurement shall be paid for at the unit bid price, which payment constitutes full compensation of materials, labor, and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1004 (2)	Finishing Hardware	Lump Sum

ITEM 1010 - DOORS, WOOD PANEL

1010.1 Description

This Item shall consist of furnishing all materials, hardware, plant, tools, labor and services necessary for complete fabrication and installation of wooden doors and windows of the type and size as shown I on the Plans and in accordance with the following specifications and I applicable specifications under Item 1003 on Carpentry and Joinery I Works.

1010.2 Material Requirements

1010.2.1 Lumber

Lumber of doors, windows and jambs, and panels when required, shall be kiln-dried with moisture content of not more than 14% and shall be of the specie indicated on the Plans and/or specified under Item 1003 on Carpentry and Joinery Works.

1010.2.2 Plywood.

Plywood for veneer of solid core and hollow core flush doors shall be 3-ply, rotary cut, 6mm thick ordinary plywood, Class B grade. Marine or waterproof plywood, rotary cut, 3-ply, 6 mm thick shall be used for flush doors at toilets and bathrooms or at places where these are exposed to moisture.

1010.2.3 Adhesive

Adhesive shall be water resistant resins and shall be non-staining.

1010.2.4 Glass

Glass for window panes shall be 3 mm thick, smoked or Industry type unless otherwise shown on the Plans or indicated in the Schedule of Doors and Windows.

1010.2.5 Capiz Shells

Capiz shells, when required for window sashes, shall be of selected quality, free from dirt or blemishes and shall be large enough to obtain flat square piece.

1010.2.6 Hardware

Hardware shall be as specified under Item 1004 on Building Hardware.

1010.3 Construction Requirements

1010.3.1 Fabrication

Wooden doors and windows, including frames, shall be fabricated in accordance with the designs and sizes shown on the Plans. The fabricated products shall be finished square, smoothly sanded and free from damage or war page.

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 intermediate rails at least 44 mm wide shall be provided for stiffness.

The stiles and the top and bottom rails shall be rebutted 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 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 r3i1s shall be filled and fitted with wood blocks of the same specie 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

Stiles and rails of panel doors shall have a minimum thickness of 44 mm and width of 140 mm.

Rails 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 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 moldings formed on both faces of stiles and rails framing the panels shall be true to shape and well defined. Intersections of moldings shall be mitered and closely fitted.

Panels of the same specie 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 ',"j 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, .1 size and type of installation shown on the Plans. Unless otherwise shown on the Plans, stiles and rails shall be Tanguile with minimum I thickness of 30 mm and width of 70 mm. Jointing of stiles and rails shall I be mortise and tenon secured with glue and bamboo pin. Stiles and rails shall rebut at the exterior face for mounting glass panes or wood I panels. Integral moldings formed as frames for panes or panels shall be true to shape, sharply defined and mitered at joints. Separate moldings, 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 Item 1010.3.1 (d) 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 both ways. 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 drier under the sun for bleaching effect. Capiz shells shall be cut square to required sizes with sharp bench cutter to produce non-serrated and non-peeling edges.

6. Sliding Type Window Sashes

Stiles of sliding type window sashes shall be framed to the top and bottom rails with mortise and tenon joints. Tenons shall be formed on the stiles. Joints shall be tightly fitted, glued and locked with bamboo pins. Top and bottom rails shall be 10 mm wider than the stiles. Top rails shall be rabbeted to form 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 Item 1010.3.1 (d) 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 Item 1010.3.1 (d) 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 joints. Tenons shall be formed in the rails. Meeting rails shall be rabbeted to provide for half lapping when in closed position. The stiles and rails shall be rabbeted as specified under Item 1010.3.1 (d) for mounting of glass panes or wood panels.

9. Door and Window Frames

Framing of the specie(s) specified under Item 1003 shall be fabricated in conformity with the profile and sizes shown on the Plans. Frames shall be assembled with tightly fitted tongue and groove joint mitered at both sides, and nailed. The assembled frames shall be finished square and flat on the same plane. Assembled frames shall be braced temporarily to prevent their distortion during delivery to the site and installation.

1010.3.2 Installation

a. 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 painted with hot asphalt at its contact surface and provided with two 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 alter laying of hollow concrete blocks, bricks or adobe. Space between frames and masonry shall be fully filled with cement mortar proportioned 1:3.

b. Hinged Doors

Hinged doors, whether panel or flush type with standard height of 2100 mm and width of not more than 900 mm shall be hung with four loose-pin butt hinges, 100 mm x 100 mm. Swing out exterior doors shall be hung with four fast-pin butt hinges. Two hinges shall be fitted 150 mm from top and bottom edge of door. The other two 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.

c. Sliding Doors

Overhead tracks, standard, locally manufactured as per Plans shall be installed level and

mounting bracket secured in place with lag screws supplied with the set. Bracket shall be spaced 1000 mm 'on centers. Hangers, two each per door leaf, shall be per fitted and bolted to the dour 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 per fitted 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.

d. 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.

e. Sliding Type Window Sashes

Sashes shall be trimmed to fit the height of opening. A clearance of 2 mm shall be provided between the toungue’s base at the top rail and the bottom of the window head. Paraffin wax shall be applied to contacts of sliding sufaces.

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 brass screws each guide.

f. Casement Type Window Sashes

Sashes shall be trimmed to fit the 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 brass-plated narrow hinges, 50 mm x 75 mm, spaced 150 mm from top and bottom of stiles. In lieu of hinges, sashes may be 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.

g. Awning type Window Sashes

Installation of awning type sashes shall be by means of casement adjusters specified under Item 1010.3.2 (6) Casement Type Window Sashes.

1010.4 Measurement and Payment

Frames of doors and windows shall be measured and paid for on the basis of number of sets completely installed and accepted by the Engineer.

Doors and windows shall be measured and for based on the number of square meters involved in the completed and accepted installation.

Payment per square meter shall include cost of required hardware and all incidental expenses, but exclusive of locks for doors. Locks shall be paid for per set completely installed.

1010.5 Basis of Payment

Payment for completely installed and accepted wooden doors and windows shall be based on actual measurement and the corresponding contract unit price thereof. Payment based on Contract Unit Price shall constitute full compensation.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1010 (2)b	Doors (Wood Panel)	Square Meter

ITEM 1007 - ALUMINUM GLASS DOORS

1007.1 Description

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

1007.2 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 Finish 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 weather strip 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.

1007.3 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 hardware shall be accurately made and properly reinforced when necessary.

1007.3.1 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 are 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.

Weather-strip shall be furnished on edges at the meeting stiles of doorsWhere aluminum is to be in contact with steel concrete cinder, block, tile, plaster or other similar masonry construction the aluminum surface shall be back pain-ted before erection with a bituminous paint.

1007.3.2 Shop Finish

Exposed aluminum surfaces shall be electro type hard coats.

1007.3.3 Protection

All aluminum parts shall be protected adequately to ensure against damaged 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.

1007.3.4 Cleaning

The Contractor does not only protect all entrance units during construction but also responsible for removal of protective materials and cleaning aluminum surfaces.Aluminum shall be thoroughly cleaned with plain water with kerosene or gasoline and then wipe surfaces using clean cotton fabric. No abrasive cleaning agents shall be permitted.

1007.4 Method of Measurement

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

1007.5 Basis of Payment

The area in square meters of aluminum glass doors installed including the main frame and ready for service as provided in Item 1007.4 shall be the basis of payment based on the unit bid or contract unit price.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1007 (1)b	Aluminum Frame Glass Door, Swing Type	Square Meter

ITEM 1008 - ALUMINUM GLASS WINDOWS

1008.1 Description

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

1008.2 Material Requirements

1008.2.1

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 B 211, Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod and Wire. Screws, nuts, washers, bolts, r rivets and other miscellaneous fastening devices shall be made of non-corrosive materials such as aluminum, stainless steel, etc. Hardware for fixing and locking devices 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.

1008.3 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 operations 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 strips 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.

1008.3.1 Window Sash

Window panels shall be joined at corners with a 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.

1008.3.2 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.

1008.3.3 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.

1008.3.4 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.

1008.3.5 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 spring loaded and afford positive lock into the jamb profile. In a tilted position, the sash shall be removable to the interior.

1008.3.6 Shop Finish

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

1008.3.7 Protection

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

1008.3.8 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 cleaning solution and then wipes surface using clean cloth rugs. No abrasive cleaning materials shall be permitted in cleaning surface.

1008.4 Method of Measurement

Aluminum glass windows fully equipped with fixing accessories and locking devices shall be measured in square meters actually installed in place and accepted to the satisfaction of the Engineer.

1008.5 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 will be made under:

Pay Item Number	Description	Unit of Measurement
1008 (1)a	Aluminum Glass Window, Sliding Type	Square Meter

ITEM 1051- RAILINGS

Refer to Item 1051, Part F. Algal Tanks (36 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1051 (6)	Stainless Steel Railing	Linear Meter

ITEM 1200 - AIR CONDITIONING AND VENTILATING SYSTEM

1200.1 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 this specification

1200.2 Material Requirements

The types, sizes, capacities, quantities and electrical requirements of the compressor, evaporator, condenser chilled water pump and condenser water pump shall be as shown on the Plans.

1200.2.1 Refrigerants

Refrigerants shall comply with the Implementing Rules of Philippine Clean Air Act 1999. The use of chlorofluorocarbons as refrigerant shall not be permitted.

1200.2.2 Refrigerant Pipes

Refrigerant pipes shall be copper tubing, type L or K or black steel pipe, Schedule 40 for 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 tor 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.

1200.2.3 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 flange Type.

1200.2.4 Pipe Insulations

Insulations shall be preformed fiberglass or its equivalent.

The insulating materials shall be covered with 100 mm x 0.13 mm thick polyethylene film which shall be overlapped by 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 protection from weather.

1200.2.5 Ductworks

Ducts shall be galvanized metal sheet of not less than the following thickness.

1. No. 26 (0.55 mm) for 300 mm wide and smaller.
2. No. 24 (0.70 mm) for 350 mm to 750 mm wide.
3. No. 22 (0.85 mm) for 775 mm to 1,500 mm wide.
4. No. 20 (1.01 mm) for 1,525 mm to 2,250 mm wide.
5. No. 18 (1.31 mm) for 2,275 mm to 2,500 mm or larger.
6. For aluminum sheets use one (1) gauge higher.

Joints and stiffeners of ducts using slip joints shall be as follows:

1. 300 mm wide and smaller, without bracing.

2. 325 mm to 750 mm wide, brace with 25 mmx 25 mmx3 mm steel angles.

3. 775 mm to 1,500 mm, brace with 31 mm x 31 mm x3 mm steel angles.

4. 1,525 mm up, brace with 38 mm x 38 mmx3 mm steel angles

Stiffeners shall be located not more than 1.200 mm from each joint.

1200.2.6 Ductwork Insulation

The application insulation materials shall be rigid board made of closed-cell extruded polystyrene foam (XPS) or equivalent 25 mm thick for ground and to floor, 13 mm thick for intermediate floor. Galvanized metal bands for ducts shall be secured and spaced 300 mm minimum center to center and corners shall be protected with galvanized metal angles.

1200.2.7 Diffusers

The type, shape, capacity, size and location shall be as shown on the Plans.

Diffusers shall be complete with frame and gasket, equalizing deflector and volume control as indicated or specified and shall have a factory-applied prime coat of paint.

1200.2.8 Dampers

Dampers shall | be of same materials as duct, at least one (1) gauge heavier and shall have accessible location, complete with locking device for adjusting and Locking damper in position.

When necessary, splitters, butterflies and louvers damper deflecting vanes for control of air volume and direction and for balancing the system shall be provided whether or not they are shown on the Plans.

1200.2.9 Fire Damper

Main duct shall be provided with proper fire dampers of the fusible link actuated Type.

Access door shall be provided in ductwork for renewal of fusible link and to reset Damper.

1200.2.10 Foundation for the Equipment

Foundation shall be provided and shall conform to the recommendation of the manufacturer of the equipment. Equipment shall be leveled on foundation by means of jacks or steel wedges. All spaces between equipment bases and Concrete foundation shall be filled with cement mortar. Cement mortar shall conform to the requirements of Subsection 1710.2.3, Cement Mortar.

1200.2.11 Electrical Works

The Contractor shall provide power supply at the pull box installed inside the machine room and shall furnish and install the main circuit breaker and starter with suitable ratings and capacities, conduits, wirings, fittings, devices and at other equipment and electrical connections to complete the installation of the system. All electrical works shall comply with the latest edition of the Philippine Electrical Code (PEC), Part 1, the ordinance of the local government and all the rules and requirements of the local power company.

1200.3 Construction Requirements

The air conditioning system shall be entirely automatic in operation and shall not require the presence of an attendant except for periodic inspection for lubrication. All equipment and materials shall be inspected upon delivery and shall be tested after installation. Pipings shall not be buried, concealed, or insulated until it has been inspected, tested and approved. Walls, floors and other parts of the building and equipment damaged by the Contractor in the prosecution of the work shall be restored as shown on the Plans.

1200.3.1 Operating Tests

Air conditioning equipment shall be tested for 8 h per day for three (3) consecutive days or longer when so directed, under the supervisions of manufacturers qualified and authorized representative, who will make necessary adjustments and instruct designated plant operating personnel for each operation and maintenance of refrigerating equipment and controls. Tests of air flow, temperature and humidity shall be made to demonstrate that each complies with the requirements as indicated in the manufacturer’s specifications.

1200.3.2 Miscellaneous

The Engineer shall be provided with three (3) bound copies of "AS BUILT" diagrams, shop

drawings, part lists, serial number and inventory of equipment including manufacturers operating and maintenance manuals.

All standard tools and equipment shall be furnished for proper and regular maintenance of installed units.

1200.4 Method of Measurement

The quantity to be paid shall be measured either by set, kilograms, square meters or by lump sum completed and accepted by the Engineer in accordance with the Plans and this Specification.

1200.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 1200.4, 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 Air Conditioning and Refrigeration completed in place and incidentals necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1200 (13)a	Air Conditioning System,2.5HP,Split type	Lump Sum
1200(5)c	Exhaust Fan, Wall Mounted, Industrial Type	Set

ITEM 1202 - AUTOMATIC FIRE SPRINKLER SYSTEM (AFSS)

1202.1 Description

This Item shall consist of furnishing and installation of Automatic Fire Sprinkler System (AFSS), inclusive of all piping and pipe fitting connections, valves, controls, electrical wiring connection and all other accessories ready for service in accordance with the Plans and this Specification.

1202.2 Material Requirements

1202.2.1 Fire Pump

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

The fire pump shall be engine or electric motor driven and capable of delivering a minimum of residual pressure of 103 KPa at the topmost and remotest sprinkler. The pump unit shall be supplied with relief valve, gate valve, suction gauge and discharge pressure gauge.

The diesel gauge shall be designed specifically intended for an automatic water sprinkler protection system. A drop in system pressure due to the operation of one (1) sprinkler pressure shall trigger 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: tachometer, oil pressure gauge, temperature gauge and control panel. A diesel fuel day tank shall be provided to supply the engine for a minimum of 2 h running time.

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

1202.2.2 Jockey Pump

Jockey Pump shall be electric motor driven, 220v/440v, 3 phase or single phase, 60-hertz power connection. The capacity to be supplied shall not be less than that indicated on the Plans.

1202.2.3 Sprinkler Head

The sprinkler head shall conform to the following requirements of Table 1202.1 or as indicated on the Plans.

Table 1202.1 Sprinkler Head Properties

Parameters	Property
Type-Spray Unit	Pendent, upright and sidewall and concealed unit
Flow Capacity, min.	80 LPM per head
K-Factor (Discharge rate from nozzle)	K-5.6, K-8 & K-11.2
Bulb Color (Temperature), min.	Red (155F / 68C) Yellow (175F / 79C) Green (200F / 93C) Purple (286F / 141C)
Pressure Rating 1. Residual Pressure, min. 2. Maximum Pressure	 103 KPa 1035 KPa
Temperature Rating	Fusing at 57.5^{o} C to 93^{o} C @ max
Finish	Chrome-Pendent-Chrome or brass upright
Pipe Thread	12.7 mm nominal
Stock of Extra Heads and Tools required a.) Pendent and Upright b.) Sprinkler Tongs	 6 pieces for 300 sprinkler 12 pieces for 300 to 1000 sprinkler 24 pieces for 1000 sprinkler or more 2 pieces

c.) Sprinkler Wrench	2 pieces
Finish (all with corrosion resistant coating)	Chrome White Polyester Brass

1202.2.4 Alarm Check Valve and Fire Alarm System

1. The alarm assembly shall be constructed and installed so 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 sign in the vicinity of the building.

2. The alarm apparatus shall be substantially supported and so located and installed that all parts shall be readily accessible for inspection, removal and repair.

3. The actual water flow, through the use of a test connection, shall be employed to test the operation of the sprinkler alarm unit as a whole.

4. An approved identification sign shall be installed near the outdoor alarm device in a conspicuous position.

1202.2.5 Alarm and Supervisory System

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

1. Water flow switch at each floor of the building

2. Fire pump and jockey pump running condition and power supplies

3. Level of water in the reservoir

4. 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.

1202.2.6 Pipes and Fittings

1202.2.6.1 Black Iron 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.

1202.2.6.2 Chlorinated Poly (Vinyl Chloride) (CPVC) Pipes and Fittings

The CPVC Sprinkler pipes SDR 13.5 shall conform to the requirements of ASTM F442,

Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe (SDR-PR). Likewise, for sprinkler fittings it shall conform to the requirements of ASTM F438, Standard Specifications for Socket-Type Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 40 (Schedule 40) and ASTM F439, Standard Specification for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80 (Schedule 80). Female threaded adapters for sprinkler head connections with brass insert. The connections shall be joined with Solvent Cement that shall conform to the requirement of ASTM F493, Standard Specification for Solvent Cements for Chlorinated Poly (Vinyl Chloride) (CPVC) Plastic Pipe and Fittings. The type of solvent cement shall be heavy bodied and flow VOC.

1202.2.7 Siamese Twin (Fire Department Connection)

The Siamese twin shall be 63 mm x 63 mm x 100 mm, 90 degrees angle female coupling national standard thread, swivel type, with protective coupling cap and joint lug.

1202.2.8 Pipe Hangers

Pipe hangers shall be steel bars, 3 mm minimum thickness, with corrosion protection or as indicated on the Plan.

1202.2.9 Foundation

Refer to Subsection 1200.2.11, Electrical Works of Item 1200, Air Conditioning and Ventilating System.

1202.2.11 Fire Extinguisher

Fire extinguishers shall have a temperature range from -4^{o} F to 120^{o} F conform to the applicable requirements of National Fire Protection Association (NPFA) 10, Standard for Portable Fire Extinguishers.

1202.2.12 Fire Hose Cabinet

Fire Hose Cabinet shall comply with the requirements of ASTM E814, Standard Test Method for Fire Tests of Penetration Firestop Systems, for fire –resistance rating of walls where they are installed. Door and frame shall be made of cold rolled steel as indicated on the Plans.

1202.3 Constructions Requirements

1202.3.1 Installation of Sprinkler System

Installation of sprinkler systems shall comply with requirements of NFPA 13: Standard for the installation of Sprinkler Systems.System sequential 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 requirement. Marked instructions and identification signboards. These sign boards shall be made of #14 gauge B.I. a sheet with baked enamel finish paint and letter instructions are shown on the Plans. Additional signboards as may be required and not specified herewith shall be furnished at no extra cost. Signboards shall be mounted on the equipment or wall nearest the equipment for easy identification and reading. Paints shall

be basically glossy red and white.

Installation of Fire Sprinkler System shall conform to the following but not limited to:

1. Anchorage in concrete – expansion shields should preferably be used in a horizontal position on the sides of concrete beams.

2. Expansion shield in vertical position. When pipes 100 mm and larger are supported entirely by expansion shields in a vertical position, the supports shall be spaced not more than 3 m apart.

3. Pipes running through concrete beams shall be avoided.

4. The pipework shall be supported, anchored and guided in order to preclude failure or deformation. The Contractor shall construct and install hangers, support, anchors, guides, and accessories as necessary to the approval of the Engineer. Supports shall be designed to carry the weight of the pipe, fluid and pipe insulation.

5. Piping shall be securely fastened to the structure without overstressing any portion of the structure itself.

Pipe supports, anchors and guides shall be secured to concrete by means of inserts or if greater load carrying capacity is required by means of steel fishplates embedded in the concrete.

6. Hangers shall be arranged so as to prevent transmission of vibration from piping to building and supports.

7. Pipe hangers and support shall be completely furnished with rods, bolts, lock, nuts, swivels coupling, brackets and all other components and accessories to allow installation to freely expand and contract.

8. Hangers spacing shall be such that the piping is installed without undue strains and stresses and provision shall be made for expansion, contraction, structural settlement and water hammer.

9. Supports, clamps and hangers shall be made of galvanized steel, fixed with drilled plugs.

10. Sprinklers shall be arranged such that there is no interference with the discharge pattern and they shall be positioned between 75 mm and 150 mm below ceilings.

11. The sprinkler and pipelines shall not be spaced too close together in order to prevent an opening sprinkler from wetting, and thereby delaying the operation of adjacent sprinklers.

12. In locations where sprinkler heads are liable to be operated or damaged by accidental blow, stout metal guards should protect them.Care shall be taken to ensure that such guards do not impede the normal operation of the sprinkler head in the event of fire.

13. Sprinklers in false ceilings areas shall be concealed or recessed. They shall be a two-piece design with closure and mounting pipe, which allows easy installation and removal.

1202.3.2 Installation of Fire Extinguisher

Fire extinguishers shall be installed in accordance with Section 10.2.6.7, Portable and Wheeled Fire Extinguisher of the Fire Code of the Philippines and NPFA 10, Chapter 6, Installation of Portable Fire Extinguisher.

1202.3.3 Acceptance Tests

1. Tests – shall be conducted by the Sprinkler System Contractor in the presence of an inspector or Authority having jurisdiction.

2. Flushing of Underground Connections – To remove foreign materials, which may have entered the piping during installation of the same as required before sprinkler piping is connected.

3. Hydrostatic Test

a. Pressure – All systems, including piping shall be tested hydrostatically at not less than 1,378 KPa (200 psi) pressure for 2 h, or at 344.5 Kpa (50 psi) when the maximum static pressure is in excess of 1,033.5 Kpa (150 psi).

b. Operating Test – All control valves shall be fully closed and opened under water pressure to ensure proper operation. Use clean, non-corrosive water.

c. 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 open. The main drain valve shall be opened and remain opened 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 representatives.

The final design of the sprinkler system shall be fully developed in accordance with the requirements of Bureau of Fire Protection Department and the rules for automatic sprinkler installation in accordance with the relevant provisions of NFPA 13, Standard for the Installation of Sprinkler Systems.

1202.3.4 Maintenance Service

1. Upon completion of the work and all tests, the services of one or more qualified personnel shall be provided by the Contractor for a period of not less than five (5) working days to provide an operating manual and train the representative of the Owner in the operation and maintenance of the fire protection system.

2. The Contractor shall provide, free of charge, maintenance service of the system for a period of at least 1 year reckoned from the date of acceptance of the work by the Engineer.

1202.3.5 Miscellaneous

Refer to Subsection 1200.3.2, Miscellaneous of Item 1200, Air Conditioning System.

1202.4 Method of Measurement

The work under this Item shall be measured by either lump sum or set installed as indicated in the Plans.

1202.5 Basis of Payment

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

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1202 (6)a3	Fire Extinguisher, 10lbs. HCFC 123 with Bracket	Set

K. ADMINISTRATIVE AND PHYCOLOGY LABORATORY BUILDING

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement

804 (2)	Embankment from Borrow	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 Days	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units)

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (5)a	Catch Basin, Concrete	Each
1001 (9)	Storm Drainage and Downspout	Lump Sum
1001 (11)	Septic Vault, Concrete	Lump Sum
1001 (1)a5	Pipe and Fittings, 50 mm dia., PVC, Series 1000	Meter
1001 (1)a7	Pipe and Fittings, 100 mm dia., PVC, Series 1000	Meter

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (4)	Plumbing Fixtures	Lump Sum
1002 (24)	Cold Water Line	Lump Sum

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (1)e1	Ceiling, Metal Frame, Gypsum Board	Square Meter
1003 (1)e2	Ceiling, Metal Frame, Prepainted Metal Panel	Square Meter

ITEM 1030 - ACOUSTICAL CEILING

1030.1 Description

This item shall consist of furnishing all materials, tools, labor and equipment required in undertaking the installation of acoustical ceiling works as shown on the Plans and according to this Specifications.

1030.2 Material Requirements

All acoustical ceiling materials shall be non-combustible. The acoustical ceiling tiles shall be in accordance with ASTM standards shown in the following table:

Table 1030.1 Test Methods for Acoustical Ceiling Materials

Property	Test Method
Classification	ASTM E1264, Standard Classification for Acoustical Ceiling Products.
Strength	ASTM C367, Standard Test Methods for Strength Properties of Prefabricated Architectural Acoustical Tile or Lay-In Ceiling Panels
Flammability	ASTM E84, Standard Test Method of Surface Burning Characteristics of Building Materials.
Fire-Resistance Rating	ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials.

Light Reflectance	ASTM E1477, Standard Test Method of Luminous Reflectance Factor of Acoustical Materials by Use of Integrating-Sphere Reflectometers.
Sound Absorption	ASTM C423, Standard Test Method for Sound Absorption and Sound Absorption Coefficients by the Reverberation Room Method.

Metal suspension is in accordance with all applicable requirements of ASTM C635, Standard Specification for the Manufacture, Performance and Testing of Metal Suspension Systems for Acoustical Tile and Lay-in Panel Ceilings.

Wire hangers shall be in accordance with all applicable requirements of ASTM A641, Standard Specification for Zinc-Coated (Galvanized) Carbon Steel Wire. Unless otherwise indicated on the Plan, the minimum diameter of wires shall be gauge 12.

Angle hangers shall be in accordance with all the applicable requirements of ASTM A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process.

Hanger rods and flat hangers shall be mild steel, zinc coated or protected with rust-inhibitive paint.Unless otherwise indicated on the Plan the acoustical sealant for exposed and concealed joints shall conform to ASTM C834, Standard Specification for Latex Sealants.

1030.3 Construction Requirements

1030.1.1 General

The acoustical ceiling materials to be used shall conform to the samples approved by the Engineer. All acoustical works shall be in accordance to all the applicable requirements of ASTM C636, Standard Practice for Installation of Metal Ceiling Suspension Systems for Acoustical Tile Lay-In Panels.

Ceiling suspension systems shall be in accordance to all the applicable requirements ASTM E580, Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions.

1030.3.2 Mock Ups

Mock-ups shall be constructed for each form of construction and finish required to validate that the installation methodology and materials complies with this specification and requirements indicated on the Plans. Mock-Ups shall have a minimum dimension of 3 m x 3 m or larger as may be required by the Engineer. The designated location of mock-ups shall be approved by the Engineer. No acoustic ceiling panel installation shall be done until the mock-ups were approved by the Engineer. Approved mock-ups may become part of the completed work subject for the Engineer’s approval.

1030.3.3 Delivery, Storage, and Handling

Acoustical ceiling units and suspension system components shall be delivered in original,

unopened packages clearly labeled with name of manufacturer, source and location, product type, description, quantity, client's name and shipping address.

Panel's protective layer shall be removed only after installation is complete to help prevent panel surface damage.

All components shall be stored in fully enclosed space where they will be protected against physical damage from direct moisture, significant change in humidity, direct sunlight, surface contamination, and any other preventable cause.

Components shall be handled with care to prevent physical damage to the surfaces and edges and prevent distortion or other physical damage. Stacking shall comply with the prescribed instructions to prevent distortion and other damage the components.

1030.3.4 Environmental Limitations

Acoustical ceilings shall not be installed unit after spaces are enclosed and weather tight and after wet work and work above ceilings is complete. Temperature, humidity and ventilation shall be maintained within limits recommended by the manufacturer. Materials shall not be installed in exterior space unless otherwise indicated on the Plan.

If the project is located within the range of moisture associated with large bodies of water, necessary materials shall be finished with appropriate coatings.

1030.3.5 Installation of Components

Unless otherwise indicated on the Plan, installation of acoustic ceiling components shall confom to the applicable requirements of ASTM C636, Standard Practice of Installation of Metal Ceiling Suspension Systems for Acoustical Tile and- Lay-In Panels and to following requirements.

1030.5.1 Hangers

Where acoustical ceilings are suspended from a structure of wood construction, hangers shall be attached with suitable mechanical devices either to the bottom edge of the wood joists or to the vertical face of the wood joists near the bottom edge.

Where acoustical ceilings are suspended from a structure of concrete construction, hangers shall be mounted using ca-in-place hanger wires, hanger inserts, or other hanger attachment devices unless otherwise shown on the plans.

All suspension wires shall not press against duct or pipes.

Hangers formed from galvanized sheet metal shall be suitable suspending carrying channels or main runners from an existing structure provided that the hangers do not yield, twist, or undergo other objectionable movement.

Diameter of wire hangers for suspending carrying channels or main runners from existing structure shall be minimum of 2.70 mm (No. 12-gauge). It shall be galvanized and soft

annealed, mild steel wire.

1030.3.5.2 Carrying Channels

Carrying channel shall be leveled to within 3.2 mm in 3.60 m. Leveling shall be performed with the supporting hangers taut to prevent any subsequent downward movement of the carrying channel when the ceiling loads are imposed, Local kinks or bends shall not be made in hanger wires as a means of leveling carrying channels.

In an installation where hanger wires are wrapped around carrying channels, the wire loops shall be tightly formed to prevent any vertical movement or rotation of the member within the loop.

1030.3.5.3 Main Runners

Main runners shall be leveled to within 6 mm in 3 m. Evaluation of levelness shall be determined from measurements taken below hanger points. Measurements shall be made after completion of the ceiling installations but prior to building occupancy.

Where main runners are supported directly by hangers, leveling shall be performed with the supporting hanger taut to prevent any subsequent downward movement of the main runners when the ceiling loads are imposed.

Local kinks or bends shall not be made in hanger wires as a means of leveling main runners.

In installations where hanger wires are wrapped through or around main runners, the wire loops shall be tightly wrapped and sharply bent to prevent any vertical movement or rotation of the member within the loops. The wire shall be wrapped around itself a minimum of three full turns (360 degree each) within a 75 mm length. For safety purposes, the bottom of the hanger wires shall either be cut close to the vertical portion of the wire or be bent upward parallel to the vertical portion of the hanger wire.

When installing fire resistive main runners, all fire expansion relief cut outs in the main runner shall be installed within 75 mm of a vertical support hanger wire. Vertical support hanger wire spaced greater than 75 mm from fire expansion relief cut outs is only permitted when load performance has been evaluated at a greater distance.

1030.3.5.4 Cross Runners

Cross runners shall be supported by either main runners or by the other cross runners to within 0.80 mm of the required center distances. This tolerance shall be noncumulative beyond 3.60 m. The intersecting runners shall form a right angle.

The exposed surfaces of two intersecting runners shall lie within a vertical distance of 0.40 mm of each other with the abutting cross member always above the continuous main member.

1030.3.5.5 Splines

Splines used to form a concealed mechanical joint seal between adjacent tiles shall be

compatible with tile kerf design so that the adjacent tile will be horizontal when installed. Where splines are longer than the dimension between edges supporting members running perpendicular to the splines, the splines shall be placed so that they rest either all above or all below the main running members.

1030.3.5.6 Assembly Devices

Abutting sections of the main runner shall be joined by means of suitable connections such as splices, interlocking ends, tab locks, pin locks as indicated in the Plan. A joint connection shall provide sufficient alignment so that the exposed surfaces of two abutting main runners lie within a vertical distance of 0.40 mm of each other and within a horizontal distance of 0.40 mm of each other.

There shall be no visually apparent angular displacement of the longitudinal axis of one runner with respect to other. Assembly devices shall provide sufficient spacing control so that horizontal gasps between exposed surfaces of either abutting or intersection members shall not exceed 0.50 mm.

Spring Wire clips used for supporting main runners shall maintain tight contact between the main runners and the carrying channels when the ceiling loads are imposed on the runners.

1030.3.5.7 Ceiling Fixtures

Fixtures installed in acoustical tie or lay-in panel ceilings shall not compromise ceiling performance.

Fixtures shall not be supported from main runners or across runners if the weight of the fixture causes the total dead load to exceed the deflection capability of the ceiling suspension system. In such cases the fixture shall be separately supported.Fixtures shall not be installed so that main runners or across will be eccentrically loaded unless otherwise indicated to the Plan where provision is inherent in the system to prevent undesirable section rotation and displacement. In any case, runners supporting ceiling fixtures shall not rotate more than 2 degrees after the fixture loads are imposed.

1030.3.6 Inspection of Surfaces

The contractor shall verify and examine all surfaces and the conditions under which all acoustical ceiling work is to be performed and must notify all unsatisfactory conditions to the Engineer. No work shall be performed unless all unsatisfactory conditions have been corrected and accepted by the Engineer.

1030.3.7 Preparation of Surfaces

Before any installation of work begins, all surfaces shall be clean, dry, level and free from irregularities and tested for adhesive bond.

1030.3.8 Installation of Acoustical Ceiling Materials

The installation of acoustical materials shall be in accordance with the detailed section and

with the manufacturer's manual instructions. Acoustical materials shall be cut as required to fit the perpendicular condition and should be properly secured by anchorage and other accessories to complete the installation. No mechanical work shall be exposed on the finish work. All joints around electrical outlets, pipes, and other work extending through materials shall be sealed with caulking, Unless otherwise shown on the Plans, grid members and tile joints shall be parallel to perimeter walks with pattern centered in room areas in both directions.

1030.3.9 Cleaning of Surfaces

The finished surfaces shall be cleaned and must be free from any spots, dirt marks and dust by the use of a soft art gum eraser. For larger areas with larger smudges, use chemical treated new sponge rubber pad or wallpaper cleaner. Dust shall be removed by brushing lightly with soft brush or clean rag, or by vacuuming with soft brush attachment.

1030.4 Method Measurement

The work commenced under this Item shall be measured by the ceiling area covered in square meters.

1030.5 Basis Payment

The quantity determined shall be paid for at the Contract Unit Price which constitutes full compensation including labor, materials, tools and equipment and incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1030 (1)	Acoustical Ceiling Panel	Square Meter

ITEM 1004 - HARDWARE

Refer to Item 1004, Part J. Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1004 (2)	Finishing Hardware	Lump Sum

ITEM 1007 - ALUMINUM GLASS DOORS

Refer to Item 1004, Part J. Staff Quarters and Fish Food Storage Building.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1007 (2)	Aluminum Glass Door (Sliding Type/Swing Type)	Square Meter

ITEM 1008 - ALUMINUM GLASS WINDOWS

Refer to Item 1008, Part J. Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1008 (1)	Aluminum Glass Window (Sliding Type/Swing Type)	Square Meter

ITEM 1010 - WOODEN DOORS AND WINDOWS

Refer to Item 1010, Part J. Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1010 (2)b	Doors (Wood Panel)	Square Meter

ITEM 1018 - CERAMIC TILES

Refer to Item 1018, Part J. Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1018 (1)	Glazed tiles and Trims	Square Meter
1018 (2)	Unglazed Tiles	Square Meter

ITEM 1021 - CEMENT FLOOR FINISH

Refer to Item 1021, Part J. Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1021 (1)a	Cement floor finish, Plain	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter
1027 (3)	Decorative Stone	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 Units).

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

ITEM 1034 - DAMPPROOFING

1034.1 Description

This Item shall consist of furnishing all dampproofing materials on concrete surfaces, labor, tools, equipment and other facilities and undertaking the proper installation works in accordance with the Plans and this Specification

1034.2 Material Requirements

1034.2.1 Asphalt Cement

Asphalt for mop coat shall be in accordance with the applicable requirements of ASTM D449M, Standard Specification for Asphalt Used in Dampproofing and Waterproofing.

The Asphalt shall be prepared from crude petroleum by suitable refining processes to conform the applicable physical requirements of each type of asphalt to be used.

1034.2.1.1. Classification of Asphalt used in Dampproofing

Type I – A soft, adhesive, "self-healing" asphalt that flows easily under the mop and is suitable for use below grade under uniformly moderate temperature conditions both during the process of installation and during service.

Type II – A somewhat less susceptible asphalt than Type I, with good adhesive and "seal-healing" properties, suitable for use above grade where it will no be exposed to temperature exceeding 50 Celsius.

Type III – An asphalt less susceptible to temperature than Type II, with good adhesive properties, and suitable for use above grade on vertical surface exposed to direct sunlight or temperatures above 50 Celsius.

1034.2.2.12 Physical Requirements

The asphalt shall be homogenous and free from water. Each type of asphalt shall conform to the requirements of Table 1034.1.

Table 1034.1 Physical Requirements of Asphalt Used in Dampproofing

	Type I		Type II		Type III	
	Min	Max	Min	Max	Min	Max
Softening Point (ring-and-ball), °C.	46	60	63	77	82	93
Flash Pint (Cleveland Open Cup), d°C.	232	-	232	-	246	-
Penetration:						

0 °C, 200 g, 60 s; 0.1mm	5	-	10	-	10	-
25 °C, 50g, 5 s; 0.1mm	100	-	-	130	-	100
Ductility at 25 °C, cm	30	-	10	-	2	-
Solubility in trichloroethylene, %	99	-	99	-	99	-

1034.2.2 Coal-Tar Pitch

Coal-tar pitch shall be in accordance with the suitable requirements of ASTM D450M, Coal-Tar Pitch Used in Roofing, Dampproofing, and Waterproofing.

1034.2.2.1 Classification of Coal-tar Pitches:

Type I – suitable for use in built-up roofing, damproofing and membrade waterproofing systems.

Type II – suitable for use in dampproofing and in membrane waterproofing systems.

1032.2.2.2 Physical Requirements

Coal-tar pitch shall be homogenous and free of water. Each type shall be conform to the physical requirements of Table 1043.2.

Table 1034.2 Physical Requirements of Coal-Tar Pitched Used in Dampproofing

	Type I	**Type II**
Water, max., %	0	0
Specific Gravity, 25/25 °C	1.22 to 1.34	1.22 to 1.34
Softening point (ring and ball), °C	52 to 60	41 to 52
Flash Point, Cleveland open cup, min., °C	190	175
Total Pitch soluble in carbon disulfide, %	72 to 85	72 to 85
Ash, max, %	0.50	0.50
Total Distilate:		

0 to 300 °C, max %	10	10
0 to 315 °C, max %	-	-
0 to 360 °C, max %	-	-
Specific Gravity of distillate from 0 to 32 to 300 °C, min. 38/15.5 °C	1.03	1.03
Doftening point (ring-and-ball) of residue from distillation to 300 °C, max., °C	80	80

1034.2.3 Emulsified Asphalt

Emulsified asphalt for dampproofing shall be accordance with the suitable requirements of ASTM D1227, Standard Specification for Emulsified Asphalt Used as Protective Coating for Roofing.

1034.2.3.1 Classification of Emulsified Asphalt

Type II, Class 1 – emulsified asphalt prepared with mineral colloid emulsifying agents and containing fibers other than asbestos.

Type II, Class 2 – emulsified asphalt prepared with chemical emulsifying agents and containing fillers or fibers other than asbestos.

Type III, Class 1 – emulsified asphalt prepared with mineral colloid emulsifying agents, without fibrous reinforcement.

Type III, Class 2 – emulsified asphalt prepared with chemical emulsifying agents, without fibrous reinforcement.

1034.2.3.2 Physical Requirements

The emulsified asphalt shall conform to the physical requirements of Table 1034.3.

Table 1034.3 Physical Requirements of Emulsified Asphalt

	Type II Class 1		Type III Class 1		Type II Class 2 Type III Class 2	
Weight per Liter, kg	Min	Max	Min	Max	Min	Max

Weight per Liter, g	0.98	1.08	0.98	1.04	1.10	1.14
Residue by Evaporation %	980	1080	980	1040	1100	1140
Water Content, %	45	55	74	53	40	60
Ash Content of Residue,%	5	25	-	8	30	50
Water Content, %	-	55	-	53	40	60
Flammability					No Tendency to flash or ignite	
Firm Set, h		24	-	24	-	24
Heat Test, 100 ± 3 °C					No blistering, sagging or slipping	
Flexibility, 0 0.05 °C					No cracking or flaking	
Resistance to Water					No blistering or reemulsification	
Direct Flame Test					Coating shall char in place	

1034.2.4 Primer

10343.2.4.1 Asphalt Primer

Asphalt primer shall be in accordance with the suitable requirements of ASTM D41M, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.

1. Classification of Primer

Type I – is characterized as asphalt primer with a generally higher solvent-to-asphalt ratio.

Type II – is characterized as asphalt primer with a lesser solvent-to-asphalt ration than Type I.

2. Physical Requirements

The Asphalt Primer shall conform to the following requirements.

Water,Vol %, max, Type I and Type II	0.5
Saybolt Furol Viscosity at 25 oC, Type I	25 to 125 s
Saybolt Furol Viscosity at 25 oC, Type II	120 to 500 s
Distillation, Volume % of the Primer	
Up to 225°C, Type I	Not less than 35
Up to 360°C, Type I	Not more than 65
Up to 225°C, Type II	Not less than 30
Up to 360°C, Type II	Not more than 60

The residue obtained from the distillation up to 360oC shall conform to the following requirements:

Penetration at 25 °C, 100 g, 5 s	25 to 50
Matter Soluble in Trichoroethylene	Not less than 99%

1034.2.4.2 Coal-Tar Pitch

Coal-tar pitch primer shall be in accordance with the suitable requirements of ASTM D43M, Standard Specification for Coal Tar Primer Used in Roofing, Dampproofing, and Waterproofing.

Coal Tar be a distillate of coal-gas tar or coke-oven tar and shall conform to the following requirements:

Water	Not more than 1%

Consistency at 5 ℃	Entirely fluid and crystal free
Specific Gravity, 38/15.5 ℃	Not less than 1.06
Matter Insoluble in Benzene	Not more than 0.5%
Distilation, based on water-free oil:	
Up to 210 ℃	Not more than 1%
Up to 235 ℃	Not more than 10%
Up to 355 ℃	Not more than 65%
Coke Residue	Not more than 2%

1034.2.3.4 Emulsified Asphalt Primer

Primer for emulsified asphalt shall conform to the manufacturer's approved primer.

1034.2.5 Polyethylene Sheet

Polyethylene (Polythene) sheet shall be used over bitumen painter surface where specified and shall consist of 0.13 mm thick polythene sheet (500 gauge) complying with ATM D2103, Standard Specification for Polyethylene Film and Sheeting.

1034.3 Construction Requirements

Dampproofing coating shall not be used if the concrete surface involve was subjected to a continuous or even an intermittent head of water. Drainage system shall be provided to prevent development of such a head. Dampproofing coating shall not be used to bridge or seal cracks, so that if cracks are present or will develop later, dampproofing will not be effective.

1034.3.1 Surface Preparation

The surface preparation shall be in accordance whenever applicable with Subsection

1016.3.1 Surface Preparation

Prior to the application of a barrier material, it is generally considered necessary to test for adequacy of surface preparation. Before dampproofing, the surface shall be inspected and approved by the Engineer.

1034.3.2 Release Agents on Forms

Release agents on forms, such as oil, wax, grease and silicone, which will transfer to the concrete surface during placement, shall not be used if a damping barrier system will be applied later. Trademark paint systems approved by the Engineer applied to forms and formulated to prevent contamination of the concrete surface shall be used.

1034.3.3 Tests for Surface Quality Prior to Application

The quality of the concrete surface is an important factor affecting adhesion of damping barrier systems. Tests for cleanliness and dryness of the surface shall be conducted prior to dampproofing the surface. The number of tests and the areas to be tested shall be as directed by the Engineer.

1034.3.3.1 Cleanliness of Surface

In a dusty condition, wipe the surface with a dark cloth. If white powder sticks to the cloth, the surface is considered to be too dusty and therefore unsatisfactory to receive a damping system.

On an only condition, sprinkle water on the dried concrete surface. If the water spreads out immediately instead of standing as droplets, it may be concluded that the surface is not contaminated by oils or dust. The test will not reveal the presence of other surface contaminants such as carbonates and alkalies.

The pH of the concrete shall be tested in accordance with ASTM d4252, Standard Test Method for pH of Chemically Cleaned or Etched Concrete Surfaces. A pH below four (4) shall be considered unacceptable.

1034.3.3.2 Dryness of Surface

In cases where there is a question about the moisture content, evaluate the concrete in accordance with ASTM D4263, Standard Test Method for Indicating Moisture in Concrete by the Plastic Sheet Method, or other suitable test procedures and treatment in accordance with the surfacing manufacturer's recommendations.

1034.3.4 Ambient Conditions Prior to Application

Dampproofing should be applied in the afternoon after the concrete surface had been exposed to the sun and air for at least 6 h.

1034.3.5 Application

The work shall be done by workmen experience in the application of dampproofing and the Contractor shall coordinate dampproofing operations with other phases of the work to prevent staining or damaging finished work. The Contractor shall repair or replace damaged finished work to the satisfaction of the Engineer. Dampproofing shall be applied as shown on the Plans.

Curing concrete or masonry surface shall be in accordance with Subsection 900.3.13, Curing concrete of Item 900, Structural Concrete except for the used of liquid membrane curing compound. Allow the concrete surface to dry at least 10 days after completion of curing. Apply damp proofing material to a dry, clean, reasonably smooth surface that is free of dust and loose materials.

Damp proofing shall not be applied when the ambient temperature or the concrete temperature is below 7.2 °C, unless the Engineer specifically allows.

Apply a light coating of the primer to the concrete surface after preparation, cleaning and drying Apply the primer to thoroughly and uniformly coat the surface. Apply the finish coat after the prime coat cures but still tacky to the touch.

Apply two (2) coats of asphalt at the rate approximately 1.25 kg/m2 of surface per coat. Apply prime coat and asphalt coats uniformly, covering the surface and thoroughly work them into the surface.

Make the total of the final two (2) asphalt coats approximately 2 mm thick. Allow asphalt coats to be harder before allowing contact with water or backfill material.

Apply a single layer of polyethylene sheet 0.13 mm thick (500 gauge) on dampproof course (generally applied at basement levels which restricts the movement of moisture through walls and floors) or as specified. The polyethylene sheet shall be place in such a way to ensure proper bond with the asphalt layer.

1034.4 Method of Measurement

This Item shall be measured in square meters for areas actually applied with damp proofing materials and accepted by the Engineer.

1034.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 1034.4, Method of Measurement shall be paid for at the Contract Unit Price for Dampproofing work which price and payment shall be full compensation for furnishing and applying dampproofing materials including the use of equipment and tools, labor and incidentals necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1034	Dampproofing	Square Meter

ITEM 1046 - MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter

1046 (2)a2	CHB Non- Load-Bearing (including Reinforcing Steel), 150mm	Square Meter

ITEM 1051 - RAILINGS

Refer to Item 1051, Part F. Algal Tanks (36 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1051 (6)	Stainless Steel Railings	Liear Meter

ITEM 1100 - CONDUITS, BOXES & FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
1100 (10)	Conduits, Boxes & Fittings (Conduit Works/ Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1101 (2)b2	Electrical Wire, 3.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b3	Electrical Wire, 5.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b4	Electrical Wire, 8.0mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b8	Electrical Wire, 38.0mm² TW/THHN/THW², Stranded	Meter

1101 (2)b9	Electrical Wire, 50.0mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b11	Electrical Wire, 80mm² TW/THHN/THWN², Stranded	Meter

ITEM 1102- POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES.

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board with Main & Branch Breakers	Lump Sum

ITEM 1103 - LIGHTING FIXTURES

Refer to Item 1103, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (3)	Cabinets	Square Meter

ITEM 1202 - AUTOMATIC FIRE SPRINKLER SYSTEM (AFSS)

Refer to Item 1202, Part J. Staff Quarters and Fish Food Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1202 (6)a3	Fire Extinguisher, 10lbs /HCFC 123 w/ Bracket	Set

ITEM SPL 1 - DEWATERING

Refer to SPL 1, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 1200 - AIR CONDITIONING AND VENTILATING SYSTEM

Refer to Item 1200, Part J. Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1200 (13)	Air Conditioning System	Lump Sum

L. TWO (2) UNITS PUMP HOUSE

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804 (1)	Embankment from Structure Excavation	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Structure Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a1	Reinforcing Steel (Deformed), Grade 40	Kilogram

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 1000 - TERMITE CONTROL WORK

Refer to Item 1000, Part C. Site Dvelopment Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1000 (1)	Soil Poisoning	Liter

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (1)a5	Pipe and Fittings, 50mm dia., PVS\C Series 1000	Meter
1001(1)a7	Pipe and Fittings, 100mm dia., PVS\C Series 1000	Meter

ITEM 1047 - METAL STRUCTURES

Refer to Item 1047, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum
1047 (10)	Metal Structure Accessories	Lump Sum

ITEM 1046 - MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (1)e1	Ceiling, Metal Frame,Gypsum Board	Square Meter
1003 (1)e2	Ceiling, Metal Frame,Prepainted Metal Panel	Square Meter

ITEM 1005 - STEEL WINDOWS

1005.1 Description

This Item shall consist of furnishing and installing steel windows ,(fixed, project-in, project-out, side hung-out or side hung-in) fully equipped with fixing accessories and locking devices in accordance with the Plans and this Specification.

1005.2 Material Requirements

1005.2.1 Steel Windows -Hot Rolled and Hot Rolled Fire Rated

(Fixed, Project-In, Project-Out, Side Hung-Out or Side Hung-In)

The frame and ventilator sections shall be hot rolled steel. Steel sheet shall conform to ASTM A1011M, Standard Specification for Steel Sheet, and Stip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low Alloy with Improved Formability and Ultra-High Strength. The frame or ventilator sections shall have a minimum thickness of 3 mm and a front to back depth dimension of 35 mm. Muntin bars shall be hot rolled steel. Glazing beads shall be extruded aluminum or steel. Weather-stripping shall be extruded vinyl.

1005.2.2 Steel Windows - Cold-Formed and Cold-Formed Fire Rated

(Fixed, Project-In, Project-Out, Side Hung-Out or Side Hung-In)

The frame and ventilator shall be composed of ASTM A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy Coated (Galvannealed) by the Hot-Dip Process, low carbon cold rolled formed Steel sections with a minimum thickness of 0.90 mm. Windows shall be defined and categorized as commercial and industrial windows with a minimum Combined weight of frame and ventilator of 4.0 kg/m and capable of passing a structural load test of 146.50 kg/m². The frame and ventilator sections shall have a minimum front to back depth dimension of 47.50 mm. Only labeled fire protection rated glazing material shall be used in fire-rated windows. The individual glazing material exposed area shall not exceed 0.85 m² with no dimension exceeding 1,370 mm unless otherwise tested. When Continuous glazing angles or channels are used to hold the glass in a window, these continuous members must be steel. Muntin bars shall have a tee shaped face min. of 30 mm. Glazing beads shall be cold rolled steel with a minimum thickness of 0.90 mm. Weatherstripping shall be extruded vinyl or Ethylene Propylene Diene Monomer (EPDM) rubber.

1005.2.3 Casement Windows

Casement or side-hung ventilators which swing outward, have hinges, locking handles, sill operators, or simplex hardware as required in the Plans. Ventilators may also be designed to open inward and have hinges, simplex hardware, and sill pull.

Hinges shall be an extension or close type, friction or non-friction type, made from steel, stainless steel, or bronze with non-ferrous pins or steel pins with non-ferrous bushings or washers. Two (2) hinges are provided per ventilator, except for ventilators exceeding 1.70 m in height, which are supplied with three (3) hinges or two (2) hinges and a midpoint closing

mechanism. A single locking handle, manufacturer's standard, shall be furnished for each Ventilator except for ventilators exceeding 1.70 m in height, which are supplied with two (2) point locking devices or two (2) individual locking handles.

When under-screen operators are specified, they shall be in accordance with the manufacturer's standard, and non-friction type hinges shall be furnished. Locking handles and under screen operator housings shall be manufacturer's standard design. They shall be attached securely to the windows with brass or other corrosion-resisting screws.

1005.2.4 Projected Windows

Projected-out ventilators shall have top rail sliding downward and the bottom rail swinging outward and upward. Projected-in ventilators shall have bottom rail sliding upward and the top rail swinging inward and downward.

Each ventilator is balanced on two (2) heavy steel side arms attached securely to the ventilator and to the frame, and two (2) non-ferrous friction shoes sliding in the channel of the jamb frame sections which shall hold the ventilator firmly in open positions. As an option, ventilators may be balanced on four (4) bar steel hinge assemblies. Supporting arms and hinge assemblies shall be Concealed when the ventilator is closed.

Projected-in ventilators shall be provided with locking handles ,or spring catches. Projected-out ventilators shall be provided with locking handles manufacturer's standard under-screen operator when specified. If the locking rail of the ventilator is more than 2 m above floor level, hardware designed for pole operation shall be furnished. Ventilators exceeding 1.40 m in width are supplied with two (2) locking handles.Locking handles, spring catches, and under screen operator attachments shall be manufacturer's standard design. They shall be attached Securely to the windows with brass or other Corrosion-resisting screws.

1005.2.5 Awning Windows

Awning windows provide simultaneous operation for large areas of outward opening ventilators. Ventilators linked in unison are activated and controlled by means of a detachable crank handle at the sill. For windows where sills are out of reach, remote controls can be provided for manual or electrical operation.Windows shall be made from heavy intermediate materials and construction as described under windows in the hot-rolled sections.

Awning ventilators shall have support on two (2) hinges and two (2) arms, or on two (2) steel slide arms pivoted to vent and to the principal frame member. Provide bronze-brushed pivots and hinges with bronze pins or as specified in the Plans.Design the ventilators to close and weather on each other, or independent meeting rails assembled as part of the window frame.

1005.2.6 Double and Single Hung Windows

Double-hung ventilators can be raised and lowered within a double-channel frame, the bottom unit within the inner channel and the upper unit within the outward channel. The positioning of ventilators in the frame Controls the amount of ventilation. Closing requires both units to be fully extended and locked at the horizontal center rail. Single-hung ventilators require that the

upper exterior unit be non-operable and that the lower unit be operable.

Each ventilator shall have one (1) sash balance attached securely to each jamb of the ventilator and to the frame which shall hold the ventilator firmly in an open position. Fusible links (if required) shall be fastened at the head of each balancer of the lower ventilation so that the ventilator may close automatically in case of fire.Ventilators shall have a sweep lock at the horizontal center rail. Two (2) Sweep locks shall be furnished for ventilators exceeding 0.96 m in width.Sweep locks and lift handles shall be of standard design and shall be attached securely to the windows with brass or other corrosion-resisting screws

1005.2.7 Accessories

Steel windows shall be provided with first-class quality and locally available hardware, clips, pins, anchors, glazing beads and fastenings, necessary for complete installation and operation of ventilators.

1005.2.7.1 Anchors

Hot-dip galvanized steel anchors shall be used. Anchors and fastenings to heads. jambs, and sills of openings shall be fastened securely to windows or frames. Each frame shall be anchored at jambs with a minimum of three (3) steel anchors. Perforated anchor stems shall be provided for mortar keying with anchor flanges of sufficient width to provide sliding friction fit inside frames. Perforated stems shall be extended not less than 100 mm into masonry. For anchorage at concrete walls and prepared openings, equip frames with manufacturer's standard bent-clips located approximately 150 mm from each end and at the midpoint.

1005.2.7.2 Hardware

All operable sash shall be equipped with a latching device which can be secured from inside. The item, type, and function of hardware required shall be specified under individual window type. Hardware shall be attached securely to windows with corrosion-resistant bolts or machine screws. Use of sheet metal screws shall not be allowed. At fixed screens, adapt the hardware to permit operation of ventilators. Hardware for each window furnished at the factory shall be fitted and tested to ensure satisfactory operation and security.

Hardware Materials and Finish

Non-magnetic type stainless steel exposed hardware shall be provided with Satin finish; white bronze with satin finish; yellow bronze with the dull (Oxidized) finish. Use steel or malleable iron hinges, with non-ferrous pins, or with steel pins and non-ferrous bushings or washers.

1005.2.7.3 Fasteners

Fasteners shall be fabricated from 100% re-melted steel. prime exposed heads of coated or plated fasteners and finished to match adjacent material.

1005.2.7.4 Metal I Sub-frames and Stools

Metal sub-frames and stools shall conform with the Plans to suit the particular window. It shall match exposed surfaces with the windows.

1005.2.7.5 Screens

Screens shall conform to ASTM D3656M. Standard Specification for Insect Screening and Louver Cloth Woven from Vinyl-Coated Glass Yarns. It Shall be Class 2, 18 by 14 mesh and the color shall be either charcoal or gray.

1005.2.8 Special Operators

1005.2.8.1 Pole Operators

Pole operators shall be provided for windows having operating hardware or locking rails more than 2 m above the floor. One (1) pole operator shall be provided for each room, and one (1) pole hanger for each pole in location as indicated on the Plans.

1005.2.8.2 Extension Crank Operators

Removable handles shall be provided for crank-operated rotary operators located more than 2 m above the floor. One (1) removable handle shall be provided for each room.

1005.2.8.3 Mechanical Operators

Manual motorized operators shall be provided for group operation of continuous rows of windows, and for windows located at unusual heights, where other types of remote operation are not feasible. Operators that Open and dose windows shall be provided without appreciable deflection, vibration or rattle.

Transmission lines shall be equipped with means of adjustment. Control window units in groups with operators as recommended by window manufacturer for the particular window arrangement shown, unless specifically indicated otherwise. Mechanical operators shall used in one of the following types:

1. On-Sill Operators: Centrally located, manually controlled mechanisms for adjusting ventilators, assembled of bronze telescoping shafts with machine cut threads. Conceal, except for linkage members, by appropriate covers. Provide one (1) operator, secured to the sill, for each window. Finish operators exposed to view to match hardware finish. Finish covers to match window casings.

2. Geared Lever-Arm Operator: Provide power unit with machine-cut gears and machined thrust bearings housed in a dustproof oil-tight case, with provision for lubrication. Provide torsion shaft of standard black iron pipe not less than 25 mm inside diameter. Rigidly clamp steel or malleable iron operating arms to the shaft and connect to the ventilator by push bar and hinge bracket. Support the operating mechanism on brackets securely attached to building structure or mullions. No Single line is allowed to extend more than 9 m from either or both sides of the power unit.

3. Geared Rack-and-Pinion Operator: Provide power unit with machine-cut. gears and machined thrust bearings housed in a dustproof oil-tight case, with provision for lubrication. Provide torsion shaft of standard black iron pipe not less than 25 mm on inside diameter. Cut steel rack to a pitch that will mesh accurately with the cut teeth on a steel or cast iron pinion. Fasten pinion securely to torsion shaft. Provide a steel rack with a hinged bracket for attaching to the ventilator. Hold rack in mesh with pinion by steel yoke with bearing rollers of solid brass or cadmium plated steel. Support the operating mechanism on steel brackets securely attached to building structure or mullions. No single line is allowed to extend more than 15 m from either or both sides of the power unit.

4. Operating Arms and Racks

Each ventilator, not more than 900 mm wide shall be provided with a single operating arm or rack attached at the center of the rail. Each ventilator more than 900 mm wide shall be provided with two (2) operating arms or racks attached to side rails or near ends of the horizontal rail of the ventilator.

5. Chain Control

Provide power unit with hand chain, operating over chain wheel wift a chain guard.Drill and secure wheel to Worm shaft by key. Terminate chain approximately 600 mm above the floor. Where building construction makes it impracticable to hang chain vertically from the power unit, furnish single or double chain idlers to convey chain to point shown or directed or double chain idlers to convey chain to point shown or directed.

6. Steel Shaft Control

Provide a power unit with a vertical standard black iron pipe of not less than19 mm inside diameter or solid steel shaft with malleable iron or steel coupling. Support vertical shaft with brackets spaced not over 2m apart. Where hand operating wheel is indicated 1.5m above floor, place the wheel in a horizontal position. Secure wheel in place permanently. Furnish universal joints or beveled gears to locate control at the point Shown or as directed on the nearest wall or column. Where practicable, mount vertical shafts on walls instead of pilasters.

1005.3 Construction Requirements

1005.3.1 Submittals

The Contractor shall submit shop drawings showing window and installation details, including anchorage, fastening, and recommended sealing methods. Show dimensioned elevations with opening and window Sİzes.

Test reports shall be provided for all pertinent standards.

1005.3.2 Fabrication and Welds

All steel windows shall be fabricated in accordance with the approved shop drawings. Frame and ventilator sections shall be solid one-piece sections and corners shall be welded and

dressed. Flanges forming the weathering Contacts shall be rolled integral with sections to provide close contact with both inside and outside points of contact. Muntin bars shall be interlocked and continuous from head to sill and jamb to jamb except that bars in one direction may be discontinued if they are securely welded at the intersection. All windows shall be designed for inside (or outside) glazing.

The screen shall be provided with frames of steel with finish matching that of windows. Equip frames with removable splines of steel or vinyl. Form groove in the frame for holding screen cloth in place with non cylindrical splines. Make spline and groove assembly so that cloth cannot be removed from the groove by pressure on cloth. Make splines of such size and shape that rotation of spline in the groove will be prevented and spline will tightly hold the cloth in place.

1005.3.3 Installation

Steel windows shall be installed by experienced personnel and in strict accordance with the approved shop drawings. All steel window shall be set plumb and true to line, without warp or rack of frames or ventilators. The joints between the window frame and masonry shall be carefully caulked. Contacts between windows or doors and adjacent steel including mullions shall be sealed with mastic furnished and applied by the Contractor. Windows shall be designed for glazing from the outside with spring wire glazing clips and glazing putty.

Mullions and anchors shall be manufacturer's standard, vertical mullions, anchors and bolts for attaching shall be furnished where required. Adequate anchorage shall be provided to ensure firm installation.

Attach ventilator hardware and adjust ventilators to operate smoothly, free from the twist and be weather tight when closed prior to field glazing. Ventilators shall remain closed and locked during glazing. The field painting of windows must be performed prior to installation and shall include paint coverage to all surfaces of the frames. Cleaning of masonry and other exterior or interior surfaces shall be done prior to installation.

The exterior joints between the windows, trim and muntins shall be properly sealed watertight with an approved sealant and neatly pointed. Attach ventilator hardware, as required, and adjust ventilators to operate smoothly free from the twist and to be weather tight when closed and latched. Any abraded Surface of the window finish shall be cleaned and touched up with air dry paint, as approved and furnished by the Contractor in color to match factory applied finish.Any materials that show visual evidence of biological growth due to the presence of moisture must not be installed on the building project.

Insect Screens

Screens with hinged or sliding wickets shall be provided as required. The wire cloth shall be held taut with a removable spline. Screens shall be removable from the window, held in place by clips. After assembly, windows shall be pretreated, epoxy or zinc coated, followed by the manufacturer's Standard finish.Screens shall be installed with weave parallel to frames. It shall stretch tight for a smooth appearance. Edges shall be concealed in spline channels.

1005.3.4 Cleaning

The Contractor shall be responsible for protecting the windows and related materials during storage on the job and during and after installation, The Contractor shall leave the window surfaces clean after installation.

Any protection necessary due to the cleaning of materials adjacent to the windows shall be the responsibility of the Contractor.

1005.3.5 Delivery and Storage

All steel windows shall be delivered to the project site in undamaged condition. All steel windows and components shall be stored on edge, out of contact with the ground, under a watertight covering, and arranged to avoid bending, warping, or other damage.

1005.4 Method of Measurement

Steel windows shall be measured by actual in place installed with respective design/style and type of operation in square meters or lump Sum. Window accessory shall be measured by actual in place installed in lump sum.

1005.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 1005.4, Method of Measurement shall be paid for at the Contract Unit Price for each of the Pay Items listed below that is included in the Bill of Quantities, which price and payment shall be full compensation for furnishing all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement
1005 (5)	Steel Windows	Lump Sum

ITEM 1006 - STEEL DOORS AND FRAMES

1006.1 Description

This Item shall consist of furnishing and installing all fabricated steel doors and frames equipped with fixing accessories and locking devices in accordance with the Plans and/or shop drawings and as herein specified.

1006.2 Material Requirements

All door cladding plates or panels shall be formed from gauge 20 cold-rolled, prime quality steel. Frames shall be formed from gauge 16 cold-rolled steel. The materials used shall conform

to the specification requirement of ASTM-A505, , Standard Specification for Steel Sheet and Strip, Alloy, Hot-rolled and Cold-rolled.

1006.2.1 Tubular Door (Casement/Sliding)

1006.2.1.1

Hollow steel doors shall be custom built of size and details as indicated on the Plans and/or shop drawings. Cladding of doors shall be flush or louver type. Doors shall be 44 mm thick, side hinged or overhead· hung, as called for on the Plans.

1006.2.1.2

Flush doors shall be constructed from two outer steel sheets not lighter than gauge 20, with edges welded and finished flush. The outer face sheets shall be reinforced with gauge 24 vertical channels or interlocking zee members. Sound insulation fillers of cork fiberboard, mineral wool board or asbestos shall be placed full height in spaces between reinforcing channels. Doors shall have smooth, flush surfaces without any visible joints or seams on exposed faces or stile edges except around glazed or louvered pane inserts. Top and bottom frame of doors shall have continuous reinforcing channels welded to face sheets. The channel for exterior doors shall be inverted type, not lighter than gauge 16, constructed to form a weather seal. Glazed opening shall be provided where indicated and molding around glazed openings shall not be lighter than gauge 20 metal.

1006.2.2 Grille Doors

Grille doors shall be of flat, square or round bars (wrought iron) as indicated on the Plans framed on galvanized black iron pipe or flat wrought iron bars, of the design shown on the Plans.

1006.2.3 Fire Rated Exit Steel Doors

Fire rated doors shall be swing type. The assemblies of the fire door such as the frame, hardware and other accessories shall be in accordance with National Fire Protection Association (NFPA 80), Standard for Fire Doors and Opening Protectives. Testing of fire rated doors shall be in accordance with ASTM E119, Standard Test Methods for Fire Tests of Building Construction and Materials. Fire rated doors are a part of a passive fire protection system to reduce the spread of fire between separate compartments of a structure and to enable safe exit from a structure in case of a fire. Steel fire doors are rated by time (in minutes or hours) that a door can withstand exposure to fire test conditions.

Rating include 90 minutes, 60 minutes, 45 min, and 20 min, with a maximum rating requirement of any swing type fire door of 3 hours. Rating of fire doors shall be in accordance with NFPA 80.

1006.2.4 Fabricated Steel Door Frames

Fabricated steel door frames shall be machine pressed true to details, to size and shape as shown

on the Plans and shall have fill welded unit of knockdown field assembled type construction at corners and other joints.

1006.2.5 Steel Louvers

Louvers shall be machine pressed conforming to the size and design indicated on the Plans. The steel sheets shall meet the requirement of ASTM A505, Standard Specification for Steel Sheet and Strip, Alloy, Hot-Rolled and Cold-Rolled; rivets of ASTM B316M, Standard Specification for Alluminum-Alloy Rivet and Cold – Heading Wire and Rods, and screws, bolts, nuts and washers of ASTM b211, Standard Specification for Aluminum and Aluminum - Alloy Bar, Rod and Wire.

1006.2.6 Anchors and Fasteners

Anchors shall be steel, zinc coated or painted with rust inhibited paint, of sizes, shapes and design per manufacturer’s standards. Floor anchors shall not be lighter than gauge 18, with exception of jamb anchors for installing door frames in metal latch and plaster assemblies which shall be minimum of gauge 16 and shall not extend no more than 20 mm out of the back of the jamb.

1006.3 Construction Requirements

1006.3.1 Fabrication

Corner joints of frames shall be mitered and welded conforming to manufacturer's standard manual for metal doors. All contact edges are closed tight. Welds on the exposed surface shall be ground smooth and shall be neat in appearance.

Joints for knock-down type frame corners shall be designed for simple field assembly of header to jamb members by concealed tenon, splice plates, or other type concealed in interlocking joints that will produce square and rigid corners. Joints shall be securely locked in place during erection and the alignment of adjoining members shall be maintained. All bolted connections shall be provided with lock units.

1006.3.2 Shop Finish

Steel doors, frames and louvers shall be cleaned thoroughly, hot or cold phosphate-treated to assure maximum paint adherence and prime finish, in accordance with the following operations:

1. After fabrication, grease and dirt shall be removed by a hot alkali solution and rinsed with hot water.

2. After cleaning, all parts shall be immersed in hot or cold phosphate solution and rinsed with a diluted solution or chronic acid.

3. After drying under controlled temperature, one coat of shop primer shall be applied by dipping type especially developed for materials treated with phosphates.

The cleaning, phosphate, dipping or spraying of shop primer and even drying shall be done on a continuous operation in the factory.

1006.3.3 Installation

Steel doors, frames and louvers shall be set plumb and true in 'The joint between frame and masonry shall be carefully contacted between door/frame and adjacent steel shall be sealed with mastic. Fire rated exit steel doors shall be installed in accordance with NFPA 80 and the Fire Code of the Philippines. A fire rated fire exit door shall have a label attached. It shall be free from any obstruction, which could prevent the door from operating properly. Gaps left in the opening between the wall and the door frame must be properly filled with resisting material.

1006.3.4 Wall Anchors

A minimum of three anchors shall be provided for each jamb. Anchors shall be located opposite the top and bottom hinges and midway between top and bottom anchors.

Anchors for fastening frames to masonry shall be adjustable, and perforated and shall extend not less than 200 mm into masonry.

Anchors for fastening frames to metal or wood stud partitions shall be welded to metal or nailed to wood studs respectively.

Anchors for fastening frames to previously placed concrete or masonry shall be secured to existing construction with expansion bolts. Frames shall be fastened securely with anchors.

Anchors for fastening frames to partitions of plaster on metal lathe shall be secured firmly to the back of frames that shall receive the latch. Adjustable strut anchors shall be provided on each side of the frame for fastening to the structural members of the partition and of the ceiling framing above. The size and type of strut anchors shall be as recommended by the metal door manufacturer.

1006.3.5 Floor Anchors

Floor anchors shall be provided at the bottom of each jamb member, anchors shall be fixed/ adjustable and drilled for 10mm diameter anchor bolts.

Where floor fill occurs, the bottom of frames shall terminate at the indicated finished floor levels and shall be supported by adjustable extension clips resting on and anchored to the structural slab.

1006.3.6 Hardware

Side bronze butts for side hung doors, overhead pocket hardware for track and roller types and locksets shall be suitable for the service required and subject to the approval of the Engineer and as provided in Item 1004, Hardware.

Hardware for fire rated doors shall be in accordance with NFPA 80 and the Fire Code of the Philippines.

1006.4 Method of Measurement

The quantity to be paid for under this Item shall be the actual furnished and installed steel doors, frames, louvers, accessories and hardware measured in square meters/lump sum as shown on the Plans.

1006.5 Basis of Payment

The quantity as determined in Section 1006.4, Method of Measurement shall be paid for at unit price stipulated in the Contract's Bill of Quantities.

The payment shall constitute the full compensation for furnishing all the necessary materials, providing necessary equipment and tools in installing the steel doors and frames, labor cost and all the incidental expenses necessary to complete the work.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1006 (6)	Steel Door and Frames	Square Meter

ITEM 1013 - CORRUGATED METAL ROOFING

Refer to Item 1013, Part E. of Larval Rearing Tanks(120 Units) with Conical Hatching Tanks

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1013 (2)	Fabricated Metal Roofing Accessory	Linear Meter

ITEM 1014 - PREPAINTED METAL SHEETS

Refer to Item 1014, Part E. of Larval Rearing Tanks(120 Units) with Conical Hatching Tanks

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1014 (1)b2	Pre-painted metal sheet,above 0.6 mm, Rib type, long Span	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tank (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)a	Painting Works, Masonry/Concrete	Square Meter
1032 (1)c	Painting Works, Steel	Square Meter

ITEM 1100 - CONDUITS, BOXES AND FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1100(10)	Conduits, Boxes & Fittings (Conduit Works/Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1101 (2)b2	Electrical Wire, 3.5mm² THHN/THWN², Stranded	Meter
1101 (2)b3	Electrical Wire, 5.5mm² THHN/THWN², Stranded	Meter
1101 (2)b4	Electrical Wire, 8.0mm² THHN/THWN², Stranded	Meter

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board w/ Main and Branch Breakers	Lump Sum

ITEM 1103 - LIGHTING FIXTURES

Refer to Item 1103, Part E of Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1201 - WATER PUMPING SYSTEM

1201. Description

This Item shall consist of furnishing and installation of water pumping system, inclusive of all pipings and pipe fitting connections, valves, controls, capacitive flow meters, electrical wirings, tanks and all accessories ready for service in accordance with the Plans and this Specification.

1201.2 Material Requirements

1201.2.1 Water Pump

Pumps shall be end suction centrifugal type conforming to the requirements of American Water Works Association (AWWA) E 101, Standard for Vertical Turbine Pumps- Line Shaft and Submersible Type or AWWA E 103, Standard for Horizontal and Vertical Line-Shaft Pumps whichever is applicable. Booster Pumps and jet pumps shall only be required if deemed necessary.

Pumps shall be supplied with a pump nameplate easy to read and corrosion resistance containing complete pump information including: pump manufacturer's name, serial number, pump model number, number of stages, speed, total dynamic head in meter and discharge capacity in gpm (m^3/hr or liters per second), pump horsepower, year manufactured, and the

like and shall conform with the Technical Specification given by the designer.

The type, size, capacity, location, quantity and electrical requirements of Pumping units shall be as specified in the Plans.

1201.2.2 Water Tank

1201.2.2.1 Overhead/ Elevated Water Tank

The materials used for water storage structures shall provide stability and Durability, as well as protect the quality of the stored water. Steel structures shall follow the Current American Water Works Association standards concerning Steel tanks, standpipes, reservoirs, and elevated tanks wherever they are applicable. Other materials of construction may be acceptable when properly designed to meet the requirements of this specification.

The tank shall be provided with manhole, cover, drain pipes, distribution pipe outlet overflow pipes and air vent, and float switch or electrode to automatically stop and start the operation of the pump.

1.Polyethylene Tanks

Polyethylene tanks shall be made of 100% approved food grade polyethylene material conforming to the requirements of ASTM D1998, Standard Specification for Polyethylene Upright Storage Tanks. The polyethylene tanks shall be seamless and be treated to protect it from harmful ultraviolet rays.

2. Steel Tanks

Steel tanks shall be AISI steel Grade 304 conforming to AWWA D 100,Standard for Welded Carbon Steel Tanks for Water Storage or AWWA D 103,Standard for Factory-Coated Bolted Steel Tanks for Water Storage. The steel tanks shall be groove designed with built-in drain valve and air vent.

3. Fiberglass Tanks

Fiberglass tanks shall Conform to the applicable requirements of AWWA DI20, Thermosetting Fiberglass-Reinforced Plastic Tanks.

4. Concrete Tanks

Materials for the construction of concrete tanks shall be in accordance with the requirements of Item 900, Structural Concrete and Item 902, Reinforcing Steel Waterproofing of water tanks shall be in accordance with Item 1016, Waterproofing.

1201.2.2.2 Saddle for Water Tank

Saddles shall be provided and shall conform to the recommendation of the manufacturer of the equipment. Equipment shall be situated in a concrete and non-concrete saddle. All spaces between equipment bases and concrete foundation shall be filled with cement mortar.

1201.2.3 Pipes and Fittings

Pipes and fittings shall be made of brass, copper; cast iron, galvanized malleable, galvanized wrought iron, galvanized steel or other approvematerials conforming to the applicable requirements of Item 1002, Plumbing. All pipes and fittings of the same material shall be supplied by a single manufacturer to ensure uniformity of standards and composition.

1201.2.4 Valves

All valves shall be of a rating suitable for the design working pressure of the system and shall conform to the applicable requirements of Item 1603, Valves.

1201.2.5 Electrical Equipment and Appurtenances

All electrical equipment and appliances to be used for the system shall be in conformity with the Philippine Electrical Code (PEC), Part 1 and with the recommendations of the manufacturer. Wherever practical, electrical equipment and components shall be designed for the ultimate conditions and loads. Electrical equipment shall include panels, bussing, shot circuit protective devices, motor starters, motor control centers (MCC) buckets, transformers, lighting panels, conduit and conductors.

Power supply shall also be provided by the Contractor at the pull box installed inside the machine room and shall furnish and install the main circuit breaker and starter with suitable ratings and capacities, conduits, wirings, fittings, devices and all other equipment and electrical connections needed to complete the electrical installation of the system.

1201.3 Construction Requirements

1201.3.1 General

The installation of all water pumping system equipment shall be in accordance the requirements of AWWA Standards, ASME Standards, Philippine Society Mechanical Engineering (PSME) Code and the Philippine Electrical Code (PEC), Part 1.

1201.3.2 Storage of Equipment and Appurtenances

Equipment should be stored in a dry space when they are delivered on site. Special rust preventive measures to protect the internal parts of pumps shall be applied if the equipment must be stored for an extended period of time. Such provisions shall be removed completely before final installation and the bearings should then be re-lubricated.

1201.3.3 Installation

1201.3.3.1 Pumps

Each pump and electric motor shall be installed in accordance with the written instruction of the manufacturer and under the direct supervision of the manufacturer's representative and the Mechanical Engineer. Pump assemblies shall be adjusted such that driving units are properly aligned, plumbed and leveled with driven units and interconnecting shafts and couplings.

Misalignment shall not be compensated by use of flexible couplings. After the pump and driver have been set in position, aligned, and shimmed to proper elevation, the space between bottom of baseplate and concrete foundation shall be removed after grout is set and packed void with grout.

Connect suction and discharge piping without imposing strain to pump flanges. Foundations shall be constructed in conformity with the instructions of the manufacturer and with the Plans and drawings.

Anchor bolts and expansion bolts shall be set accurately. Anchor bolts shall be sized and furnished by the Pump Manufacturer.

1201.3.3.2 Water Tanks

The erection of overhead tanks shall be in accordance with AWWA D 100 AWWA D 102, whichever is applicable.

All welds in the tank and structural attachments shall be made in a manner to ensure complete fusion with the base metal, within the limits specified for each joint, and in strict accordance with the qualified welding procedure specifications. For bolted steel tanks, all bolts shall be located and installed according to the instructions provided by the manufacturer. Gasketing and sealants or both shall be supplied by the manufacturer and installed between all joints in compliance with the erection instructions. Water storage tanks shall be disinfected in accordance with AWWA C 652 Disinfection of Water Storage Facilities.

1201.3.3.3 Pipes and Fittings

Installation and disinfection of pipes and fittings shall conform to the requirements of Item 1002, Plumbing

1201.3.3.4 Valves

Installation of valves shall conform to the requirements of Item 1063, Valves.

1201.3.3.5 Electrical Equipment and Appurtenances

All Electrical equipment and appurtenances shall be installed in accordance with the PEC Part 1 and with the instructions of the manufacturer.

1201.3.4 Testing

All Electrical tests shall be done to demonstrate that the system complies with the requirements of the Plans and Specifications. All pumps and water storage tanks shall be tested in accordance with the applicable AWWA standards. Testing of pipes, fittings and valves shall conform to Item 1002, Plumbing and Item 1603, Valves.

1201.3.5 Guarantee and Service

All equipment, materials and workmanship shall be guaranteed for a period of

1 year from date of completion. At any time within the period of guarantee and

Upon notification, the Contractor shall repair and rectify the deficiencies, including replacement of parts or entire units.

1201.3.6 Miscellaneous

The Contractor shall submit three (3) bound copies "AS BUILT" diagrams to ensure compliance with the shop drawings, part lists, serial number and inventory of equipment including manufacturers operating and maintenance manuals. All standard tools and equipment shall be furnished for proper and regular maintenance of installed equipment.

1201.4 Method of Measurement

The work under this Item shall be measured either by set and lump sum actual placed and installed water pumping system as indicated on the Plans.

1201.5 Basis of Payment

The quantity as determined in Section 1201.4, Method of Measurement shall be paid for at unit price stipulated in the Contract's Bill of Quantities. The payment shall constitute the full compensation for furnishing all the necessary materials providing necessary equipment and tools in installing the water pumping system, labor cost and all the incidental expenses necessary to complete the work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1201(2)a	Centrifugal Pump w/ Control, 4hp	Set
1201(2)b	Centrifugal Pump w/ Control, 2hp	Set

SPL 9 - SAND FILTER TANK (50 PSI), VALVE MODEL

Description

This item contains important information about the installation, operation and safe usage of this product. This information should be given to the owner and/or operator of this equipment after installation or left on or near the filter.

Material Requirements:

The vessel(s) shall be constructed of multi-layer fiber glass. Layers shall consist of a combination of chopped glass and woven roving in an isophthalic-polyester matrix. The vessel shall be assembled from one side shell and two domed ends which shall be joined with an adhesive and reinforced with FRP layup. The vessel(s) shall be capable of withstanding 50 psi

internal pressure. Alternate construction methods shall not be acceptable.

Vessels shall be provided with ABS saddle style support bases with a means of rotating the saddle for leveling purposes. The use of adhesive to hold the saddle to the vessel is not acceptable. The wetted surface shall be a modified polyester gel coat (GC).

The gel coat shall be a modified polyester gel coat equivalent to a Cook gel coat 943-AN-023 with a thickness of no less than 10 mils.The external surface shall be smooth in appearance and be free of cracks or other defects. The exterior surface shall be supplied with an all-weather coating.

Coating shall be urethane based with UV inhibitors. The surface coating shall be almond colored. Each tank shall have one influent header fitted with sufficient distributors to properly distribute incoming flow evenly across the sand bed surface and one effluent header with sufficient laterals equally distributed not less than 12 inches below the filtering sand bed with a total effective slot area such that the average velocity through the slots will not exceed 6 feet per second at the design flow rate.

Both headers shall be fabricated of schedule 80 PVC and all distributors and laterals shall be threaded and replaceable. The laterals shall be 2 3⁄8 inch diameter by 10 inches long with 2" NPT connections and constructed of ABS plastic with molded ‘V’-groove slots. Laterals with machined or cut slots shall not be accepted. Laterals shall be threaded at right angles into the header pipe. Exterior influential and effluent pipe connections shall be 6" VanStone-style flanges. Each tank shall have a 12 inch by 16 inch access manhole with yokes, molded cover, o-ring, and T316 stainless steel hardware.

The system shall be designed for installation against a back or side wall with all servicing accessible without moving tank(s). When the system is off, the tank(s) must remain full of water and not allow water to gravity drain back to the source in order to prevent disturbance of the sand bed. Each tank shall have an automatic and manual air release system and shall be of non-corrosive materials. A sufficient quantity of #20 U.S. grade clean crystal silica sand to cover filter elements with a minimum 12 inch sand bed shall be furnished and installed into each tank and shall be free of limestone or clay.

The filter vessel shall carry a ten (10) year limited warranty covering defects in material and workmanship, the first three years of which shall not be prorated.

For Single Tank System Diaphragm Valve Face Piping Kits

1. The system, including external piping, shall be fully solvent-welded. System shall be supplied with a media dump port and anchor setting template.

2. The backwash procedure must be accomplished by backwashing using water from the pool in reverse flow through the filter to the waste line.

3. The influent, effluent and waste manifolds shall be constructed of schedule 80 PVC piping and fittings. The system shall include (2) three-way hydraulically operated diaphragm valves to direct the flow during the backwash cycle. For Two Tank System Diaphragm Valve Face

Piping Kits.

4. The system, including external piping, shall be fully solvent-welded. System shall be supplied with media dump ports and anchor setting templates.

5. Each tank in the system shall be capable of being backwashed individually using filtered water from the remaining tanks. The common method of backwashing by using raw source water in a reverse flow through the filter or filters will not be acceptable.

6. The influent, effluent and waste manifolds shall be constructed of schedule 80 PVC piping and fittings. The system shall include (1) three-way hydraulically operated diaphragm valve per tank to direct the flow during the backwash cycle. And one two-way hydraulically operated diaphragm valve as a priority valve. Semi-Automatic Controls for Diaphragm Valve Face Piping Kits.

7. Valve actuation to initiate the backwash cycle shall be a single-knob control using a multi-port control valve to distribute water to hydraulically operated multi-port control valve, and influent, effluent, and multiport pressure gages shall be mounted on a common panel.

Construction Requirements

Installation

Only a qualified service person should install the sand filter. This filter is designed and intended for use to filter water.

Introduction:

The following general information describes how to install the Fiberglass Sand Filter. This filter operates under pressure and if assembled improperly or operated with air in the water circulation system, the top closure can separate and result in an accident causing property damage or serious bodily injury. A warning label has been affixed to the top of the filter and should not be removed. Keep safety labels in good condition and replace them if missing or illegible.

How the Filter Works:

The high rate sand filter is designed to operate for years with a minimum of maintenance and when installed, operated and maintained in accordance with these instructions, it will provide years of trouble free operation.

Dirt is collected in the filter as the water flows through the control valve at the side of the filter and is directed into the top bulkhead. Dirty water flows into the diffuser at the top of the tank and is directed downward into the top surface of the filter sand bed. The dirt is collected in the sand bed and the clean water flows through the laterals and lower piping at the bottom of the filter up into the lower bulkhead. The flow then goes into the control valve at the side of the filter. Clean water is returned through the piping system into the pool.

The pressure will rise and the flow to the pool will be lowered as the dirt is collected in the

filter. Eventually, the filter will become so clogged with dirt that it will be necessary to perform the backwash procedure. It is important to know when to backwash the filter. Backwashing is discussed further under the subsequent sections of this guide.

Please note that a filter removes suspended matter and does not sanitize the pool. The pool water must be sanitized and the water must be chemically balanced for sparkling clear water. Your filtration system should be designed to meet your local health codes. As a minimum, you must be sure that your system will turn over the total volume of water in your pool at least two to four times in a twenty four hour period.

Failure to operate your filter system or inadequate filtration can cause poor water clarity obstructing visibility in your pool and can allow diving into or on top of obscured objects which can cause serious personal injury or drowning.

Clear water is the result of proper filtration as well as proper water chemistry. Pool chemistry is a specialized area and you should consult your local pool service specialist for specific details. In general, proper pool sanitation requires a free chlorine level of 1 to 3 PPM and a pH range of 7.2 to 7.6. Filters should never be tested or subjected to air or gas under pressure.

All gasses are compressible and under pressure create a danger. Severe bodily injury or property damage could occur if the filter is subjected to air or gas pressure.

1. Check cartons for any evidence of damage due to rough handling in shipment. If carton or any filter components are damaged, notify the freight carrier immediately.

2. Carefully remove the accessory package and the filter tank from the carton.

3. Mount the filter on a permanent slab, preferably concrete poured in a form or on a platform constructed of concrete block or brick. DO NOT use sand to level the filter or for the pump mounting, as it will wash away.

4. Provide space and lighting for routine maintenance access. Do not mount electrical controls over the filter. One needs to be able to stand clear of the filter when starting the pump. Minimum space requirements may be found on the large nameplate on the filter.

5. Position filter so that the port locations are in the desired final positions. Follow valve installation procedures.

6. If you have a Multiport Valve, assemble the valve to the tank, being sure the o-ring on the valve fittings are in place and are clean. Use a lubricant, applied lightly, such as silicone grease, Dow #33, #40 or GE 300 or 623, or similar product on o-rings and o-ring grooves prior to assembly.

7. If you have a two position slide valve, align the valve with the tank so that the handle is toward the top of the tank, push the valve into ports and turn the valve nuts snugly on the tank fittings. It is not necessary to cinch the valve nuts to the tank fitting beyond hand tightness.

8. The shipping straps used to support the TR100C-3, TR140C and the TR140C-3 multi-

diffuser should be removed before loading sand and gravel in the filter.

9. Before pouring the sand into the filter, look inside and check the lower under-drain for broken or loose laterals (or fingers), which may have been accidentally damaged by rough handling during shipment. Replace any broken parts if necessary.

Failure to position the Automatic Air Vent inside of the Closure will allow excessive trapped air to accumulate in the filter. Trapped air and the closure not properly closed can cause the closure to separate and could cause severe bodily injury and/or property damage.

10. Pivot the diffuser out of the center of the tank on the TR40, 50, 60, TR60 ClearPro, 100 & 140 by rotating the diffuser assembly counter clockwise. (NOTE: The multi-diffuser assembly should not be moved on models TR100HD, TR100C, TR100C-3 and TR140C, TR140C-3. After installing the filter media as described below, check to make sure the tops on the diffusers are parallel to the top of the sand bed.)

Fill the tank about half full of water. Pour pea gravel first (if used) and then the sand into the top of the filter at a slow rate so that the impact of the filter media does not damage the laterals. Fill the filter to the proper level to maintain the freeboard.

Pivot the diffuser assembly back to its vertical position if it was moved. Be certain the automatic air vent is protruding into the top of the closure. Ensure that the automatic air vent is in the center of the filter closure. Wash away all sand around the threaded opening at the top of the tank.

For Threaded Closures Use care when installing closure. The closure should turn freely in the filter, if resistance to closure insertion is felt, then slowly remove the closure by turning counter-clockwise. The starting thread of the tank and closure must engage properly in order to secure the closure. Do not cross-thread closure.

Failure to install the closure properly can cause the closure to separate and could cause severe bodily injury and/or property damage. For Oval Closures Use care when installing closure. The closure should be inserted into the tank by placing the small diameter of the oval closure into the larger diameter of the tank opening. Insert the side of the closure that does not have the pressure gauge and air bleeder first. The closure will need to be inserted at a 30° angle. Once the closure is inside the tank, it can be rotated 90° and lifted up to seal the tank. The aluminum bridge with load spring can then be placed over the closure bolt and the hand knob tightened to load the closure properly. The knob should be tightened by hand only.do not use a wrench to tighten the knob. You could damage the tank or closure and cause a failure by using a wrench. Failure to install the closure properly can cause the closure to separate and could cause severe bodily injury or property damage. Never attempt to tighten or loosen the closure with the pump running. Failure to follow this instruction can result in the closure separating and causing severe bodily injury or property damage.

11. Assemble the pressure gauge and bleeder valve to the closure lid. Clean the lid o-ring and lubricate with silicone grease such as Dow #33, 40 or GE 300, 623 lubricant. Place the closure lid on the filter and tighten, making certain the air vent is up inside the dome of the closure.

12. With the plastic wrench, provided with the filter, tighten the closure as tight as possible using two hands on the wrench handles. As a minimum, the closure must be hand tight + 1/4 turn.

13. The oval closure that is used on the TR140C-3 and the TR100C-3 models will need to be installed as described in the above warning note for oval closures.

14. Assemble piping and pipe fittings to pump and valve. All piping must conform to local and state plumbing and sanitary needs.

15. Use sealant compounds on all male connections of pipe and fittings. Use only pipe compounds suited for plastic pipe. Support pipe to prevent strains on filter, pump or valve.

16. Long piping runs and elbows restrict flow. For best efficiency, use the fewest possible number of fittings, and large diameter pipe (at least 2" for TR100 and TR140, at least 3" for TR100C-3 and TR140C-3)

Operating at excessive vacuum levels can cause the tank to crack and could cause property damage.

17. When installing backwash lines, it is recommended that a vacuum breaker be installed on installations where the backwash line length exceeds 40 ft. or the backwash line discharges more than 10 ft. lower than the surface of the pool. Alternatively a vacuum break pit should be provided.

18. A check valve is recommended between the filter and heater to prevent hot water "back-up" which will damage the filter and valve.

19. The maximum operating pressure of the unit is 50 pounds per square inch (psi) and 75 pounds per square inch (psi) for the Triton HD model (only). Never operate this filter above these pressures or attach a pump to this filter that has more than 50 psi shut off pressure or 75 psi shut off pressure for the Triton HD model (only).

20. Never install a chlorinator upstream of the filter. Always locate downstream and with a check valve between the chlorinator and filter.

21. A positive shut off valve is not recommended at the outlet of the filtering system. If the system is ever run with such a valve closed, the internal air relief system becomes inoperative and risk of tank separation could exist. Additionally, running the system with no flow will seriously damage the equipment.

22. Never store pool chemicals within 10 ft. of your pool filter. Pool chemicals should always be stored in a cool, dry well ventilated area.

23. The oval closure used on the TR100C-3 and TR140C-3 is designed to provide a vacuum relief mechanism that protects the tank from vacuum conditions. The closure will allow air to enter the tank if the tank is higher than 8 ft. above the water level. In these cases, when the filter restarts after shut down, you may observe air being returned to the pool in the return

fittings. This is not unusual, it is simply the automatic air relief in the filter removing the air in the filter.

Initial Start-up

1. On a new pool, clean the pool before filling the pool with water. Excessive dirt and large particles can cause damage to the pump and filter.

2. Ensure the backwash line is open so that water is free to come from the pool and flow out the backwash line. Set the valve position as follows:

a. If using a Multiport valve, set the valve to the backwash position.

b. If using a Two Position Slide Valve, push the handle down to backwash position and engage lock by twisting the handle.

3. Check the pump strainer pot to be sure it is full of water. Air entering a filter and tank closure not installed properly can cause the closure to seperate and could cause severe bodily injury and/or property damage.

4. Check closure on filter for tightness.

5. Open the manual air bleeder on the filter closure. Stand clear of the filter and start the pump allowing it to prime.

6. Close the air bleeder on the closure when all the air is removed from the filter and a steady stream of water emerges.

NOTE: Pool filter sand is typically pre-washed and should not require extensive backwashing. However, the shipping process may cause excessive abrasion which could require an extended backwash cycle at initial start-up; continue to backwash until the backwash water is as clear as the pool water. To prevent equipment damage and possible injury, always turn the pump off before changing the valve position.

7. Stop the pump. Set the valve position as follows: a. If using a Multiport valve, set the valve to the filter position. b. If using the Two Position Slide Valve, raise the handle to filter position and engage valve lock by twisting the handle.

8. Ensure all suction and pool return lines are open so that water is free to come from the pool and return to the pool.

9. Open the manual air bleeder on the filter closure. Stand clear of the filter and start the pump.

10. Close the air bleeder on the filter closure when all the air is removed from the filter and a steady stream of water emerges.

11. The filter has now started its filtering cycle. You should ensure that water is returning to the pool and take note of the operating pressure when the filter is clean

Maintenance

Filter Care

1. To clean the exterior of the filter of dust and dirt, wash with a mild detergent and water then hose off. Do not use solvents.

2. If internal maintenance is required, sand may be removed by removing the sand drain from the bottom of the filter and flushing with a garden hose. Pentair Sand Vacuum P/N 542090 may also be used.

3. If after a number of years, the filter tank appears foggy in color or rough in texture, the tank surface can be painted. We recommend the use of a Quick Dry Spray Enamel. Do NOT paint the valve. Always visually inspect filter components during normal servicing to ensure structural safety. Replace any item which is cracked, deformed or otherwise visually defective. Defective filter components can allow the filter top or attachments to separate and could cause severe bodily injury or property damage.

4. The filter closure on your Triton Sand Filter was manufactured with high quality corrosion resistant materials. This part should be carefully inspected whenever servicing your filter. If excessive leakage is noted coming from the closure/tank interface, the closure and o-ring should be carefully inspected and replaced if any signs of deterioration exist.

5. Your filter is a pressure vessel and should never be serviced while under pressure. Always relieve tank pressure and open air bleeder on the filter closure before attempting to service your filter.

6. When restarting your filter, always open the manual air bleeder on the filter closure and stand clear of the filter.

Cleaning Frequency

1. The filter on a new pool should be backwashed, and cleaned after approximately 48 hours of operation to clean out plaster dust and/or construction debris.

2. There are three different ways to identify when the filter needs backwashing.

a. The most accurate indicator on pool systems with a flow meter is to backwash when the flow decreases 30% from the original (clean filter) flow. For example, if the original flow was 60 GPM, the filter should be backwashed when the flow is reduced by about 20 GPM (or 30%) to 40 GPM.

b. A more subjective and less accurate indicator is to observe the amount of water flowing from the flow directionals located in the wall of the pool. The filter should be backwashed once it is detected that the flow has been reduced by about 30%.

c. The most commonly used but less accurate indicator is to backwash when the filter gauge reading increases 10 PSI over the initial (clean filter) reading.

3. It is important not to backwash the filter solely on a timed basis such as every three days. It is also important to note that backwashing too frequently actually causes poor filtration. Factors like weather conditions, heavy rains, dust or pollen, and water temperature all affect the frequency of backwash. As you use your pool, you will become aware of these influences.

4. If at any time the starting pressure after backwashing the filter indicates 4 to 6 PSI higher than normal starting pressure, it is time to perform a chemical cleaning procedure.

Filter Backwash Procedure

To prevent equipment damage and possible injury, always turn off pump before changing valve positions.

1. Stop the pump.

2. Ensure that the suction and backwash lines are open so that water is free to come from the pool and flow out the backwash line. Set control valve position as follows:

a. If using a Multiport Valve, set valve to backwash position.

b. If using a Two Position Slide Valve, push handle down to backwash position and engage lock by twisting handle.

3. Stand clear of the filter and start the pump.

4. Backwash filter for approximately 3 to 5 minutes or until backwash water is clean.

5. Stop the pump.

a. If using a Multiport Valve, set the valve to rinse position and continue with remaining steps.

b. If using a Two Position Slide Valve, skip to step 8.

6. Stand clear of the filter and start the pump.

7. Rinse filter for approximately 30 seconds.

8. Stop the pump and set valve as follows:

a. If using a Multiport Valve, set the valve to filter position.

b. If using a Two Position Slide Valve, raise handle to filter position and engage valve lock by twisting handle.

9. Ensure that pool return line is open so that water may freely flow from the pool back to the pool.

10. Open manual air bleeder on Triton closure. Stand clear of filter and start pump.

11. Close manual air bleeder of the closure when all the air is removed and a steady stream of

water emerges from the bleeder.

12. The filter has now started its filtering cycle. You should ensure that water is returning to the pool and take note of the filter pressure.

13. The filter pressure, in the above Step 12, should not exceed the pressure originally observed on the filter when it was initially started. If after backwashing, the pressure is 4 to 6 PSI above the start condition, it will be necessary to chemically clean the sand bed.

Chemical Cleaning Procedure

1. It is recommended that an approved cleaner be used. Please contact your local pool chemical supplier or retail store for the proper cleaner. These cleaners will remove oils, scale and rust from the sand bed in one cleaning operation.

2. Mix a solution following the manufacturer's instructions on the label.

3. Backwash the filter.

4. If the filter is below pool level, shut off the pump and close appropriate valving to prevent draining the pool.

5. Shut off the pump, open filter drain and let filter drain. Place valve in backwash position.

6. After the filter has drained, close filter drain and remove the pump strainer pot lid.

7. Ensure that the backwash lines are open.

8. Turn the pump on and slowly pour the cleaning solution into the pump strainer with the pump running.

9. Continue adding solution until the sand bed is saturated with cleaning solution. Replace lid on pump. 10. Shut off the pump and leave the filter in the backwash position. Allow the filter to stand overnight (12 hours). 11. Replace the pump lid and follow backwash procedures. Do not allow the cleaning solution to get into the pool.

Troubleshooting

This filter operates under high pressure

When any part of the circulating system, (e.g., closure, pump, filter, valve(s), etc.), is serviced, air can enter the system and become pressurized.

Pressurized air can cause the top closure to separate which can result in severe injury, death, or property damage. To avoid this potential hazard, follow these instructions:

1. If you are not familiar with your pool filtering system and/or heater:

a. Do NOT attempt to adjust or service without consulting your dealer, or a qualified pool

technician.

b. Read the entire Installation & User's Guide before attempting to use, service or adjust the pool filtering system or heater.

2. before repositioning valve(s) and before beginning the assembly, disassembly, or any other service of the circulating system:

(A) Turn the pump OFF and shut OFF any automatic controls to ensure the system is NOT inadvertently started during the servicing;

(B) Open the manual air bleeder valve;

(C) Wait until all pressure is relieved.

3. Whenever installing the filter closure follow the filter closure warnings exactly.

4. Once service on the circulating system is complete follow initial start-up instructions exactly.

5. Maintain a proper circulation system properly. Replace worn or damaged parts immediately, (e.g., closure, pressure gauge, valve(s), o-rings, etc).

6. Be sure that the filter is properly mounted and positioned according to instructions provided.

Method of Measurement

The quantity to be paid for will be measured as per individual item, Basis of Payment for the complete Sand Filter Tank (50 PSI), Valve Model as furnished on site and in accordance with these design standards, specifications and as accepted by the Engineer.

Basis of Payment

Method of Measurement shall be paid for at the unit bid price which payment constitutes 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
SPL 9	Sand Filter Tank (50 psi), Valve Model	Set

SPL 1 - DEWATERING

Refer to SPL 1, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

M. TRIPLEX BUILDING

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Pay Item Number	Description	Unit Of Measurement
804 (2)	Embankment from Borrow	Cubic Meter
804 (7)	Gravel Fill	Cubic Meter

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of measurement

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

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 1047 - METAL STRUCTURES

Refer to Item 1047, Part D. Broodstock Tanks (7 units)

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1047 (1)	Structural Steel	Lump Sum
1047 (10)	Metal Structure Accessories	Lump Sum

ITEM 1046 - MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non- Load-Bearing (including Reinforcing Steel), 100mm	Square Meter

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1046, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

ITEM 1000 - TERMITE CONTROL WORK

Refer to Item 1000, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1000 (1)	Soil Poisoning	Liter

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) w/ Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement

1003 (1)e1	Ceiling, Metal Frame,Gypsum Board	Square Meter
1003 (1)e2	Ceiling, Metal Frame, Prepainted Metal Panel	Square Meter

ITEM 1010 - DOORS, WOOD PANEL

Refer to Item 1010, Part J of Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1010 (2)b	Doors (Wood Panel)	Square Meter

ITEM 1011 - ROLL - UP DOORS

1011.1 Description

This Item shall consist of furnishing all roll-up door materials, labor, tools and equipment required in accordance with the Plans and this Specification.

1011.2 Material Requirements

Roll-up doors shall be surfaced mounted type designed for exterior service opening as indicated on the Plans. Component parts shall conform to the following material specifications:

1. Curtain - shall be manufactured of interlocking curved or flat slats, rolled from galvanized and bonderized steel, aluminum or stainless steel as the case may be.

Curtain is composed of:

a. Interlocking slats shall roll up on a drum supported at head of opening on brackets and shall be balanced by helical springs. Slats shall be formed in a cold-rolled process in continuous lengths of galvanized steel interlocked to form curtains.

b. Endlocks - shall be malleable iron riveted to each end of alternate slats to achieve slat alignment and to serve as a wearing surface. These are called continuous when they reinforce both ends of all slats, alternate when every other slat.

c. Bottom bar - shall be manufactured from two (2) equal sized angles, minimum 3 mm thick bolted back to back with appropriate half slat at lowest edge of curtain. In addition, the exterior door shall have a compressible and replaceable rubber or vinyl weather seal

attached to the bottom rail.

2. Counterbalance barrel assembly - shall include spring barrel which serves as load carrying beam encases counter balance mechanism and provide axis around Curtain coils. As it arises barrel rings are involute shapes of malleable iron to assure proper Counter balance for all points of travel. Oil tempered torsion type counter balance springs are Wound from heat treated steel, to provide accuracy in balancing doors.

3. Hood - shall be manufactured from 0.60 mm thick (minimum) galvanized sheet metal, flanged at top for attachment to header and flanged at bottom to provide longitudinal stiffness. Hood shall enclose curtain col and Counter balance mechanism.

4. Bracket Plates shall be made of precisely formed plate with permanently sealed ball bearings, designed to enclose the end of the curtain coil and provide support for counter balance pipe at each end. The bracket plates shall have a minimum thickness of 6.35 mm.

5. Guides/Wall Angles - shall be fabricated from structural steel angles or precision roll formed channels and angles. Especially adaptable for doors exposed to heavy wind pressure. Wall angles of structural steel shall have a minimum thickness of 3.18 mm. Designed with groove depths varying from 50 mm to 150 mm depending upon the width of the door, and set cut from the face of the wall to facilitate the travel of the curtain.

1011.2.1 Wind Load

Steel and aluminum roll-up doors shall be designed to withstand wind loads of 0.957 KPa and 2.87 KPa respectively, in a fully-closed position, and can be designed to withstand higher wind loads upon request.

1011.3 Construction Requirements

Roll-up doors shall be electronically or mechanically operated and with provision for manual operation by means of hand chain. Accessories needed for the satisfactory performance of the roll-up door shall be built-in with the unit as per manufacturer's instruction.

1011.3.1 Erection/ Installation

1. Structural steel angles shall be set and installed properly aligned, plum, level, square true to profile section and rigidly anchored with adjacent Concrete surface walls.

2. All adjacent items of work shall be allowed to be completed before any installation work is started except the installation of structural steel angles.

3. Roll-up doors shall be allowed in accordance with the manufacturer’s instruction manual or as indicated in the shop drawing approved.

4. All anchors and insets for guides, brackets and other accessories shall be located accurately.

1011.3.2 Locking Devices

Curtain shall be located at each end of the bottom bar by concealed side bolts which shall engage a lock wedge in each guide . A plunger type cylinder lock is provided as standard equipment.

1011.4 Method of Measurement

The work executed under this Item shall be measured by the number of sets or lump sum of roll-up doors installed at jobsite completed and ready for service.

The computed unit shall bear type of materials and area of opening covered and shall be accepted by the Engineer.

1011.5 Basis of Payment

The accepted work quantified and provided in the Bill of Quantities shall be paid for at the unit Bid price which constitutes full compensation for furnishing all materials, labor, tools, equipment and other incidentals necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1011 (1)b	Roll-Up Door, Aluminum	Set

ITEM 1008 - ALUMINUM GLASS WINDOWS

Refer to Item 1008, Part J. Staff Quarters and Fish Food Storage Building.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1008 (1)a	Aluminum Glass Window, Sliding Type	Square Meter

ITEM 1005 - STEEL WINDOWS

Refer to Item 1005, Part L. Two (2) Units Pump House.

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement

1005 (5)	Steel Windows	Lump Sum

ITEM 1013 - CORRUGATED METAL ROOFING

Refer to Item 1013, Part E. Larval Rearing Tanks (120 Units) w/ Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1013 (2)	Fabricated Metal Roofing Accessory	Linear Meter

ITEM 1014 - PREPAINTED METAL SHEETS

Refer to Item 1014, Part E. Larval Rearing Tanks(120 Units) with Conical Hatching Tanks

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1014 (1)b2	Pre-painted metal sheet, 0.6mm, Rib type, long Span	Square Meter

ITEM 1018 - CERAMIC TILES

Refer to Item 1018, Part J of Staff Quarters and Fish Food Storage Building.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1018 (1)	Glazed tiles and Trims	Square Meter
1018 (2)	Unglazed tiles	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 Units).

Payment will 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

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (4)	Plumbing Fixtures	Lump Sum

ITEM 1001 -STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units)

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1001 (8)	Sewer Line Works	Lump Sum

ITEM 1002 - PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units)

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1002 (24)	Cold Water Line	Lump Sum

ITEM 1100 - CONDUITS, BOXES AND FITTINGS

Refer to Item 1100, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1100 (10)	Conduits, Boxes & Fittings (Conduit Works/Conduit Rough-In)	Lump Sum

ITEM 1101 - WIRES, CABLES AND WIRING DEVICES

Refer to Item 1101, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1101 (2)b2	Electrical Wire, 3.5mm² TW/THHN/THWN², Stranded	Meter
1101 (2)b4	Electrical Wire, 8.0mm² TW/THHN/THWN², Stranded	Meter

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

Refer to Item 1102, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (1)	Panel Board with Main & Branch Breakers	Lump Sum

ITEM 1103 - LIGHTING FIXTURES

Refer to Item 1103, Part E of Larval Rearing Tanks (120 Units) with Conical Hatching Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1103 (1)	Lighting Fixtures	Lump Sum

ITEM 1102 - POWER LOAD CENTER, SWITCHGEAR AND PANELBOARDS, AND OTHER OVERCURRENT PROTECTION DEVICES

Refer to Item 1102, Part C. Site Development Work..

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1102 (16)a1	Generator, Single or Three phase, Stand-by	Lump Sum

N. BERTHING DOCK

ITEM 801 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

801.1 Description

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

801.2 Construction Requirements

801.2.1 General

The Contractor shall perform the work described above, within and adjacent to the construction site, on Government land or easement, as shown on the Plans or as directed by the Engineer.

All salvageable material shall be removed, without unnecessary damage, in sections or pieces which may be readily transported, and shall be stored by the Contractor at specific places on the project or as otherwise shown in the Special Provisions. Salvaged material which is damaged through negligence shall be replaced or restored at the Contractor's expense.

Waste material may be disposed of by the Contractor in Government-owned sites as shown in the Special Provision or permitted by the Engineer. Otherwise, the Contractor shall arrange disposal of waste at no expense to the Government and shall be in accordance with the

requirements for disposal site selection and hauling activity stipulated in the Contract.

Perishable material shall be handled as designated in Subsection 800.2.2, Clearing and Grubbing of Item 800, Clearing and Grubbing. Non-perishable material may be disposed of outside the limits of view from the project with written permission of the property owner on whose property the material is placed. Copies of all agreements with property owners shall be furnished to the Engineer. Basements or cavities left by the structure removal shall be filled with acceptable material, approved by the Engineer, to the level of the surrounding ground and, if within the prism of construction, shall be Compacted to the required density.

There shall be no separate payment for excavating for the removal of structures and obstructions, or for filling and compacting the remaining cavity.

Structures that are designated to be relocated shall be moved to a new location specified by the Engineer and shall be restored to its original condition with all connections properly made, all in accordance with the Contract and Plans

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

All existing bridges, culverts and other drainage structures in use by traffic shall not be removed until satisfactory arrangements have been made to accommodate traffic.

The removal of existing culverts within embankment areas will be required only as necessary for the installation of new structures.

Unserviceable culverts which are designated to be removed shall be broken down or crushed, otherwise, sealed or plugged. All retrieved culvert for future use, as determined by the Engineer, shall be carefully removed and all precautions shall be employed to avoid breakage or structural damage to any of its parts.

All sections of structures removed which are not designated for stockpiling or re-laying shall become the property of the Government and be removed from the project or disposed of in a manner approved by the Engineer.

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

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

The Contractor shall submit a bridge demolition plan, for approval of the engineer, showing all the methods and stages of demolition/removal of the existing bridge(s), or portions of bridges as specified. Explosives shall not be used for bridge demolition, except as specifically

allowed by the Special Provisions.

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

Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work, unless otherwise provided in the Special Provisions. In coordination with the proper authorities, the Contractor shall submit an acceptable blasting plan for the approval of the Engineer. Prior to commencement of blasting operation, the Contractor shall assess job hazard for safety and shall perform a pre-blasting survey of adjacent structures to identify features that must be adequately protected.

When removing manholes, catch basins or drop inlets, any functioning sewer lines connected to it shall be restored and properly connected. Satisfactory by- pass service shall be maintained during construction operations.

801.2.3 Removal of Pipes Other than Pipe Culverts

Unless otherwise provided, all pipes shall be carefully removed and every precaution taken to avoid breakage or damage.

Pipes to be re-laid shall be removed and stored when necessary so that there will be no loss due to damage before re-laying. The Contractor shall replace sections of pipe lost from storage or damaged by negligence, at his own expense.

End sections shall be measured as part of the overall length of pipe.

801.2.4 Removal of Existing Pavement, Sidewalks, Curbs, Gutters, and Similar Structures

All concrete pavement, sidewalks, curbs, gutters, and similar structures, designated for removal, shall be:

1. Broken into pieces and to be used for other structures on the project, subject for the approval of the Engineer.

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

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

801.2.5 Removal of Portions of Existing Structure

Removal of portions of pavement, sidewalks, curbs, gutters, and similar structures shall be undertaken with sufficient care as to avoid breakage or damage to the portion of the structure

designated to remain.

The portion of structure shall be removed from an existing joint, or sawed and chipped to a true line with a vertical face.

Before concrete removal begins, a saw cut, 19 mm deep when steel reinforcement is to remain and deeper when steel reinforcement is to be removed with concrete, shall be made into the surface of the concrete at the perimeter of the removal limits.

Concrete shall be completely removed, exposing the deformed surface of the bar, from existing steel reinforcing bars which extend from the existing members and are specified to remain. Steel reinforcement that are to be removed shall be cut to a minimum of 25.4 mm behind the final surface, where void resulted to the removal thereof shall be filled with epoxy mortar and finished to a sound, smooth, uniform colored Surface.

The retained concrete surface at which fresh concrete surface will be placed shall be roughened, cleaned, and saturated. When a portion of existing concrete is removed without replacement, the concrete surface of the remaining portion shall be cleaned to a smooth surface of less than 1.6 mm profile.

In case of damage to the remaining structure, it shall be repaired or replaced at the Contractor's expense.For structures with an asphalt wearing course, the wearing course shall be removed separately before removing the portion designated to be removed.

801.2.6 Removal of Foundations

Existing foundation shall be removed to a depth of at least 1.5 m below finished ground elevation or subgrade elevation as shown on the Plans or as directed by the Engineer.

Basement floors shall be broken up to promote drainage. Basements or other cavities left by the removal of structures shall be filled and should match the level of surrounding ground. Fill within the slopes of the roadbed shall be compacted to meet the requirements in compacting earth embankments per Item 804, Embankment.

801.3 Method of Measurement

Where the Contract stipulates that payment will be made for removal of obstructions on a lump sum basis, the Pay Item will include all structures and obstructions encountered within the construction site including those not specified in Section 801.4, Basis of Payment.

Where the Contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the Contract and in the Standardized Pay Items of Work for Civil Works Construction.

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

801.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 801.3, Method of Measurement shall be paid for at the Contract Unit Price or lump sum price bid for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for removing and disposing of obstructions, including materials, labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.The price shall also include backfilling, salvaging of materials removed, their Custody , preservation storage on the right-of-way and disposal as provided herein.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
801 (6)	Removal of Structures and Obstruction	Cubic Meter

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit Of Measurement
804 (2)	Embankment from Borrow	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 units)

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1) a1	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 Days	Cubic Meter

ITEM 901- LEAN CONCRETE

Refer to Item 901, Part H. Conditioning Pond

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
901 (1)	Lean Concrete	Cubic Meter

ITEM 903- FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 1027- CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027 (1)	Cement Plaster Finish	Square Meter

ITEM 1046- MASONRY WORKS

Refer to Item 1046, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1046 (2)a1	CHB Non Load Bearing (Including Reinforcing Steel) 100mm	Square Meter

ITEM 506 - STONE MASONRY

Refer to Item 506, Part H. Conditioning Pond

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
506 (1)	Stone Masonry	Cubic Meter

ITEM 1717 – SHEET PILE

1717.1 Description

This Item shall consist of furnishing, driving, cutting off, and placing of sheet piles including necessary excavations for the construction of flood walls, erosion barriers, retaining walls and shoring protection works in conformity with the lines, grades, and dimensions shown on the Plans.

This specification also covers temporary sheet piling to be constructed where shown on the Plans. This sheet piling shall be removed upon completion of the permanent work, except that some sections may be left in place when so ordered by the Engineer.

1717.2 Material Requirements

1717.2.1 Timber Sheet Piles

The timber, unless otherwise definitely noted on the Plans or in the Special Provisions, may consist of any species which will satisfactorily stand driving.

It shall be sawn or hewn with square corners and shall be free from wormholes, loose knots,

wing shakes, decay or unsound portions or other defects which might impair its strength or tightness.

1717.2.2 Concrete Sheet Piles

Concrete shall conform to the requirements of Item 900, Structural Concrete. Concrete shall be Class "C" unless otherwise specified in the Plans.Concrete shall be proportioned to achieve a range of 150 mm to 200 mm slump, self-compacting mix.

The use of appropriate plasticizer/additives to assure mix fluidity and consistency shall be allowed and with the Engineer's approval. A retardant of proven adequacy and approved by the Engineer may be used to ensure that early hardening of concrete during operation will not occur.

Reinforcing steel shall conform to the requirements of Item 902, Reinforcing Steel. Prestressing reinforcing steel shall be high-tensile steel wire conforming to AASHTO M 204, Standard Specification for Uncoated Stress-Relieved Steel Wire for Prestressed Concrete (ASTM A 421M) or other high-tensile metals conforming to AASHTO Standards.

1717.2.3 Steel Sheet Piles

Steel sheet piles shall meet the requirements of AASHTO M 202, Standard Specification for Steel Sheet Piling (ASTM A328M) or AASHTO M 223, Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Steels of Structural Quality (ASTM A572M).

1717.2.3.1 Permanent Steel Sheet Piling

Steel sheet piles shall be of the type, weight and section modulus indicated on the Plans or Special Provisions, and shall conform to the requirements of AASHTO M 202 (ASTM A328M), or AASHTO M 223 (ASTM A572M). All other sheet piles shall meet the requirements prescribed above the particular material specified. The joints shall be practically watertight when the piles are in place.

Steel corners, tees, wyes, and crosses shall meet the requirements of ASTM A328M or ASTM A690M, Standard Specification for High-Strength Low-Alloy Nickel, Copper, Phosphorus Steel H-Piles and Sheet Piling with Atmospheric Corrosion Resistance for Use in Marine Environments.

Steel sheet piles required for the project shall be the type and weight shown on the drawings. Sheet piling shall be constructed with a weathering finish.

Additional length beyond those indicated on the drawings may be required to provide for trimming of tops of sheet piling.

The interlocks between steel sheet pile sections shall be configured such that the average width of the annular space between all contact points of the interlocks shall be a maximum of three (3) mm, as determined by Engineer.

Steel sheet piles and interlocks shall not have excessive kinks, camber or twist that would

prevent the pile from reasonably free sliding to grade.

All fabricated connections shall be made with the use of angles or bent plates, as necessary, and shall be adequately welded or connected with high strength bolts as accepted by the Engineer.

Handling Holes:

1. If handling holes are provided, they shall be two (2) standard 65 mm diameter handling holes located 150 mm from one (1) end.

2. The Holes shall be plugged by welding a piece of steel over the hole prior to installing any riprap, backfill or drop structure cap.

3. The plated hole shall be watertight.

Unless specified otherwise, do not furnish used material under the piling steel sheet permanent bid items.

1717.2.3.2 Temporary Steel Sheet Piling

Temporary sheet piling shall be any type of adequately braced sheet pile wall which the Contractor elects to build to satisfy, and which does satisfy, the condition that existing facilities be properly retained during excavation for the placement of substructure or other facilities.

Furnish temporary steel sheet piling with a section modulus equal to or greater than the plans show. It shall extend 305 mm or higher above the retained grade unless the plans show a greater height.

The contractor may employ used steel sheet piling in good condition.

1717.2.4 Polyvinyl Chloride (PVC) Sheet Piles

The PVC Sheet Piles shall conform to the Specifications shown in Table 1717.1.

Table 1717.1 PVC Sheet Pile

Property	Test Method	Unit	Specification
Thickness, Min.	-	mm	5.50
Weight, Min.	-	kg/m	3.20
Moment of Inertia, Min.	-	Cm^4/m	3266
Section Modulus, Min.	-	Cm^3/m	369.50
Ultimate Moment, Min.	-	kg-m/m	1662
Allowable Moment, Min.	-	kg-m/m	825

Tensile Strength, Min.	ASTM D638	MPa	34
Flexural Strength, Min.	ASTM D790	MPa	70
Modulus of Elasticity, Min.	ASTM D790	MPa	2600
Notched Izod Impact, Min.	ASTM D256	kg/cm	2.4
Heat Deflection Temperature, Min.	ASTM D648	Degrees C	70

Note:

ASTM D638 – Standard Test Method for Tensile Properties of Plastic

ASTM D790 – Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.

ASTM D256 – Standard Test Methods for Determining the Izod Pendulum Impact Resistance of Plastics

ASTM D648 – Standard Test Method for Deflection Temperature of Plastics Under Flexural Load in the Edgewise Position

Mill certificate as a substitute document for Notched Izod Impact Test is acceptable if testing locally is unavailable.The kind and type of PVC sheet piles shall be specified on the approved Plans and Bill of Quantities.

1717.3 Construction Requirements

1717.3.1 Submittals

1. The contractor shall provide information from the manufacturer that indicates the sheet piling meets or exceeds the Specifications listed in this section.

2. The contractor shall submit verification from the manufacturer that the hammer can deliver the required energy.

3. Splice locations, if necessary, shall be reviewed and accepted by Engineer prior to installation.

1717.3.2 Examination

Do not begin sheet pile installation until the earthwork in the area where the piles are to be driven has been completed to the extent that the grade elevation is at no more than 305 mm above or below the top of the piling elevation as indicated on the drawings.

1717.3.3 Preparation

Any fill along the alignment of the sheet pile must be in place to sub-grade elevations and

compacted prior to driving the sheet pile.

Fill material (except riprap, boulders, bedding, and grout) is not to be placed around the sheet pile after the sheet pile is in place.

All clearing within the area to be occupied by the steel sheet piles shall be completed before the piling is installed.

1717.3.3.1 Location and Site Preparation for PVC Sheet Piles

All excavations for the foundation on which the PVC sheet piles are to be driven shall be completed before the pile driving unless otherwise specified or approved by the Engineer. Any requirement for granular fill and lean concrete shall be indicated on the Plans or as directed by the Engineer. It is important to establish a temporary driving guide for building a straight wall. This is done by placing the horizontal wood or metal bars attached to temporary vertical pilings driven along the planned wall position. The net result will look like a split rail fence, with two horizontal bars spanning between vertical pilings. While the precise placement of the horizontal bars is not critical, the suggested spacing is at least 1 m apart.

1717.3.3.2 Determination of Pile Length for PVC Sheet Pile

Pile length shall be determined by the Engineer from the results of the sub-soil investigation.

The individual sheets have interlocking male and female joints, which interlock with adjacent.

Generally, when designing with plastic materials, it is important for engineers to consider creep. Creep is the deformation or plastic flow of the PVC when subjected to any sustained load over time. It is important to keep the sustained stress levels below 22 MPa. If design stress above this value is used, creep effects increase exponentially. When loaded, the PVC sheet piles are mostly subjected to bending forces. Under bending forces, the sheet piling experiences tension in the outer flat sections and compression in the inner flat sections. The interlocks may be subjected to either compression or tension forces depending on the local loading conditions. One of the important properties of the PVC sheet pile profile is Allowable Bending Moment. This is a function of the section modulus and allowable stress. The section modulus describes the geometry of the PVC sheet piling, and the allowable stress defines the recommended allowable stress.

Maximum allowable stress of 22 MPa shall be used when designing a PVC sheet pile structure that conforms to the specifications. The minimum section modulus for the supplied sheeting should be based on the designed maximum bending moment required and maximum allowable stress.

1717.3.4 Installation

Sheet piles shall be driven to elevation shown on the Plans or as directed by the Engineer. Where impractical to drive to plan elevation due to subsurface conditions, the driving of piles may be stopped at a higher elevation with the written permission of the Engineer. However, before granting such permission, the engineer shall ascertain that the Contractor has adequate

equipment for the required driving and that the piles can be driven to the plan elevation with the proper use of this equipment.

The top of the piling shall be driven or cut-off to a straight line at the elevation indicated on the Plans.

The requirements governing the installation of sheet piling shall conform in general to those governing bearing piles as set forth under Item 1716, Piling.

For Steel Sheet Piles

The Contractor shall brace and/or provide soil grading as necessary during construction operations in order to provide lateral stability for the sheet pile wall. The sheet pile wall has been designed for the soil grades of the final configuration denoted on the drawings only. Other temporary configurations during the construction period shall not be allowed.

Care shall be taken during driving to keep from causing deformations of the top of the piles, splitting of section, or breaking of the interlock between sections. Care shall also be taken during driving to prevent and correct any tendency of steel sheet piles to twist or get out of plumb.

Steel Z piling shall be driven with the ball-end leading. Proper care and planning shall be used to allow for this construction procedure in both immediate and possible future walls.

Alternate Z piles shall be reversed end for proper interlocking in the “normal” position. Piles shall also be aligned properly to maintain a “normal” driving width.

For sheet piles driven into the native soils, pre-drilled soils, or excavated soils a vibratory driver may be used as long as the required depth is obtained.

For sheet piles being driven into bedrock, an approved hammer utilizing minimum hammer energy of 39.9 J/mm² of steel section shall be used to obtain the required depth or virtual refusal. The hammer shall be clearly marked so that it can be identified at the job site.

Steel sheet pile that is full length as shown on the drawings and is required to be driven below the specified cut-off elevation shall be spliced with additional steel sheet piling with a full penetration butt weld.

Temporary sheet piling shall be safely designed and shall be carried to adequate depths and braced as necessary for proper performance of the work. Construction shall be such as to permit excavation as required. Interior dimensions shall be such as to give sufficient clearance for construction of forms and their inspection and for batter pile clearance when necessary. Movements of sheet piling or bracing which prevent the proper completion of the substructure shall be corrected at the sole expense of the contractor. No part of the temporary sheet piling or bracing shall be allowed to extend into the substructure without the written permission of the Engineer.

Working drawings and design calculations for temporary sheeting shall be submitted to the

Engineer. The working drawings and design calculations shall be prepared, sealed, and signed by an Engineer. The furnishing of such plans shall not serve to relieve the contractor of any part of his responsibility for the safety of the work or for the successful completion of the project.

Unless otherwise ordered by the Engineer, all parts of the temporary sheet piling shall be removed upon completion of the work for which it was provided. The excavation shall be backfilled and properly compacted, prior to removal of piling unless otherwise permitted by the Engineer. Sheet piling may be left in place at the option of the Contractor if so permitted by the Engineer, provided that it is cut off at an elevation as directed by the Engineer and the cut-offs removed from the site.

1717.3.4.1 Driving and Cutting Off

1. General

Coordinate driving operations to prevent damage or displacement of concrete in substructure units or damage to adjacent facilities due to vibrations.

Drive sheeting with a variation of 6 mm or less per 300 mm from the vertical or from the batter the plans show. Ensure that the sheet piles are within 150 mm of the Plan position after driving. Do not damage sheet piles attempting to correct for misalignment.

Remove and replace, or otherwise correct, sheet piles the engineer deems unacceptable. Submit details of planned corrections to the engineer for review and approval before initiating any corrective actions. Drive sheet piles to or beyond the required tip elevation the plans show.

2. Driving System

Furnish a sheet pile driving system capable of driving the sheet piles to the required minimum tip elevation the plans show.

The engineer may order the contractor to remove a pile driving system component from service if it causes insufficient energy transfer or damages the sheet piles, Do not return a component to service until the engineer determines that it has been satisfactorily repaired or adjusted.

Sheet piles shall be driven with diesel, air, steam, gravity, hydraulic, or vibratory hammers.

3. For PVC Sheet Piles

Prior to the commencement of work, The contractor shall submit for approval a written statement addressing the appropriate installation equipment, tools, steel mandrel (if necessary) and other driving tools in connection with the method of construction based on the soil conditions.

It would be beneficial for the installer to coordinate with the PVC sheet pile manufacturer on the recommendation regarding equipment and driving aids The Engineer shall require the contractor and the supplier of the mandrel whenever necessary.

4. PVC Sheet Pile Driving

All PVC Sheet piles shall be driven as shown on the Plans or as directed by the Engineer. If it is determined that the soil conditions warrant a mandrel, then holes should be drilled in the appropriate locations to bolt the sheets to the top of the mandrel. Drive the initial sheet piles with the male lock leading, since the female lock may fill up with soil and hinder driving if used as the leading edge. Make certain that the initial sheet is properly positioned, square and plumb, as it will influence the orientation of subsequent sheets. Also, ensure that the sheets are placed up against the pile guide as they are positioned for driving. The sheets shall be driven as close to plumb as possible, not more than 3 degrees from plumb in any direction.

If a mandrel is used, as each sheet is driven to depth, the bolts are removed and the mandrel is withdrawn, leaving the PVC sheet piles behind. In some cases, friction may cause the PVC sheet piles to withdraw. If this happens, the PVC sheet pile can be re-driven directly with a vibro hammer, as the soil has already been penetrated below the sheets. If you need to make a gradual curve, to follow the contours of the driving guide, you may do so by rotating the locks slightly. The locks are designed to allow 6-10 degrees of rotation per interlock. If you need to make a sharp turn, the sheet piles have universal comers for 90 to 45 degrees turns.

Vertical pilings can be driven with a vibro hammer, and also with the use of earth anchors to achieve maximum efficiency in countering slip plane effect and/or active wedge of the soil. Any method of anchorages such as dead man anchor or driven ledge type of anchor is allowed provided that the designed, required applied force in the rod or cable are achieved. In the case of using the same PVC sheet piles laid horizontally serving as a dead man, backfilling procedure should be similar to the formation of road embankment. Layering and compacting to a minimum of 90% relative density to ensure that PVC sheet pile as the horizontal dead man will not move outward. Further, Take care to ensure that the anchor pilings are located properly according to the Engineer’s instruction outside of the slip plane or active wedge of the soil. Because the concrete cap will preclude adjustment at the wall end, it is recommended that the tiebacks consist of a long rod with threaded ends, and a shorter rod (0.50 – 1.0 m) with threaded ends, along with a turnbuckle to allow for the adjusting tension between them after installation to ensure wall straightness. Drill through the sheet's outer flange, the hole being centered 30 mm to 40 mm away from a perpendicular flange. Thread the short rod through the hole and secure it to the PVC sheet pile with galvanized washers and nuts. The turnbuckle for the bottom tieback should be tightened completely to maintain its position, while the top turnbuckle is tightened more or less as needed to adjust the straightness of the wall.

If a mid-wall water ids required, then the tieback rods should penetrate the front and rear waler as well as the sheet pile that is between them. Galvanized nuts and washers should be used to secure the front and rear of the water system, with the tieback rod also attaching to the anchor piling in the same manner. Intermediate short threaded rods should be used in between the tiebacks to secure the front and rear walers.

For the concrete cap, the pile cap is poured using normal concrete forming techniques and rebar. The PVC sheet piles should be penetrated at intervals for the rebar and to allow the concrete to flow from side to side, strengthening and utilizing the cap.

The contractor shall be responsible for the correct embedded pile length as per approved plans.

Reuse of PVC sheet piles is strictly prohibited.

5. Pile Records

The contractor shall keep record of all PVC sheet piles driven. A copy of the record shall be given to the Engineer within 2 days after each PVC sheet pile is driven. The record form to be used shall be approved by the Engineer. The pile records shall give full information on the following:

1. PVC sheet pile type and dimension;
2. Date of driving;
3. Driving equipment: type, weight & efficiency of the hammer, etc.;
4. Depth driven and tip elevation
5. Details of any interruption in driving

Level of pile top immediately after driving and the level when all PVC sheet piles in the group are driven

5. Cut-Offs

Sheet piles shall be cut-off at the elevations the plans show or as the Engineer directs. Pile cut-offs become the contractor's property.

Cut-offs not incorporated into the work shall be properly disposed of.

6. Wales

Steel sheet piling shall be braced with waling strips as the plans show. Preferably, make the wales one (1) length between corners and bolt to the piles.

1717.3.4.2 Painting Structural Steel

Surfaces of metals to be painted shall be thoroughly cleaned of rust, loose mill, scale, dirt, oil, or grease, and other foreign substances. Unless cleaning is to be done by sandblasting, all weld areas, before cleaning is begun, shall be neutralized with proper chemical, after which they shall be thoroughly rinsed with water. Cleaning may be by any of the following three methods:

1. Hand Cleaning

The removal of rust, scale and dirt shall be done by the use of metal brushes, scrapers, chisels, hammers or other effective means. Oil and grease shall be removed by the use of gasoline or benzene. Bristle or wood fiber brushes shall be used for removing loose dust.

2. Sandblasting

Sandblasting shall remove all scales and other substances down to the base metal. Special attention shall be given to the cleaning of corners and reentrant angles. Before painting, sand adhering to the steel in corners and elsewhere shall be removed. The cleaning shall be approved by the Engineer prior to any painting. The material shall be painted before the rust forms and

not later than 2 h after cleaning.

3. Flame Cleaning

Oil and grease shall be removed by washing with a suitable solvent. Excess solvent shall be wiped from the work before proceeding with the subsequent operation. The surface to be painted shall be cleaned and dehydrated (freed of occluded moisture) by the passage of oxyacetylene flames which have oxygen to acetylene of at least one. The inner cones of these flames shall have a ratio length to port diameter of at least eight (8) and shall not be more than 4 mm center to center. The oxyacetylene flames shall be traversed over the surface of the steel in such manner and at such speed that the surface is dehydrated, and dirt, rust, loose scale, scale in the form of blisters or scabs, and similar foreign matter are freed by the rapid intense heating by the flames. The flames shall not be traversed so slowly that loose scale or other foreign matter is fused to the surface of the steel.

The number, arrangement, and manipulation of the flames shall be such that all parts of the surface are adequately cleaned and dehydrated. Promptly after the application of the flames, the surface of the steel shall be wire-brushed, hand scraped wherever necessary and then swept and dusted to remove all free materials and foreign particles. Compressed air shall not be used for this operation. Paint shall be applied promptly after the steel has been cleaned and while the temperature of the steel is still above that of the surrounding atmosphere, so that there will be no re condensation of moisture on the cleaned surfaces.

4. Shop Painting of Structural Steel

When all fabrication work is completed and has been tentatively accepted, all surfaces not painted before assembling shall be given two coats of Red Lead Shop Paint conforming to the requirements of this Specification. (The inside of top chords for trusses and laced members or inaccessible parts, except contact surfaces, may be painted before assembling). Shipping pieces shall not be located for shipment until thoroughly dry. No painting shall be done after loading the materials on transport vehicles.

Erection marks for field identifications of members shall be painted upon previously painted surfaces.

With the exception of abutting joints and base plates, the machine-finished surface shall be coated, as soon as practicable after acceptance with a hot mixture of white lead and tallow before removal from the shop. The composition used for coating machine-finished surface shall be mixed in the following proportions shown in Table 1717.2

Table 1717.2 Coating for Machine-Finished Surface

Pure Tallow	Pure White Lead	Linseed Oil
1915 grams	958 grams	1.0 liter

5. Field Painting of Structural Steel

When the erection work is complete including riveting, and straightening of bent metal, all adhering rust, scale, dirt, grease or other foreign material shall be removed as specified under cleaning of surfaces.

As soon as the Engineer has examined and approved all field rivets, the heads of such rivets and field bolts, all welds and any surfaces from which the shop coat of paint has become worn off or has otherwise become defective, shall be cleaned and thoroughly covered with one coat of shop coat paint.

When the paint applied for "touching up" rivet heads and abraded surfaces have become thoroughly dry, such field coats as called for shall be applied. In no case shall a succeeding coat be applied until the previous coat has dried throughout the full thickness of the film. All small cracks and cavities which were not sealed in a watertight manner by the first field coat shall be filled with a pasty mixture of red lead and linseed oil before the second field coat is applied. The following provisions shall apply to the application of all field coats.

To secure a maximum coating on edges of plates or shapes, rivet heads and other parts subjected to special wear and attack, these parts shall first be stripped, followed immediately by the general painting of the whole surface, including the edges and rivet heads.

The application of the final coats shall be deferred until adjoining concrete work has been placed and finished. If concreting operations have damaged that paint, the surface shall be recleaned and repainted.

1717.3.4.3 Defective Piles and Damaged Coatings

Any sheet pile ruptured in the interlock or otherwise damaged during installation shall be pulled and replaced.

Damaged coatings on painted steel sheet piles shall be prepared and repainted in accordance with the manufacturer's specifications of the original coating.

Damaged galvanized coatings shall be repaired in accordance with ASTM A780M, Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.

For PVC Sheet Piles

Any PVC sheet pile delivered with defect damaged in driving due to internal defects or by improper driving (driven out of its proper location) or driven below the elevation indicated in the Plans or required by the Engineer, shall be corrected at the Contractor's expense by one of the following methods approved by the Engineer for the Pile in question:

1. Any PVC sheet pile delivered with defects shall be replaced by a new pile.

2. Additional PVC sheet pile shall be driven at the location as directed by the Engineer.

1717.3.4.4 Storage, Delivery and Handling

Do not subject piles to damage by impact bending stresses in transporting to and storing piles onsite.

Store and handle piles such that corrosion protection coating will not be damaged.

Materials delivered to the site shall be new and undamaged and shall be accompanied by certified test reports. Provide the manufacturer's name and mill identification mark on the PVC sheet piles. Store and handle PVC sheet piles in the manner recommended by the manufacturer to prevent permanent deflection, distortion or damage to the interlocks as minimum support on level blocks or racks spaced not more than 3 m apart and not more than 0.60 m from the ends. Storage of PVC sheet piles should also facilitate required inspection activities to prevent damage due to weathering and temperature prior to installation.

1173.4.5 Quality Control

For each shipment, the Contractor shall submit mill certificates provided by the sheet pile manufacturer prior to installing piling. Include in the identification data piling type, section depth, section width, sheet thickness, section modulus, certification of material, drop impact performance and lock and angle performance.

The quality test shall be conducted and passed satisfactorily prior to use.

1717.4 Method of Measurement

Sheet piling will be measured by the linear meter of sheet piling as shown on the Plans or as directed in writing by the Engineer, Complete in place and accepted. However, measurement of piling which has been delivered to plan length and cannot be driven according to plan or directed elevation because of subsurface condition shall be measured as if driven to that elevations.

Steel sheet piling can also be measured for payment by the kilogram and per piece of end connection of sheet piling as shown on the Plans or as directed in writing by the Engineer, completed in place and accepted.

Temporary sheet piling will be measured for payment by meters of temporary sheet piling completed and accepted, as computed from the horizontal and vertical payment lines shown on the plans or as ordered. If no payment limits are shown on the plans, the limits used for payment will be the actual horizontal limit of temporary sheet piling installed and accepted, and the vertical limit as measured from the bottom of the exposed face of the sheeting to the top of the retained earth behind the sheeting.

No measurement will be made of end extensions or returns necessary for the safety of the retained facility.

Sheet piling left in place solely at the Contractor's option, with the Engineer's permission, will not have an additional payment at the Contract Unit Price per square meter for "Sheet Piling Material Left in Place."

1717.5 Basis of Payment

Payment of sheet piles as determined in Section 1717.4, Method of Measurement shall be made at the Contract Unit Price per meter, kilogram and piece. Such payment shall be considered full compensation for furnishing all materials, labor, equipment, tools, paint, bolts, wales and incidentals necessary to complete the Item.

Payment for temporary sheet piling shall be made at the Contract Unit Price per meter, measured as described in Section 1717.4, Method of Measurement which price shall include all materials, equipment, and labor incidental to the construction and removal of the temporary sheet piling required at the locations specified on the plans.

Payment shall be made under:

Pay Item Number	DesSPL cription	Unit of Measurement
1717 (2)a2	Sheet Piles, Steel, Cofferdaming	Lump Sum

ITEM SPL 1- DEWATERING WORKS

Refer to Item 1, Part C. Site Development Work

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

O. 1 UNIT BOX CULVERT

ITEM 101 - REMOVAL OF STRUCTURE & OBSTRUCTION

101.1 Description

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

101.2 Construction Requirements

101.2.1 General

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

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

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

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

Steel bridges and wood bridges when specified to be salvaged shall be carefully dismantled without damaged. Steel members shall be match marked unless such match marking is waived by the Engineer. All salvaged material shall be stored as specified in Subsection 101.2.1.Structures designated to become the property of the Contractor shall be removed from the right-of-way. Blasting or other operations necessary for the removal of an existing structure or obstruction, which may damage new construction, shall be completed prior to placing the new work, unless otherwise provided in the Special Provisions.

101.2.3 Removal of Pipes Other than Pipe Culverts

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

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

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

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

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

(3) Otherwise demolished and disposed off as directed by the Engineer.

When specified, ballast, gravel, bituminous materials or other surfacing or pavement materials shall be removed and stockpiled as required in Subsection 101.2.1, otherwise such materials shall be disposed off as directed.

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

101.3 Method of Measurement

When the Contract stipulates that payment will be made for removal of obstructions on a lump-sum basis, the pay item will include all structures and obstructions encountered within the roadway. Where the contract stipulates that payment will be made for the removal of specific items on a unit basis, measurement will be made by the unit stipulated in the Contract. Whenever the Bill of Quantities does not contain an item for any aforementioned removals, the work will not be paid for directly, but will be considered as a subsidiary obligation of the Contractor under other Contract Items.

101.4 Basis of Payment

The accepted quantities, measured as prescribed in Section 101.3, shall be paid for at the Contract unit price or lump sum price bid for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for removing and disposing of obstructions, including materials, labor, equipments, tools and incidentals necessary to complete the work prescribed in this Item. The price shall also include backfilling, salvage of materials removed, their custody, preservation, storage on the right-of-way and disposal as provided herein.

Payment will be made under

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

ITEM 103- STRUCTURE EXCAVATION

103.1 Description

Add the following paragraphs to Section 103.1:

Structure excavation shall also include the furnishing and placing of approved foundation fill materials to replace unsuitable materials encountered below the foundation elevations of the structures.

For purpose of classification of structure excavation as basis for measurement and payment, bridge excavation shall be measured and paid differently from other structure excavations.

Structure excavation for bridges starts after the temporary shoring, cribbing and cofferdam construction is completed. The excavation shall be done mechanically or manually and will proceed until ten (10) centimeters (minimum) higher than the abutment and pier footing designed bottom elevation. The final excavation and trimming shall be done manually to conform to the level and lines indicated in the Plans. The bottom of the excavation works shall be free from irregular mounds or any foreign materials.

Structure excavation shall be limited to the excavation for bridges, box culverts, revetments, pipe culverts, retaining walls, headwalls, wing walls, catch basins, manholes, drop inlets, and other structures for the whole or part of the structure as shown on the Plans. The work shall consist of excavation in earth or rock within the limits of the work as specified or shown on the Plans and backfilling of these structures with suitable material. The work shall also include disposal of surplus materials, all necessary draining, pumping (dewatering), bailing, sheeting, shoring, the construction of cribs and cofferdams and their subsequent removal, and the removal of existing structures or parts thereof which obstruct or encroach upon the structural excavation.

Excavation for structures shall not be classified for measurement and payment as “Structure Excavation Above Ordinary Water Level (OWL)” and “Structure Excavation Below Ordinary Water Level” as the case may be.

The water elevations shown on the Plans are approximate only and any variation in elevation found during construction shall not be used as a basis for extra compensation for this Item.

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

103.2 Construction Requirements

103.2.2 Excavation

In the first paragraph under this Subsection, supplement the following:

Any excavation carried beyond the limits shown or described on the Plans or Specifications or beyond the dimension resulting from adjustments made by the Engineer shall be backfilled with materials acceptable and as directed by the Engineer.

Structure or Bridge Excavation will be classified as “Common Excavation” and “Rock Excavation”.

Rock Excavation shall consist of hard material in masses (including individual rock boulders exceeding 1.0 m^3 in volume) which in the opinion of the Engineer cannot be excavated without blasting and all materials that, in the opinion of the Engineer, require blasting, or the use of hydraulic breaker mounted to hydraulic excavator of at least 120 Kw, or the use of compressed air drilling for their removal, and that cannot be extracted by ripping with a tractor of at least 200 Kw with a single, rear-mounted, heavy-duty ripper.

103.2.4 Cofferdams

At the end of the paragraph of this sub-section, add the following:

The Contractor shall submit Plans required to show in detail the design, procedure and method of construction of the temporary facilities as means of support or protection to enhance or facilitate excavation under critical situations as when the presence of water or other natural phenomenon threaten the stability of the permanent structures to be constructed therein.

103.2.6 Backfill and Embankment for Structures Other than Pipe Culverts

Modify text under this Sub-Section, with the following:All structural backfill material shall consist of material free from organic material or other unsuitable material as determined by the Engineer and as shown on Plans.

Structural Backfill Gradation:

Sieve Size (ASTM E11)	Percent Passing
75mm(3”)	100
9.5mm(3/8”)	55-100
4.75mm(No.4)	35-85
0.60mm(No.30)	20-50
0.075mm(No. 200)	0-15

The Engineer may instruct other graduation from the roadway or structural excavation of which PI is less than 12 or other appropriate PIs.

103.2.7 Bedding, Backfill, and Embankment for Pipe Culverts

Add the following paragraph at the end of this Sub-Section:

If shown in the Plans as “Foundation Fill” other than Pipe Culvert, such materials shall be equivalent to these specified in Item 200-Aggregate Subbase Course.

103.2.8 Disposal Areas

Refer to the above Sub-section 102.2.10.

103.3.3 Foundation Fill

Add the following paragraph at the end of this Sub-Section:

If shown in the Plans as "Foundation Fill", including bridges, box-culverts, buildings, tunnel and other than Pipe Culvert, such materials equivalent to these specified in Item 200-Aggregate Subbase Course, shall be measured for payment under this Section for payment.

103.3.4 Shoring, Cribbing and Related Work

Modify the text of Sub-Section 103.3.4 (4) and add the following:

Shoring, cribbing, and related protective works, except for these of river bridge construction, if required in the construction shall not be measured and paid for separately but shall be considered subsidiary to the item for which they are constructed and utilized.

The shoring and cribbing and cofferdam for the river bridge construction shall be measured for payment at "lump sum" as provided in the BOQ.

103.3.5 Basis of Payment

Modify the second sentence of Sub-Section 103.3.5 including items (1), (2), (3) and (4) and substitute the following paragraph:

The payment for structure excavation shall be deemed to include the cost of backfilling, shoring and cribbing, except river bridge excavation, protective works, removing and disposing unsuitable materials off-site and removal and hauling of excess suitable materials to stockpiles as directed by the Engineer.

The payment shall be the full compensation for the work item including the cost of labor, equipment, tools and incidentals necessary to complete the work prescribed in this item.

No measurement for separate payment to the Contractor shall be made for backfill being the relevant compensation included by the Contractor in his rates in the Bill of Quantities in the pay items for excavation for structures.

Pay Item Number	Description	Unit of Measurement
103 (1)	Structure Excavation	Cubic Meter

ITEM 404 - REINFORCING STEEL

404.1 Description

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

404.2 Material Requirements

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

404.3 Construction Requirements

404.3.1 Order Lists

Before materials are ordered, all order lists and bending diagrams shall be furnished by the Contractor, for approval of the Engineer. The approval of order lists and bending diagrams by the Engineer shall in no way relieve the Contractor of responsibility for the correctness of such lists and diagrams. Any expense incident to the revisions of materials furnished in accordance with such lists and diagrams to make them comply with the Plans shall be borne by the Contractor.

404.3.2 Protection of Material

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

404.3.3 Bending

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

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

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

therein.

404.4 Placing and Fastening

All steel reinforcement shall be accurately placed in the position shown on the Plans or required by the Engineer and firmly held there during the placing and setting of the concrete. Bars shall be tied at all intersections except where spacing is less than 300mm in each directions, in which case, alternate intersections shall be tied. Ties shall be fastened on the inside.Distance from the forms shall be maintained by means of stays, blocks, ties, hangers, or other approved supports, so that it does not vary from the position indicated on the Plans by more than 6mm. Blocks for holding reinforcement from contact with the forms shall be precast mortar blocks of approved shapes and dimensions. Layers of bars shall be separated by precast mortar blocks or by other equally suitable devices. The use of pebbles, pieces of broken stone or brick, metal pipe and wooden blocks shall not be permitted. Unless otherwise shown on the Plans or required by the Engineer, the minimum distance between bars shall be 40mm. Reinforcement in any member shall be placed and then inspected and approved by the Engineer before the placing of concrete begins. Concrete placed in violation of this provision may be rejected and removal may be required. If fabric reinforcement is shipped in rolls, it shall be straightened before being placed. Bundled bars shall be tied together at not more than 1.8m intervals.

404.5 Splicing

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

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

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

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

404.6 Lapping of Bar Mat

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

404.7 Method of Measurement

The quantity of reinforcing steel to be paid for will be the final quantity placed and accepted in the completed structure.No allowance will be made for tie-wires, separators, wire chairs and other material used in fastening the reinforcing steel in place.

If bars are substituted upon the Contractor's request and approved by the Engineer and as a result thereof more steel is used than specified, only the mass specified shall be measured for payment. No measurement or payment will be made for splices added by the Contractor unless directed or approved by the Engineer. When there is no item for reinforcing steel in the Bill of Quantities, costs will be considered as incidental to the other items in the Bill of Quantities.

404.8 Basis of Payment

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

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
404 (1)a	Reinforcing Steel, Grade 40	Kilogram

ITEM 405 – STRUCTURAL CONCRETE

405.1 Description

405.1.1 Scope

This Item shall consist of furnishing, bending, placing and finishing concrete in all structures except pavements in accordance with this Specification and conforming to the lines, grades, and dimensions shown on the Plans.

Concrete shall consist of a mixture of Portland Cement, fine aggregate, coarse aggregate, admixture when specified, and water mixed in the proportions specified or approved by the Engineer.

405.1.2 Classes and Uses of Concrete

Five classes of concrete are provided for in this Item, namely: A, B, 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 heavily reinforced substructures.

The important parts of the structure included are slabs, beams, girders, columns, arch ribs, box culverts, reinforced abutments, retaining walls, and reinforced footings.

Class B – Footings, pedestals, massive pier shafts, pipe bedding, and gravity walls, unreinforced or with only a small amount of reinforcement.

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.

405.2 Material Requirements

405.2.1 Portland Cement

It shall conform to all the requirements of Subsection 311.2.1.

1. Fine Aggregate

It shall conform to all the requirements of Subsection 311.2.2.

2. Coarse Aggregate

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

Table 405.1 – Grading Requirements for Coarse Aggregate

Sieve Designation		Mass Percent Passing				
Standard Mm	**Alternate US Standard**	**Class A**	**Class B**	**Class C**	**Class P**	**Class Seal**
63	2-1/2”	100	100			
50	2”	95 – 100	95 – 100			
37.5	1-1/2”	-	-			100
25	1”	35 – 70	35 – 70		100	95 – 100
19.0	¾”	-	-	100	95 – 100	-
12.5	½”	10 – 30	10 – 30	90 – 100	-	25 – 60
9.5	3/8”	0 - 5	0 - 5	40 – 70	20 – 55	-
4.75	No.4			0 – 15*	0 – 10*	0 – 10*

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

1. Preformed Sponge Rubber and Cork, conforming to AASHTO M 153.

2. Hot-Poured Elastic Type, conforming to AASHTO M 173.

3. Preformed Fillers, conforming to AASHTO M 213.

4. Water, It shall conform to the requirements of Subsection 311.2.4

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

6. Admixtures, Admixtures shall conform to the requirements of Subsection 311.2.7

7. Curing Materials, Curing materials shall conform to the requirements of Subsection 311.2.8.

8. Expansion Joint Materials, Expansion joint materials shall be:

9. Elastomeric Compression Joint Seals, These shall conform to AASHTO M 220.

10.Elastomeric Bearing Pads, These shall conform to AASHTO M 251 or Item 412 – Elastomeric Bearing Pads.

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

405.3 Sampling and Testing of Structural Concrete

As work progresses, at least one (1) sample consisting of three (3) concrete cylinder test specimens, 150 x 300mm (6 x 12 inches), shall be taken from each seventy five (75) cubic meters of each class of concrete or fraction thereof placed each day.

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

Tests for strength shall be made in accordance with the following:

Sampling of fresh concrete	T 141
Weight per Cubic meter and air content (gravimetric) of concrete	T 121
Sieve analysis of fine and coarse aggregates	T 27
Slump of Portland Cement Concrete	T 119
Specific gravity and absorption of the fine aggregates	T 85

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

Making and Curing concrete compressive and flexural tests specimens in the field	T

23
Compressive strength of molded concrete Cyclinders T
22

405.4 Production Requirements

405.4.1 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 405.2, 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.

The mix shall either be designed or approved by the Engineer. A change in the source of materials during the progress of work may necessitate a new mix design. The strength requirements for each class of concrete shall be as specified in Table 405.2.

Table 405.2 - Composition and Strength of Concrete for Use in Structures

Class Of Concrete	Minimum Cement Content Per m^3 kg (bag**)	Maximum Water/ Cement Ratio kg/kg	Consistency Range in Slump mm (inch)	Designated Size of Coarse Aggregate Square Opening Std. mm	Minimum Compressive Strength of 150x300mm Concrete Cylinder Specimen at 28 days, MN/m^2 (psi)
A	360 (9 bags)	0.53	50 – 100 (2 – 4)	37.5 – 4.75 (1-1/2" – No. 4)	20.7 (3000)
B	320 (8 bags)	0.58	50 – 100 (2 – 4)	50 – 4.75 (2" – No. 4)	16.5 (2400)
C	380 (9.5 bags)	0.55	50 – 100 (2 – 4)	12.5 – 4.75 (1/2" – No. 4)	20.7 (3000)
P	440 (11 bags)	0.49	100 max. (4 max.)	19.0 – 4.75 (3/4" – No. 4)	37.7 (5000)
Seal	380 (9.5 bags)	0.58	100 – 200 (4 - 8)	25 – 4.75	20.7 (3000)

				(1” – No. 4)	

The measured cement content shall be within plus or minus 2 mass percent of the design cement content.

Based on 40 kg/bag

405.4.2 Consistency

Concrete shall have a consistency such that it will be workable in the required position. It shall be of such a consistency that it will flow around reinforcing steel but individual particles of the coarse aggregate 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. The quantity of mixing water shall be determined by the Engineer and shall not be varied without his consent. Concrete as dry as it is practical to place with the equipment specified shall be used.

405.4.3 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 (-) 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 percent.

3.Aggregates

Stockpiling of aggregates shall be in accordance with Subsection 311.2.10. All aggregates whether produced or handled by hydraulic methods or washed, shall be stockpiled or binned for draining for at least 12 hours prior to batching.

Rail shipment requiring more than12 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 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 one-half (0.5) percent 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 1-1/2 hours 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 batch is carried on the truck, without spilling of material from one batch compartment into another.

6. Admixtures

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

The use of Calcium Chloride as an admixture will not be permitted.

405.4.4 Mixing and Delivery

Concrete may be mixed at the site of construction, 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 except as modified in the following paragraphs of this section, for truck mixing or a combination of central point and truck mixing or truck agitating. Delivery of concrete shall be regulated so that placing is at a continuous rate unless delayed by the placing operations. The intervals between delivery of batches shall not be so great as to allow the concrete inplace to harden partially, and in no case shall such an interval exceed 30 minutes.

In exceptional cases and when volumetric measurements are authorized, for small project requiring less than 75 cu.m. per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.Concrete mixing, by chute is allowed provided that a weighing scales for determining the batch weight will be used.

For batch mixing at the site of construction 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 percent above the mixer's nominal capacity may be permitted, provided concrete test data for strength, segregation, and uniform consistency are satisfactory and provided no spillage of concrete takes place. The batch shall be so charge into the drum that a portion of the water shall enter in advance of the cement and aggregates. The flow of water shall be uniform and all water shall be in the drum by the end of the first 15 seconds of the mixing period. Mixing time shall be measured from the time all materials, except water, are in the drum. Mixing time shall not be less than 60 seconds for mixers having a capacity of $1.5m^3$ or less. For mixers having a capacity greater than $1.5m^3$, the mixing time shall not be less than 90 seconds. If timing starts, the instant the skip reaches its maximum raised position, 4 seconds shall be added to the specified mixing time. Mixing time ends when the discharge chute opens.

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

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

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.

1. Mixing Concrete: General

Concrete shall be thoroughly mixed in a mixer of an approved size and type that will insure a uniform distribution of the materials throughout the mass.

All concrete shall be mixed in mechanically operated mixers. Mixing plant and equipment for transporting and placing concrete shall be arranged with an ample auxiliary installation to provide a minimum supply of concrete in case of breakdown of machinery or in case the normal supply of concrete is disrupted. The auxiliary supply of concrete shall be sufficient to complete the casting of a section up to a construction joint that will meet the approval of the Engineer.

Equipment having components made of aluminum or magnesium alloys, which would have contact with plastic concrete during mixing, transporting or pumping of Portland Cement concrete, shall not be used.

Concrete mixers shall be equipped with adequate water storage and a device of accurately measuring and automatically controlling the amount of water used.

Materials shall be measured by weighing. The apparatus provided for weighing the aggregates

and cement shall be suitably designed and constructed for this purpose. The accuracy of all weighing devices except that for water shall be such that successive quantities can be measured to within one percent of the desired amounts. The water measuring device shall be accurate to plus or minus 0.5 mass percent. All measuring devices shall be subject to the approval of the Engineer. Scales and measuring devices shall be tested at the expense of the Contractor as frequently as the Engineer may deem necessary to insure their accuracy.

Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the Engineer more than one mass percent for cement, 1-1/2 mass percent for any size of aggregate, or one (1) mass percent for the total aggregate in any batch.

2. 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 20mm 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 $0.5m^3$ or more, the scale and weigh hopper for Portland Cement shall be separate 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 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 1-1/2 minutes 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 one hour or more, the mixer shall be thoroughly cleaned.

3. Mixing Concrete at Central Plant

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

4. 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 other-wise 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 minutes after the cement has been added either to the water or aggregate, but when cement is charged into a mixer drum containing water or surface wet aggregate and when the temperature is above 32^{o}C, this limit shall be reduced to 15 minutes. The limitation in time between the introduction of the cement to the aggregate and the beginning of the mixing may be waived when, in the 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 in Subsection 405.4.4 (3) at a stationary mixer may be reduced to 30 seconds and the mixing completed in a truck mixer. The mixing time in the truck mixer shall be as specified for truck mixing.

5. Transporting Mixed Concrete

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

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

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

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

When a truck mixer or agitator is used for transporting concrete to the delivery point, discharge shall be completed within one hour, 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^{o}C, or above, a time less than one hour will be required.

6. Delivery of Mixed Concrete

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 minutes. The methods of delivering and handling the concrete shall be such as will facilitate placing of the minimum handling.

405.5 Method of Measurement

The quantity of structural concrete to be paid for will be the final quantity placed and accepted in the completed structure. No deduction will be made for the volume occupied by pipe less than 100mm (4 inches) in diameter or by reinforcing steel, anchors, conduits, weep holes or expansion joint materials.

405.6 Basis of Payment

The accepted quantities, measured as prescribed in Section 405.5, shall be paid 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, placing and finishing concrete including all labor, equipment, tools and incidentals necessary to complete the work prescribed in the item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
405 (1)	Structural Concrete, Class A	Cubic Meter

ITEM 414- FORMS AND FALSEWORKS

414.1 Description

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

414.2 Material Requirements

414.2.1 Formwork

The materials used for smooth form finish shall be plywood, tempered concrete-form-grade hardboard, metal, plastic, paper or other acceptable materials capable of producing the desired finish for form-facing materials.

Form-facing materials shall produce a smooth, uniform texture on the concrete. Form-facing materials with raised grain, torn surfaces, worn edges, patches, dents, or other defects that will impair the texture of concrete surfaces shall not be permitted. No form-facing material shall be specified for rough form finish.

414.2.1.1 Formwork accessories

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

414.2.1.2 Formwork release agents

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

414.2.2 Falsework

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

414.3 Construction Requirements

414.3.1 Design

Falsework and Formworks design and drawings shall be in accordance, with Item 407 Concrete Structure subsection 407.3.9 and 407.3.12 respectively.

414.3.1.1 Formwork and Falsework Drawings

When complete details for forms and falseworks are not shown, prepare and submit drawings to the Engineer, showing the following:

1. Details for constructing safe and adequate forms and falsework that provide the necessary rigidity, support the loads imposed, and produce in the finished structure the required lines and grades. See subsection 414.3.1.2 for design loads. See Subsection 414.3.1.3 for design stresses, loadings and deflections. See subsection 414.3.2 for manufactured assemblies.

2. The maximum applied structural load on the foundation material. Include a drainage plan or description of how foundations will be protected from saturation, erosion, and/or scour see subsection 414.3.3.1.

3. The description of all proposed material. Describe the material that is not describable by standard nomenclature (such as AASHTO or ASTM specified) based on manufacturer's test and recommended working loads. Provide evaluation data for falsework material showing that the physical properties and conditions of the material can support the loads assumed in the design.

4. The design calculations and material specifications showing that the proposed system will support the imposed concrete pressures and other loads.

Provide an outline of the proposed concrete placement operation listing the equipment, labor, and procedures to be used for duration of each operation.A superstructure placing diagram showing the concrete placing sequence and construction joint locations shall be included.

5. Design calculations for proposed bridge falsework. A registered professional engineer proficient in structural design shall design, sign, and seal the drawings. The falsework design calculations shall show the stresses and deflections in load supporting members.

6. Anticipated total settlements of falsework and forms shall be shown. Include falsework footing settlement and joint take-up. Design for anticipated settlements not to exceed 20 millimeters.

Design and detail on falsework supporting deck slabs and overhangs on girder bridges so there is no differential settlement between the girders and the deck forms during placement of deck concrete. Design and construct the falsework to elevations that include anticipated settlement during concrete placement and required camber to compensatefor member deflections during construction.

7. Support system for form panels supporting concrete deck slabs and overhangs on girder bridges.

8. Details for strengthening and protecting falsework over or adjacent to roadways and railroads during each phase of erection and removal. See subsection 414.3.3.2.

9. Intended steel erection procedures with calculations in sufficient detail to substantiate that

the girder geometry will be correct. See subsection 414.3.3.3.

Details of proposed anchorage and ties for void forms shall be submitted. See subsection 414.3.4 for void form requirements.

Separate Falsework drawings for each structure shall be submitted to the Engineer for approval, except for identical structures with identical falsework design and details.

414.3.1.2 Design Loads for Forms and Falsework

414.3.1.2.1 Vertical Design Loads

Dead loads include the mass of concrete, reinforcing steel, forms and falsework. Consider the entire superstructure, or any concrete mass being supported by falsework to be a fluid dead load with no ability to support itself. If the concrete is to be prestressed, design the falsework to support any increase or readjusted loads caused by the prestressing forces.

The assumed density of concrete, reinforcing steel, and forms shall be not less than 2600 kilograms per cubic meter for normal concrete and not less than 2100 kilograms per cubic meter for lightweight concrete.

Consider live loads to be actual mass of equipment to be supported by falsework applied as concentrated loads at the point of contact plus a uniform load of not less than 1000 pascals applied over the area supported, plus 1100 newtons per meter applied at the outside edge of the deck falsework overhangs.

The total vertical design load for falsework shall be the sum of vertical dead and live loads. The total vertical design load used shall be not less than 4800 pascals.

414.3.1.2.2 Horizontal Design Loads

Use an assumed horizontal design load on falsework towers, bents frames and other falsework structures to verify lateral stability.

The assumed horizontal load is the sum of the actual horizontal loads due to equipment construction sequence, or other causes an~ an allowance for wind.

However, in no case is the assumed horizontal load shall be less than 2 percent of the total supported dead load at .the location under consideration.

The minimum wind allowance for each heavy-duty steel shoring having a vertical load carrying capacity exceeding 130 kilonewtons per leg is the sum of the products of the wind impact area, shape factor and the applicable wind pressure value for each height zone.

The wind impact area is the total projected area of all elements in the tower face normal to the applied wind. Assume the shape factor for heavy duty shoring to be 2.2. Determine wind pressure value from Table 1.

Table 1 Design Wind Pressure-Heavy Duty Steel Shoring

Height Zone Above Ground Meter	Wind Pressure Value-Pa	
	Adjacent to Traffic	At Other Locations
0 9-15 15-30 Over 30	960 1200 1450 1675	720 960 1200 1450

The minimum wind allowance on all other types of falsework, including falsework supported on heavy-duty shoring, is the sum of the products of the wind impact area and the applicable wind pressure value for each height zone. The wind impact area is the gross projected area of the falsework and unrestrained portion of the permanent structure, excluding the areas between falsework posts or towers where diagonal bracing is not used. Used design wind pressures from Table 2.

Table 2 Design Wind Pressure-Other Types of Falseworks

Height Zone Above Ground Meter	Wind Pressure Value-PA	
	For Members over and Bents Adjacent to Traffic Openings	At Other Locations
0 9-15 15-30 Over 30	320 Q 400 Q 480 Q 560 Q	240 Q 320 Q 400 Q 480 Q

Note: Q=O.3+O.2~ but not more than 3. W is the width of the falsework system in meters measured in the direction of the wind force being considered

414.3.1.2.3 Lateral Fluid Pressure

For concrete with retarding admixture, fly ash or other pozzolan replacement for cement, design form, form ties and bracing for a lateral fluid pressure based on concrete with a density of 2400 kilograms per cubic meter. For concrete containing no pozzolans or admixtures, which affect the time to initial set, the lateral fluid pressure shall be determined based on concrete temperature and rate of placement according to ACI Standard 347R, Guide for Formwork for Concrete.

414.3.1.3 Design Stresses, Loads and Detections for Forms and Falsework

The allowable maximum design stresses and loads listed in this section are based on the used of undamaged high-quality material. If lesser quality material is used, reduce the allowable stresses and loads. The following maximum stresses, loads and deflections in the falsework design shall not be exceeded.

414.3.1.3.1 For Timber

Compression perpendicular to the grain = 3100 kilopascals

Compression parallel to the grain (1) = 3309/ (L/d)^2 megapascals

Note: (1) Not to exceed 11 megapascals

Where:

L = Unsupported length

d = Least dimension of a square or rectangular column or the width of a square of equivalent cross-sectional area for round columns

Flexural stress· 12.4 mega pascals

Note: Reduced to 10 megapascals for members with a nominal depth of 200 millimeters or less

Horizontal shear = 1300 kilopascals

Axial tension - 8.3 megapascals

Deflection due to the mass of concrete may not exceed 1/500 of the span even if the deflection is compensated for by camber strips

Modulus of elasticity (E) for timber = 11.7 gigapascals

Maximum axial loading on timber piles = 400 kilonewtons

414.3.1.3.2 For Steel

For identified grades of steel the design stresses (other than stresses due to flexural compression) specified in the Manual of Steel Construction as published by the AISC shall not be exceeded.

When the grade of steel cannot be positively identified, the design stresses other than stresses due to flexural compression shall not be exceeded, either specified in the AlSC Manual or ASTM A 36M structural steel or the following:

Tension, axial and flexural = 150 megapascals

Compression, axial = 110000 - 2.6(L/r)^2 kilopascals

Note: (L/r) shall not exceed 120

Shear on the web gross section of rolled shapes = 100 megapascals

Web crippling for rolled shapes = 185 megapascals

For all grades of steel, do not exceed the following design stresses and deflection:

Compression flexural (1) = 82.750/(Ld/bt) megapascals

Note: (1) Not to exceed 150 mega pascals for unidentified steel or steel conforming to ASTM A 36. Not to exceed 0.6 Fy for other Identified steel.

Where:

L =: Unsupported length

d = Least dimension of a square or rectangular column or the width of square of equivalent cross-sectional area for round columns or the depth of beams

b = Width of the compression flange

t = Thickness of the compression flange ,

r = Raduis of gyration of the member

Fy = Specified minimum yield stress for the grade of steel used

Deflection due to the mass of concrete may not exceed 1/500 of the span even if the deflection is compensated for by camber strips.

Modulus of elasticity (E) for steel = 210 gigapascals

414.3.1.3.3 Other requirements

Limit falsework spans supporting T-beam girder bridges to 4.3 meters plus 8.5 times the overall depth of T-beam girder.

414.3.2 Manufactured Assemblies

For jacks, brackets, columns, joist and other manufactured devices, the ultimate load carrying capacity of the assembly shall not exceed the manufacturer's recommendations or 40 percent based on the manufacturer's tests or additional tests ordered. The maximum allowable dead load deflection of joists shall be 1/500 of their spans.

Catalog or equivalent data shall be submitted to the Engineer showing the manufacturer's recommendations or perform tests, as necessary to demonstrate the adequacy of any manufactured device proposed for use. No substitution is allowed on manufacturer's components unless the manufacturer's data encompasses such substitutions or field tests reaffirm the integrity of the system.

If a component of the falsework system consists of a steel frame tower exceeding 2 or more levels high, the differential leg loading within the steel tower unit shall not exceed 4 to 1. An exception may be approved if the manufacturer of the steel frame certifies, based on manufacturer's tests, that the proposed differential loadings are not detrimental to the safe load

carrying capacity of the steel frame.

414.3.3 Falsework Construction

The falsework construction shall be in accordancewhenever applicable, with Item 407 Concrete Structure subsection 407.3.10 Falsework Construction.

414.3.3.1 Falsework Foundations

All ground elevations at proposed foundation location shall be verified before design.

Where spread footing type foundations are used, determine the bearing capacity of the soil. The maximum allowable bearing capacity for foundation material, other than rock, is 190 kilopascals.

The edge of footing shall not be located closer than 300 millimeters from the Intersection of the bench and the top of the slope. Unless the excavation for footings is adequately supported by shoring, the edge of the footings shall not be closer than 1.2 meters or the depth of excavation, whichever is greater, from the edge of the excavation.

When falsework is supported by footings placed on paved. well-compacted slopes of berm fills, do not strut the falsework to columns unless the column is founded on rock or supported by piling.

The spread footings to support the footing design load at the assumed bearing capacity of the soil shall be designed without exceeding anticipated settlements. Steel reinforcement shall be provided in concrete footings.

When individual steel towers have a maximum leg loads exceeding 130 kilonewtons, uniform settlement under all legs or each tower under all loading conditions shall be provided.

Protect the foundation from adverse effects for the duration of its use.

414.3.3.2 Falsework Over or Adjacent to Roadways and Railroads

Falsework shall be designed and constructed to be protected from vehicle impact. This includes falsework posts that support members crossing over a roadway or railroad and other falsework posts If they are located in the row of falsework posts nearest to the roadway or railroad and if the horizontal distance from the traffic side of the falsework to the edge of pavement or to a point 3 meters from the centerline of track is less than the total height of the falsework.

Additional features shall be provided to ensure that this falsework will remain stable if subjected to impact by vehicles. Use vertical design loads for these falsework posts, columns, and towers (but not footings) that are greater than or equal to either of the following:

1. 150 percent of the design load calculated according to subsection 414.3.1.2 but not including any increased or readjusted loads caused by prestressing forces.

2. The increased or readjusted loads caused by prestressing forces.

Temporary traffic barriers shall be installed before erecting falsework towers or columns adjacent to an open public roadway. Barriers shall be located so that falsework footings or pile caps are at least 75 millimeters clear of concrete traffic barriers and all other falsework members are at least 300 mm clear. Do not remove barriers until approved.

Use falsework columns that are steel with a minimum section modulus about each axis of 156,000 cubic millimeters or sound timbers with a minimum section modulus about each axis of 4,100,000 cubic millimeters.

Mechanically connect the base of each column or tower frame supporting falsework over or immediately adjacent to an open public road to its supporting footing or provide other lateral restraint to withstand a force of not less than 9 kilonewtons applied to the base of the column in any direction. Mechanically connect such columns or frames to the falsework cap or stringer to resist a horizontal force of not less than 4.5 kilonewtons In any direction. Neglect the effects of frictional resistance.

Brace or tie exterior girders, upon which overhanging bridge deck falsework brackets are hung, to the adjacent interior girders as necessary to prevent rotation of exterior girders or overstressing the exterior girder web.

Mechanically connect all exterior falsework stringers and stringers adjacent to the end of discontinuous caps, the stringer or stringers over points of minimum vertical clearance and every fifth remaining stringer, to the falsework cap or framing. Provide mechanical connections capable of resisting load in any direction, including uplift on the stringer, if not less than 2.2 kilonewtons. Connections shall be installed before traffic is allowed to pass beneath the span.

16 millimeters diameter or larger bolts to connect timber members shall be used to brace falsework bents located adjacent to roadways or railroads.

Sheath falsework bents within 6 meters of the centerline of a railroad track solid in the area between 1 and 5 meters above the track on the side facing the track.

Construct sheathing of plywood not less than 16 millimeters thick or lumber not less than 25 millimeters nominal thickness. Adequate bracing shall be provided on such bents so that the bent resists the required assumed horizontal load or 22 kilonewtons, whichever is greater, without the aid of sheathing.

Provide at least the minimum required vertical and horizontal clearances through falsework for roadways, railroads, pedestrians, and boats.

414.3.3.3 Falsework for Steel Structures

Falsework design loads shall consist of the mass of structural steel, the load of supported erection equipment, and all other loads supported by the falsework.

Falsework and forms for concrete supported on steel structures shall be designed so that loads are applied to girder webs within 150 millimeters of flange or stiffener. Distribute the loads in a manner that does not produce local distortion of the web. Do not use deck overhang forms

that require holes to be drilled into the girder webs.

Strut and tie exterior girders supporting overhanging deck falsework brackets to adjacent interior girders to prevent distortion and overstressing of the exterior girder web.

Do not apply loads to existing, new or partially completed structures that exceed the load carrying capacity of any part of the structure according to the load factor design methods of the AASHTO Bridge Design Specifications using load group IB.

Build supporting falsework that will accommodate the proposed method of erection without overstressing the structural steel, as required and will produce the required final structural geometry, intended continuity and structural action.

414.3.4 Forms

The forms construction shall be in accordance whenever applicable, with Item 407 Concrete Structure subsection 407.3.13 Formwork Construction.

Form panels to be used shall be in good condition free of defects on exposed surfaces. If form panel material other than plywood is used, it shall have flexural strength, modulus of elasticity and other physical properties equal to or greater than the physical properties for the type of plywood specified.

Furnish and place form panels for exposed surfaces in uniform widths of not less than 1 meter and in uniform lengths of not less than 2 meters except where the width of the member formed is less than 1 meter.

Arrange panels in symmetrical patterns conforming to the general lines of the structure. Place panels for vertical surfaces with the long dimension horizontal and with horizontal joints level and continuous. For walls with sloping footings which do not abut other walls, panels may be placed with the long dimension parallel to the footing.

Form panels shall be precisely aligned on each side of the panel joint by means of supports or fasteners common to both panels.

Use form ties and anchors that can be removed without damaging the concrete surface. Construct metal ties or anchorages within the forms to permit their removal to a depth of at least 25 millimeters from the face without damage to the concrete.

Fill cavities with cement mortar and finish to a sound, smooth, uniform colored surface.

Support roadway slab forms of box girder type structures on wales or similar supports fastened, as nearly as possible, to the top of the web walls.

Form exposed curved surfaces to follow the shape of the curve, except on retaining walls that follow a horizontal curve.

The wall stems may be a series of short chords if all of the following apply:

1. Chords within the panel are the same length.

2. Chords do not vary from a true curve by more than 15 millimeters at any point.

3. All panel points are on the true curve.

When architectural treatment is required, make the angle points for chords in wall stems fall at vertical rustication joints.

Earth cuts as forms for vertical or sloping surfaces shall not be used unless otherwise required or permitted by the Contract.

414.3.4.1 Stay in place deck forms

Use permanent or stay in place forms only when permitted by the contract.

Fabricate permanent steel bridge deck forms and supports from steel conforming to ASTM A653M coating designation 2600, any grade except grade 340 class 3.

Install forms according to accepted fabrication and erection drawings. Do not rest form sheets directly on the top of stringer or floor beam flanges. Securely fasten sheets to form supports. Place form supports in direct contact with the stringer flange or floor beam. Make all attachments with permissible welds, bolts or clips. Do not weld form supports to flanges of steels not considered weldable or to portions of flanges subject to tensile stresses.

Clean wire brush and paint 2 coats of zinc dust zinc-oxide primer (FSS TTP-641 type II no color added) any permanently exposed form metal where the galvanized coating has been damaged. Minor heat discoloration in areas of welds need not be touched up.

Locate transverse construction joints in slabs at the bottom of a flute. Field drill 6 millimeter diameter weep holes at not less than 300 millimeters on center along the line of the joint.

414.3.4.2 Void forms

Store void forms in a dry location to prevent distortion. Secure the forms using anchors and ties which leave a minimum of metal or other supporting material exposed at the bottom of the finished slab.

Make the outside surface of the forms waterproof. Cover the ends with waterproof mortar tight caps. Use premolded 6 millimeters thick rubber joint filler around the perimeter of the caps to permit expansion.

Provide a PVC vent near each void form. Construct vents so the vent tube shall not extend more than 13 millimeters below the bottom surface of the finished concrete after form removal. Protect void forms from the weather until concrete is placed.

414.3.4.3 Metal Forms

The specification for forms relative to design, mortar tightness, filleted corners, beveled

projection, bracing, alignment, removal, reuse and oiling also apply to metal forms.

414.3.6 Removal of Forms and Falsework

The removal of forms and falsework shall be in accordance whenever applicable. with Item 407 Concrete Structure subsection 407.3.11 Removing falsework and subsection 407.3.14 Removal of forms and falsework.

Where necessary remove all forms except the following:

1. Interior soffit forms for roadway deck slabs of cast-in-place box girders.

2. Forms for the interior voids of precast members

3. Forms for abutments or piers when no permanent access is available into the cells or voids.

Install a reshoring system if falsework supporting the sides of girder stems with slopes steeper than 1:1 are removed before placing deck slab concrete. Design the reshoring system with lateral supports which resist all rotational forces acting on the stem, including those caused by the placement of deck slab concrete. Install the lateral supports immediately after each form panel is removed and before release of supports for the adjacent form panel.

414.3.6 Acceptance

Forms and falsework (including design, construction, and removal) shall be evaluated and approved by the Engineer.

When the falsework installation is complete and before concrete placement or removal begins, the falsework shall be inspected by the Engineer.

The Engineer shall certify in writing that the installation conforms to the contract, the approved falsework drawings (including approved changes) and acceptable engineering practices.

414.4 Method of Measurement

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

Whenever the Bill of Quantities does not contain an item for form and falsework, the work will not be paid directly but will be considered as a subsidiary obligation of the contractor under other Contract Items.

414. 5 Basis of Payment

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

Payment will be made under:

Pay Item Number	Description	Unit Measurement
414 (1)	Forms and Falseworks	Lump Sum

P. ACCESS ROAD

ITEM 102 – EXCAVATION

Removal of Unsuitable Material

Dewatering; Stabilized the area of the conditioning pond to be used for diverting water from fish pond 1 and another remaining Part of fishpond 2.

Dredging; Excavation areas must be dredged to remove combined sticky water and muck before the excavation starts. The materials result of dredging must be removed and disposed off by the contractor to the designated areas as shown in the plan or approved by the Engineer

Excavation; Removal of Unsuitable Material;

All unsuitable materials shall be excavated to the depth necessary and conduct Field Density Test to check if it also meets a stable natural base, or in accordance with general notes and in conformity with lines, grades and dimensions shown in the plans established by the Engineer. When the excavation is finished the Engineer may require the Contractor to dispose of the unsuitable material in designated areas.

Roadway Excavation; Roadway excavation will include excavation and grading for roadways, parking areas, intersections, approaches, slope rounding, benching, waterways and ditches; removal of unsuitable material from the roadbed and beneath embankment areas; and excavating selected material found in the roadway as ordered by the Engineer for specific use in the improvement. Roadway excavation will be classified as “unclassified excavation”, “rock excavation”, “common excavation”, or “muck excavation” as indicated in the Bill of Quantities and hereinafter described.

(1) Unclassified Excavation. Unclassified excavation shall consist of the excavation and disposal of all materials regardless of its nature, not classified and included in the Bill of Quantities under other pay items.

2) Common Excavation. Common excavations shall consist of all excavation not included in the Bill of Quantities under “rock excavation” or other pay items.

3) Muck Excavation. Muck excavation shall consist of the removal and disposal of deposits of saturated or unsaturated mixtures of soils and organic matter not suitable for foundation material regardless of moisture content.

Construction Requirements:

When there is evidence of discrepancies on the actual elevations and that shown on the Plans, a pre-construction survey referred to the datum plane used in the approved Plan shall be untaken by the Contractor under control of the Engineer to serve as basis for the computation of the actual volume of the excavated materials. All excavations shall be finished to a reasonably smooth and uniform surface. No materials shall be wasted without authority of the Engineer. Conservation of Topsoil Where provided for on the Plans or in the Special Provisions, suitable topsoil encountered in excavation and on areas where embankment is to be placed shall be removed to such extent and to such depth as the Engineer may direct. The removed topsoil shall be transported and deposited in storage piles at locations approved by the Engineer. The topsoil shall be completely removed to the required depth from any designated area prior to the beginning of regular excavation or embankment work in the area and shall be kept separate from other excavated materials for later use.

Utilization of Excavated Material

All suitable material removed from the excavation shall be used in the formation of the embankment, subgrade, shoulders, slopes, bedding, and backfill for structures, and for other purposes shown on the Plans or as directed. Only approved materials shall be used in the construction of embankments and backfills. All excess material, including rock and boulders that cannot be used in embankments shall be disposed of as directed. Material encountered in the excavation and determined by the Engineer as suitable for topping, road finishing, slope protection, or other purposes shall be conserved and utilized as directed by the Engineer. Borrow material shall not be placed until after the readily accessible roadway excavation has been placed in the fill, unless otherwise permitted or directed by the Engineer. If the Contractor places more borrow than is required and thereby causes a waste of excavation, the amount of such waste will be deducted from the borrow volume.

Prewatering

Excavation areas and borrow pits may be prewatered before excavating the material. When prewatering is used, the areas to be excavated shall be moistened to the full depth, from the surface to the bottom of the excavation. The water shall be controlled so that the excavated material will contain the proper moisture to permit compaction to the specified density with the use of standard compacting equipment. Prewatering shall be supplemented where necessary, by truck watering units, to ensure that the embankment material contains the proper moisture at the time of compaction.

The Contractor shall provide drilling equipment capable of suitably checking the moisture penetration to the full depth of the excavation.

Presplitting

Unless otherwise provided in the Contract, rock excavation which requires drilling and shooting shall be presplit.

Presplitting to obtain faces in the rock and shale formations shall be performed by: (1) drilling holes at uniform intervals along the slope lines, (2) loading and stemming the holes with appropriate explosives and stemming material, and (3) detonating the holes simultaneously.

Prior to starting drilling operations for presplitting, the Contractor shall furnish the Engineer a plan outlining the position of all drill holes, depth of drilling, type of explosives to be used, loading pattern and sequence of firing. The drilling and blasting plan is for record purposes only and will not absolve the Contractor of his responsibility for using proper drilling and blasting procedures. Controlled blasting shall begin with a short test section of a length approved by the Engineer. The test section shall be presplit, production drilled and blasted and sufficient material excavated whereby the Engineer can determine if the Contractor's methods are satisfactory. The Engineer may order discontinuance of the presplitting when he determines that the materials encountered have become unsuitable for being presplit.

The holes shall be charged with explosives of the size, kind, strength, and at the spacing suitable for the formations being presplit, and with stemming material which passes a 9.5 mm (3/8 inch) standard sieve and which has the qualities for proper confinement of the explosives.

The finished presplit slope shall be reasonably uniform and free of loose rock. Variance from the true plane of the excavated backslope shall not exceed 300 mm (12 inches); however, localized irregularities or surface variations that do not constitute a safety hazard or an impairment to drainage courses or facilities will be permitted. A maximum offset of 600 mm (24 inches) will be permitted for a construction working bench at the bottom of each lift for use in drilling the next lower presplitting pattern.

Excavation of Ditches, Gutters, etc.

All materials excavated from side ditches and gutters, channel changes, irrigation ditches, inlet and outlet ditches, toe ditchers, furrow ditches, and such other ditches as may be designated on the Plans or staked by the Engineer, shall be utilized as provided in Subsection 102.2.3.

Ditches shall conform to the slope, grade, and shape of the required cross-section, with no projections of roots, stumps, rock, or similar matter. The Contractor shall maintain and keep open and free from leaves, sticks, and other debris all ditches dug by him until final acceptance of the work.

Furrow ditches shall be formed by plowing a continuous furrow along the line staked by the Engineer. Methods other than plowing may be used if acceptable to the Engineer. The ditches shall be cleaned out by hand shovel work, by ditcher, or by some other suitable method, throwing all loose materials on the downhill side so that the bottom of the finished ditch shall be approximately 450 mm (18 inches) below the crest of the loose material piled on the downhill side. Hand finish will not be required, but the flow lines shall be in satisfactory shape to provide drainage without overflow.

Excavation of Roadbed Level

Rock shall be excavated to a depth of 150 mm (6 inches) below subgrade within the limits of the roadbed, and the excavation backfilled with material designated on the Plans or approved by the Engineer and compacted to the required density. When excavation methods employed by the Contractor leave undrained pockets in the rock surface, the Contractor shall at his own expense, properly drain such depressions or when permitted by the Engineer fill the depressions with approved impermeable material.

Material below subgrade, other than solid rock shall be thoroughly scarified to a depth of 150 mm (6 inches) and the moisture content increased or reduced, as necessary, to bring the material throughout this 150 mm layer to the moisture content suitable for maximum compaction. This layer shall then be compacted in accordance with Subsection 104.3.3.

Borrow Areas

The Contractor shall notify the Engineer sufficiently in advance of opening any borrow areas so that cross-section elevations and measurements of the ground surface after stripping may be taken, and the borrowed material can be tested before being used. Sufficient time for testing the borrowed material shall be allowed.

All borrow areas shall be bladed and left in such shape as to permit accurate measurements after excavation has been completed. The Contractor shall not excavate beyond the dimensions and elevations established, and no material shall be removed prior to the staking out and cross-sectioning of the site. The finished borrow areas shall be approximately true to line and grade established and specified and shall be finished, as prescribed in Clause 61, Standard Specifications for Public Works and Highways, Volume 1. When necessary to remove fencing, the fencing shall be replaced in at least as good condition as it was originally. The Contractor shall be responsible for the confinement of livestock when a portion of the fence is removed.

Removal of Unsuitable Material

Where the Plans show the top portion of the roadbed to be selected topping, all unsuitable materials shall be excavated to the depth necessary for replacement of the selected topping to the required compacted thickness.

Where excavation to the finished graded section results in a subgrade or slopes of unsuitable soil, the Engineer may require the Contractor to remove the unsuitable material and backfill to the finished graded section with approved material. The Contractor shall conduct his operations in such a way that the Engineer can take the necessary cross-sectional measurements before the backfill is placed.

The excavation of muck shall be handled in a manner that will not permit the entrapment of muck within the backfill. The material used for backfilling up to the ground line or water level, whichever is higher, shall be rock or other suitable granular material selected from the roadway excavation, if available. If not available, suitable material shall be obtained from other approved sources. Unsuitable material removed shall be disposed off in designated areas shown on the Plans or approved by the Engineer.

Method of Measurement

The cost of excavation of material which is incorporated in the Works or in other areas of fill shall be deemed to be included in the Items of Work where the material is used.

Measurement of Unsuitable or Surplus Material shall be the net volume in its original position.

For measurement purposes, surplus suitable material shall be calculated as the difference between the net volume of suitable material required to be used in embankment corrected by applying a shrinkage factor or a swell factor in case of rock excavation, determined by laboratory tests to get its original volume measurement, and the net volume of suitable material from excavation in the original position. Separate pay items shall be provided for surplus common, unclassified and rock material.The Contractor shall be deemed to have included in the contract unit prices all costs of obtaining land for the disposal of unsuitable or surplus material.

Basis of Payment

The accepted quantities, measured as prescribed in Section 102.3 shall be paid for at the contract unit price for each of the Pay Items listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the removal and disposal of excavated materials including all labor, equipment, tools, and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
102 (2)	Surplus Common Excavation	Cubic Meter

Item 105 – SUBGRADE PREPARATION

105.1 Description

This Item shall consist of the preparation of the subgrade for the support of overlying structural layers. It shall extend to full width of the roadway.

Unless authorized by the Engineer, subgrade preparation shall not be done unless the Contractor is able to start immediately the construction of the pavement structure.

105.2 Material Requirements

Unless otherwise stated in the Contract and except when the sub grade is in rock cut, all materials below sub grade level to a depth 150 mm or to such greater depth as may be specified shall meet the requirements of Section 104.2, Selected Borrow for Topping.

105.3 Construction Requirements

105.3.1 Prior Works

Prior to commencing preparation of the sub grade, all culverts, cross drains, ducts and the like (including their fully compacted backfill), ditches, drains and drainage outlets shall be completed. Any work on the preparation of the subgrade shall not be started unless prior work herein described shall have been approved by the Engineer.

105.3.2 Subgrade Level Tolerances

The finished compacted surface of the subgrade shall conform to the allowable tolerances as specified hereunder:

Permitted variation from design THICKNESS OF LAYER	20mm
Permitted variation from design LEVEL OF SURFACE	30mm
Permitted SURFACE IRREGULARITY MEASURED BY 3m STRAIGHT EDGE	30mm
Permitted variation from design CROSSFALL OR CAMBER	0.5%
Permitted variation from design LONGITUDINAL GRADE over 25 m length	0.1%

105.3.3 Subgrade in Common Excavation

Unless otherwise specified, all materials below subgrade level in earth cuts to a depth 150 mm or other depth shown on the Plans or as directed by the Engineer shall be excavated. The material, if suitable, shall be set side for future use or, if unsuitable, shall be disposed off in accordance with the requirements of Subsection 102.2.9.

Where material has been removed from below subgrade level, the resulting surface shall be compacted to a depth of 150 mm and in accordance with other requirements of Subsection 104.3.3.All materials immediately below subgrade level in earth cuts to a depth of 150 mm, or to such greater depth as may be specified, shall be compacted in accordance with the requirements of Subsection 104.3.3.

105.3.4 Subgrade in Rock Excavation

Surface irregularities under the subgrade level remaining after trimming of the rock excavation shall be leveled by placing specified material and compacted to the requirements of Subsection 104.3.3.

105.3.5 Subgrade on Embankment

After the embankment has been completed, the full width shall be conditioned by removing any soft or other unstable material that will not compacted properly.

The resulting areas and all other low sections, holes, or depressions shall be brought to grade

with suitable material. The entire roadbed shall be shaped and compacted to the requirements of Subsections 104.3.3. Scarifying, blading, dragging, rolling, or other methods of work shall be performed or used as necessary to provide a thoroughly compacted roadbed shaped to the cross-sections shown on the Plans.

105.3.6 Subgrade on Existing Pavement

Where the new pavement is to be constructed immediately over an existing Portland Cement concrete pavement and if so specified in the Contract the slab be broken into pieces with greatest dimension of not more than 500 mm and the existing pavement material compacted as specified in Subsection 104.3.3, as directed by the Engineer.

The resulting subgrade level shall, as part pavement construction be shaped to conform to the allowable tolerances of Subsection 105.3.2 by placing and compacting where necessary a leveling course comprising the material of the pavement course to be placed immediately above.

Where the new pavement is to be constructed immediately over an existing asphalt concrete pavement or gravel surface pavement and if so specified in the Contract the pavement shall be scarified, thoroughly loosened, reshaped and recompacted in accordance with Subsection 104.3.3. The resulting subgrade level shall conform to the allowable tolerances of Subsection 105.3.2.

105.3.7 Protection of Completed Work

The Contractor shall be required to protect and maintain at his own expense the entire work within the limits of his Contract in good condition satisfactory to the Engineer from the time he first started work until all work shall have been completed.

Maintenance shall include repairing and recompacting ruts, ridges, soft spots and deteriorated sections of the subgrade caused by the traffic of the Contractor’s vehicle/equipment or that of the public.

105.3.8 Templates and Straight-edges

The Contractor shall provide for use of the Engineer, approved templates and straight-edges in sufficient number to check the accuracy of the work, as provided in this Specification.

105.4 Method of Measurement

105.4.1 Measurement of Items for payment shall be provided only for:

The compaction of existing ground below subgrade level in cuts of common material as specified in Subsection 105.3.3.The breaking up or scarifying, loosening, reshaping and recompacting of existing pavement as specified in Subsection 105.3.6.

The quantity to be paid for shall be the area of the work specified to be carried out and accepted by the Engineer.

105.4.2

Payment for all work for the preparation of the subgrade, including shaping to the required levels and tolerances, other than as specified above shall be deemed to be included in the Pay Item for Embankment.

105.5 Basis of Payment

The accepted quantities, measured as prescribed in Section 105.4, shall be paid for at the appropriate contract unit price for Pay Item listed below that is included in the Bill of Quantities which price and payment shall be full compensation for the placing or removal and disposal of all materials including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
105 (1)	Subgrade Preparation	Square Meter

ITEM 200 – AGGREGATE SUB-BASE COURSE

Description

This item shall consist of furnishing, placing and compacting an aggregate subbase course on a prepared subgrade in accordance with this Specification and the lines, grades and cross-sections shown on the Plans, or as directed by the Engineer.

Material Requirements

Aggregate for subbase shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter.

The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable subbase. The subbase material shall conform to Table 200.1, Grading Requirements

Table 200.1 – Grading Requirements

Sieve Designation	Mass Percent Passing

Standard, mm	Alternate US Standard	
50	2”	100
25	1”	55 – 85
9.5	3/8”	40 – 75
0.075	No. 200	0 - 12

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and plasticity index not greater than 12 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve, shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion Tests as determined by AASHTO T 96.

The material shall have a soaked CBR value of not less than 25% as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density and determined by AASHTO T 180, Method D.

Construction Requirements

200.3.1 Preparation of Existing Surface

The existing surface shall be graded and finished as provided under Item 105, Subgrade Preparation, before placing the subbase material.

200.3.2 Placing

The aggregate subbase material shall be placed at a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

200.3.3 Spreading and Compacting

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150 mm or less, the material may be spread and compacted in

one layer. Where the required thickness is more than 150 mm, the aggregate subbase shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.The moisture content of subbase material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the subbase material shall be compacted thoroughly with approved tampers or compactors.

If the layer of subbase material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.Compaction of each layer shall continue until a field density of at least 100 percent of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191.

200.3.4 Trial Sections

Before subbase construction is started, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m^2 shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for subbase, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

200.3.5 Tolerances

Aggregate subbase shall be spread with equipment that will provide a uniform layer which when compacted will conform to the designed level and transverse slopes as shown on the Plans.

The allowable tolerances shall be as specified hereunder:

Permitted variation from design THICKNESS OF LAYER	±20 mm

Permitted variation from design LEVEL OF SURFACE	+10 mm -20 mm
Permitted variation from design SURFACE IRREGULARITY Measured by 3-m straight-edge	20 mm
Permitted variation from design CROSSFALL OR CAMBER	±0.3%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	±0.1%

Method of Measurement

Aggregate Subbase Course will be measured by the cubic meter (m^3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course.

No allowance will be given for materials placed outside the design limits shown on the cross-sections.

Trial sections shall not be measured separately but shall be included in the quantity of subbase herein measured.

Basis of Payment

The accepted quantities, measured as prescribed in Section 200.4, shall be paid for at the contract unit price for Aggregate Subbase Course which price and payment shall be full compensation for furnishings and placing all materials, including all labor, equipment, tools and incidentals necessary to complete the work prescribed in this Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
200 (1)	Aggregate Subbase Course,200mm thick	Cubic Meter

ITEM 311 – PORTLAND CEMENT CONCRETE PAVEMENT

311.1 Description

This Item shall consist of pavement of Portland Cement Concrete, with or without reinforcement, constructed on the prepared base in accordance with this Specification and in conformity with lines, grades, thickness and typical cross-section shown on the Plans.

311.2 Material Requirements

311.2.1 Portland Cement

It shall conform to the applicable requirements of Item 700, Hydraulic Cement. Only Type I Portland Cement shall be used unless otherwise provided for in the Special Provisions. Different brands or the same brands from different mills shall not be mixed nor shall they be used alternately unless the mix is approved by the Engineer.

However, the use of Portland Pozzolan Cement Type IP meeting the requirements of AASHTO M 240/ASTM C 695, Specifications for Blended Hydraulic Cement shall be allowed, provided that trial mixes shall be done and that the mixes meet the concrete strength requirements, the AASHTO/ASTM provisions pertinent to the use of Portland Pozzolan Type IP shall be adopted.

Cement which for any reason, has become partially set or which contains lumps of caked cement will be rejected.

Cement salvaged from discarded or used bags shall not be used.Samples of Cement shall be obtained in accordance with AASHTO T 127.

311.2.2 Fine Aggregate

It shall consist of natural sand, stone screenings or other inert materials with similar characteristics, or combinations thereof, having hard, strong and durable particles.

Fine aggregate from different sources of supply shall not be mixed or stored in the same pile nor used alternately in the same class of concrete without the approval of the Engineer.

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

If the fine aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 10 mass percent.

The fine aggregate shall be free from injurious amounts of organic impurities.

If subjected to the colorimatic test for organic impurities and a color darker than the standard is produced, it shall be rejected.

However, when tested for the effect of organic impurities of strength of mortar by AASHTO T 71, the fine aggregate may be used if the relative strength at 7 and 28 days is not less than 95 mass percent.

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

Table 311.1 – Grading Requirements for Fine Aggregate

Sieve Designation	Mass Percent Passing

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

311.2.3 Coarse Aggregate

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

It shall contain not more than one (1) mass percent of material passing the 0.075 mm (No. 200) sieve, not more than 0.25 mass percent of clay lumps, nor more than 3.5 mass percent of soft fragments.If the coarse aggregate is subjected to five (5) cycles of the sodium sulfate soundness test, the weighted loss shall not exceed 12 mass percent.

It shall have a mass percent of wear not exceeding 40 when tested by AASHTO T 96.

If the slag is used, its density shall not be less than 1120 kg/m^3 (70 lb./cu. ft.). The gradation of the coarse aggregate shall conform to Table 311.2.

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

Table 311.2 – Grading Requirement for Coarse Aggregate

Sieve Designation		**Mass Percent Passing**		
Standard Mm	**Alternate U. S. Standard**	**Grading A**	**Grading B**	**Grading C**
75.00	3 in.	100	-	-
63.00	2-1/2 in.	90-100	100	100
50.00	2 in.	-	90-100	95-100
37.5	1-1/2 in.	25-60	35-70	-
25.0	1 in.	-	0-15	35-70

19.0	¾ in.	0-10	-	-
12.5	½ in.	0-5	0-5	10-30
4.75	No. 4	-	-	0-5

311.2.4 Water

Water used in mixing, curing or other designated application shall be reasonably clean and free of oil, salt, acid, alkali, grass or other substances injurious to the finished product. Water will be tested in accordance with and shall meet the requirements of Item 714, Water. 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.

311.2.5 Reinforcing Steel

It shall conform to the requirements of Item 404, Reinforcing Steel. Dowels and tie bars shall conform to the requirements of AASHTO M 31 or M 42, except that rail steel shall not be used for tie bars that are to be bent and restraightened during construction. Tie bars shall be deformed bars. Dowels shall be plain round bars. Before delivery to the site of work, one-half of the length of each dowel shall be painted with one coat of approved lead or tar paint.

The sleeves for dowel bars shall be metal of approved design to cover 50 mm (2 inches), plus or minus 5 mm (1/4 inch) of the dowel, with a closed end, and with a suitable stop to hold the end of the sleeve at least 25 mm (1 inch) from the end of the dowel. Sleeves shall be of such design that they do not collapse during construction.

311.2.6 Joint Fillers

Poured joint fillers shall be mixed asphalt and mineral or rubber filler conforming to the applicable requirements of Item 705, Joint Materials.

Preformed joint filler shall conform to the applicable requirements of Item 705. It shall be punched to admit the dowels where called for in the Plans. The filler for each joint shall be furnished in a single piece for the full depth and width required for the joint.

311.2.7 Admixtures

Air-entraining admixture shall conform to the requirements of AASHTO M 154.

Chemical admixtures, if specified or permitted, shall conform to the requirements of AASHTO M 194.

Fly Ash, if specified or permitted as a mineral admixture and as 20% partial replacement of Portland Cement in concrete mix shall conform to the requirements of ASTM C 618.

Admixture should be added only to the concrete mix to produce some desired modifications to the properties of concrete where necessary, but not as partial replacement of cement.

311.2.8 Curing Materials

Curing materials shall conform to the following requirements as specified;

a. Burlap cloth	AASHTO M 182
b. Liquid membrane forming compounds	AASHTO M 148
c. Sheeting (film) materials	AASHTO M 171

Cotton mats and water-proof paper can be used.

311.2.9 Calcium Chloride/Calcium Nitrate

It shall conform to AASHTO M 144, if specified or permitted by the Engineer, as accelerator.

311.2.10 Storage of Cement and Aggregate

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

Storage buildings shall have capacity for storage of a sufficient quantity of cement to allow sampling at least twelve (12) days before the cement is to be used. Bulk cement, if used, shall be transferred to elevated air tight and weatherproof bins. Stored cement shall meet the test requirements at any time after storage when 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 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.

311.2.11 Proportioning, Consistency and Strength of Concrete

The Contractor shall prepare the design mix based on 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”.

It is the intent of this Specification to require at least 364 kg of cement per cubic meter of concrete to meet the minimum strength requirements. The Engineer shall determine from laboratory tests of the materials to be used, the cement content and the proportions of aggregate

and water that will produce workable concrete having a slump of between 40 and 75 mm (1-1/2 and 3 inches) if not vibrated or between 10 and 40 mm (1/2 and 1-1/2 inches) if vibrated, and a flexural strength of not less than 3.8 MPa (550 psi) when tested by the third-point method or 4.5 MPa (650 psi) when tested by the mid-point method at fourteen (14) days in accordance with AASHTO T97 and T177, respectively; or a compressive strength of 24.1 MPa (3500 psi) for cores taken at fourteen (14) days and tested in accordance with AASHTO T24.

Slump shall be determined using AASHTO T 119.

The designer shall consider the use of lean concrete (econocrete) mixtures using local materials or specifically modified conventional concrete mixes in base course and in the lower course composite, monolithic concrete pavements using a minimum of 75 mm (3 inches) of

conventional concrete as the surface course.

The mix design shall be submitted to the Engineer for approval and shall be accompanied with certified test data from an approved laboratory demonstrating the adequacy of the mix design. A change in the source of materials during the progress of work may necessitate a new design mix.

311.3 Construction Requirements

311.3.1 Quality Control of Concrete

1. General

The Contractor shall be responsible for the quality control of all materials during the handling, blending, and mixing and placement operations.

2. Quality Control Plan

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 insure that the concrete produces complies with the Specifications. The Engineer shall be provided free access to recent plant production records, and if requested, informational copies of mix design, materials certifications and sampling and testing reports.

3. Qualification of Workmen

Experienced and qualified personnel shall perform all batching or mixing operation for the concrete mix, and shall be present at the plant and job site to control the concrete productions whenever the plant is in operation. They shall be identified and duties defined as follows:

a. Concrete Batcher. The person performing the batching or mixing operation shall be capable of accurately conducting aggregate surface moisture determination and establishing correct scale weights for concrete materials. He shall be capable of assuring that the proportioned batch weights of materials are in accordance with the mix design.

b. Concrete Technician. The person responsible for concrete production control and sampling

and testing for quality control shall be proficient in concrete technology and shall have a sound knowledge of the Specifications as they relate to concrete production. He shall be capable of conducting tests on concrete and concrete materials in accordance with these Specifications. He shall be capable of adjusting concrete mix designs for improving workability and Specification compliance and preparing trial mix designs. He shall be qualified to act as the concrete batcher in the batcher's absence.

4. Quality Control Testing

The Contractor shall perform all sampling, testing and inspection necessary to assure quality control of the component materials and the concrete.

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.

5. Documentation

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.

311.3.2 Equipment

Equipment and tools necessary for handling materials and performing all parts of the work shall be approved by the Engineer as to design, capacity and mechanical condition. The equipment shall be at the jobsite sufficiently ahead of the start of construction operations to be examined thoroughly and approved.

1. Batching Plant and Equipment

a. General. The batching shall include bins, weighing hoppers, and scales for the fine aggregate and for each size of coarse aggregate. If cement is used in bulk, a bin, a hopper, and separate scale for cement shall be included. The weighing hopper shall be properly sealed and vented to preclude dusting operation. The batch plant shall be equipped with a suitable non-resettable batch counter which will correctly indicate the number of batches proportioned.

b. Bins and Hoppers. Bins with adequate separate compartments for fine aggregate and for each size of coarse aggregate shall be provided in the batching plant.

c. Scales. Scales for weighing aggregates and cement shall be of either the beam type or the springless-dial type. They shall be accurate within one-half percent (0.5%) throughout the range of use. Poises shall be designed to be locked in any position and to prevent unauthorized change.

Scales shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy.

Automatic Weighing Devices. Unless otherwise allowed on the Contract, batching plants shall be equipped with automatic weighing devices of an approved type to proportion aggregates and bulk cement.

2. Mixers.

a. General. Concrete may be mixed at the Site of construction or at a central plant, or wholly or in part in truck mixers. Each mixer shall have a manufacturer's plate attached in a prominent place showing the capacity of the drum in terms of volume of mixed concrete and the speed of rotation of the mixing drum or blades.

b. Mixers at Site of Construction. Mixing shall be done in an approved mixer capable of combining the aggregates, cement and water into a thoroughly mixed and uniform mass within the specified mixing period and discharging and distributing the mixture without segregation on the prepared grade. The mixer shall be equipped with an approved timing device which will automatically lock the discharge lever when the drum has been charged and released it at the end of the mixing period. In case of failure of the timing device, the mixer may be used for the balance of the day while it is being repaired, provided that each batch is mixed 90 seconds. The mixer shall be equipped with a suitable nonresettable batch counter which shall correctly indicate the number of the batches mixed.

c. Truck Mixer and Truck Agitators. Truck mixers used for mixing and hauling concrete, and truck agitators used for hauling central-mixed concrete, shall conform to the requirements of AASHTO M 157.

d. Non-Agitator Truck. Bodies of non-agitating hauling equipment for concrete shall be smooth, mortar-tight metal containers and shall be capable of discharging the concrete at a satisfactory controlled rate without segregation.

3. Paving and Finishing Equipment

The concrete shall be placed with an approved paver designed to spread, consolidate, screed and float finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finishing will be necessary to provide a dense and homogeneous pavement in conformance with the Plans and Specifications.

The finishing machine shall be equipped with at least two (2) oscillating type transverse screed.

Vibrators shall operate at a frequency of 8,300 to 9,600 impulses per minute under load at a maximum spacing of 60 cm.

4. Concrete Saw

The Contractor shall provide sawing equipment in adequate number of units and power to complete the sawing with a water-cooled diamond edge saw blade or an abrasive wheel to the

required dimensions and at the required rate. He shall provide at least one (1) stand-by saw in good working condition and with an ample supply of saw blades.

5. Forms

Forms shall be of steel, of an approved section, and of depth equal to the thickness of the pavement at the edge. The base of the forms shall be of sufficient width to provide necessary stability in all directions. The flange braces must extend outward on the base to not less than 2/3 the height of the form.

All forms shall be rigidly supported on bed of thoroughly compacted material during the entire operation of placing and finishing the concrete. Forms shall be provided with adequate devices for secure setting so that when in place, they will withstand, without visible spring or settlement, the impact and vibration of the consolidation and finishing or paving equipment.

311.3.3 Preparation of Grade

After the subgrade of base has been placed and compacted to the required density, the areas which will support the paving machine and the grade on which the pavement is to be constructed shall be trimmed to the proper elevation by means of a properly designed machine extending the prepared work areas compacted at least 60 cm beyond each edge of the proposed concrete pavement. If loss of density results from the trimming operations, it shall be restored by additional compaction before concrete is placed. If any traffic is allowed to use the prepared subgrade or base, the surface shall be checked and corrected immediately ahead of the placing concrete.

The subgrade or base shall be uniformly moist when the concrete is placed.

311.3.4 Setting Forms

1. Base Support.

The foundation under the forms shall be hard and true to grade so that the form when set will be firmly in contact for its whole length and at the specified grade. (Any roadbed, which at the form line is found below established grade, shall be filled with approved granular materials to grade in lifts of three (3) cm or less, and thoroughly rerolled or tamped.) Imperfections or variations above grade shall be corrected by tamping or by cutting as necessary.

2. Form Setting

Forms shall be set sufficiently in advance of the point where concrete is being placed. After the forms have been set to correct grade, the grade shall be thoroughly tamped, mechanically or by hand, at both the inside and outside edges of the base of the forms. The forms shall not deviate from true line bv more than one (1) cm at any point.

3. Grade and Alignment

The alignment and grade elevations of the forms shall be checked and corrections made by the Contractor immediately before placing the concrete. Testing as to crown and elevation, prior

to placing of concrete can be made by means of holding an approved template in a vertical position and moved backward and forward on the forms.

When any form has been disturbed or any grade has become unstable, the form shall be reset and rechecked.

311.3.5 Conditioning of Subgrade or Base Course

When side forms have been securely set to grade, the subgrade or base course shall be brought to proper cross-section. High areas shall be trimmed to proper elevation. Low areas shall be filled and compacted to a condition similar to that of surrounding grade. The finished grade shall be maintained in a smooth and compacted condition until the pavement is placed.

Unless waterproof subgrade or base course cover material is specified, the subgrade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dry, the subgrade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

311.3.6 Handling, Measuring and Batching Materials

The batch plant site, layout, equipment and provisions for transporting material shall be such as to assure a continuous supply of material to the work.

Stockpiles shall be built up in layers of not more than one (1) meter in thickness. Each layer shall be completely in place before beginning the next which shall not be allowed to "cone" down over the next lower layer. Aggregates from different sources and of different grading shall not be stockpiled together.

All washed aggregates and aggregates produced or handled by hydraulic methods, shall be stockpiled or binned for draining at least twelve (12) hours before being batched.

When mixing is done at the side of the work. aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers of adequate capacity and construction to properly carry the volume required. Partitions separating batches shall be adequate and effective to prevent spilling from one compartment to another while in transit or being dumped. When bulk cement is used, the Contractor shall use a suitable method of handling the cement from weighing hopper to transporting container or into the batch itself for transportation to the mixer, with chute, boot or other approved device, to prevent loss of cement, and to provide positive assurance of the actual presence in each batch of the entire cement content specified.

Bulk cement shall be transported to the mixer in tight compartments carrying the full amount of cement required for the batch. However, if allowed in the Special Provisions, it may be transported between the fine and coarse aggregate. When cement is placed in contact with the aggregates, batches may be rejected unless mixed within 1-1/2 hours of such contact. Cement in original shipping packages may be transported on top of the aggregates, each batch containing the number of sacks required by the job mix.

The mixer shall be charged without loss of cement. Batching shall be so conducted as to result in the weight to each material required within a tolerance of one (1) percent for the cement and two (2) percent for aggregates.

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 over than one (1) percent. Unless the water is to be weighed, the water-measuring equipment shall include an auxiliary tank from which the measuring tank shall be equipped with an outside tap and valve to provide checking the setting, unless other means are provided for readily and accurately determining the amount of water in the tank. The volume of the auxiliary tank shall be at least equal to that of the measuring tank.

311.3.7 Mixing Concrete

The concrete may be mixed at the site of the work in a central-mix plant, or in truck mixers. The mixer shall be of an approved type and capacity. Mixing time will be measured from the time all materials, except water, are in the drum. Ready-mixed concrete shall be mixed and delivered in accordance with requirements of AASHTO M 157, except that the minimum required revolutions at the mixing speed for transit-mixed concrete may be reduced to not less than that recommended by the mixer manufacturer. The number of revolutions recommended by the mixer manufacturer shall be indicated on the manufacturer's serial plate attached to the mixer. The Contractor shall furnish test data acceptable to the Engineer verifying that the make and model of the mixer will produce uniform concrete conforming to the provision of AASHTO M 157 at the reduced number of revolutions shown on the serial plate.

When mixed at the site or in a central mixing plant, the mixing time shall not be less than fifty (50) seconds nor more than ninety (90) seconds, unless mixer performance tests prove adequate mixing of the concrete is a shorter time period.

Four (4) seconds shall be added to the specified mixing time if timing starts at the instant the skip reaches its maximum raised positions. Mixing time ends when the discharge chute opens. Transfer time in multiple drum mixers is included in mixing time. The contents of an individual mixer drum shall be removed before a succeeding batch is emptied therein.

The mixer shall be operated at the drum speed as shown on the manufacturer's name plate attached on the mixer. Any concrete mixed less than the specified time shall be discarded and disposed off by the Contractor at his expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic metre, as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to ten (10) percent above the mixer's nominal capacity may be permitted provided concrete test data for strength, segregation, and uniform consistency are satisfactory, and provided no spillage of concrete takes place.

The batches shall be so charged into the drum that a portion of the mixing water shall be entered 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 fifteen (15) seconds of the mixing period. The throat of the drum shall be kept free of such accumulations as may restrict the free flow of materials into the drum.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or non-agitating truck specified in Subsection 311.3.2, Equipment. The time elapsed from the time water is added to the mix until the concrete is deposited in place at the Site shall not exceed forty five (45) minutes when the concrete is hauled in non-agitating trucks, nor ninety (90) minutes when hauled in truck mixers or truck agitators, except that in hot weather or under other conditions contributing to quick hardening of the concrete, the maximum allowable time may be reduced by the Engineer.

In exceptional cases and when volumetric measurements are authorized for small project requiring less than 75 cu.m. of concrete per day of pouring, the weight proportions shall be converted to equivalent volumetric proportions. In such cases, suitable allowance shall be made for variations in the moisture condition of the aggregates, including the bulking effect in the fine aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

Concrete mixing by chute is allowed provided that a weighing scales for determining the batch weight will be used.

Retempering concrete by adding water or by other means shall not be permitted, except that when concrete is delivered in truck mixers, additional water may be added to the batch materials and additional mixing performed to increase the slump to meet the specified requirements, if permitted by the Engineer, provided all these operations are performed within forty-five (45) minutes after the initial mixing operation and the water-cement ratio is not exceeded. Concrete that is not within the specified slump limits at the time of placement shall not be used. Admixtures for increasing the workability or for accelerating the setting of the concrete will be permitted only when specifically approved by the Engineer.

311.3.8 Limitation of Mixing

No concrete shall be mixed, placed or finished when natural light is insufficient, unless an adequate and approved artificial lighting system is operated.

During hot weather, the Engineer shall require that steps be taken to prevent the temperature of mixed concrete from exceeding a maximum temperature of 90^0F (32^0C)

Concrete not in place within ninety (90) minutes from the time the ingredients were charged into the mixing drum or that has developed an initial set shall not be used. Retempering of concrete or mortar which has partially hardened, that is remixing with or without additional cement, aggregate, or water, shall not be permitted.

In order that the concrete may be properly protected against the effects of rain before the concrete is sufficiently hardened, the Contractor will be required to have available at all times materials for the protection of the edges and surface of the unhardened concrete.

311.3.9 Placing Concrete

Concrete shall be deposited in such a manner to require minimal rehandling. Unless truck mixers or non-agitating hauling equipment are equipped with means to discharge concrete

without segregation of the materials, the concrete shall be unloaded into an approved spreading device and mechanically spread on the grade in such a manner as to prevent segregation. Placing shall be continuous between transverse joints without the use of intermediate bulkheads. Necessary hand spreading shall be done with shovels, not rakes. Workmen shall not be allowed to walk in the freshly mixed concrete with boots or shoes coated with earth or foreign substances.

When concrete is to be placed adjoining a previously constructed lane and mechanical equipment will be operated upon the existing lane, that previously constructed lane shall have attained the strength for fourteen (14) day concrete. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three (3) days.

Concrete shall be thoroughly consolidated against and along the faces of all forms and along the full length and on both sides of all joint assemblies, by means of vibrators inserted in the concrete. Vibrators shall not be permitted to come in contact with a joint assembly, the grade, or a side form. In no case shall the vibrator be operated longer than fifteen (15) seconds in any one location.

Concrete shall be deposited as near as possible to the expansion and contraction joints without disturbing them, but shall not be dumped from the discharge bucket or hopper into a joint assembly unless the hopper is well centered on the joint assembly. Should any concrete material fall on or be worked into the surface of a complete slab, it shall be removed immediately.

311.3.10 Test Specimens

As work progresses, at least one (1) set consisting of three (3) concrete beam test specimens, 150 mm x 150 mm x 525 mm or 900 mm shall be taken from each 330 m^2 of pavement, 230 mm depth, or fraction thereof placed each day. Test specimens shall be made under the supervision of the Engineer, and the Contractor shall provide all concrete and other facilities necessary in making the test specimens and shall protect them from damage by construction operations. Cylinder samples shall not be used as substitute for determining the adequacy of the strength of concrete.

The beams shall be made, cured, and tested in accordance with AASHTO T 23 and T 97.

311.3.11 Strike-off of Concrete and Placement of Reinforcement

Following the placing of the concrete, it shall be struck off to conform to the cross-section shown on the Plans and to an elevation such that when the concrete is properly consolidated and finished, the surface of the pavement will be at the elevation shown on the Plans. When reinforced concrete pavement is placed in two (2) layers, the bottom layer shall be struck off and consolidated to such length and depth that the sheet of fabric or bar mat may be laid full length on the concrete in its final position without further manipulation. The reinforcement shall then be placed directly upon the concrete, after which the top layer of the concrete shall be placed, struck off and screeded. Any portion of the bottom layer of concrete which has been placed more than 30 minutes without being covered with the top layer shall be removed and replaced with freshly mixed concrete at the Contractor's expense. When reinforced

concrete is placed in one layer, the reinforcement may be firmly positioned in advance of concrete placement or it may be placed at the depth shown on the Plans in plastic concrete, after spreading by mechanical or vibratory means.Reinforcing steel shall be free from dirt, oil, paint, grease, mill scale and loose or thick rust which could impair the bond of the steel with the concrete.

311.3.12 Joints

Joints shall be constructed of the type and dimensions, and at the locations required by the Plans or Special Provisions. All joints shall be protected from the intrusion of injurious foreign material until sealed.

1. Longitudinal Joint

Deformed steel tie bars of specified length, size, spacing and materials shall be placed perpendicular to the longitudinal joints, they shall be placed by approved mechanical equipment or rigidly secured by chair or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other materials or enclosed in tubes or sleeves. When shown on the Plans and when adjacent lanes of pavement are constructed separately, steel side forms shall be used which will form a keyway along the construction joint. Tie bars, except those made of rail steel, may be bent at right angles against the form of the first lane constructed and straightened into final position before the concrete of the adjacent lane is placed, or in lieu of bent tie bars, approved two-piece connectors may be used.

Longitudinal formed joints shall consist of a groove or cleft, extending downward from and normal to, the surface of the pavement. These joints shall be effected or formed by an approved mechanically or manually operated device to the dimensions and line indicated on the Plans and while the concrete is in a plastic state. The groove or cleft shall be filled with either a premolded strip or poured material as required.

The longitudinal joints shall be continuous, there shall be no gaps in either transverse or longitudinal joints at the intersection of the joints.

Longitudinal sawed joints shall be cut by means of approved concrete saws to the depth, width and line shown on the Plans. Suitable guide lines or devices shall be used to assure cutting the longitudinal joint on the true line. The longitudinal joint shall be sawed before the end of the curing period or shortly thereafter and before any equipment or vehicles are allowed on the pavement. The sawed area shall be thoroughly cleaned and, if required, the joint shall immediately be filled with sealer.

Longitudinal pavement insert type joints shall be formed by placing a continuous strip of plastic materials which will not react adversely with the chemical constituent of the concrete.

2. Transverse Expansion Joint

The expansion joint filler shall be continuous from form to form, shaped to subgrade and to the keyway along the form. Preformed joint filler shall be furnished in lengths equal to the pavement width or equal to the width of one lane. Damaged or repaired joint filler shall not

be used.

The expansion joint filler shall be held in a vertical position. An approved installing bar, or other device, shall be used if required to secure preformed expansion joint filler at the proper grade and alignment during placing and finishing of the concrete. Finished joint shall not deviate more than 6 mm from a straight line. If joint fillers are assembled in sections, there shall be no offsets between adjacent units. No plugs of concrete shall be permitted anywhere within the expansion space.

3. Transverse Contraction Joint/Weakened Joint

When shown on the Plans, it shall consist of planes of weakness created by forming or cutting grooves in the surface of the pavement and shall include load transfer assemblies. The depth of the weakened plane joint should at all times not be less than 50 mm, while the width should not be more than 6 mm.

a.Transverse Strip Contraction Joint. It shall be formed by installing a parting strip to be left in place as shown on the Plans.

b. Formed Groove. It shall be made by depressing an approved tool or device into the plastic concrete. The tool or device shall remain in place at least until the concrete has attained its initial set and shall then be removed without disturbing the adjacent concrete, unless the device is designed to remain in the joint.

c. Sawed Contraction Joint. It shall be created by sawing grooves in the surface of the pavement of not more than 6 mm, depth should at all times not be less than 50 mm, and at the spacing and lines shown on the Plans, with an approved concrete saw. After each joint is sawed, it shall be thoroughly cleaned including the adjacent concrete surface.

Sawing of the joint shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually 4 to 24 hours. All joints shall be sawed before uncontrolled shrinkage cracking takes place. If necessary, the sawing operations shall be carried on during the day or night, regardless of weather conditions. The sawing of any joint shall be omitted if crack occurs at or near the joint location prior to the time of sawing. Sawing shall be discounted when a crack develops ahead of the saw. In general, all joints should be sawed in sequence. If extreme conditions exist which make it impractical to prevent erratic cracking by early sawing, the contraction joint groove shall be formed prior to the initial set of concrete as provided above.

4. Transverse Construction Joint

It shall be constructed when there is an interruption of more than 30 minutes in the concreting operations. No transverse joint shall be constructed within 1.50 m of an expansion joint, contraction joint, or plane of weakness. If sufficient concrete has been mixed at the time of interruption to form a slab of at least 1.5 m long, the excess concrete from the last preceding joint shall be removed and disposed off as directed.

5. Load Transfer Device

Dowel, when used, shall be held in position parallel to the surface and center line of the slab by a metal device that is left in the pavement.

The portion of each dowel painted with one coat of lead or tar, in conformance with the requirements of Item 404, Reinforcing Steel, shall be thoroughly coated with approved bituminous materials, e.g., MC-70, or an approved lubricant, to prevent the concrete from binding to that portion of the dowel. The sleeves for dowels shall be metal designed to cover 50 mm plus or minus 5 mm (1/4 inch), of the dowel, with a watertight closed end and with a suitable stop to hold the end of the sleeves at least 25 mm (1 inch) from the end of the dowel.

In lieu of using dowel assemblies at contraction joints, dowel may be placed in the full thickness of pavement by a mechanical device approved by the Engineer.

311.3.13 Final Strike-off (Consolidation and Finishing)

1. Sequence

The sequence of operations shall be the strike-off and consolidation, floating and removal of laitance, straight-edging and final surface finish. Work bridges or other devices necessary to provide access to the pavement surface for the purpose of finishing straight-edging, and make corrections as hereinafter specified, shall be provided by the Contractor.

In general, the addition of water to the surface of the concrete to assist in finishing operations will not be permitted. If the application of water to the surface is permitted, it shall be applied as fog spray by means of an approved spray equipment.

2. Finishing Joints

The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material assembly, also under and around all load transfer devices, joint assembly units, and other features designed to extend into the pavement. Concrete adjacent to joints shall be mechanically vibrated as required in Subsection 311.3.9, Placing Concrete.

After the concrete has been placed and vibrated adjacent to the joints as required in Subsection 311.3.9, the finishing machine shall be brought forward, operating in a manner to avoid damage or misalignment of joints. If uninterrupted operation of the finishing machine, to over and beyond the joints causes segregation of concrete, damage to, or misalignment of the joints, the finishing machine shall be stopped when the front screed is approximately 20 cm (8 inches) from the joint. Segregated concrete shall be removed from in front of and off the joint. The front screed shall be lifted and set directly on top of the joint and the forward motion of the finishing machine resumed. When the second screed is close enough to permit the excess mortar in front of it to flow over the joint, it shall be lifted and carried over the joint. Thereafter, the finishing machine may be run over the joint without lifting the screeds, provided there is no segregated concrete immediately between the joint and the screed or on top of the joint.

3. Machine Finishing

a. Non-vibratory Method. The concrete shall be distributed or spread as soon as placed. As soon as the concrete has been placed, it shall be struck off and screeded by an approved finishing machine. The machine shall go over each area of pavement as many times and at such intervals as necessary to give the proper compaction and leave a surface of uniform texture. Excessive operation over a given area shall be avoided. The tops of the forms shall be kept clean by an effective device attached to the machine and the travel of the machine on the forms shall be maintained true without wobbling or other variation tending to affect the precision finish.

During the first pass of the finishing machine, a uniform ridge of concrete shall be maintained ahead of the front screed in its entire length.

b. Vibratory Method. When vibration is specified, vibrators for full width vibration of concrete paving slabs, shall meet the requirements in Subsection 311.3.2, Equipment. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structures, and throughout the pavement, the Contractor will be required to furnish equipment and method which will produce pavement conforming to the Specifications. All provisions in item (a) above not in conflict with the provisions for the vibratory method shall govern.

4. Hand Finishing

Hand finishing methods may only be used under the following conditions:

a. In the event of breakdown of the mechanical equipment, hand methods may be used to finish the concrete already deposited on the grade.

b. In narrow widths or areas of irregular dimensions where operations of the mechanical equipment is impractical, hand methods may be used.

Concrete, as soon as placed, shall be struck off and screeded. An approved portable screed shall be used. A second screed shall be provided for striking off the bottom layer of concrete if reinforcement is used.

The screed for the surface shall be at least 60 cm (2 feet) longer than the maximum width of the slab to be struck off. It shall be of approved design, sufficiently rigid to retain its shape, and constructed either of metal or other suitable material shod with metal.

Consolidation shall be attained by the use of suitable vibrator or other approved equipment.

In operation, the screed shall be moved forward on the forms with a combined longitudinal and transverse shearing motion, moving always in the direction in which the work is progressing and so manipulated that neither end is raised from the side forms during the striking off process. If necessary, this shall be repeated until the surface is of uniform texture, true to grade and cross-section, and free from porous areas.

5. Floating

After the concrete has been struck off and consolidated, it shall be further smoothed, trued, and consolidated by means of a longitudinal float, either by hand or mechanical method.

a. Hand Method. The hand-operated longitudinal float shall be not less than 365 cm (12 feet) in length and 15 cm (6 inches) in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated from foot bridges resting on the side forms and spanning but not touching the concrete, shall be worked with a sawing motion while held in a floating position parallel to the road center line, and moving gradually from one side of the pavement to the other. Movement ahead along the centerline of the pavement shall be in successive advances of not more than one-half the length of the float. Any excess water or soupy material shall be wasted over the side forms on each pass.

b. Mechanical Method. The mechanical longitudinal float shall be of a design approved by the Engineer, and shall be in good working condition. The tracks from which the float operates shall be accurately adjusted to the required crown. The float shall be accurately adjusted and coordinated with the adjustment of the transverse finishing machine so that a small amount of mortar is carried ahead of the float at all times. The forward screed shall be adjusted so that the float will lap the distance specified by the Engineer on each transverse trip. The float shall pass over each area of pavement at least two times, but excessive operation over a given area will not be permitted. Any excess water or soupy material shall be wasted over the side forms on each pass.

c. Alternative Mechanical Method. As an alternative, the Contractor may use a machine composed of a cutting and smoothing float or floats suspended from and guided by a rigid frame. The frame shall be carried by four or more visible wheels riding on, and constantly in contact with the side forms. If necessary, following one of the preceding methods of floating, long handled floats having blades not less than 150 cm (5 feet) in length and 15 cm (6 inches) in width may be used to smooth and fill in open-textured areas in the pavement. Long-handled floats shall not be used to float the entire surface of the pavement in lieu of, or supplementing, one of the preceding methods of floating. When strike off and consolidation are done by the hand method and the crown of the pavement will not permit the use of the longitudinal float, the surface shall be floated transversely by means of the long-handled float. Care shall be taken not to work the crown out of the pavement during the operation. After floating, any excess water and laitance shall be removed from the surface of the pavement by a 3-m straight-edge or more in length. Successive drags shall be lapped one-half the length of the blade.

6. Straight-edge Testing and Surface Correction

After the floating has been completed and the excess water removed, but while the concrete is still plastic, the surface of the concrete shall be tested for trueness with a 300 cm long straight-edge. For this purpose, the Contractor shall furnish and use an accurate 300-cm straight-edge swung from handles 100 cm (3 feet) longer than one-half the width of the slab. The straight-edge shall be held in contact with the surface in successive positions parallel to the road center line and the whole area gone over from one side of the slab to the other as necessary. Advances along the road shall be in successive stages of not more than one-half the length of the straight-edge. Any depressions found shall be immediately filled with freshly mixed concrete, struck off, consolidated and refinished. High areas shall be cut down and refinished. Special attention shall be given to assure that the surface across joints meets the requirements for

smoothness. Straight-edge testing and surface corrections shall continue until the entire surface is found to be free from observable departures from the straight-edge and the slab conforms to the required grade and cross-section.

Final Finish

If the surface texture is broom finished, it shall apply when the water sheen has practically disappeared. The broom shall be drawn from the center to the edge of the pavement with adjacent strokes slightly overlapping. The brooming operation should be so executed that the corrugations produced in the surface shall be uniform in appearance and not more than 1.5 mm in depth. Brooming shall be completed before the concrete is in such condition that the surface will be unduly roughened by the operation. The surface thus finished shall be free from rough and porous areas, irregularities, and depressions resulting from improper handling of the broom. Brooms shall be of the quality size and construction and be operated so as to produce a surface finish meeting the approval of the Engineer. Subject to satisfactory results being obtained and approval of the Engineer, the Contractor will be permitted to substitute mechanical brooming in lieu of the manual brooming herein described.

If the surface texture is belt finished, when straight-edging is complete and water sheen has practically disappeared and just before the concrete becomes non-plastic, the surface shall be belted with 2-ply canvas belt not less than 20 cm wide and at least 100 cm longer than the pavement width. Hand belts shall have suitable handles to permit controlled, uniform manipulation. The belt shall be operated with short strokes transverse to the center line and with rapid advances parallel to the center line.

If the surface texture is drag finished, a drag shall be used which consists of a seamless strip of damp burlap or cotton fabric, which shall produce a uniform gritty texture after dragging it longitudinally along the full width of pavement. For pavement 5 m or more in width, the drag shall be mounted on a bridge which travels on the forms. The dimensions of the drag shall be such that a strip of burlap or fabric at least 100 cm wide is in contact with the full width of pavement surface while the drag is used. The drag shall consist of not less than 2 layers of burlap with the bottom layer approximately 15 cm wider than the layer. The drag shall be maintained in such condition that the resultant surface is of uniform appearance and reasonably free from grooves over 1.5 mm in depth. Drag shall be maintained clean and free from encrusted mortar. Drags that cannot be cleaned shall be discarded and new drags be substituted.

Regardless of the method used for final finish, the hardened surface of pavement shall have a coefficient of friction of 0.25 or more. Completed pavement that is found to have a coefficient of friction less than 0.25 shall be grounded or scored by the Contractor at his expense to provide the required coefficient of friction.

8. Edging at Forms and Joints

After the final finish, but before the concrete has taken its initial set, the edges of the pavement along each side of each slab, and on each side of transverse expansion joints, formed joints, transverse construction joints, and emergency construction joints, shall be worked with an approved tool and rounded to the radius required by the Plans. A well – defined and continuous radius shall be produced and a smooth, dense mortar finish obtained. The surface of the slab

shall not be unduly disturbed by tilting the tool during the use.

At all joints, any tool marks appearing on the slab adjacent to the joints shall be eliminated by brooming the surface. In doing this, the rounding of the corner of the slab shall not be disturbed. All concrete on top of the joint filler shall be completely removed.

All joints shall be tested with a straight-edge before the concrete has set and correction made if one edge of the joint is higher than the other.

311.3.14 Surface Test

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 3-m straight-edge or other specified device. Areas showing high spots of more than 3 mm but not exceeding 12 mm in 3 m shall be marked and immediately ground down with an approved grinding tool to an elevation where the area or spot will not show surface deviations in excess of 3 mm when tested with 3 m straight-edge. Where the departure from correct cross-section exceeds 12 mm, the pavement shall be removed and replaced by and at the expense of the Contractor.

Any area or section so removed shall be not less than 1.5 m in length and not less than the full width of the lane involved. When it is necessary to remove and replace a section of pavement, any remaining portion of the slab adjacent to the joints that is less than 1.5 m in length, shall also be removed and replaced.

311.3.15 Curing

Immediately after the finishing operations have been completed and the concrete has sufficiently set, the entire surface of the newly placed concrete shall be cured in accordance with either one of the methods described herein. Failure to provide sufficient cover material of whatever kind the Contractor may elect to use, or the lack of water to adequately take care of both curing and other requirements, shall be a cause for immediate suspension of concreting operations. The concrete shall not be left exposed for more than ½ hour between stages of curing or during the curing period.

In all congested places, concrete works should be designed so that the designed strength is attained.

1. Cotton of Burlap Mats

The surface of the pavement shall be entirely covered with mats. The mats used shall be of such length (or width) that as laid they will extend at least twice the thickness of the pavement beyond the edges of the slab. The mat shall be placed so that the entire surface and the edges of the slab are completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mat shall be so placed and weighted down so as to cause them to remain in intimate contact with the covered surface. The mat shall be maintained fully wetted and in position for 72 hours after the concrete has been placed unless otherwise specified.

2. Waterproof Paper

The top surface and sides of the pavement shall be entirely covered with waterproof paper, the units shall be lapped at least 45 cm. The paper shall be so placed and weighted down so as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimension but each unit as laid will extend beyond the edges of the slab at least twice the thickness of the pavement, or at pavement width and 60 cm strips of paper for the edges. If laid longitudinally, paper not manufactured in sizes which will provide this width shall be securely sewed or cemented together, the joints being securely sealed in such a manner that they do not open up or separate during the curing period. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed. The surface of the pavement shall be thoroughly wetted prior to the placing of the paper.

3. Straw Curing

When this type of curing is used, the pavement shall be cured initially with burlap or cotton mats, until after final set of the concrete or, in any case, for 12 hours after placing the concrete. As soon as the mats are removed, the surface and sides of the pavement shall be thoroughly wetted and covered with at least 20 cm of straw or hay, thickness of which is to be measured after wetting. If the straw or hay covering becomes displaced during the curing period, it shall be replaced to the original depth and saturated. It shall be kept thoroughly saturated with water for 72 hours and thoroughly wetted down during the morning of the fourth day, and the cover shall remain in place until the concrete has attained the required strength.

4. Impervious Membrane Method

The entire surface of the pavement shall be sprayed uniformly with white pigmented curing compound immediately after the finishing of the surface and before the set of the concrete has taken place, or if the pavement is cured initially with jute or cotton mats, it may be applied upon removal of the mass. The curing compound shall not be applied during rain.

Curing compound shall be applied under pressure at the rate 4 L to not more than 14 m^2 by mechanical sprayers. The spraying equipment shall be equipped with a wind guard. At the time of use, the compound shall be in a thoroughly mixed condition with the pigment uniformly dispersed throughout the vehicle. During application, the compound shall be stirred continuously by effective mechanical means. Hand spraying of odd widths or shapes and concrete surface exposed by the removal of forms will be permitted. Curing compound shall not be applied to the inside faces of joints to be sealed, but approved means shall be used to ensure proper curing at least 72 hours and to prevent the intrusion of foreign material into the joint before sealing has been completed. The curing compound shall be of such character that the film will harden within 30 minutes after application. Should the film be damaged from any cause within the 72 hour curing period, the damaged portions shall be repaired immediately with additional compound.

5. White Polyethylene Sheet

The top surface and sides of the pavement shall be entirely covered with polyethylene sheeting. The units used shall be lapped at least 45 cm. The sheeting shall be so placed and weighted down so as to cause it to remain in intimate contact with the surface covered. The sheeting as prepared for use shall have such dimension that each unit as laid will extend beyond the edges

of the slab at least twice the thickness of the pavement. Unless otherwise specified, the covering shall be maintained in place for 72 hours after the concrete has been placed.

311.3.16 Removal of Forms

After forms for concrete shall remain in place undisturbed for not less than twenty four (24) hours after concrete pouring. In the removal of forms, crowbars should be used in pulling out nails and pins. Care should be taken so as not to break the edges of the pavement. In case portions of the concrete are spalled, they shall be immediately repaired with fresh mortar mixed in the proportion of one part of Portland Cement and two parts fine aggregates. Major honeycomb areas will be considered as defective work and shall be removed and replaced at the expense of the Contractor. Any area or section so removed shall not be less than the distance between weakened plane joint nor less than the full width of the lane involved

311.3.17 Sealing Joints

Joints shall be sealed with asphalt sealant soon after completion of the curing period and before the pavement is opened to traffic, including the Contractor's equipment. Just prior to sealing, each joint shall be thoroughly cleaned of all foreign materials including membrane curing compound and the joint faces shall be clean and surface dry when the seal is applied.

The sealing material shall be applied to each joint opening to conform to the details shown on the Plans or as directed by the Engineer. Material for seal applied hot shall be stirred during heating so that localized overheating does not occur. The pouring shall be done in such a manner that the material will not be spilled on the exposed surfaces of the concrete. The use of sand or similar material as a cover for the seal will not be permitted.

Preformed elastomeric gaskets for sealing joints shall be of the cross-sectional dimensions shown on the Plans. Seals shall be installed by suitable tools, without elongation and secured in placed with an approved lubricant adhesive which shall cover both sides of the concrete joints. The seals shall be installed in a compressive condition and shall at time of placement be below the level of the pavement surface by approximately 6 mm.

The seals shall be in one piece for the full width of each transverse joint.

311.3.18 Protection of Pavement

The Contractor shall protect the pavement and its appurtenances against both public traffic and traffic caused by his own employees and agents. This shall include watchmen to direct traffic and the erection of and maintenance of warning signs, lights, pavement bridges or crossovers, etc. The Plans or Special Provisions will indicate the location and type of device or facility required to protect the work and provide adequately for traffic.

All boreholes after thickness and/or strength determinations of newly constructed asphalt and concrete pavements shall be immediately filled/restored with the prescribed concrete/asphalt mix after completion of the drilling works. Any damage to the pavement, occurring prior to final acceptance, shall be repaired or the pavement be replaced.

311.3.19 Concrete Pavement – Slip Form Method

If the Contract calls for the construction of pavement without the use of fixed forms, the following provisions shall apply:

1. Grade

After the grade or base has been placed and compacted to the required density, the areas which will support the paving machine shall be cut to the proper elevation by means of a properly designed machine. The grade on which the pavement is to be constructed shall then be brought to the proper profile by means of a properly designed machine. If the density of the base is disturbed by the grading operation, it shall be corrected by additional compaction before concrete is placed. The grade should be constructed sufficiently in advance of the placing of the concrete. If any traffic is allowed to use the prepared grade, the grade shall be checked and corrected immediately before the placing of concrete.

2. Placing Concrete

The concrete shall be placed with an approved slip-form paver designed to spread, consolidate, screed and float-finish the freshly placed concrete in one complete pass of the machine in such a manner that a minimum of hand finish will be necessary to provide a dense and homogenous pavement in conformance with the Plans and Specifications. The machine shall vibrate the concrete for the full width and depth of the strip of pavement being placed. Such vibration shall be accompanied with vibrating tubes or arms working in the concrete or with a vibrating screed or pan operating on the surface of the concrete. The sliding forms shall be rigidly held together laterally to prevent spreading of the forms. The forms shall trail behind the paver for such a distance that no appreciable slumping of the concrete will occur, and that necessary final finishing can be accomplished while the concrete is still within the forms. Any edge slump of the pavement, exclusive of edge rounding, in excess of 6 mm shall be corrected before the concrete has hardened.The concrete shall be held at a uniform consistency, having a slump of not more than 40 mm (1-12/ inches). The slip form paver shall be operated with as nearly as possible a continuous forward movement and that all operations of mixing, delivering and spreading concrete shall be coordinated so as to provide uniform progress with stopping and starting of the paver held to a minimum. If, for any reason, it is necessary to stop the forward movement of the paver the vibratory and tamping elements shall also be stopped immediately. No tractive force shall be applied to the machine, except that which is controlled from the machine.

3. Finishing

The surface smoothness and texture shall meet the requirements of Subsections 311.3.13 and 311.3.14.

4. Curing

Unless otherwise specified, curing shall be done in accordance with one of the methods included in Subsection 311.3.15. The curing media shall be applied at the appropriate time and shall be applied uniformly and completely to all surfaces and edges of the pavement.

5. Joints

All joints shall be constructed in accordance with Subsection 311.3.12.

6. Protection Against Rain

In order that the concrete may be properly protected against rain before the concrete is sufficiently hardened, the Contractor will be required to have at all times materials for the protection of the edges and surface of the unhardened concrete.

Such protective materials shall consist of standard metal forms or wood planks having a nominal thickness of not less than 50 mm (2 inches) and a nominal width of not less than the thickness of the pavement at its edge for the protection of the pavement edges, and covering material such as burlap or cotton mats, curing paper or plastic sheeting materials for the protection of the surface of the pavement. When rain appears imminent, all paving operations shall stop and all available personnel shall begin placing forms against the sides of the pavement and covering the surface of the unhardened concrete with the protective covering.

311.3.22 Acceptance of Concrete

The strength level of the concrete will be considered satisfactory if the averages of all sets of three (3) consecutive strength test results equal or exceed the specified strength, f_c' and no individual strength test result is deficient by more than 15% of the specified strength, f_c'.

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 failed test results is acceptable in place.

At least three (3) representative cores shall be taken from each member or area of concrete in place that is considered deficient. The location of cores shall be determined by the Engineer so that there will be at least impairment of strength of the structure.

The obtaining and testing of drilled cores shall be in accordance with AASHTO T 24.

Concrete in the area represented by the cores will be considered adequate if the average strength of the cores is equal to at least 85% of, and if no single core is less than 75% of, the specified strength, f_c'.If the strength of control specimens does not meet the requirements of this Subsection, and it is not feasible or not advisable to obtain cores from the structure due to structural considerations, payment of the concrete will be made at an adjusted price due to strength deficiency of concrete specimens as specified hereunder:

Deficiency in Strength of Concrete Specimens, Percent (%)	Percent (%) of Contract Price Allowed
Less than 5	100
5 to less than 10	80

10 to less than 15	70
15 to less than 20	60
20 to less than 25	50
25 or more	0

311.3.23 Opening to Traffic

The Engineer will decide when the pavement may be opened to traffic. The road will not be opened to traffic until test specimens molded and cured in accordance with AASHTO T 23 have attained the minimum strength requirements in Subsection 311.2.11.

If such tests are not conducted prior to the specified age the pavement shall not be operated to traffic until 14 days after the concrete was placed.

Before opening to traffic, the pavement shall be cleaned and joint sealing completed.

Tolerance and Pavement thickness

1. General

The thickness of the pavement will be determined by measurement of cores from the completed pavement in accordance with AASHTO T 148.

The completed pavement shall be accepted on a lot basis. A lot shall be considered as 1000 linear meters of pavement when a single traffic lane is poured or 500 linear meters when two lanes are poured concurrently. The last unit in each slab constitutes a lot in itself when its length is at least ½ of the normal lot length. If the length of the last unit is shorter than ½ of the normal lot length, it shall be included in the previous lot. Other areas such as intersections, entrances, crossovers, ramp, etc., will be grouped together to form a lot. Small irregular areas may be included with other unit areas to form a lot.

Each lot will be divided into five (5) equal segments and one core will be obtained from each segment in accordance with AASHTO T 24.

2. Pavement Thickness

It is the intent of this Specification that the pavement has a uniform thickness as called for on the Plans for the average of each lot as defined. After the pavement has met all surface smoothness requirements, cores for thickness measurements will be taken.In calculating the average thickness of the pavement, individual measurements which are in excess of the specified thickness by more than 5 mm will be considered as the specified thickness plus 5 mm and measurements which are less than the specified thickness by more than 25 mm shall not be included in the average. When the average thickness for the lot is deficient, the contract unit price will be adjusted for thickness in accordance with paragraph (3 below).

Individual areas within a segment found deficient in thickness by more than 25 mm shall be

evaluated by the Engineer, and if in his judgment, the deficient areas warrant removal, they shall be removed and replaced by the Contractor with pavement of the specified thickness at his entire expense. However, if the evaluation of the Engineer is that the deficient area should not be removed and replaced, such area will not be paid.

When the measurement of any core is less than the specified thickness by more than 25 mm, the actual thickness of the pavement in this area will be determined by taking additional cores at no less than 5 m intervals parallel to the center line in each direction from the affected location until a core is found in each direction, which is not deficient in thickness by more than 25 mm. The area of slab for which no payment will be made shall be the product of the paving width multiplied by the distance along the centerline of the road between transverse sections found not deficient in thickness by more than 25 mm.

The thickness of the remainder of the segment to be used to get the average thickness of each lot shall be determined by taking the average thickness of additional cores which are not deficient by more than 25 mm.

3. Adjustment for Thickness

When the average thickness of the pavement per lot is deficient, payment for the lot shall be adjusted as follows:

Deficiency in the Average Thickness per lot (mm)	**Percent (%) of Contract Price Per Lot**
0 – 5	100% payment
6 – 10	95% payment
11 – 15	85% payment
16 – 20	70% payment
21 – 25	50% payment
More than 25	Remove and replace/ No payment

No acceptance and final payment shall be made on completed pavement unless core test for thickness determination is conducted, except for Barangay Roads where the implementing office is allowed to waive such test.

311.4 Method of Measurement

The area to be paid for under this Item shall be the number of square meters (m^2) of concrete pavement placed and accepted in the completed pavement. The width for measurements will be the width from outside edge to outside edge of completed pavement as placed in accordance with the Plans or as otherwise required by the Engineer in writing.

The length will be measured horizontally along the centerline of each roadway or ramp. Any curb and gutter placed shall not be included in the area of concrete pavement measured.

311.5 Basis of Payment

The accepted quantity, measured as prescribed in Section 311.4, shall be paid for at the contract unit price for Portland Cement Concrete Pavement, which price and payment shall be full compensation for preparation of roadbed and finishing of shoulders, unless otherwise provided by the Special Provisions, furnishing all materials, for mixing, placing, finishing and curing all concrete, for furnishing and placing all joint materials, for sawing weakened plane joints, for fitting the prefabricated center metal joint, for facilitating and controlling traffic, and for furnishing all labor, equipment, tools and incidentals necessary to complete the Item.

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
311 (1)	Portland Cement Concrete Pavement (200mm thk)	Square meter

Q. SEAWATER SUPPLY PIPELINE

ITEM 1002 – PLUMBING

Refer to Item 1002, Part D. Broodstock Tanks (7 Units)

Payment will be made under:

Pay Item Number	Description	Unit of Measurement
1002 (3)e	PVC Pipes (blue) with Fittings, 50mm. diameter	Meter
1002 (3)h	PVC Pipes (blue) with Fittings,100mm. diameter	Meter

R. INTAKE PIPE AND INTAKE TANK

SPL 10 - REMOVAL OF SEAGRASS

Affected seagrasses shall be relocated to a suitable receiver site away from the impacted area prior to the excavation of the trench and the mobilization of manpower and machineries. However, in the identification of the receiver site, several criteria shall be considered. The

nearest receiver site shall have a low seagrass density cover but with similar substrate as the impacted site. It shall also be found inhabited with similar species as the source site to help ensure higher survival of transplanted seagrasses. Moreover, certain suitable conditions shall be considered for successful settlement and/or colonization. This includes light availability, hydrodynamic environment substratum type or nutrient availability.

Herein technique and approach reviewed and highlighted in a published paper have been developed and trialed internationally which showed relatively high degree of success. As cited by proponents and ecological researchers there is no "one solution fits all" approach to suit the life history traits of all species across all conditions. The emerging tools make seagrass restoration feasible for many species and at the large spatial scales needed to restore seagrass meadows and associated ecosystem services. In implementing seagrass restoration, several techniques range from seed based restoration, (Buoy Deployed Seeding or BuDS, Dispenser injection seeding, etc.), establishment of nurseries for seedling culture among others. However, for this activity, the technique involving the Anchoring of shoots with iron nails and the Use of artificial In-water structures discussed herein may be combined and explored depending on the availability of manpower and financial resources. Prior to the full implementation of the restoration activity, field trial of the recommended method is highly recommended.

a. Anchoring of shoots with iron nails

In using this method, seagrass shoots are often planted directly into the substrate (e.g., Matheson et al., 2017), however, several anchoring techniques shall be used in varying degrees. In employing this technique, shoots with 5-10 cm rhizome shall be attached to iron nails of 8 cm x 0.3 cm by winding a thin iron wire of 0.5 mm thickness around the rhizome and nail. The nails are uncoated pure iron and corroded within the 1st year without leaving heavy metals in the sediment.

During transplanting, the rhizome and nail are gently pushed about 1cm down into the sediment ensuring that the base of the shoot is sitting at the sediment water interface. This technique provides sufficient weight to keep the transplanted shoots in place. Transplantation shall be laid out in a chess board pattern, mixing bare bottom and transplanted areas.

b. Use of artificial In-water structures

These are used as anchoring devices to increase the chance of transplant units' survival. There are several anchoring devices cited however, the use of biodegradable materials such as hessian and jute sacks are encouraged.

These materials can promote the establishment of naturally dispersing seedlings, protect seeds from predation, enhance survival of restored shoots and exclude bioturbation animals, thus increasing survival rates. (Source: Yi Mei Tan et al, Frontiers in Marine Science, "Seagrass Restoration is Possible: Insights and Lessons from Australia and New Zealand", August 2020 Volume 7 Article 617)

The PAgO shall lead the implementation of this plan in collaboration with the technical experts from the DENR and BFAR-RFO 1.

Implementation schedule shall start one to two months before the installation of the HPDE seawater intake pipe, considering that activities for seagrass rehabilitation and mitigation can only be carried out during low tide.

Following DENR recommendations, coral habitat that may be lost will be compensated by restoration /enhancement of the species through the deployment of engineered artificial reefs within the nearest locally managed Marine Protected Area in the Barangay in close coordination with the Bureau of Fisheries and Aquatic Resources.

This undertaking is a type of structural/physical rehabilitation as a direct/active intervention to offset the affected corals within the construction footprint. A total budget of PhP 698,212.50 is needed to undertake the coral habitat mitigation plan in close coordination with BFAR through the deployment of 45 units of concrete artificial reef to the site within the coastal area of Arnedo as validated and recommended by BFAR.

Budgetary requirements for this plan shall be charged to the Coastal Resource Management Program of the Provincial Government of Pangasinan with a yearly allocation of PhP5 million.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 10	Removal of Seagrass	Lump Sum

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 Units)

Payment shall be made under:

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

ITEM 1717 – SHEET PILES

Refer to Item 1717, Part N. Berthing Dock.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1717 (8)	PVC Sheet Piles, Furnish and Driven	Linear Meter

SPL 1 **- DEWATERING**

Refer to SPL 1, Part D. Broodstock Tanks (7 Units)

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 1	Dewatering	Lump Sum

ITEM 804- EMBANKMENT

Refer to Item 804, Part C. Site Development Work

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
804 (7)	Gravel Fill	Cubic Meter

ITEM 902- REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1)a	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 903- FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 900- STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter

ITEM 804- EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
804 (1)a	Embankment from Structure Excavation	Cubic Meter

SPL 11 - INSTALLATION OF SINKER

Description

This Item shall consist of installation, placing and finishing of concrete sinker of the type, size, shape and grade required in accordance with this Specification and in conformity with the requirements shown on the Plans or as directed by the Engineer.

Material Requirements

This relates to a method of manufacturing a fishing net sinker and more specifically to a method of manufacturing an environmentally friendly cement sinker for a fishing net, wherein a fishing net formerly manufactured with lead is manufactured with cement to prevent environmental contamination that threatens the aquatic ecosystem of organisms living in freshwater, sea, etc., and has excellent durability.

The method of the present invention for manufacturing an environment friendly cement sinker for a fishing net comprises a method for manufacturing the environment friendly cement sinker for a fishing net comprising a mixing step wherein sand , cement ,and water are formulated into a paste form; a formation preparation step wherein the paste that has been prepared in said mixing step is placed in a basic frame with a certain shape and thickness and prepared into a plate form; a formation step wherein the composition that has been prepared in said formation

preparation step is introduced in a formation roller and formed and processed into the form of a sinker; a drying step wherein the composition that has been completely formed in the form of a sinker is dried; and a finishing and processing step wherein the appearance of the composition in a sinker form that has been completed of drying is finished.

Construction Requirements

The manufacture method that the environment-friendly type fishery water mud that the present invention relates to weighs down is characterized in that, comprises the steps: sand 20, cement 10 and water 30 mixing are manufactured the whipping step S110 of pastel form; To put in the basic mold 50 of shape with regulation and thickness through the pastel of above-mentioned whipping step S110, and make it form the plate shape, horizontal amplitude in accordance with regulations, longitudinally width cuts off the molding preparation process S120 of above-mentioned plate shape pastel; To put in the format roll 60 through the composition 40 of above-mentioned molding preparation process S120, making its processing and forming is to angle the forming step S130 that weighs down form; To the molded drying steps S140 that carries out drying for the composition 40 that angles the bob form; And the profile of angling the composition 40 that weighs down form that drying finishes carried out accurately machined fine finishing step S150.

Preferably, in above-mentioned whipping step S110, mix the water 30 of the sand 20 of cement 10, 35～40 percentage by weights of 55～60 percentage by weights and 5 percentage by weights and stirIn above-mentioned forming step S130, be provided with a plurality of above-mentioned format rolls 60, be provided with pole 70 between format roll 60, the composition 40 of the above-mentioned molding preparation process S120 of process can be wound on by the format roll 60 of rotation and be formed as the form of angling bob when being the center rotation on the above-mentioned pole 70 and with pole 70.

Above-mentioned drying steps S140 can be made of following two steps: will weigh down shape composition 40 through angling of above-mentioned forming step S130 and place drying appliance 80 to remove the drying steps first time of moisture; After angling of the above-mentioned drying appliance 80 separation process above-mentioned first time of drying steps weighed down shape composition 40, in the air dry chamber, carry out the drying steps second time of air dry, more preferably, above-mentioned drying appliance 80 is by using the synthetic resin raw material, to angle the bob form to carry out symmetry processing and to form the moon after quarter, utilizing silicon materials to make it be shaped to sun carves, and engrave the mold raw material of coating regulation at the silicon sun of molding and separate above-mentioned silicon sun after solidifying and carve, can constitute thus and angle the mold that weighs down form.

And, preferably, in above-mentioned fine finishing step S150, will be rotated with the columnar rotating cylinder 90 that angles the above-mentioned composition 40 that weighs down the form molding to put into hollow, can carry out fine finishing to profile thus.Environment-

friendly type fishery water mud constructed in accordance weighs down and has in manufacture or attached to the effect of preventing heavy metal pollution in the process of using on setline or the fishing net. The manufacturing method that environment-friendly type fishery water mud involved in the present invention weighs down has the pollution that pre-preventing heavy metal causes can make the effect that environment-friendly type fishery water mud shock-resistant and that durability is outstanding weighs down simultaneously.

The manufacture method that environment-friendly type fishery water mud involved in the present invention weighs down is characterized in that, comprises the steps: to manufacture the whipping step S110 of pastel form by allotment sand 20, cement 10 and water 30; To put in the basic mold 50 with regulation shape and thickness through the pastel of above-mentioned whipping step S110, and make it form plate shape, length in accordance with regulations, the molding preparation process S120 of the above-mentioned plate shape of slit shearing pastel; To put in the format roll 60 through the composition 40 of above-mentioned molding preparation process S120, making its processing and forming is the forming step S130 that angles the form of bob; To the molded drying steps S140 that carries out drying for the composition 40 that angles the bob form; The profile of angling the composition 40 that weighs down form that drying is good is carried out accurately machined fine finishing step S150.

Method of Measurement

The quantity to be paid for will be measured as per individual item, Basis of Payment for the complete installation of sinker as furnished on site and in accordance with these design standards, specifications and as accepted by the Engineer.

Basis of Payment

Method of Measurement shall be paid for at the unit bid price which payment constitutes full compensation of materials, labor, equipment, tools and incidentals necessary to complete the work.

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement
SPL 11	Installation of Sinker	Pieces

ITEM 1001 - STORM DRAINAGE AND SEWERAGE SYSTEM

Refer to Item 1001, Part D. Broodstock Tanks (7 Units).

Payment shall be made under:

Payment Item Number	Description	Unit of Measurement
1001 (1)c8	Pipes and Fittings, 500mm. Diameter, High Density Polyethylene(HDPE)	Meter

ITEM 1003 - CARPENTRY AND JOINERY WORKS

Refer to Item 1003, Part E. Larval Rearing Tanks (120 Units) with Conical Hatching Tanks

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1003 (17)	Carpentry and Joinery Works	Board Foot

S. PERIMETER FENCE AND MAIN GATE

ITEM 801 - REMOVAL OF STRUCTURES AND OBSTRUCTIONS

Refer to Item 801, Part N. Berthing Dock.
Payment shall be made under:

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

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

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

ITEM 804 - EMBANKMENT

Refer to Item 804, Part C. Site Development Work.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
804 (7)	Gravel Fill	Cubic Meter

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900 (1)c	Structural Concrete, Class A, 3000 psi, 28 Days	Cubic Meter

ITEM 902 - REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1)a	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903 (1)	Formworks and Falseworks	Lump Sum

ITEM 1027 - CEMENT PLASTER FINISH

Refer to Item 1027, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1027(1)	Cement Plaster Finish	Square Meter

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks (7 units).

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032(1)a	Painting works, Masonry/Concrete	Square Meter
1032(1)c	Painting works, Steel	Square Meter

ITEM 1722 - FENCE AND RAILINGS

1722.1 Description

This Item shall consist of furnishing and constructing fences either CHB, precast, cyclone/ welded wire, precast plant box, and railings in accordance with the details, and at the locations, shown on the Plans, or as required by the Engineer.

1722.2 Material Requirements

1722.2.1 Concrete Hollow Block (CHB) Fence

CHB shall conform to the applicable requirements of Item 1046, Masonry Works.

1722.2.2 Precast Fence

Precast fence shall conform to the applicable requirements of Item 900, Structural Concrete.

If commercial precast fences are to be used, it shall be indicated in the Plans and shall be approved and certified by the Architect/ Engineer.

1722.2.3 Welded Wire Fence

1722.2.3.1 Right-Of-Way Fence

Typhoon style welded wire mesh fence system shall be indicated in the Plans and certified and approved by the Engineer prior to application.

1. Wire shall be hardened elongated, 7 gauge, stretched diameter.

    a. The material breaking point of the welded mesh shall be at least 427 MPa.

    b. The tensile strength of the wire mesh shall be at least 427 MPa.

    c. The elongation factor of the wire mesh shall be 7%.

    d. Welding points shall be able to withstand force of at least 5.3 KN.

2. Terminal Posts:

    a. The square steel tubing can be substituted with schedule 40 steel pipe only if the fence manufacturer has confirmed in writing that the tubular member is compatible with installation of the mesh fence panels.

    b. Post Caps: Each post shall have a square cap to seal out moisture. Flat and form plastic to the shape of the post. Coating to match the fabric.

    c. Base Plates and Miscellaneous Hardware: ASTM A36, Standard Specification for Carbon Structural Steel.

3. Bottom Rails and Bracing:

The rectangular steel tubing can be substituted with schedule 40 steel pipe only if the fence manufacturer has confirmed in writing that the tubular member is compatible with installation of the mesh fence panels.

4. Fence hardware: Manufacturer fittings, and all hot-dip galvanized.

    a. The fasteners connecting panels to each post shall be 3 mm diameter "U" shaped wire fasteners.

    b. Hat brackets (horizontal connectors of the welded wire mesh fence) shall be 1.3 mm thick by 30 mm long pre-molded clip fastener.

    c. Gouge ties (vertical connectors of the welded wire mesh fence): 1.3 mm thick by 15 mm long pre-molded clip fastener.

5. Gate Hardware: Hinges, latches, drop rods, as needed, shall be hot dip galvanized steel and sized to assure proper gate operation.

1722.2.3.2 Concrete

For alignment and grade, horizontal alignment and grades shall be verified as established by survey and Plan dimensions and elevations. Securely set posts in alignment at proper depth and height, and rigid bracing where needed.

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

Footing hole shall be clear of roots or other organic materials. Moist hole prior to concrete pour. No water standing at the bottom of the hole.

Concrete shall be consolidated and air pockets shall be removed.

1722.2.3.3 Shop Finishes

Hot dip galvanized posts and welded wire mesh after fabrication shall he in accordance with ASTM A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

1722.2.4 Precast Plant Box Fence

Portland cement, aggregates and water shall conform to the applicable requirements of Subsections 900.2.1, Portland Cement, 900.2.2, Concrete Aggregates, and 900.2.3, Water of Item 900, Structural Concrete

For its coloring, pigments used shall be inorganic, resistant to alkalinity and used as per Plans and of manufacturer's, and Contractor's recommendations with the approval and certification of the Engineer.

Item 1032, Painting, Varnishing and Other Related Works shall also be used if its requirements are applicable.

1722.2.5 Railings

It shall be in accordance with the applicable requirements in Item 1051, Railings.

1722.3 Construction Requirements

1722.3.1 Concrete Hollow Block (CHB) Fence

CHB shall conform to the applicable requirements of Item 1046, Masonry Works.

1722.3.2 Precast Fence

1722.3.2.1 Installation

Precast fence shall be installed as per manufacturer's recommendations with the approval of the Engineer.

Reinforcement steel, bars and wire fabric shall be thoroughly cleaned before placing and again before the concrete is placed, shall be accurately positioned and secured in place. Standard bar charts shall be provided for all beam steel off the ground.

All reinforcement shall be installed with the following clearances between reinforcing steel and face of concrete:

a. Footing, pier or beam bottom: 75 mm

b. Earth-formed pier of beam sides: 50 mm

c. Formed footing, pier or beam sides exposed: 25 mm

d. Precast exposed to weather: panels 19 mm post 32 mm

Splices within continuous unscheduled reinforcing steel shall have a minimum lap of 30 bar diameters.

Footing size shall be based on soil properties at the site.

Fresh poured concrete shall be tamped into place by steel rammer, slicing tools or mechanical vibrator until Concrete is thoroughly compact and without void.

Make excavations for footing to undisturbed soil or to the depth noted on the drawings. Leave the bottom-bearing surface clean and smooth. If footing excavations are made deeper than intended, only concrete shall be used for fill. All loose material shall be removed from grade beam excavations prior to Concrete pour.

Posts and panels to be plumb shall be aligned and leveled.

1722.3.2.2 Damaged Units

The Contractor shall replace panels and other components of work that have been damaged at his own expense.

Prior to substantial completion of the fence, the Contractor shall clean the surfaces of the fence.

1722.3.2.3 Cleanup

The Contractor shall clean up the site and dispose of all debris, trash, excavated soil, etc. to the satisfaction of the Construction inspector.

1722.3.3 Installation of Welded Wire Fence

For concrete footings, holes shall be drilled or dig for post footings in firm undisturbed or compacted soil. Depth and post embedment shall be indicated in the Plans or directed by the Engineer. Trowel tops of footings and slope or dome to direct water away from posts. Slope, do not dome, in pedestrian paving.

For posts which are set in concrete footings shall be plumbed vertical. Post depth and spacing shall be indicated on the Plans and as directed by the Engineer. Space posts shall be at lesser distance between centers to Compensate for terrain variation such as sharp variations in incline or decline.

Welded mesh panels shall be installed according to manufacturer's instructions and generally as follows:

1. Begin at the corner/start post. Layout each piece of the welded wire mesh fence. Connect mesh panels with a minimum of 8 junction clips per panel.

2. Connect one end of the tensioning device to the intermediate post that is fastened to support the brace. Connect the other end of the tensioning device to the connected panels. Mesh panels shall be tensioned with 8.90 KN. pull in a tensioning device. Leave tensioning device connected until the adjacent section is installed and tensioned. Repeat this operation until the welded mesh fence is installed from corner post to corner post.

3. Trim panels as needed for landscaped purposes.

For fence fabric, pull fabric taut and tie to posts, rails and tension wires. Fabric shall remain under tension after pulling force is released.Gates shall be installed plumb, level, and secure for full opening without interference.

Install ground-set items in concrete as recommended by the fence manufacturer. Adjust hardware for smooth operation and lubricate. Sliding gates shall operate smoothly and easily under minimum pressure.

1722.3.4 Handling, Storage, and Delivery of Precast Plant Box Fence

1722.3.4. 1 Handling

Precast plant box fence units shall be handled and transported in a manner to minimize damage. Lifting devices or holes shall be consistent with industry standards. Lifting shall be accomplished with methods or devices intended for this purpose as indicated on shop drawings. Upon request, the precast concrete producer/ supplier shall provide documentation on acceptable handling methods for the product.

1722.3.4.2 Storage

Precast Plant Box Fence units shall be stored in a manner that will minimize potential damage.

1722.3.4.3 Delivery

Precast plant box fence units shall be delivered to the site in accordance with the delivery schedule to avoid excessive build-up of units in storage at the site. Upon delivery to the jobsite all precast concrete units shall be inspected by the Engineer for quality and final acceptance.

1722.3.4.4 Final Acceptance

Upon final acceptance, the Engineer shall acknowledge and understand the appropriate methods for handling the accepted precast plant box fence unit(s).

Upon acceptance by the Engineer, the precast plant box fence manufacturer Shall not be responsible for replacing damaged product resulting from improper handling practices on the job site.

The damaged precast plant box fence unit shall be replaced by the Contractor at his own expense.

1722.3.5 Installation of Precast Plant Box Fence

1722.3.5.1 Site Access

The Contractor shall be responsible for providing adequate access to the site to facilitate hauling, storage and proper handling of the precast plant box fence units.

1722.3.5.2 Installation

Precast plant box fence units shall be installed to the lines and grades shown in the Plans.

Precast plant box fence units shall be lifted by suitable lifting devices at points provided by the precast plant box fence producer/ supplier.

Precast plant box fence units shall be installed in accordance with applicable industry standards or as directed by the Engineer.

Upon request, the precast plant box fence producer/supplier shall provide installation instructions.

Field modifications to the product shall relieve the precast producer/ supplier of liability if such modifications result in the failure of the precast plant box fence unit.

1722.3.5.3 Watertightness

Where watertightness is a necessary performance characteristic of the precast plant box fence unit's end use, watertight joints, pipe-entry connectors and inserts should be used to ensure the integrity of the entire system.

1722.3.6 Railings

Railings shall conform to the applicable requirements of Item 1051, Railings.

1722.4 Method of Measurement

The quantity to be paid for shall be the number of square meters or linear meters measured center to center of posts of fencing erected in place and accepted.

1722.5 Basis of Payment

The quantity, as determined in Section 1722.4, Method of Measurement shall be paid for at the contract price per unit of measurement respectively for each of the particular items listed below and as shown in the Bid Schedule, which price and payment shall be full compensation for furnishing and placing all materials and for all labor, equipment, tools and incidentals necessary to complete the Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1722	Fence and Railings	Linear Meter

SPL 12 - PRE - FABRICATED STEEL GATE

Description

This Item shall consist of furnishing, fabricating and installing the gate for buildings and other similar structures of the material or combination of materials in accordance with this Specification and in conformity with the Plans.Gates shall be classified as wooden, metal, stainless steel and glass, in accordance with the predominating material contained in each.

Material Requirements .

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.

Reinforcing Steel

It shall conform to the requirements of Subsection 900.2.4, Metal Reinforcement of Item 900, Reinforced Concrete.

Metal

Steel base metal to be welded shall be open-hearth or electric furnace steel conforming to MSHTO M 183 unless otherwise shown on the approved Plans.

Stainless Steel (Non-Ferrous Metal)

It shall conform to the requirements of ASTM A 276 M, Standard Specification for Stainless Steel Bars and Shapes or as called for in the Plans.

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 Specification C 1048, Standard Specification for Heat-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass and ASTM Specification C 1172, and Standard Specification for Laminated Architectural Flat Glass.The minimum thickness of glass shall be six (6) mm unless otherwise indicated in the Plans.

Aluminum

It shall conform to the requirements of AASHTO M 193, Standard Specification for Cast Aluminum Alloy Posts, ASTM B 221, Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes or ASTM B 308 - Standard Specification for Aluminum-Alloy 6061-T6 Standard Structural Profiles or as called for in the Plans.

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.

Construction Requirements

General

Gates shall be constructed in accordance with the Plans and shall not reflect any unevenness in the structure/ building.

All gate posts shall be set plumb unless otherwise indicated in the Plans.

Wooden Gates

The construction requirements shall be in conformance, whenever applicable, with Section 1003.3.1 Quality of Materials of Item 1003, Carpentry and Joinery Works.

Metal Gates

This shall be fabricated in accordance with the dimensions shown on the approved Plans. In case of welded gates, 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.

Stainless Steel

This 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.

Glass Gates

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

Method of Measurement

The work done under this Item shall be measured in linear meter of covered or installed with pre-fabricated steel gate and accepted to the satisfaction of the Engineer / Architect

Basis of Payment

The actual area of prefabricated steel gate in square meter, shall be paid for at the unit bid or contract unit price which payment shall constitute full compensation including labor, materials, tools and incidents necessary to complete this Item.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
SPL 12	Pre - Fabricated Steel Gate	Lump Sum

T. SOLAR LED STREET LIGHT

ITEM 803 - STRUCTURE EXCAVATION

Refer to Item 803, Part D. Broodstock Tanks.

Payment shall be made under:

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

ITEM 902 – REINFORCING STEEL

Refer to Item 902, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
902 (1)a	Reinforcing Steel (Deformed) Grade 40	Kilogram

ITEM 903 - FORMWORKS AND FALSEWORKS

Refer to Item 903, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
903(1)	Formworks and Falseworks	Lump Sum

ITEM 900 - STRUCTURAL CONCRETE

Refer to Item 900, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
900(1)c	Structural Concrete, Class A, 3000 psi, 28 days	Cubic Meter

SPL 13 - SOLAR POWERED LED STREET LIGHT

Description

This Item shall consist of furnishing of materials, equipment, and labor for the installation of roadway lighting which includes the luminaire, pole, concrete footing/foundation, power supply, and other necessary components, as shown on the Plans and as directed by the Engineer.

Material Requirements

All materials shall be brand new and shall be of the approved type.

It shall conform to the requirements of the Philippine Electrical Cede (PEC) and the products locally manufactured shall bear a Philippine Standard (PS) mark, while imported products shall

bear Import Commodity Clearance (ICC) certification marks duly issued by the Bureau of Philippine Standards (BPS).

The light emitted by the luminaire shall have color temperature in the range Of 2000 K -2500 K (warm white), 3000K -4500K (cool white) or 5500K -6500K (daylight). For primary roads, warm white shall be used.

Solar-Powered LED Roadway Lighting

The LED modules, solar photovoltaic (PV) modules, controllers, and battery pack can be replaced independently and shall each have warranty certificate issued by the manufacturer or by the distributor certified by the manufacturer indicating a minimum of six (6) years warranty period.

Light Emitting Diode (LED) Luminaire

Light Emitting Diode (LED) shall conform to the applicable requirements for LED Road Luminaires of the Roadway Lighting Guidelines of the Department of Energy, latest edition. The luminaire shall have no risk linked to infrared, blue-light and UV radiation in accordance with IEC/EN 62471. The LED housing assembly shall be suitable for outdoor use and shall be rated as IP65.

Battery

The battery shall be deep cycle, lithium-ion type. It shall have low maintenance requirements, long service life (minimum of three years), and excellent capacity performance even in high temperature.

The battery pack shall have heat insulation and temperature detection for charging and discharging protection.

Solar Photovoltaic Module

Photovoltaic (PV) modules shall be made of crystalline high power/efficiency cells and shall be used and must be warranted for output wattage, which must be greater than 90% after 10 years and less than 80% after 25 years. The PV modules shall be provided a protective device against Surges.

Charge Controller

The charge controller shall have an automatic dusk-dawn circuit based on the Solar Photovoltaic module as sensor for switching on/off the streetlight without manual intervention and as specified operation profile during project analysis. All this control shall keep the system operating at peak performance and increases the system's lifespan,

High Pressure Sodium (HPS) Luminaire

HPS luminaire, ballasts, controllers, and other necessary components can be replaced independently and shall each have warranty certificate issued by the manufacturer or by the

distributor certified by the manufacturer indicating a minimum of six (6) years warranty period.

1. Luminaires shall be Type Ill and Medium semi-cutoff. Roadway shall be properly aimed and designed in such a way that it will not produce high discomfort: glare or low illumination to motorists and pedestrians.

2. Luminaires shall be designed for roadway lighting with built-in ballast for use with a high-pressure sodium lamp. The luminaires shall bear the UL label. All luminaires shall be mounted with a zero-degree tilt from horizontal.

3. The luminaire housing, both upper and lower, shall be die-cast aluminum jointed by an integrally cast pin hinge at the mounting and a one-hand latch at the door enclosing the lamp and/or ballast.

4. The lens shall be a clear, tempered, high-quality, heat-resistant glass with no aberrations and shall be secured in the supporting frame.

5. The reflector shall be of drawn aluminum and have a highly reflective surface. The reflector edge shall have an elastomer gasket which seats firmly against the lens door to seal the optical system. The optical system shall have a filter permitting it to breathe during lamp heat-up and cool-down.

6. Ballasts shall operate within the range of voltage-current characteristic parameters that are compatible with the lamp used. Ballasts shall be capable of lamps starting at ambient temperatures down to minus 29°C.

Pole

The pole shall be constructed of hot dip galvanized GI pipe of 3 mm minimum thickness, a minimum lower and upper diameter of 200 mm and 75mm diameter, and a pole surface of matte or dull finished grade in order to prevent glare. The pole should have the provision to hold the weatherproof lamp housing individually per case, the battery box at an appropriate height, and as well as the Solar Photovoltaic panel, that shall be mounted on top of the pole.

Each Pole shall have an inspection door or hand hole and shall have a suitable gasketed screw cover. After the pole has been erected, sealed and fixed in the foundation block, a coat of finishing aluminum paint shall be applied. Pole shall be provided with galvanized steel anchor bolts threaded top end and with a hooked bent at an angle end at the bottom. Size of the anchor bolts shall be as indicated on the Plans.Pole shaft shall comply with ASTM A53M, Standard Specification for Pipe, Steel, Black and Hot Dipped, Zinc Coated, Welded and Seamless.

Anchor bases shall be provided with hot-dipped, galvanized steel anchor bolts with double nuts and washers, threaded at the top end and bended at 90 degrees at the bottom end. Galvanized nuts, washer, and ornamental covers shall also be provided for anchor bolts. Galvanizing shall be in accordance with the requirements of ASTM A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware or AASHTO M 111M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products, or ASTM A123/A123M, Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.

Electric Cables

The electric cable shall be twin core PVC insulated water and UV resistant copper cable of 1.5 mm minimum size.

Photo Electric Control/Timer Switch

Roadway lighting shall be provided with reliable photoelectric controls either internal or external to keep lights turned on/off automatically that conform to ANSI C136.10, Roadway and Arcs Lighting Equipment - Lacking Type Photocontrol Devices and Mating Receptacles - Physical and Electrical Interchangeable and testing, latest revision or equivalent and it shall be located as indicated on the Plans.

The timer switch shall be for prompt power switching off and on at the real-time for main light and advertising space in a separate time setting.

Conduit

Metallic conduit shall be standard rigid steel, zinc coated or galvanized steel conduit conforming to UL 6, Electrical Rigid Metal -Conduit Steel.

Non-metallic conduit or for ground and underground use without concrete encasement shall be rigid Polyvinyl Chloride (PVC) conforming to UL 651, Schedule 40, 80 Type EB and A Rigid PVC Conduit and Fittings.

Conduit Bodies, Boxes and Fittings

All conduit bodies, boxes and fittings shall be made watertight, dust tight and galvanized steel conforming to UL 5148, Conduit, Tubing and Cable Fittings. The terminal box on the module shall be designed for long-term outdoor operation in harsh environments with an opening for replacing the cable if necessary.

Roadway Lighting Pole Concrete Footing

Roadway lighting pole footing shall be Class A concrete conforming to the requirements of Item 405, Structural Concrete.

Electrical Conductors and Grounding

Entire system shall be grounded and bonded in accordance with the requirements of the latest edition of Philippines Electrical Code and shall conform to the applicable requirements of National Electrical Code of the Philippines Chapter 2, Use and Identification of Grounded Conductors.

Grounding wire shall be made of bare copper stranded, soft drawn wire and shall be installed in one continuous length without splice or joint. Ground rods shall be made of copper-clad steel of not less than 20 mm diameter x 3 in in length driven in full length into earth. The size of the ground rod and ground wells shall be as shown on the Plans and the resistance shall not be more than 5 ohms.

All conductors and grounding size shall not be less than the indicated sizes as shown on the Plans.

Programmable Logic Controller

Lighting system for tunnels shall be controlled and monitored by the Supervisory Control and Programmable Logic Controller (PLC). The PLC base unit power supply shall be 100-230VAC,I/0 16 nos., I/P; 8 nos. 24 VDC, Relay O/P; 8 nos., and shall have a program memory of 64000 steps RAM (internal). It shall also have all necessary accessories and operational manual

Lighting Control Panel/Panel board

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

Panel board cabinets shall be designed and fabricated for pole surface mounted. Enclosures shall be fabricated to be watertight, dust tight, temper proof, dead front suitable for outdoor installation, and shall conform to the applicable requirements of the National Electrical Manufacturers Association (NEMA) 250, Enclosures for Electrical Equipment (1000 V Maximum), Type 3R, lockable with padlocks.The panel board cabinets shall be designed and fabricated for pole surface mounted and shall be given two coats of light gray color both interior and exterior cabinet.Conduit entry shall be at the top and bottom. A directory holder shall be provided inside the panel and ground lug for ground wire connection. Nameplate of laminated plastic shall be attached by means of stainless-steel rivets or permanent adhesive showing panel board number.

Circuit Breakers

All circuit breakers shall be plug in and thermal magnetic type, manually or electrically operated as required with ratings and capacity as shown on the Plans and shall be in accordance with UL 489, Molded-Case Circuit Breakers, Molded-Case Switches and Circuit-Breaker Enclosures.

All circuit breakers shall have inverse-time tripping characteristics on overload and instantaneous trip on short circuits. It shall have a quick make or break toggle mechanism, trip-free operating handle, and shall be equipped with arc quenches. Each multi-pole breaker shall be designed to have a common trip so that an overload or short on one pole will automatically cause all poles of the breakers to open.

Terminal Connector

Connectors for wiring shall be rated at least 600 volts and shall be of the following types:

For 5.5 mm2 and smaller conductors/cables: Rugged material, such as phenolic, shall be mounted end-to-end without spacing. The pressure type tin plate copper connectors shall have nonflammable and self-extinguishing insulation with temperature rating equal to that of the

conductor insulation.

For 8.0 mm2 and above conductors/cables: Type of construction shall be one-piece and material shall be phenolic. Terminal configuration shall be done by binding screw terminals. Solderless type connectors made of compact, high strength, high copper alloy, split-bolt, and free running threads and highly resistant to corrosion and cracking shall be used.

Maximum pressure and assure/secure connection on all combinations of run and tap conductors shall be provided.

Emergency Lighting System

In case of power failure, a minimum lighting illumination level shall be immediately available from designated emergency light fixtures as well as from emergency exit signaling which are both deriving electric power from UPS Battery as indicated on the Plans.

The minimum lighting shall be available for 30 min to cover the necessary margin of elapsed time in-between power supply interruption and back-up power operation.

Main Feeder Distribution System

The main feeder distribution system shall be composed of conduit, electrical conductors and light control or panel board conforming to the material requirements specified herein.

Underground Electrical Works

Underground electrical works shall conform to the material requirements of Item 633, Cable Duct System.

Corrosion Protection

Ferrous metal raceways, cable armor, boxes, cable sheathing, cabinets, elbows, couplings, nipples, fittings, supports, and support hardware shall be permitted to be installed in concrete or in direct contact with soil. Corrosion protection shall be provided in areas subject to severe corrosive influences where made of material approved for the condition, or where provided with corrosion protection approved for the condition as indicated in the Plans or as approved by the Engineer.

System Protection

All roadway lighting systems shall be protected by an overcurrent device. The overcurrent device shall be size rated or setting not higher than the allowable ampacity of the conductor. The circuit breakers shall be of the thermal magnetic type having inverse-time tripping characteristics on overload and instantaneous trip on short circuits, shall be equipped with arc quenches, shall have quick-make and quick-break toggle mechanism, and shall have trip-free operating handles. Each multi-pole breaker shall have a common trip so that an overload on one pole will automatically cause all poles of the breakers to open.

Testing

A full type test for luminaire shall be in accordance with IEC 60598-2-3. For the humidity test, it shall be carried out at a relative humidity around 95% and at an ambient temperature of 28°C.LEDs shall have test reports from IESNA LM80-08 and TM-21-11 qualified for relevant LED product testing.

Construction Requirements

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

Roadway Lighting Poles

All roadway lighting poles shall be constructed of cold rolled mild steel of a sufficient gauge having yield strength of not less than 248.2 Mpa and shall be followed with a prime coat of paint within 24 h. The prime coat of paint shall be compatible with the finish ccrat of paint.

Pole shall be threaded at the top end of the foundation and adjustment shall be provided for permanent vertical position with the bracket arm in proper position for luminaire location and size as shown on the Plans.

The pole shall be provided with a hand hole and grounding lug attachment at the elevation and a cable entry slot sized and located as shown on the plans. The slot shall be free of burrs and sharp edges.

Luminaire Assembly

Luminaire assembly shall be strongly constructed, weatherproof, hail proof, insect proof, corrosion proof, solar (including ultra-violet) resistant, and vandal resistant. It shall be mounted horizontally on a mast arm and shall be mechanically clamped to a 48-60 mm nominal diameter metal pipe end of the mast arm and adjusted to the required position using a clamping plate with at least two (2) -9.5 mm minimum diameter hexagonal head clamping bolts if applicable. The luminaire shall pass the IEC 60598 vibration test. The luminaire housing shall bear a nameplate that identifies it as to type, rating, manufactured date, manufacturer and catalog data.

Ballast

Ballasts shall be of the encapsulated or vacuum impregnated type, the process of vacuum impregnation shall be such that the interstices of the windings are completely filled with the

Impregnating material. Connections shall be brought out to a suitable brass screw terminal block mounted on the ballast housing. Terminal blocks with steel screws will not be acceptable.

Conduit

All electrical conduits and fittings shall be installed in their correct positions and locations as shown on the Plans. The conduits shall be directly embedded in earth, except under paved areas and roadways, the conduit shall be encased in concrete and the end of conduits shall be plugged with patching compounds at all outlets, or boxes at the ends of conduits to keep the conduits

dry. Trenches in which the PVC conduits are laid shall follow the alignment as indicated on the Plans. In trenches and sidewalks, the PVC conduit shall be laid on a 10 cm sand bed and covered by a layer of sand, 20 cm thick measured from the upper level of the bed. For trenches under paved areas the same procedures shall be followed except the concrete shall be used in the place of sand. After placing the concrete, the remaining part of the trench shall be backfilled up to the sub-grade level with soil compacted properly. Cables shall be installed in one length from point to point and no joints shall be permitted. Before the cables are pulled, the Contractor shall see to it that the conduits are continuous and clear of debris, stone, and sand. Sharp bends shall not be permitted. A minimum covering of 0.45 in under the pavement shall be required for the conduits under the roadway.

Conduit Boxes, Boxes and Fittings

Conduit boxes for pulling and splicing wires and outlet boxes shall be provided for installation of wiring devices and. As a rule, junction boxes or pull boxes in all runs greater than 30 in in length, for horizontal runs. For other lengths, boxes shall be provided as required for splicing or pulling. Pull boxes shall be installed in inconspicuous but accessible locations. Conduit boxes shall be installed plumb and securely fastened. They shall be set flush with the surface of the structure in which they are installed where conduits are run concealed.

All conduits shall be fitted with approved standard galvanized bushing and locknuts where they enter cabinets and conduit boxes. Junction and pull boxes of code gauge steel shall be provided as indicated on the Plans or as required to facilitate the pulling of wires and cables.

Roadway Lighting Pole Concrete Footing

The shape of Roadway lighting pole concrete footing shall be as shown on the Plans.

Excavation and backfill for foundation including disposal of surplus material shall be provided. Excavated holes for concrete footings shall be neat or properly formed and fi.ee from loose materials when the concrete is placed.

When placed, the concrete shall be wall consolidated to completely fill and devoid in the hole and around the pole when embedded. Concrete shall be moist wired and for not less than 4 days

Anchor bolt circle dimensions shall be furnished and rigid template shall be used to center the anchor bolts in the foundation with exposed threaded ends, at least three (3) threads vertically positioned in concrete. Unless otherwise specified, the template shall be oriented so that the mast arm of the lighting standard is perpendicular to the centerline of the roadway. The top of the concrete foundation shall be constructed in level and only shims used to rake the lighting standard shall be permitted. Shims with break-away couplings shall not be permitted. Each foundation shall have an imprinted arrow/s on the top of the foundation to indicate the direction of the cable duct run.

Electrical Conductors and Grounding

All electrical conductors and grounding shall be furnished and installed by the Contractor with

the sizes as indicated on the plans. All connections shall be mechanically and electrically sound and secured by insulating tape. Solderless connectors of approved type shall be used for making connections of power cables. The insulations then shall be built up again to normal thickness with rubber and vinyl plastic tapes. Splices in conductors shall only be made at pull boxes, hand holes or cabinets. No kicks or abrasions in the insulation or protection covering shall be found in installed conductors.

All grounding system installation shall be executed in accordance with the Plans. Grounding system shall include ground rods and ground wire taps as shown in the approved design. The ground wire is connected to the top or side of the ground rod. The ground rod, ground wire connection is made by a thermo-weld process. The wire and ground rod are required to be free of oxidized materials, moisture, and other contaminants prior to inserting the wire and the ground rod into the properly sized mold. The welding material is required to sufficiently cover and secure the conductor to the rod. The completed connection is required to be nonporous. This connection includes a quick-disconnect type connector kit so that in the event of a pole knockdown the connection readily breaks without damage to the buried conductor.

Lighting Control Panel/Panel board

All panel boards shall be installed by the Contractor at the locations indicated on the Drawings. All panels shall be of dead front construction furnished with trims for surface mounting. Electrical components shall be completely wired and installed in the enclosure in proper position and ready for operation. Power cables shall enter the panel board enclosure through conduits. All branch circuit conduits shall enter the panel board from the bottom.

Circuit Breakers

Circuit breakers shall be mounted so that any individual branch breakers can be removed without disturbing adjacent units or without loosening or removing supplement insulation.

Test and Guarantee

Upon completion of the electrical construction work, the Contractor shall provide all test equipment. The Contractor shall then submit copies of all test results to the Engineer.

After the installation of all cables, the Contractor shall test the insulation resistance of all feeders and connected equipment with a 600 V megger for grounds and short circuits. testing shall include measuring of insulation resistance. These measurements shall be recorded by feeder and branch circuit number indicating the resistance values between phases and ground.

All effective and calibrated apparatus, materials and labor required for conducting tests shall be supplied and made available by the Contractor.

The Contractor shall guarantee that the electrical installation is done and in accordance with the Plans and Specifications.

Method of Measurement

The work under this item shall be measured either by pieces, set or lump sum, actually placed and installed as shown on the Plans.

The quantity of roadway lighting and electrical works to be paid for shall be the number of lighting poles of single and double luminaires to include all conduits, luminaires, all wirings, panel board, nuts, washer, fasteners, conduit clamps, bolts, capacitors, coils and others including all necessary materials and accessories needed for moisture and fungus control, corrosion protections and all other incidentals needed to make the system operational and accepted to comply with the requirements of the latest edition of the Philippine Electrical Code, and any other ordinances including payment of necessary permits from local enforcing authorities.

The concrete footing will be measured and paid for as provided under Item 405, Structural Concrete. The quantity of structural concrete to be paid for shall be the final quantity placed and accepted in the completed structure.

Reinforcing steel bars will be measured and paid for as provided under Item 404, Reinforcing Steel.

The quantity to be paid for shall be the final quantity placed and accepted in the completed footing.

Basis of Payment

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

Pay Item Number	Description	Unit of Measurement
SPL 13	Solar Powered LED Street Light (200 Watts)	Sets

ITEM 1032 - PAINTING, VARNISHING AND OTHER RELATED WORKS

Refer to Item 1032, Part D. Broodstock Tanks.

Payment shall be made under:

Pay Item Number	Description	Unit of Measurement
1032 (1)a	Painting works, Masonry Concrete	Square Meter

Section VII. Drawings

Table of Contents

118-125	DRAINAGE AND TREATMENT CANAL
126-171	ADMINISTRATIVE AND PHYCOLOGY LABORATORY BUILDING
172-186	STAFF QUARTERS AND FISH FEED STORAGE BUILDING
187-197	TRIPLEX BUILDING
198-208	TWO-UNIT PUMPHOUSE
209-210	REINFORCED CONCRETE BOX CULVERT
211-219	INTAKE TANK AND HDPE INTAKE PIPE
220-222	BERTHING DOCK
223-229	ACCESS ROAD
230-232	PERIMETER FENCE
233-234	SOLAR-POWERED LIGHTS

Section VIII. Bill of Quantities

Please follow the link for downloadable and editable Bill of Quantities:
https://docs.google.com/spreadsheets/d/17xHHJK3ApnJhnuNUTo3GVw4NIOEsUvJJ/edit?usp=drive_link&ouid=113528639800540329317&rtpof=true&sd=true

Section IX. BIDDING FORMS

Please follow the link: PRDP SU PANGASINAN PBD Section IX. Bidding Forms.docx

for downloadable and editable templates.


Republic of the Philippines
gppb
Government Procurement Policy Board