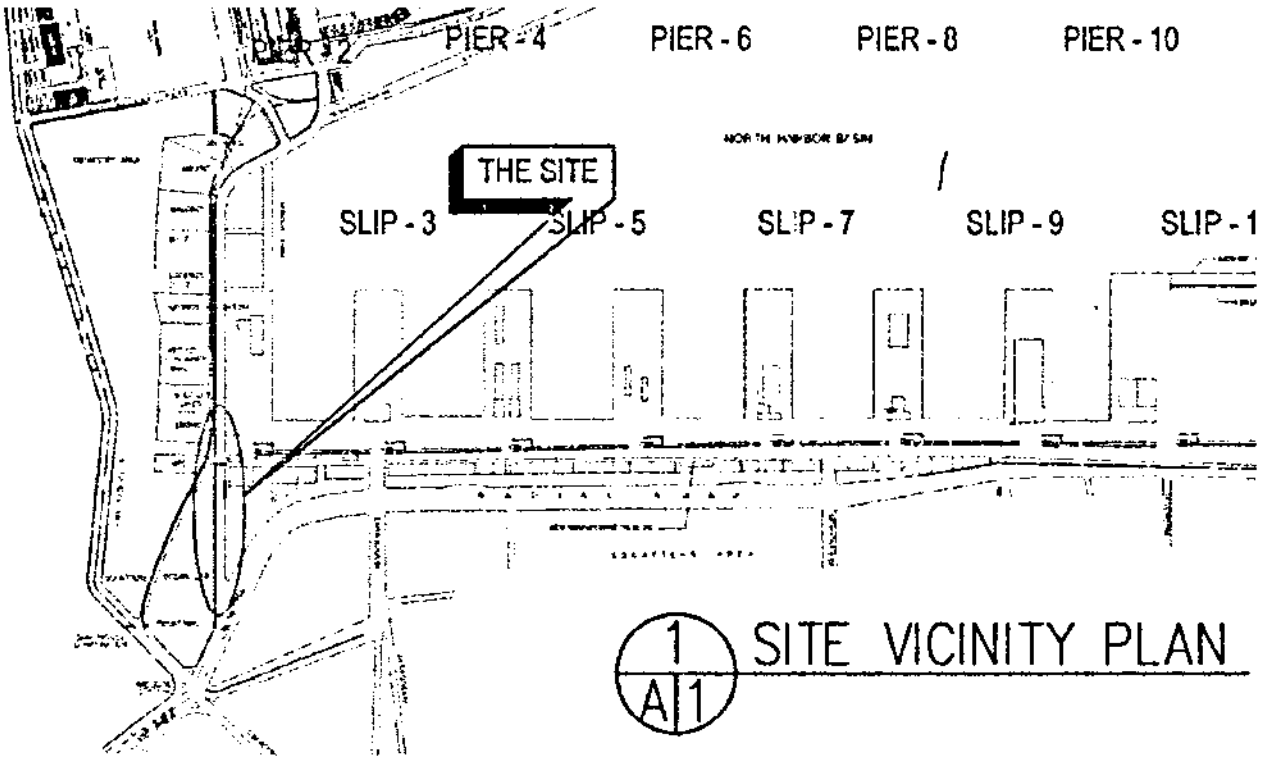
BAGONG PILIPINAS

PHILIPPINE PORTS AUTHORITY

# ROAD PAVEMENT AND DRAINAGE REHABILITATION ALONG DELPAN-ISLA PUTING BATO (IPB) ROADWAY

AT SLIP-0, NORTH HARBOR, TONDO, MANILA
(PROJECT ID NO. HO-RM INFRA-AGME-24-033)




# BID DOCUMENTS

**JUNE 2024**

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# *GLOSSARY OF TERMS, ABBREVIATIONS, AND ACRONYMS*

# *Glossary of Terms, Abbreviations, and Acronyms*

**ABC** – Approved Budget for the Contract.

**ARCC** – Allowable Range of Contract Cost.

**BAC** – Bids and Awards Committee.

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

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

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

**BIR** – Bureau of Internal Revenue.

**BSP** – Bangko Sentral ng Pilipinas.

**CDA** – Cooperative Development Authority.

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

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

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

**CPI** – Consumer Price Index.

**DOLE** – Department of Labor and Employment.

**DTI** – Department of Trade and Industry.

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

**GFI** – Government Financial Institution.

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

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

**GOP** – Government of the Philippines.

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

**LGUs** – Local Government Units.

**NFCC** – Net Financial Contracting Capacity.

**NGA** – National Government Agency.

**PCAB** – Philippine Contractors Accreditation Board.

**PhilGEPS** - Philippine Government Electronic Procurement System.

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

**PSA** – Philippine Statistics Authority.

**SEC** – Securities and Exchange Commission.

**SLCC** – Single Largest Completed Contract.

**UN** – United Nations.

BAGONG PILIPINAS

PHILIPPINE PORTS AUTHORITY

# INVITATION TO BID

## FOR THE

## ROAD PAVEMENT AND DRAINAGE REHABILITATION ALONG DELPAN-ISLA PUTING BATO (IPB) ROADWAY AT SLIP 0, NORTH HARBOR, TONDO, MANILA

The Philippine Ports Authority, through the Corporate Budget of the Authority for CY 2024, intends to apply the sum of **P14,101,087.12** being the Approved Budget for the Contract (ABC) to payments under the contract for the **ROAD PAVEMENT AND DRAINAGE REHABILITATION ALONG DELPAN-ISLA PUTING BATO (IPB) ROADWAY AT SLIP 0, NORTH HARBOR, TONDO, MANILA (HO-RM INFRA-AGME 24-033)**. Bids received in excess of the ABC shall be automatically rejected at bid opening.

The Philippine Ports Authority now invites bids for the above Procurement Project. Completion of the Works is required in **Two Hundred Twenty (220) calendar days** from the receipt by the successful bidder of the Notice to Proceed. Bidders should have completed a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II (Instructions to Bidders).

Bidding will be conducted through open competitive bidding procedures using a non-discretionary "pass/fail" criterion as specified in the 2016 Revised Implementing Rules and Regulations (IRR) of Republic Act (RA) 9184.

Interested bidders may obtain further information from the Philippine Ports Authority Bids and Awards Committee (BAC) and inspect the Bidding Documents at the address given below from 8:00 a.m. to 5:00 p.m., Monday to Friday.

A complete set of Bidding Documents may be acquired by interested Bidders on **18 July 2024** from the given address and website(s) below and upon payment of the applicable fee for the Bidding Documents, pursuant to the latest Guidelines issued by the GPPB, in the amount of **TWENTY FIVE THOUSAND PESOS (P25,000.00)**. The Procuring Entity shall allow the bidder to present its proof of payment for the fees in person.

The Philippine Ports Authority's Bids and Awards Committee will hold a Pre-Bid Conference on **26 July 2024 at 10:00 a.m.** at the PPA Function Room, 7th Floor, PPA Bldg., Bonifacio Drive, South Harbor, Port Area, Manila, which shall be open to all prospective bidders.

Bids must be duly received by the BAC Secretariat through manual submission at the office address indicated below on or before **08 August 2024 at 1:00 p.m.** Late bids shall not be accepted.

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

Bid opening shall be on **08 August 2024 at 2:00 p.m.** at the 7th Floor, PPA Building, A. Bonifacio Drive, South Harbor, Port Area, Manila. Bids will be opened in the presence of the bidders' representatives who choose to attend the activity.

The Philippine Ports Authority reserves the right to reject any and all bids, declare a failure of bidding, or not award the contract at any time prior to contract award in accordance with Sections 35.6 and 41 of the 2016 revised Implementing Rules and Regulations of RA No. 9184, without thereby incurring any liability to the affected bidder or bidders.

- Required PCAB Registration: SMALL B – Roads, Highways, Pavement, Railways, Airport Horizontal Structure and Bridges

For further information, please refer to:

BAC Secretariat, Philippine Ports Authority
5th Floor, PPA Bldg., A. Bonifacio Drive,
South Harbor, Port Area, Manila
Telephone Nos. 8527-47-35
8527-83-56 to 83 loc. 539
PPA Website: www.ppa.com.ph
PhilGEPS Website: www.philgeps.gov.ph

**MARK JON S. PALOMAR**
Chairperson, PPA Head Office Bids and Awards
Committee for Engineering Projects (HO-BAC-EP)

# SECTION II

# INSTRUCTIONS TO BIDDERS

## 1. Scope of Bid

The Procuring Entity, ***Philippine Ports Authority*** invites Bids for the ***Road Pavement and Drainage Rehabilitation along Delpan-Isla Puting Bato (IPB Roadway at Slip-0, North Harbor), Tondo, Manila*** with Project Identification Number ***HO-RM INFRA-AGME-24-033.***

The ***Road Pavement and Drainage Rehabilitation along Delpan-Isla Puting Bato (IPB Roadway at Slip-0, North Harbor), Tondo, Manila*** is for the construction of Works, as described in Section VI (Specifications).

## 2. Funding Information

2.1. The ***Philippine Ports Authority*** through the source of funding as indicated below for ***CY 2024*** in the amount of ***₱ 14,101,087.12.***

2.2. The source of funding is:

***PPA Corporate Fund.***

## 3. Bidding Requirements

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

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

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

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

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

## 5. Eligible Bidders

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

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

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

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

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

## 6. Origin of Associated Goods

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

## 7. Subcontracts

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

The Procuring Entity has prescribed that:

**Subcontracting is not allowed.**

7.2. Subcontracting of any portion of the Project does not relieve the Contractor of any liability or obligation under the Contract. The Supplier 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. Pre-Bid Conference

The Procuring Entity will hold a pre-bid conference for this Project on the specified date and time and either at its physical address and/or through videoconferencing/webcasting as indicated in paragraph 6 of the **IB.**

## 9. Clarification and Amendment of Bidding Documents

Prospective bidders may request for clarification on and/or interpretation of any part of the Bidding Documents. Such requests must be in writing and received by the Procuring Entity, either at its given address or through electronic mail indicated in the **IB**, at least ten (10) calendar days before the deadline set for the submission and receipt of Bids.

## 10. Documents Comprising the Bid: Eligibility and Technical Components

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

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

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

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

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

## 11. Documents Comprising the Bid: Financial Component

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

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

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

## 12. Alternative Bids

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

## 13. Bid Prices

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

## 14. Bid and Payment Currencies

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

14.2. *Payment of the contract price shall be made in:*

**Philippine Pesos.**

## 15. Bid Security

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

15.2. The Bid and bid security shall be valid until **One Hundred Twenty (120) days from the date set for Bid Opening**. Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

## 16. Sealing and Marking of Bids

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

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

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

## 17. Deadline for Submission of Bids

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

## 18. Opening and Preliminary Examination of Bids

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

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

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

## 19. Detailed Evaluation and Comparison of Bids

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

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

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

## 20. Post Qualification

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

## 21. Signing of the Contract

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

# SECTION III

# BID DATA SHEET

# Bid Data Sheet

<table>
<tr><td>ITB Clause</td><td colspan="3"></td></tr>
<tr><td>5.2</td><td colspan="3">For this purpose, contracts similar to the Project refer to contracts which have the same Major Categories of Works which shall be:</td></tr>
<tr><td></td><td>Description/Clarification</td><td>Unit of Measure</td><td>Quantity (at least)</td></tr>
<tr><td></td><td>1. Construction of Concrete Road Pavement<br>2. Construction of Drainage System</td><td>sq.m.<br>lin.m.</td><td>1,224.92<br>172.53</td></tr>
<tr><td>7.1</td><td colspan="2">Portion of Works allowed to be subcontracted:<br>Subcontracting is not allowed</td><td>Maximum Percentage allowed to be subcontracted:<br>Subcontracting is not allowed</td></tr>
<tr><td>10.3</td><td colspan="3">For Joint Venture:<br>Special PCAB License</td></tr>
<tr><td>10.4</td><td colspan="3">The key personnel must meet the required minimum years of experience set below:</td></tr>
<tr><td></td><td>Key Personnel</td><td>General Experience</td><td>Relevant Experience (Minimum)</td></tr>
<tr><td></td><td>a. Project Manager<br>b. Project Engineer<br>c. Materials Engineer I<br>d. Construction Safety and Health Officer<br>e. Foreman</td><td></td><td>Five (5) years<br>Three (3) years<br>One (1) year<br>One (1) year<br>Five (5) years</td></tr>
</table>

| | |
|---|---|
| 10.5 | *The minimum major equipment requirements are the following:*<br><br>**Please refer to Section VIII, *Annex 3 Minimum Major Equipment Requirements*** |
| 12 | *Value Engineering Clause:*<br><br>**Not Allowed** |
| 15.1 | The bid security shall be in the form of a Bid Securing Declaration or any of the following forms and amounts:<br><br>a. The amount of not less than **₱ 282,021.74,** if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit;<br><br>b. The amount of not less than **₱ 705,054.35**, if bid security is in Surety Bond. |
| 16 | Each bidder shall submit one (1) original and six (6) copies of the Technical and Financial Proposals, properly labelled, book-bound, with hard cover and corresponding index tabs. Failure to comply with the requirements is a ground for the automatic disqualification of the bidder. |
| 19.2 | Partial bids:<br><br>**Not Allowed** |
| 20 | *Other appropriate licenses and permits required:*<br>**None** |
| 21 | *Other contract documents are as follows:*<br><br>*Construction Schedule and S-Curve, Manpower Schedule, Construction Methods, Equipment Utilization Schedule, Construction Safety and Health Program approved by the Department of Labor and Employment and PERT/CPM or other acceptable tools of project scheduling.* |

# SECTION IV

# GENERAL CONDITIONS OF CONTRACT

## 1. Scope of Contract

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

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

## 2. Sectional Completion of Works

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

## 3. Possession of Site

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

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

## 4. The Contractor's Obligations

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

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

**5. Performance Security**

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

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

**6. Site Investigation Reports**

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

**7. Warranty**

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

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

**8. Liability of the Contractor**

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

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

**9. Termination for Other Causes**

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

## 10. Dayworks

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

## 11. Program of Work

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

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

## 12. Instructions, Inspections and Audits

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

## 13. Advance Payment

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

## 14. Progress Payments

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

## 15. Operating and Maintenance Manuals

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

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

# SECTION V

# SPECIAL CONDITIONS OF CONTRACT

# Special Conditions of Contract

| GCC Clause | |
|---|---|
| 2 | *Sectional Completion:*<br><br>**None** |
| 3.1 | The Procuring Entity shall give possession of all parts of the Site to the Contractor upon commencement of the project. |
| 6 | *Site Investigation Report:*<br><br>**None** |
| 7.2 | *Permanent structures: Fifteen (15) years*<br><br>Buildings of types 4 and 5 as classified under the National Building Code of the Philippines and other structures made of steel, iron, or concrete which comply with relevant structural codes (e.g., DPWH Standard Specifications), such as, but not limited to, steel/concrete bridges, flyovers, aircraft movement areas, ports, dams, tunnels, filtration and treatment plants, sewerage systems, power plants, transmission and communication towers, railway system, and other similar permanent structures |
| 10 | No dayworks are applicable to the contract. |
| 11.1 | The Contractor shall submit the Program of Work to the Procuring Entity's Representative within ____ days of delivery of the Notice of Award. |
| 11.2 | The amount to be withheld for late submission of an updated Program of Work is _____. |
| 13 | The provision on advance payments or mobilization fees in the terms and conditions of all contracts/ purchase orders/ job orders for goods, services and infrastructure projects that will be signed or executed shall henceforth be excluded. |
| 14 | No further instructions. |
| 15.1 | The date by which operating and maintenance manuals are required is _____.<br><br>The date by which "as built" drawings are required is _____. |
| 15.2 | The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is _____. |

# SECTION VI

# TECHNICAL SPECIFICATIONS

# DIVISION 01 : PAVEMENT DEMOLITION

## DESCRIPTION:

This item consists of the demolition of existing portland cement and/or bituminous concrete pavement as shown on the plans. Removal of demolished pavements shall be as specified herein.

## CONSTRUCTION METHODS:

1. Existing pavements shall be broken into pieces of such size easily handled by power-driven machinery or other suitable means.
2. Where only a portion of the existing pavement is to be demolished, special care shall be exercised to avoid damage to that portion of the pavement to remain in place. The existing pavement shall be cut to the neat lines shown on the plans or established by the Engineer, and any existing pavement beyond the neat lines so established which is damaged or destroyed by these operations shall be replaced at the Contractor's expense with no additional compensation from the Owner.
3. Portland cement and bituminous concrete pavements which are demolished shall be legally disposed of off the port. The cost of removal and disposal of all demolished pavement shall be included in the unit price for Bituminous Concrete Pavement or Portland Cement Concrete Pavement Demolition.

Pavement demolition will include but not necessarily be limited to, any existing foundations, slabs, footings, etc. either made of concrete or asphalt which must, in the opinion of the Engineer, be removed to install new pavements, earthwork, seeding, sod, perform proper site grading, provide for positive site grading, etc. to complete the project to the intent established within the plans and specifications. Any of the above mentioned demolition related items are be removed regardless of which bid item is utilized for payment. It is incumbent upon the Contractor to visit the site and include all such existing conditions in the bid item provided for in the bid schedule.

## INTERFERENCE WITH PORT OPERATIONS

During the execution of the work, the Contractor shall not interfere with the shipping, navigation and other traffic in the port.

The Contractor shall make arrangements with the operations people on the schedule of demolition and related works to keep port operation activities undisturbed at all times.

Prior to commencement of the demolition works, the Contractor shall inform/announce to port users the schedule of disconnection of utilities.

## STORAGE AND DUMPING

Prior to the commencement of the demolition work, the Engineer shall submit to the Contractor a list in which all the materials to be salvaged and overhauled, as property of PPA, and the description of the location of their storage. Materials embedded in concrete units shall not be salvaged.

The Contractor shall separate materials to be salvaged from debris. Salvaged materials shall be loaded, transported and unloaded by the Contractor at the specified locations.

The Contractor may dump debris or extracted rocks on land areas but out of the site, which areas shall be procured and prepared at his own expense. In this case, safety measures shall be undertaken in the transporting, unloading, covering and others as requested by the Engineer.

The approximate distance of the disposal site from the project site is about five (5) kms., as designated by the PMO thru the implementing office.

**MEASUREMENT:**

Existing Portland cement and/or bituminous concrete pavement demolition as prescribed above will be measured by the square meter of pavement material demolished regardless of its thickness.

# DIVISION 02 : EXCAVATION, BACKFILLING AND DISPOSAL

## 1. Description

The Contractor shall perform all earthworks both for roadway, structures, 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.

## 2. Construction Requirements

a. General

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 undertaken by the Contractor under the control of the Engineer to serve as basis for the computation pf the actual volume of the excavated materials.

All excavations shall be finished to reasonably smooth and uniform surface. No materials shall be wasted without authority of the Engineer. Excavation operation shall be conducted so that material outside of the limits of slopes will not be disturbed. Prior to excavation, all necessary clearing and grubbing in the area shall have been performed.

The Contractor shall furnish, place and maintain all supports and shoring that may be required for the sides of the excavations, and all pumping, ditching or other approved measures for the removal or exclusion of water, including taking care of storm water and waste water reaching the site of the work from any source so as to prevent damage to the work or adjoining property.

b. Conservation of Topsoil

Where provided for on the Plans or in Special provisions, suitable topsoil encountered in the excavation and on areas where embarkment 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 excavation or embarkment work in the area and shall be kept separate from other excavated materials for later use.

c. Utilization of Excavated Materials

All suitable material removed from the excavation shall be used in the formation of the embarkment, 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 can not be properly compacted in the embarkments. All suitable materials 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 embarkments and backfills. All excess material, including rock and boulders that can not be used in embarkments shall be disposed off as directed. Materials encountered in the excavation and determined by the Engineer as suitable fortopping, road finishing, slope protection, or other purposes shall be conserved and utilized as directed by the Engineer.

d. Removal of Unsuitable Materials

Where the Plans show the bottom portion of the disposal cell bed to be selected, all unsuitable materials shall be excavated to the depth necessary for replacement of the selected clay liner to the required compacted thickness.

## 3. Method of Measurement

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

For measurement purposes, surplus suitable material shall be calculated as the difference between the net volume of suitable material required to be used in embarkment or cover material corrected by applying a shrinkage factor or 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.

# DIVISION 03 : AGGREGATE BASE COURSE

## DESCRIPTION

This Item shall consist of furnishing, placing and compacting an aggregate base course on a prepared subgrade/subbase in accordance with this Specification and the lines, grades, thickness and typical cross-sections shown on the Plans, or as established by the Engineer.

## MATERIAL REQUIREMENTS

Aggregate for base course 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 base.

In some areas where the conventional base course materials are scarce or non-available, the use of 40% weathered limestone blended with 60% crushed stones or gravel shall be allowed, provided that the blended materials meet the requirements of this Item.

The base course material shall conform to the following Grading Requirements

**Grading Requirements**

| Sieve Designation | | Mass Percent Passing | |
|---|---|---|---|
| Standard mm | Alternate US Standard | Grading A | Grading B |
| 50 | 2" | 100 | |
| 37.5 | 1 – 1/2" | - | 100 |
| 25.0 | 1" | 60 - 85 | - |
| 19.0 | 3/4" | - | 60 - 85 |
| 12.5 | 1/2" | 35 - 65 | - |
| 4.75 | No. 4 | 20 - 50 | 30 - 55 |
| 0.425 | No. 40 | 5 - 20 | 8 - 25 |
| 0.075 | No. 200 | 0 - 12 | 2 - 14 |

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 25 and plasticity index not greater than 6 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 test determined by AASHTO T 96.

The material passing the 19 mm (3/4 inch) sieve shall have a soaked **CBR value** of not less than **80%** as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density (MDD) as determined by AASHTO T 180, Method D.

If filler, in addition to that naturally present, is necessary for meeting the grading requirements or for satisfactory bonding, it shall be uniformly blended with the base course material on the road or in a pug mill unless otherwise specified or approved. Filler shall be taken from sources approved by the Engineer, shall be free from hard lumps and shall not contain more than 15 percent of material retained on the 4.75 mm (No. 4) sieve.

**CONSTRUCTION REQUIREMENTS**

*PLACING*

The aggregate base material shall be placed at a uniform mixture on a prepared sub-base/ 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.

*SPREADING AND COMPACTING*

When uniformly mixed, the mixture shall be spread to the plan thickness, for compaction.

Where the required thickness is 150mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate base 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 sub-base 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 base material shall be compacted thoroughly with approved tampers or compactors.
If the layer of base 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/ASTM D 1556.

*TRIAL SECTION*

Before base 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.

*SURVEYS AND SETTING OUT WORKS*

Before the commencement of the pavement works, the Contractor together with the Engineer shall conduct topographic survey which will form the basis of quantity measurement.

The Contractor shall set out the works and shall be solely responsible for the accuracy of such setting-out.

Prior to placement of any material, the Contractor shall establish visible construction markers to clearly define horizontal limits of the Work.

*TOLERANCES*

The aggregate base course shall be laid to the designed level and transverse slopes shown on the Plans. The allowable tolerances shall be in accordance with following:

| | |
|---|---|
| Permitted variation from design<br>THICKNESS OF LAYER | ± 10 mm |
| Permitted variation from design<br>LEVEL OF SURFACE | + 5 mm<br>-10 mm |
| Permitted SURFACE IRREGULARITY<br>Measured by 3-m straight-edge | 5 mm |
| Permitted variation from design<br>CROSSFALL OR CAMBER | ± 0.2% |
| Permitted variation from design<br>LONGITUDINAL GRADE over<br>25 m in length | ± 0.1% |

## METHOD OF MEASUREMENT

Aggregate Base Course will be measured by the cubic meter (m3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed base course. No allowance shall 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 aggregate base course.

## DIVISION 04 : PORTLAND CEMENT CONCRETE PAVEMENT

**Description:**

The thickness of the PCCP shall be 300mm. This item shall consist of Portland Cement Concrete, with or without reinforcement, constructed on the prepared base in accordance with this Specification and in conformity with the lines, grades, thickness and typical cross-section shown on the Plans.

**Material Requirements:**

1. Portland Cement. It shall conform to the applicable requirements of item 700 of ASTM, Hydraulic Cement. Only Type 1 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. Cement, which for any reason, has become partially set or which contain 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.

2. Fine Aggregates. It shall consist of natural sand, stone screenings or other inert materials with similar characteristic, or combinations thereof, having hard, strong and durable particles approved by the Engineer. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile or used alternately in the same class of concrete without the approval of the Engineer.

   It shall not contain more than three mass percent of material passing the 0.075mm (No. 200 sieve) by washing nor more than one 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 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 and if 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 below.

Table- Grading Requirements for fine Aggregates

| Sieve Designation | Mass Percent Passing |
|---|---|
| Passing 9.5 mm (3/8 in) | 100 |
| 4.75 mm (No. 4) | 95 - 100 |
| 1.18 mm (No. 16) | 45 - 80 |
| 0.300 mm (No. 50) | 5 - 30 |
| 30 0.150 mm (No. 100) | 0.10 |

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 no more than one mass percent of material passing the 0.075mm (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 aggregates is subjected to five 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 slag is used, its density shall not be less than 1120kg/m³ (70 lb/cu.ft.). The gradation of the coarse aggregate shall confirm to Table below. Only one grading specification shall be used from any source.

Table - Grading Requirements for Coarse Aggregate

| SIEVE Standard mm | DESIGNATION Alternate US Standard | MASS Grading A | PERCENT Grading B | PASSING Grading C |
|---|---|---|---|---|
| 75.0 | 3 in | 100 | - | - |
| 63.0 | 2 ½ in | 90 – 100 | 100 | 100 |
| 50.0 | 2 in | - | 90 – 100 | 95 – 100 |
| 37.5 | 1 ½ in | 25 – 60 | 35 – 70 | - |
| 25.0 | 1 in | - | 0 – 15 | 35 – 70 |
| 19.0 | ¾ in | 0 – 10 | - | - |
| 2.5 | ½ in | 0 – 5 | 0 – 5 | 10 – 30 |
| 4.75 | No. 4 | - | - | 0 – 5 |

4. Water. Water used in mixing, curing, or other designated applications 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. 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.

5. Reinforcing Steel. It shall confirm to the requirements of Item 404, Reinforcing Steel. Dowel 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 not to be bent and re-straightened 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.

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. Performed joint filler shall conform to the applicable requirements of Item 705 of ASTM. 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 place for full depth and width required for the joint.

7. Admixtures. Air-entraining admixtures shall conform to the requirements of AASHTO M 154. 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.

8. Curing Materials. Cotton mats, burlap clothe, waterproof paper, liquid membrane forming compounds, or sheeting (film) materials shall conform to the applicable requirements of Item 708, Concrete Curing Materials and Admixtures.

9. Calcium Chloride. It shall conform to AASHTO M 144, if specified or permitted by the Engineer.

10. Storage of Cement and Aggregate. All cements 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 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 shortage when wrested is ordered by the Engineer. At the time of use, all cements shall be 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 to 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 aggregates shall be stored in separate bins or in separate stockpiles sufficiently remote from each other to prevent the material at the edges of the piles from becoming intermixed.

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 Heavy Weight Concrete". It is the intent of this Specification to require approximately 9.0 bags of cement per cubic meter of concrete based on a 40 kg per bag of cement. However, richer mixes may be used in order to meet the minimum strength requirements. The Engineer shall determine from laboratory test of the materials to be used, the cement content and the proportions of aggregate and water that will produce a workable concrete having a slump between 40 and 75mm (1- ½ and 3 inches) if not vibrated or between 10 and 40mm (1/2 and 1 ½ 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 midpoint method; or a compressive strength of 24.1 MPa (3500 psi) when tested at fourteen days in accordance with AASHTO T 97, T 177 or 22, respectively.

    Slump shall be determine using AASHTO T 199.

    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 of composite, monolithic concrete pavements using a minimum of 75mm (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 work may necessitate a new design mix.

12. Construction Requirements:

*A. Quality Control of Concrete*

1. General.

The Contractor shall be responsible for the quality control of all materials during the handling, blending, 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 ensure that the concrete he produces complies with the specification. The Engineer shall be provided free access to recent plant production records, and if requested, informational copies of mixing design, material certifications and sampling and testing reports.

3. Qualification of Workmen.

Experienced and qualified personnel shall perform all batching or mixing operations 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 as follows:

a. Concrete Batcher – The person performing the batching or mixing operation shall be capable of accurately conducting aggregate surface moisture determinations and establishing correct scale weight for concrete materials. He shall be capable of assuring that the proportioned batch weight of materials is 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 test on concrete and on concrete materials in accordance with these specifications. He shall be capable of adjusting concrete mix design for improving workability and specification compliance and preparing trial mix design. 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 deficiency found, the quantities approved and nature of any corrective action taken.

The Engineer may take independent assurance samples at random location for acceptance purposes, as he deems necessary.

*B. Equipment.*

Equipment and tools necessary for handling 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 plant 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 sprinkles-dial type. They shall be accurate within one-half percent throughout the range of use. Poises shall be designed to be locked in any position and to prevent unauthorized change. Scale shall be inspected and sealed as often as the Engineer may deem necessary to assure their continued accuracy.

d. 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. Mixer

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 place 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 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 release 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 batches mixed.

c. Truck mixer and Truck Agitators – Truck mixes used for mixing and hauling concrete, and truck agitator is used for hauling central-mixed concrete shall conform to the requirements of AASHTO M 157.

d. Non-Agitator Trucks – 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 homogenous pavement in conformance with the plans and specifications. The finishing machine shall be equipped with at least two 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 blade or an abrasive wheel to the required dimensions and at required rate. He shall provide at least one stand-by saw in good working condition and with an ample supply of saw blades.

5. Forms

Forms shall be steel or wood, of an approved section, and of a 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.

*C. Preparation of Grade*

After the sub-grade or base has been placed and compacted to the required density, the areas which will support the paving machine and the grade on which the pavements are to be constructed shall be trimmed to the proper elevation by means of a property designed machine extending the work 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 sub-grade or base, the surface shall be checked and corrected immediately ahead of the placing concrete. The sub-grade or base shall be uniformly moist when the concrete is placed.

*D. 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 contract 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 3 cm or less, and thoroughly rerolled or tamped. Imperfections variations above grade shall be corrected by tamping or by cutting as necessary.
2. Form Setting. Forms shall be set sufficiently in advance at the point where concrete is being placed. After the forms have been set to correct grade, the base 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 by more the 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.

*E. Conditioning of Sub-grade or Base Course*

When side forms have been securely set to grade, the sub-grade or base course shall be brought to proper cross-section. High areas shall be trimmed to proper elevation. Low areas shall be filled and properly compacted. The finished grade shall be maintained in a smooth and compacted until the pavement is placed.

Unless waterproof sub-grade or base course cover material is specified, the sub-grade or base course shall be uniformly moist when the concrete is placed. If it subsequently becomes too dirty, the sub-grade or base course shall be sprinkled, but the method of sprinkling shall not be such as to form mud or pools of water.

*F. Handling, Measuring and Batching Materials.*

The batch plan 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 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 aggregate and aggregates produced or handled by hydraulic methods, shall be stockpiled or binned for draining at least twelve hours before being batched.

When mixing is done at the site of the work, aggregates shall be transported from the batching plant to the mixer in batch boxes, vehicle bodies, or other containers od 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, while chute, boot or other approved device. This is 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 of the batch. However, if allowed in the Special Provisions, it may be transported between the fine and coarse aggregate. When cement is placed in content with the aggregates, batches may be rejected unless mixed within 1 - 1 ½ 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 as to result in the weight to each material required within a tolerance of once percent for cement and two 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 one percent. Unless the water is to be weighed, the water measuring equipment tank shall be equipped with an outside tap and valve to provide for checking the setting, unless other means are provided for readily and accurate 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.

*G. Mixing Concrete.*

The concrete may be mixed at the site in a central mix plant, or in a 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 requirement 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 engineer verifying that the make and model of the mixer will produce uniform concrete conforming to the provisions 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 seconds nor more than ninety seconds, unless mixer performance tests prove adequate, mixing of the concrete is a shorter time period.

Four seconds shall be added to the specified mixing time if timing starts at the instant the skip reaches its maximum raise position. Mixing time ends when 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 nameplate attached on the mixer. Any concrete mixed less than the specified expense. The volume of concrete mixed per batch shall not exceed the mixer's nominal capacity in cubic meter, as shown on the manufacturer's standard rating plate on the mixer, except that an overload up to ten 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 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. The throat of the drum shall be kept free of such accumulations as it may restrict the free flow of material into the drum.

Mixed concrete from the central mixing plant shall be transported in truck mixers, truck agitators or non-agitating trucks specified in Subsection 4.5.2, 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 45 minutes when the concrete is hauled in non-agitating trucks, nor 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.

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 45 minutes after 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.

*H. 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 may require that steps be taken to prevent the temperature of mixed concrete from exceeding a specified maximum temperature of 90°F (32°C). Concrete is not place within 90 minutes from the time the ingredients were charged into the mixing drum or that has

developed 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.

*I. Placing Concrete.*

Concrete shall be deposited in such a manner to require minimal re-handling. 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 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.

Where concrete is to be placed adjoining a previously constructed lane and mechanical equipment will be operated upon the existing lane, the previously constructed lane shall have attained the strength for 14-day concrete. If only finishing equipment is carried on the existing lane, paving in adjoining lanes may be permitted after three days.

Concrete shall thoroughly be 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 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 form 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.

*J. Test Specimens.*

As work progresses, at least one set consisting of three concrete beam test specimens, 150 mm x 150 mm x 525 or 900 mm shall be taken form 330 sq.mm 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.

The beam shall be made, cured, and tested in accordance with AASHTO T 23 and T 97.

*K. 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 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 screened. 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 advanced of concrete placement of 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 bond of the steel with the concrete.

*L. Joints.*

Joints shall be constructed of the type and dimensions, and at the locations require by the plans or special provision. All joints shall be protected from the intrusion of injurious foreign material until sealed.

a) Longitudinal Joint. Deformed steel tie bars of specified length, size, spacing and materials shall be placed perpendicular to the longitudinal joint, they shall be placed by approved mechanical equipment rigidly secured by the chair or other approved supports to prevent displacement. Tie bars shall not be painted or coated with asphalt or other material, or enclosed in tubes or sleeves. When shown on the plans and when adjacent lanes of pavement are constructed separately, steel aside forms shall be used which will form 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-pieces connectors may be used.

   Longitudinal formed joints shall consist of a groove cleft, extending downward from and normal to, the surface of the pavement. These joints shall be affected or formed by an approved mechanical or manually operated device of the dimensions and line indicated on the manually operated device is in a plastic state. The groove or cleft shall be filled with either a pre-molded strip or poured material as required. The longitudinal joint 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 saw to the depth, width and line shown on the plans. Suitable guidelines or devices shall be used to assure cutting the longitude 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 material, which will not react adversely with the chemical constituent of the concrete.

b) Transverse Expansion joint. The expansion joint filler shall be continuous from form to form shaped to the subgrade and to the keyway along the form. Preformed joint filler shall be furnished in length 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.

c) Transverse Contraction 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 loaded transfer assembles.
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 and 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 Contract Joint It shall be created by sawing grooves in the surface of the pavement of the width, depth, and 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 joints shall commence as soon as the concrete has hardened sufficiently to permit sawing without excessive raveling, usually within 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 condition. 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 initial set of concrete as provided above.

d) Transverse Construction Joint It shall be constructed when there is an interruption of more the 3o minutes in the concerning operation. 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 1.50 m long, the excess concrete form the last preceding joint shall be removed and disposed of as directed.

e) Load Transfer Device Dowels, when used, shall be held in position parallel to the surface and centerline of the slab by a metal device that is left in the pavement. The portion of each dowel painted with on coat of lead or tar, in conformance with the requirements of Item 404 of ASTM, 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.

*M. Final Strike-off (Consolidation and Finishing)*

1. Sequence The sequence of operations shall be the strike-off and consolidation, floating and removal of Latinate, 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 correction 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 approved spray equipment.

2. Finishing at Joints The concrete adjacent to joints shall be compacted or firmly placed without voids or segregation against the joint material, 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. Placing concrete. After the concrete has been placed and vibrated adjacent to the joints as required, 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 screened by an approved finishing machine. The machine shall go over each area of pavement as many times and at such interval 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 machines 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 screened in its entire length.
b. Vibratory Method When vibration is specified, vibrators for full width vibration of concrete paving slabs shall meet the requirements. Equipment. If uniform and satisfactory density of the concrete is not obtained by the vibratory method at joints, along forms, at structure, and throughout the pavement, the contractor will be required to furnish equipment and method, which will produce pavement conforming to the specifications. All the provisions in item 1 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 od 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 are 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 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 265 cm (feet) in length and 15 cm (6 inches) in width, properly stiffened to prevent flexibility and warping. The longitudinal float, operated 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 successive advances of not more that one-half 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 the preceding methods of floating. When strike off and consolidations 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 operation. After floating, any excess water and latinate shall be removed from the surface of the pavement by a 3-m straightedge 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 swing 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 centerline 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. Special attention shall be given to assure that the surface across joints meets the requirements for smoothness. Straight edge testing and surface correction shall be continued until the entire surface is found to be free from observable departures form the straight edge and the slab conforms to the required grade and cross-section.

7. Final Finish. If the surface texture is broom finished, it shall be applied 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 tough 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 as 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 a 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 centerline and with a rapid advance parallel to the centerline. 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 of gritty texture after dragging it longitudinally along the full width of pavement. For pavement 5m 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 drag is used. The drag shall consist of not less than two 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 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 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 appealing 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 straightedge before the concrete has sent and correction made if one edge of the joint is higher than the other.

*N. Surface Test.*

As soon as the concrete has hardened sufficiently, the pavement surface shall be tested with a 3m straightedge or other specified device. Area showing high spots of more than 3mm 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 deviation in excess of 3 mm when tested with 3 m straightedge. 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 section to be 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.

*O. 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, 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.

1. Cotton or 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 extends at least twice 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 more completely covered. Prior to being placed, the mats shall be saturated thoroughly with water. The mat shall be so placed and weighed down so as to cause them to remain in intimate contact with the surface covered. The mats shall be maintained fully wetted in position for 72 hours 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 weighed down so as to cause it to remain in intimate contact with the surface covered. The paper shall have such dimensions 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 sized which will provide this width shall be surely 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 as hours after placing the concrete. As soon as 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 mats. The curing compound shall not be applied during rain. Curing compound shall be applied under pressure at the rate of 4L 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 shaped 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 insure 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 firm will harden within 30 minutes after application. Should the film be damaged from any cause within the 72 hour curing period, the damaged portion shall be repaired immediately with additional compound.

5. White Polythene Sheet The top surface and sides of the pavement shall be entirely covered with polythene sheeting. The units used shall be lapped at least 45 cm. The sheeting shall be so placed and weighed 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.

*P. 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 crossover, etc. the plans or special provisions will indicate the location and type od device or facility required to protect the work and provide adequately for traffic. Any damage to the pavement occurring prior to final acceptance shall be repaired or the pavement be replaced.

# DIVISION 05 : REINFORCING STEEL

## 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 whit this Specification and in conformity with the requirements shown on the plans or as directed by the Engineer.

## 2. Material Requirements

Reinforcing steel shall meet the requirements for reinforcing steel.

## 3. Construction Requirements

a. Order List

Before materials are ordered, all order lists and bending diagrams shall be furnished by the contractor, for approval of the Engineer. The approved of order lists and bending diagrams by the Engineer shall in no way relieve the contractor of responsibility for the correctness of such list's 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.

b. Protection of Material

Steel reinforcement shall be stored above the surface of the ground upon platforms, skid or other support 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 caused for rejection, provided the minimum dimension, cross sectional area and tensile properties of the material meets the physical requirements for the size and grade of steel specified.

c. 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 diameter (D) in relation to the diameter of the bar (d):

Bends and Hooks

| Nominal diameter, (d), mm | Pin diameter (D) |
|---|---|
| 10 to 20 | 6d |
| 25 to 28 | 8d |
| 32 and greater 1 | 0d |

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

d. 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 settling of the concrete. Bars shall be tied at all intersections except where spacing is less than 300 mm 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 that 6 mm. blocks for holding reinforcement from contact with the forms shall be precast mortar blocks approved shapes and dimensions. Layers of bars shall be separated by precast blocks or by other equally suitable devices. The use of Peebles, pieces of broker stone or brick, metal pipe and wooden blocks shall not be permitted. The minimum distance between bars shall be 40 mm. reinforcement any member shall be placed, inspected and approved by the Engineer before the concrete begins. Concrete placed in violation of this provision may be rejected and removal may be required.

e. 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 tapped a minimum distance of:

| Splice | Grade 40 | Grade 50 | But not less than |
|---|---|---|---|
| Tension | 24 bar dia. | 36 bar dia. | 300 mm |
| Compression | 20 bar dia. | 24 bar dia. | 300 mm |

In tapped 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 (1 1/3) the maximum size 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.

**4. Method of Measurement**

The quantity of reinforcing steel to be paid for will be the final quantity placed and accepted in the completed structure. No allowance will be made for tie-wires, separators, wire chairs and other material used in fastening the reinforcing steel in place. No measurement or payment will be made for splices added by the contractor. When there is no item for reinforcing steel in the bill of quantities, cost will be considered as incidental to the other items. (i.e. structural concrete, masonry, etc.) in the bill of quantities.

# DIVISION 06 : STRUCTURAL CONCRETE

## 1. Description

### a. Scope of Work

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, course aggregate, admixture when specified or approved by the Engineer.

### b. Classes and Uses of Concrete

Five classes of concrete are provided for in this item, namely: A, B, C, P and Seal. Each class shall be used in that part of the 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 reinforcement sections, 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.

## 2. Material Requirements

a. Portland Cement. It shall conform to the applicable requirements of item 700 of ASTM, Hydraulic Cement. Only Type 1 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.

Cement, which for any reason, has become partially set or which contain 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.

b. Fine Aggregate. It shall consist of natural sand, stone screenings or other inert materials with similar characteristic, or combinations thereof, having hard, strong and durable particles approved by the Engineer. Fine aggregate from different sources of supply shall not be mixed or stored in the same pile or used alternately in the same class of concrete without the approval of the Engineer.

It shall not contain more than three mass percent of material passing the 0.075mm (No. 200 sieve) by washing nor more than one 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 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 and if 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 below.

Table- Grading Requirements for fine Aggregates

| Sieve Designation | Mass Percent Passing |
|---|---|
| Passing 9.5 mm (3/8 in) | 100 |
| 4.75 mm (No. 4) | 95 - 100 |
| 1.18 mm (No. 16) | 45 - 80 |
| 0.300 mm (No. 50) | 5 - 30 |
| 30 0.150 mm (No. 100) | 0.10 |

c. 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 no more than one mass percent of material passing the 0.075mm (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 aggregates is subjected to five 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 slag is used, its density shall not be less than 1120kg/m³ (70 lb/cu.ft.). The gradation of the coarse aggregate shall confirm to Table below. Only one grading specification shall be used from any source.

Table - Grading Requirements for Coarse Aggregate

| Standard (Mm) | Alternate US Standard | Class A | Class B | Class C | Class D | Class Seal63 |
|---|---|---|---|---|---|---|
| 63 | 2-1/2" | | | | | |
| 50 | 2' | 100 | 100 | | | |
| 37.5 | 1-1/2" | 95 - 100 | '- | | | 100 |
| 25 | 1" | '- | 35 - 70 | '- | 100 | 95 - 100 |
| 19 | ¼" | 35 – 70 | '- | 100 | '- | 25 - 60 |
| 12.5 | ½" | '- | 10 - 30 | 90 - 100 | '- | 25 - 60 |
| 9.5 | 3/8" | 10 - 30 | '- | 40 - 70 | 20 - 55 | '- |
| 4.75 | No. 4 | 0 - 5 | 0 - 5 | 0 - 15 | 0 - 10 | 0 - 10 |

d. Water. Water used in mixing, curing, or other designated applications 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. 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.

e. Reinforcing Steel.

1) General
Steel reinforcement shall be provided as indicated, together with all necessary wire ties, chairs, spacers, supports and other devices necessary to install and secure the reinforcement properly. All reinforcement, when placed, shall be free from loose, flaky rust and scale, oil grease, clay, and other coating and foreign substances that would reduce or destroy its bond with concrete. Reinforcement shall be placed accurately and secured in place by use of metal or concrete supports, spacers and ties. Such support shall be of sufficient strength to maintain the reinforcement in place throughout the concreting operations. The supports shall be used in such manner that they will not be exposed or contribute in any way to the discoloration or deterioration of the concrete.

2) Splicing
Splices shall be by lapping to develop the full strength of the bars unless otherwise indicated, the minimum splice length shall be 40 times the bar diameter or the development length.

f. Admixtures
Admixtures shall conform to the requirements specified in PCCP Technical Specifications sub-Section.

g. Curing Materials
Curing materials shall conform to the requirements specified in PCCP Technical Specifications sub-Section.

h. Storage of Cement and Aggregates
Storing of cement and aggregates shall conform to all the requirements specified in PCCP Technical Specifications sub-Section.

**3. Sampling and Testing of Structural Concrete**

As work progresses, at least one (1) sample consisting of three (3) concrete cylinder test specimens, 150mm x 300mm (6"x12") shall be taken from each seventy five (75) cubic meter of each class of concrete of fraction thereof placed each day. Compliance with the requirements of this section shall be determined in accordance with the following standard methods of AASHTO:

| | |
|---|---|
| Sampling of fresh concrete | T 141 |
| Weight per cubic meter and air content (gravi-metric) 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 fine aggregate | T 84 |

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

| | |
|---|---|
| Making and curing concrete comprehensive and flexural test Specimens in the filed | T 23 |
| Comprehensive strength of molded concrete cylinders | T 22 |

## 4. Production Requirements

a) 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 the table below, using absolute 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.

Table – Composition and Strength of Concrete for use in Structure

| 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 150 mm x 300mm Conc. Cylinder Specimen at 28 days, $MN/m^3$ (psi) |
|---|---|---|---|---|---|
| A | (360) (9 bags) | 0.53 | 50-100 (2 – 4) | 37.5 – 4.75 (1 – ½" – 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 (¾" – No.4) | 37.7 (5000) |
| SEAL | 380 (9.5 bags) | 0.58 | 100 – 200 (4 – 8) | 25 – 4.75 (1" – No.4) | 20.7 (3000) |

The measured cement content shall be within plus (+) or minus (-) 2 mass percent of the design cement content. Based on 40 kg/bag.

b) 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 equipment to properly place it and not by 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.

c) Mixing and Delivery

Concrete may be mixed at the site of the construction, at a central point or by a combination of central point and mixing or by a combination of central point mixing truck agitating. Mixing and delivery of concrete shall be in accordance with the appropriate requirement of AASHTO M 157 except as modified in the following paragraphs of this section, for truck

mixing in combination of central point and mixing or truck agitating. Delivery of concrete shall be regulated so that placing is at a continuous rate unless delayed by placing operations. The intervals between delivery of batches shall not be so long as to allow the concrete in place to hardened partially, and in no case shall such an interval exceed 30 minutes.

In exceptional cases and volumetric measurements are authorized, for small project requiring less than 75 cubic meters 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 aggregate. Batching and mixing shall be in accordance with ASTM C 685, Section 6 through 9.

a. 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 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.

b. 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. The first batch of concrete materials placed in the mixer shall contain a sufficient excess of cement, sand and water to coat inside the drum without reducing the required mortar content of the mix.

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, hoppers, or 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 composting a batch except water shall be deposited simultaneously in the mixer.

All concrete shall be mixed for a period of not less than 1 – ½ 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. When mixing is to cease for a period of one hour or more, the mixer shall be thoroughly cleaned. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

## 5. Formwork Construction

Concrete form shall be mortar-tight, true to the dimensions, lines and grades of the structure and with sufficient strength, rigidity, shape and surface smoothness as to leave the finished works true to the dimension shown on the plans or required by the Engineer and the surface finish as specified.

The inside surface of form shall be cleaned of all dirt, mortar and foreign material. From which will later be removed shall be thoroughly coated with form oil prior to use. The form oil shall be of commercial quality form oil or other approved coating which will permit the read release of the forms and will not discolor the concrete.

Concrete shall not be deposited in the forms until work in connection with the constructing the forms has been completed, all inspected and approved said forms and materials. Such work shall include the removal of all dirt, chips, sawdust and other foreign material from the forms.

The rate of depositing concrete in forms shall be such to prevent bulging of the forms or form panels in excess of the deflections permitted by this specification. Forms shall have sufficient strength to withstand the pressure resulting from placement and vibration of the concrete, and shall be maintained rigidly in correct position.

a) Removal of Forms and Falsework
Forms and falsework shall not be removed without the consent of the Engineer. The Engineer's consent shall not relieve the contractor of responsibility for the safety of the work. Blocks and bracing shall be removed at the time the forms are removed and in no case shall any portion of the wood forms be left in the concrete.

Falsework removal for continuous or cantilevered structures shall be as directed by the Engineer or shall be such that the structure is gradually subjected to its working stress.

When concrete strength tests are used for removal of forms and supports, such removal should not begin until the concrete has attained the percentage of the specified design strength shown in the table below;

**Table – Requirements for Removal of Forms**

| Element | Minimum Time Minimum | Percentage Design Strength |
|---|---|---|
| Centering under beams frames or arches, girders | 14 days | 80% |
| Floor slabs: | 14 days | 70% |
| Walls | 1 day | 70% |
| Columns | 2 days | 70% |
| Side of Beams and all other vertical Surfaces | 1 day | 70% |

Forms and falsework shall not be released from under concrete without first determining if the concrete has gained adequate strength without regard to the time element. In the absence of strength determination, the forms and falsework are to remain in place until removal is permitted by the Engineer.

To facilitate finishing, forms used on ornamental work, railing, parapets and exposed vertical surfaces shall be removed in not less than 12 or more than 48 hours, depending upon the weather condition of concrete in columns, forms shall always be removed from them before the removal of shoring from beneath beams and girders.

b) Construction Joints
Construction joints shall be made only where shown on the plans or called for in the pouring schedule, unless otherwise approved by the Engineer. Shear keys or reinforcement shall be used, unless otherwise specified, to transmit shear or to bond the two sections together.

Before depositing new concrete on or against concrete which has hardened, the forms shall be retightened. The surface of the hardened concrete shall be roughened as required by the Engineer, in a manner that will not leave loose particles or aggregate or damage concrete at the surface.

The placing of concrete shall be carried continuously from joint to joint. The face edges of all joints which are exposed to view shall be carefully finished true to line and elevation.

c) Concrete Surface Finishing
Surface finishing shall be classified as follows:

*Class 1 – Ordinary Finish*
Immediately following the removal of forms, all formwork and irregular protection shall be removed from all surfaces except from those which are not to be exposed or are not to be waterproofed. On all surfaces the cavities produced by form ties and all other holes, honeycomb sports, broken corners or edges and other defects shall be thoroughly cleaned, and having been kept saturated with water and made true with a mortar and fine aggregate mixed in the proportions used in the grade of concrete being finished. Mortar to be used shall not be more than one (1) hour old. The mortar patches shall be cured. All construction and expansion joints in the completed work shall be left carefully tooled and free of all mortar and concrete. The joint filler shall be left exposed for its full length, with clean and true edges.

*Class 2 – Rubbed Finish*
After removal of forms, the rubbing of concrete shall be started as soon as its condition will permit. Immediately before starting this work, the concrete shall be kept thoroughly saturated with water for a minimum period of three hours. Sufficient time shall have elapsed before the wetting down to allow the mortar used to thoroughly set. The mortar shall be composed of cement and fine sand mixed in the proportions used in the grade of concrete being finished. Rubbing shall be continued until all form marks, protections and irregularities have been removed, all voids have been filled, and a uniform surface has been obtained.

Unless otherwise specified, the following surfaces shall be given a Class 2, Rubbed Finish

(1) The exposed faces of piers, abutments, wingwalls and retaining walls.
(2) The outside face of girders, T-beams, slabs, columns, brackets, curbs, headwalls, railings, arch rings, spandrel walls and parapets.

## 6. 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 less than 100 mm (4 inches) in diameter or by reinforcing steel, anchor, conduits, weep hole or expansion joint materials.

# DIVISION 07 : DRAINAGE WORKS

## SCOPE OF WORK

The works shall consist of excavation, backfilling and construction of lateral drains, construction of manholes, reconnection to existing lateral and other related works in accordance with the dimensions, size, elevation and grade as shown on the drawing and shall conform with the Specification.

At least thirty (30) days before the start of any construction related to drainage works, the Contractor shall submit to the Engineer for his approval, shop drawings of the drainage work he intends to construct. The shop drawings shall include the materials and the general method of installation he intends to employ.

## *MATERIAL REQUIREMENTS*

BACK FILL

Fill shall be in accordance with Item "Reclamation and Fill".

GRAVEL BEDDING

Gravel Bedding/gravel base shall be in accordance with the specifications of Crushed Course Aggregates in "Reinforced Concrete".

SAND BEDDING

Sand bedding shall be in accordance with Item "Reinforced Concrete (Fine Aggregates)".

CONCRETE

Mixing/Casting and steel reinforcements shall be in accordance with Item "Reinforced Concrete" while the dimensions shall be as shown on the Drawings.

CEMENT MORTAR

Cement mortar shall consist of one part Portland cement to two parts of fine aggregate with water added as necessary to obtain the required consistency.

REINFORCED CONCRETE PIPE

The fabrication of reinforced concrete pipes shall conform to the Specifications of ASTM C 76 while the testing requirements shall conform to ASTM C 497. The Engineer reserves the right to inspect and test the pipe delivered for intended purpose. Defects that are discovered after acceptance of delivery of the pipe but before installation shall be a cause for rejection.

Standard reinforcement details and concrete strength shall be in accordance with DPWH "Standard Two Meter Concrete Pipe Culvert".

STEEL GRATING

The fabrication of grating shall conform to requirements of Steel and Metal Works" and "Zinc Coatings on Iron and Steel"

All steel grades and dimensions shall conform with the approved plans.

***EXECUTION***

EARTHWORKS

All earthworks for concrete pipe culvert shall conform to the lines, grades and elevations shown on the drawings or as directed by the Engineer.

The lateral drain shall be excavated to the depth, grade and width established by the Engineer. The bedding surface shall provide a firm foundation of uniform density throughout the entire length. Soft, spongy, or otherwise unstable material encountered that will not provide a firm foundation for the concrete drainage shall be removed to the full width of the trenches and replaced by suitable material to a depth of not less than 30 cm. 100mm thick gravel bedding shall be used as foundation or otherwise as specified.

PIPE LAYING

The pipe shall be tested for water-tightness of joints before backfilling the trench. Unsatisfactory work shall be corrected without additional cost to the PPA. The collar shall have set sufficiently prior to backfilling.

Methods of installation and typical bedding for pipe conduits if not included in the plans, shall conformed to DPWH "Standard Two Meter Reinforced Concrete Culvert".

LATERAL DRAIN

Concrete cover and the steel gratings shall be set to the required elevations as shown on the drawings to fit the adjoining surfaces and shall be installed after the adjoining concrete is struck off and finished, and the fit on the frames shall be such that there is no rocking.

All completed structures shall be thoroughly cleaned of any accumulations of silts, debris or foreign matter of any kind, until finally accepted and put into service.

CATCH BASIN INLETS, MANHOLES AND OUTLETS

Lid frames shall be set to the required elevations as shown on the drawings to fit the adjoining surfaces. Lids shall be installed after the adjoining concrete is struck off and finished, and the fit on the frames shall be such that there is no rocking.

Where reconstruction of existing catch basin inlets, manholes, outlets, or similar structures are indicated, the work shall be in accordance to the details and elevations as shown on the drawings, including re-installation of existing metal frames, grates and lids, or replacing of concrete covers instead of grates that may have been lost or found lacking. All completed structures shall be thoroughly cleaned of any accumulations of silts, debris or foreign matter of any kind, until finally accepted and put into service.

FIELD DENSITY TEST

Field Density tests to determine the percent of compaction of the fill material shall be conducted until a field density of at least 95 percent of the maximum dry density in accordance with AASHTO T180, Method D has been achieved. In place density determination shall be made in accordance with AASHTO T191.

CLEARING AND DISPOSAL

Dumping or disposal of un-used excavated materials shall be coordinated to PMO. If the excavated materials are determined for disposal, the contractor will provide all necessary works and expenses for its completion in concurrence by the Engineer.

# DIVISION 08 : WELDED STRUCTURAL STEEL

1. Description

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

It is the intent of this specification to provide for work of a quality comparable to that required under the Standards Specifications for Welded Highway and Railway Bridges of the American Welding Society. In case of dispute of for situations not adequately provided for in this Specification, those designated Standard Specifications shall be considered as the final authority and shall govern except as amended by the Special Provisions.

Welding of structural Steel shall be done only when shown on the Plans or authorized in writing by the Engineer.

2. Material Requirements

Steel base metal to be welded shall be open-hearth or electric furnace steel conforming to AASHTO M 183.

All arc-welding electrodes shall conform to the requirements of American Welding Society Specifications. Electrodes shall be of classification numbers E7016, E7018 or E7028 as required for the positions, type of current and polarity, and other conditions of intended use, and to conform to any special requirements indicated on the plans.

Filler material to be used in the repair or strengthening of old structures or for joining new parts to existing steel members, shall be adopted to the material to be welded and may depart from the foregoing requirements only if agreed by the Engineer.

3. Construction Requirements

a) Equipment

1) General

All items of equipment for welding and gas cutting shall be so designed and manufactured and in such condition as to enable qualified welders to follow the procedures and attain the results prescribed in this specification

2) Arc-Welding Equipment

Welding generators and transformers shall be designed expressly for welding. They shall be capable of delivering steady currents adjustable through a range ample for the work requirements. They shall respond automatically and quickly to changes in power requirements due to variations in arc length and shall deliver full current promptly on striking an arc.

Welding cable shall have sufficient conductivity to avoid overheating and inadequate current at the arc and shall be effectively insulated against welding circuit voltage. Earth or ground connections and circuits shall be secured and adequate to carry the welding currents.

Electrode holders shall grip the electrode firmly and with good electrical contact. Approved automatic welding heads may be used, with suitable auxiliary handling equipment to provide automatic instead of manual control of electrode and welding arc.

3) Gas-Cutting Equipment

Torches and tips shall be of proper size and type of the work at hand. Suitable regulators shall afford the welder complete control over the pressure and rate of flow of each gas.

4) Protective Equipment

All personnel protective equipment shall conform to the American Standard Association Code for such equipment.

The contractor shall enforce the use of approved accessories necessary for the protection and convenience of the welders and for the proper and efficient execution of the work.

Suitable protection against the light of the arc shall be maintained by the contractor when arc-welding operation might be viewed within harmful range by persons other than the actual welders and inspectors.

b) Welding

1) General

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

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

The width of root face used, shall be not more than 1.5mm for parts less than 10mm in thickness nor more than 3mm for parts 10mm or more in thickness.

Butt welds shall be proportioned so that their surface contours will lie in gradual transition curves. For butt welded joints between base metal parts of unequal thickness, a transition shall be provided on a slope or level not greater than 1 in 2.5 to join the offset surfaces. This transition may be provided by sloping the surface of the weld material or beveling the thicker part or by combination of these two methods.

Surfaces to be welded shall be free from loose scale, slag, rust grease or other material that will prevent proper welding. Scale mill that withstands vigorous wire brushing or a light film of drying oil or rust inhibitive coating may remain.

2) Welders

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

3) Preparation of Materials for Welding

Dimensional tolerance, straightness and flatness of the structure shapes and plates shall be within the limits prescribed in the Specification.
Structural steel which is to be welded shall preferably not be painted until all welding is completed.

Preparation of edges by gas-cutting shall, wherever practicable, be done by machine gas -cutting. Machine gas-cutting edges shall be substantially as smooth and regular as those produced by edge planning and shall be left free of slag. Manual gas cutting shall be permitted only where machine gas-cutting is not practicable and with the approval of the Engineer. The edge resulting from manual gas cutting shall be inspected and smoothed with special care. All re-entrant corners shall be filleted to a radius at least 19mm. The cut lines shall not extend beyond the fillet and all cutting shall follow closely the line prescribed.

4) Assembly

The parts to be joined by fillet welds shall be brought into a close contact as practicable, and no event shall be separated more than 5mm. If the separation is 1.5mm or greater, the leg of the fillet weld shall be increased by the amount of separation. The separation between faying surfaces of lap joints and of butt joints landing on a backing structure shall not exceed 1.5mm. The fits of joints which are not sealed by welds throughout their length shall be sufficiently close to exclude water after painting. Where irregularities in rolled shape or plates, after straightening, do not permit contact within the above limits, the procedure necessary to bring the material within these limits shall be subject to the approval of the Engineer.

Cutting parts to joined by butt welds shall be carefully aligned. Where the parts are effectively restrained against bending due to eccentricity or alignment, a maximum offset of 10 percent of the thickness or the thinner part joined, but in no case more than 3mm, may be permitted as a departure from the theoretical alignment. In connecting alignment in such cases, the parts shall not be drawn into a greater slope than two (2) degrees (1 in 30). Measurement of offset shall be between centerline of parts unless otherwise shown on the plans.

When parts abutting edge to edge differ in thickness, the joint shall be of such from that the slope of either surface through the transition zone does not exceed 1 in 2.5, the thicker part being beveled, if necessary.

Members to be welded shall be brought into correct alignment and held in position by bolts, clamps, wedges, guy lines, strut and other suitable devices or tack welds until welding has been completed. The use of jigs and fixtures is recommended where applicable. Such fastening devices as may be used shall be adequate to insure safety.

Plug and slot welds may be used to transmit shear in a lap joint or to prevent the buckling or separation of lapped parts.

The diameter of the hole for a plug weld shall not be less than the thickness of the part containing it plus 8mm nor shall it be greater than 2.25 times the thickness of the weld.

The minimum center spacing of plug welds shall be four times the diameter of the hole.

The length of the slot shall be semicircular or shall have the corners rounded to a radius not less than the thickness of the part containing it plus 8mm nor shall it be greater than 2.25 times the thickness or the weld.

The end of the slot shall be semicircular or shall have the corners rounded to a radius not less than the thickness of the part containing it, except those ends which extend to the edge of the part.

The minimum spacing of lines of slot welds in a direction transverse to their length shall be 4 times the width of the slot. The minimum center to center spacing in a longitudinal direction on any line shall be 2 times the length of the slot.

The thickness of plug or slot welds in material 16mm or less in thickness shall be equal to the thickness of the material. In material over 16mm in thickness, it shall be at least one-half the thickness of the material but not less than 16mm.

Tack welds, located where the final welds will later be made, shall be subject to the same quality requirements as the final weld. Tack welds shall be as small as practicable and where encountered in the final welding, shall be cleaned and fused thoroughly with the final weld. Defective, cracked or broken tack welds shall be removed before final welding.

Members or component parts of structures shall be assembled and matchmarked prior to erection to insure accurate assembly and adjustment of position on final erection. Painted assembly marks shall be removed from any surface to be welded.

## DIVISION 09 : PROJECT BILLBOARD

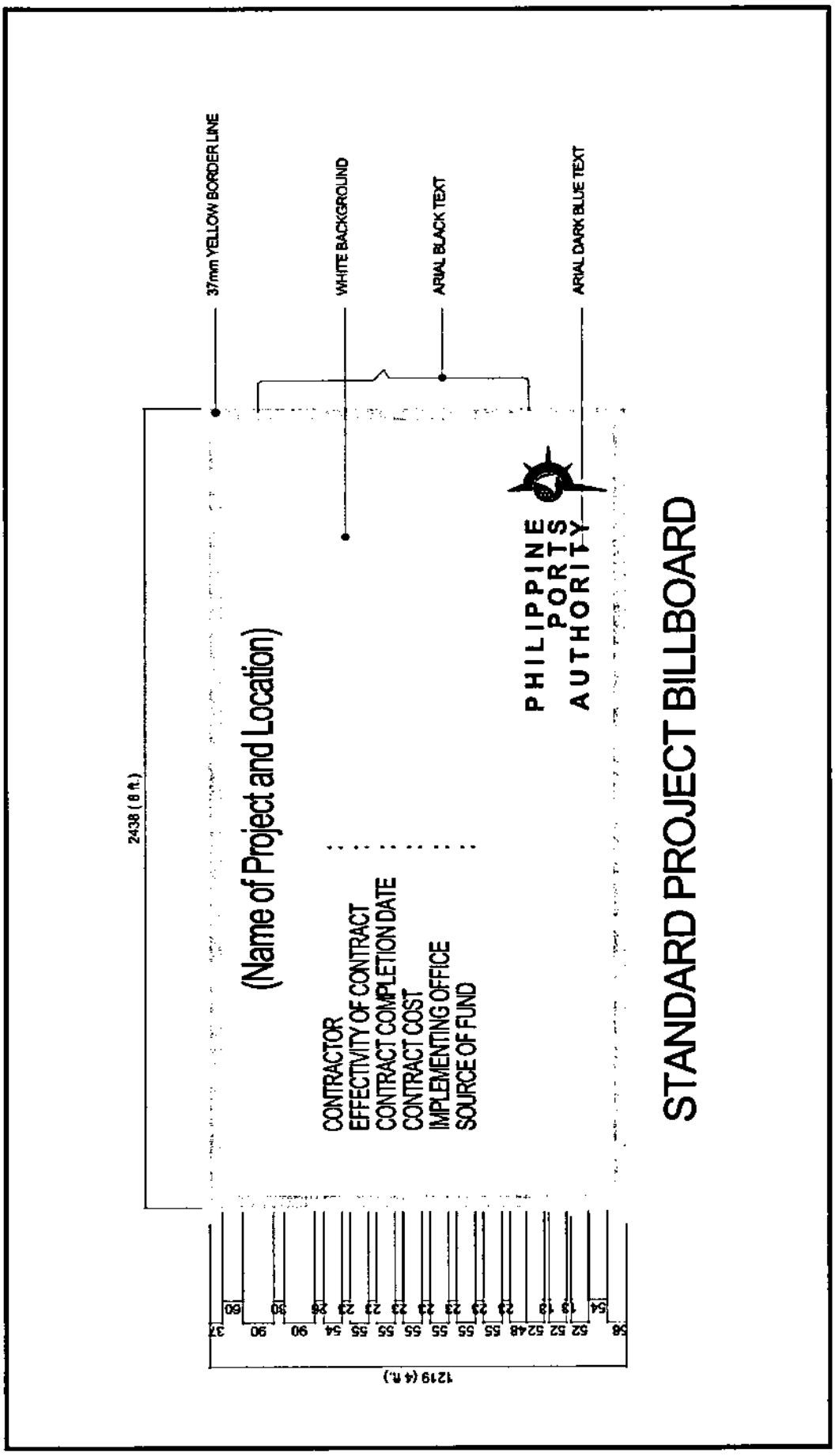
### SPECIFICATION

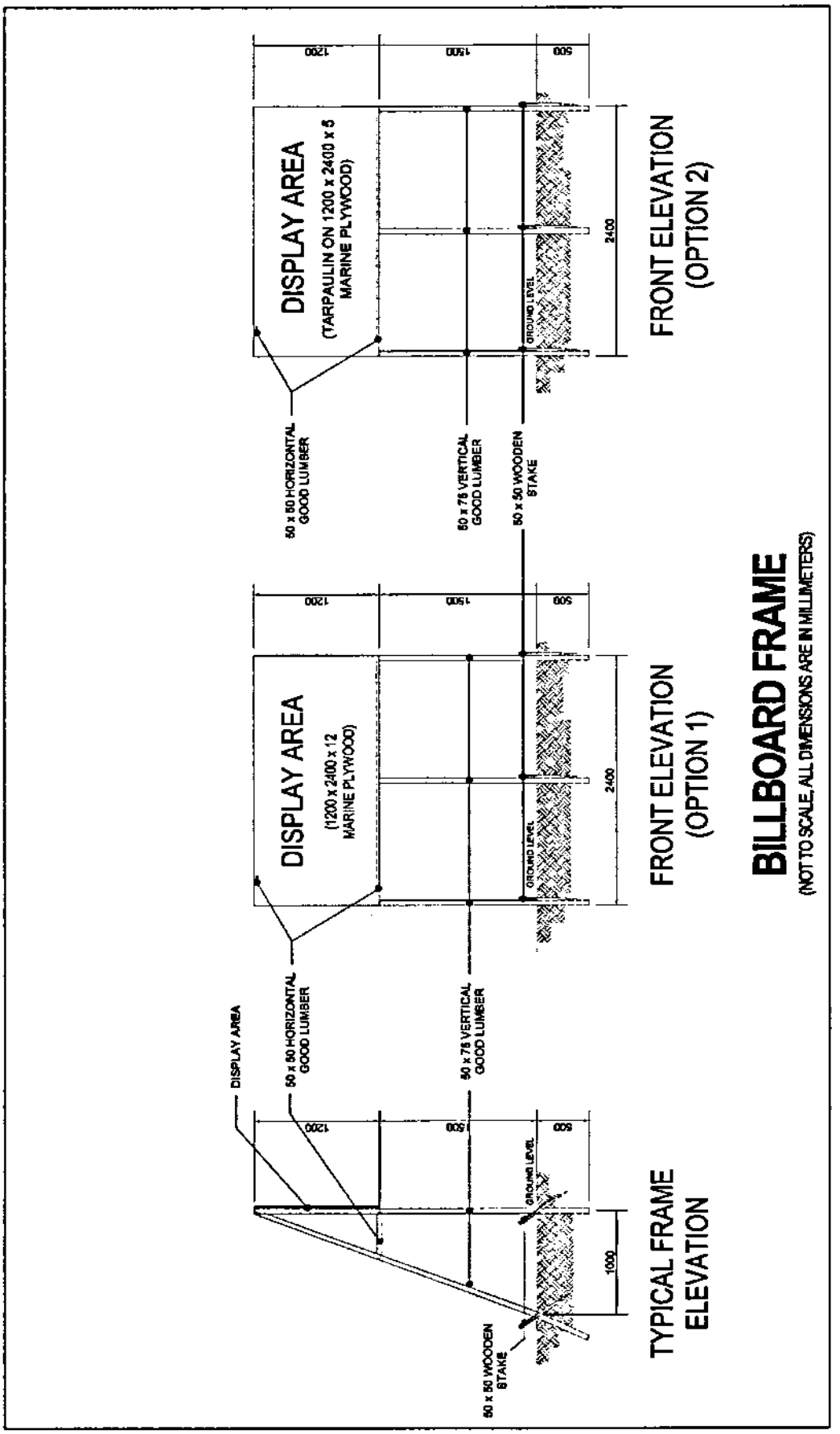
The Project Billboard shall be installed at location(s) designated by the Engineer.

The size and specifications of materials for the standard billboard shall be 4ft. x 8ft. (1,200mm x 2,400mm) using ½ inch (12mm) marine plywood or tarpaulin poster on 3/16 inch (5mm) marine plywood.

Project billboards shall not contain Name(s) and/or picture(s) of any personages.

See attached drawings for further details of the standard billboard.


STANDARD PROJECT BILLBOARD
37mm YELLOW BORDER LINE
WHITE BACKGROUND
ARIAL BLACK TEXT
ARIAL DARK BLUE TEXT
PHILIPPINE PORTS AUTHORITY
(Name of Project and Location)
CONTRACTOR
EFFECTIVITY OF CONTRACT
CONTRACT COMPLETION DATE
CONTRACT COST
IMPLEMENTING OFFICE
SOURCE OF FUND
2438 ( 8 ft.)
1219 (4 ft.)


BILLBOARD FRAME
(NOT TO SCALE, ALL DIMENSIONS ARE IN MILLIMETERS)
FRONT ELEVATION
(OPTION 2)
DISPLAY AREA
(TARPAULIN ON 1200 x 2400 x 6
MARINE PLYWOOD)
50 x 50 HORIZONTAL
GOOD LUMBER
50 x 75 VERTICAL
GOOD LUMBER
50 x 50 WOODEN
STAKE
GROUND LEVEL
2400
1200
1500
500
FRONT ELEVATION
(OPTION 1)
DISPLAY AREA
(1200 x 2400 x 12
MARINE PLYWOOD)
TYPICAL FRAME
ELEVATION
DISPLAY AREA
1000

## DIVISION 10 : SAFETY SIGNAGES AND BARRICADES

### DESCRIPTION

This work includes the furnishing and installing of safety signages and barricades in accordance with the specifications and to the details shown below in the drawings, or as directed by the Engineer.

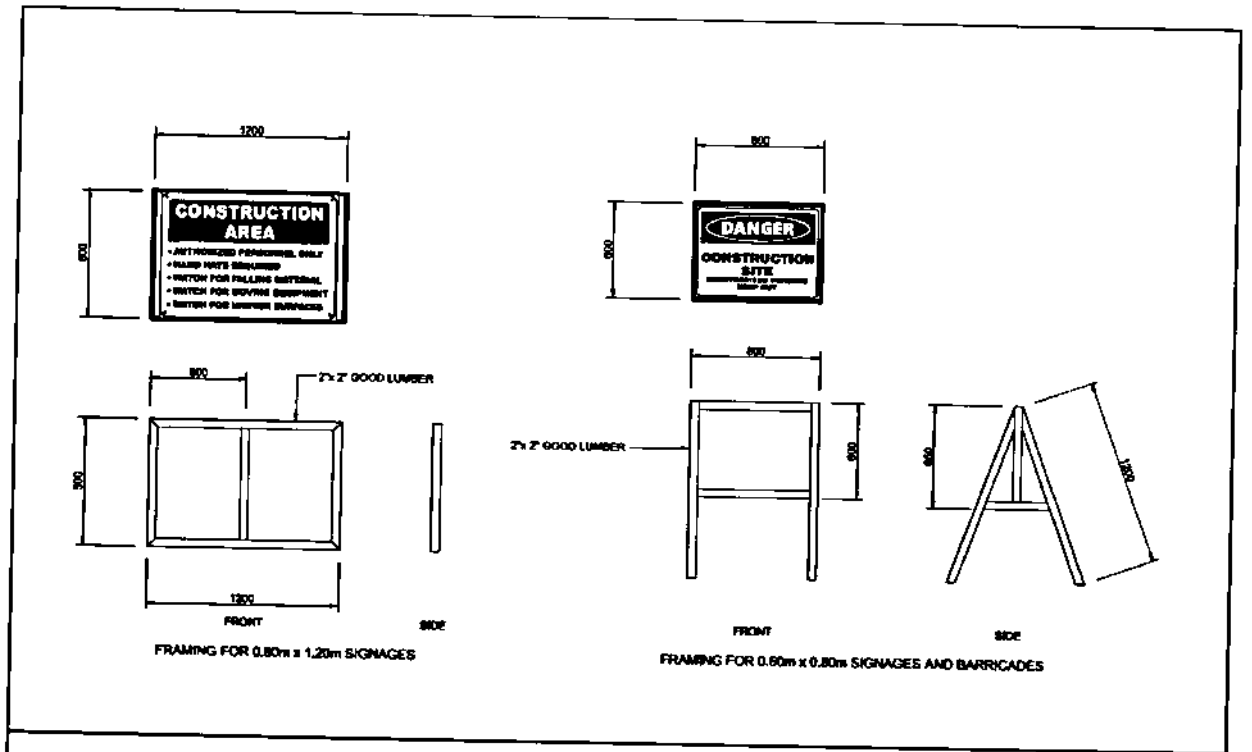
### SPECIFICATION

The Signage's and Barricades shall be installed at location(s) designated by the Engineer.

The sizes of the standard signages shall be 2-2/3ft x 4ft (800mm X 1,200mm) for fixed type and 2ft x 2–2/3ft (600mm x 800mm) for mobile type. For barricade standard 2ft x 2–2/3ft (600mm x 800mm) shall be provided.

The materials to be used for signages and barricades are ½ inch (12mm) marine plywood or tarpaulin poster on 2" x 2" (50mm x 50mm) good lumber frame (see drawing below).

The printing or painting shall be the discretion of the Engineer.




STANDARD PLAN FOR SIGNAGES AND BARRICADES

# SECTION VII

# DRAWINGS (APPROVED PLANS)

# SECTION VII

# DRAWINGS AND APPROVED PLANS
## (SEE ISSUED APPROVED PLANS)

**LIST OF DRAWINGS**:

A - Site Vicinity Plan, Site Development Plans

B-1 - Pavement Plan, Cross Section at "A", Cross Section at "B"

B-2 - Detail of Construction Joint "A", "B", Construction Joint @ End Existing to New Pavement Connection, Area pf Sidewalk for Restoration, Details for Concrete Sidewalk, Details for RC Curb & Gutter, Details of Expansion Joint, Details of Contraction Joint.

C-1 - Drainage Layout of IPB RD. to Marcos RD., Profile along the centerline of the Proposed 910 mm (36") RCPC of Section IPB Rd. to Marcos RD.

C-2 - Plan of MH-A1 & MH-A2, Section of MH-A1, Rebar Reinforcement of MH-A1, Section of MH-A1, Rebar Reinforcement of MH-A1

C-3 - Section of MH-A2, Rebar Reinforcement of MH-A2, Plan of MH-A3, Section of MH-A2, Rebar Reinforcement of MH-A2, Spot Detail of "A", Spot Detail "B"

C-4 - MH-A1,2 & 3 Cover Detail, MH-A1 & 2 Framing Detail, MH-A3 Framing Detail, Cast Iron Grating, Section Details, Framing Section Details.

D-1 - Drainage Layout of Marcos R> to Slip-0, Profile along centerline of the proposed 910mm (36") RCCP of section Marcos RD. to Slip-0

D-2 - Section of MH-A2, Rebar reinforcement of MH-A2

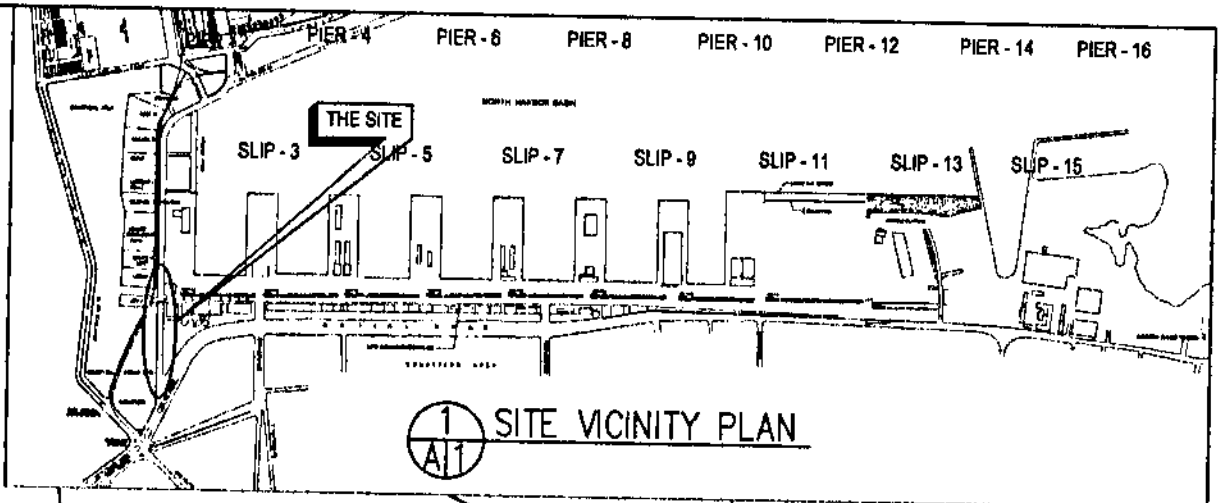
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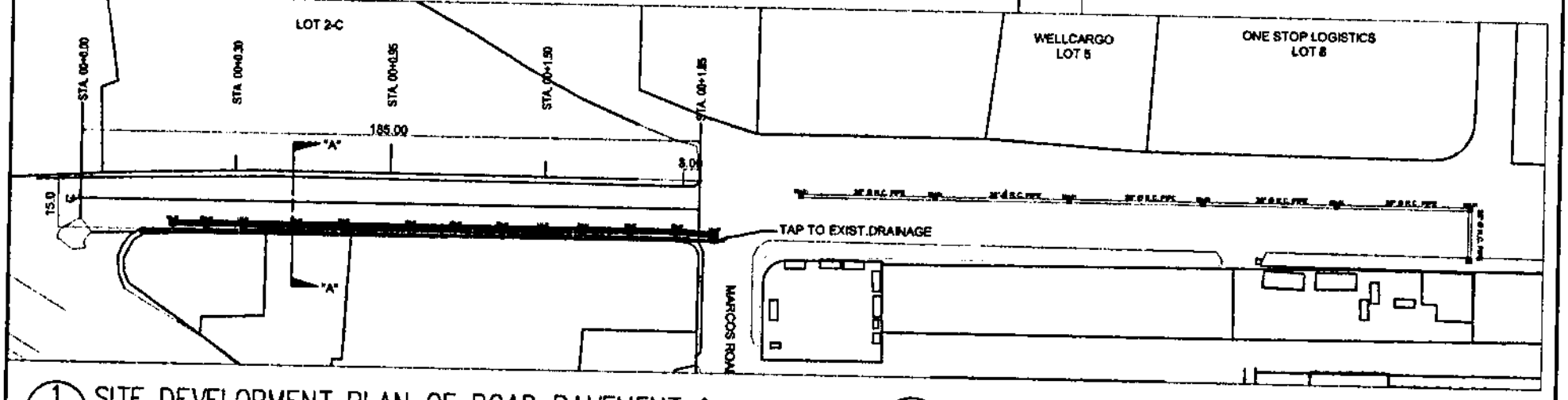
B. PAVEMENT PLAN, SECTION AND BLOW-UP DETAILS FOR DELPAN GATE TO MARCOS ROAD SECTION

C. DRAINAGE PLAN, SECTION AND BLOW-UP DETAILS FOR DELPAN GATE TO MARCOS ROAD SECTION

D. DRAINAGE PLAN, SECTION AND BLOW-UP DETAILS FOR MARCOS ROAD TO SLIP – 0 SECTION

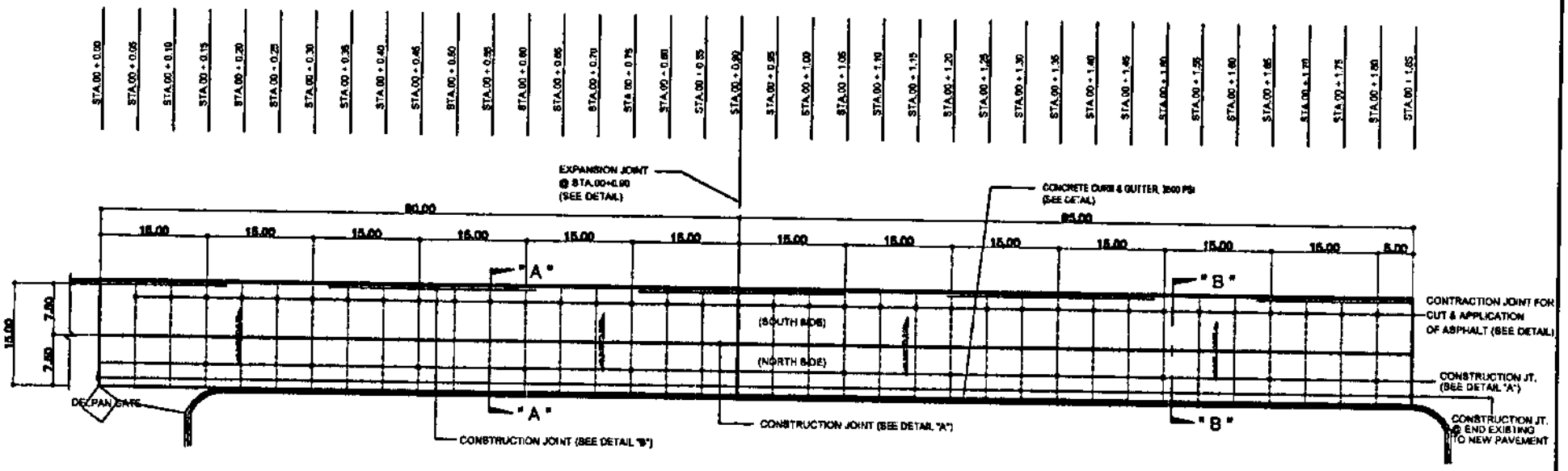

1 / A1 SITE VICINITY PLAN



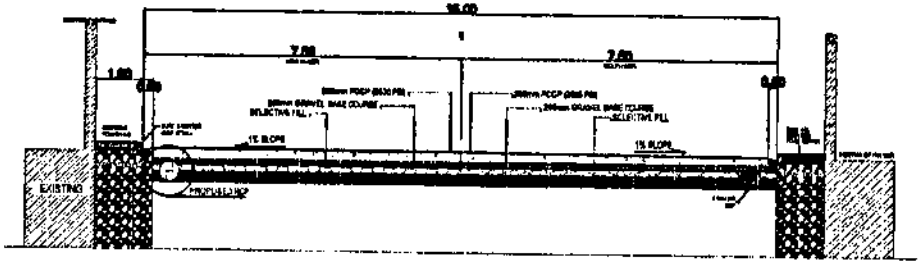

1 / A2 SITE DEVELOPMENT PLAN OF ROAD PAVEMENT & DRAINAGE FROM DELPAN GATE TO MARCOS RD. SECTION

1 / A3 SITE DEVELOPMENT PLAN OF DRAINAGE MARCOS RD. TO SLIP–0 SECTION

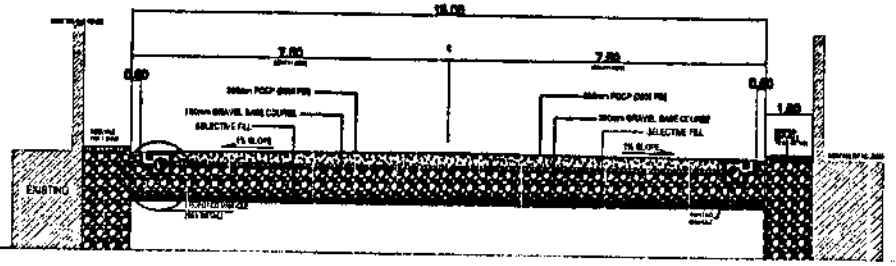
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|---|---|---|---|---|---|---|---|
| PHILIPPINE PORTS AUTHORITY | FROM THE OFFICE OF: PORT MANAGEMENT OFFICE-NCR NORTH | PROJECT TITLE: Road Pavement and Drainage Rehabilitation along Delpan - Isla Puting Bato (IPB) Roadway @ Slip-0 North Harbor, Tondo, Manila<br>LOCATION: North Harbor, Tondo, Manila | PREPARED BY: JOHN JACKSON J. FRAGO, Engineer A | RECOMMENDED BY: JOSNEL G. MANALON, Principal Engineer A | APPROVED: JON GABRIELL M. MANANSALA, Acting Port Manager, PMO-NCR North | SHEET CONTENT: AS-SHOWN | SHEET NO.: A |




1/B1 PAVEMENT PLAN
SCALE N.T.S.




1/B2 CROSS SECTION AT "A"
SCALE N.T.S.




1/B3 CROSS SECTION AT "B"
SCALE N.T.S.

| | | | | | | |
|---|---|---|---|---|---|---|
| PHILIPPINE PORTS AUTHORITY | FROM THE OFFICE OF: PORT MANAGEMENT OFFICE-NCR NORTH | PROJECT TITLE: Road Pavement and Drainage Rehabilitation along Delpan - Isla Puting Bato (IPB) Roadway @ Sip-O North Harbor, Tondo, Manila<br>LOCATION: North Harbor, Tondo, Manila | PREPARED BY: JOHN JACKSON J. FRAGO, Engineering Assistant | RECOMMENDED BY: JOENEL G. MANALON, Project Engineer A | APPROVED: JON GABRIELL M. MANANSALA, Acting Port Manager, PMO-NCR North | SHEET CONTENT: AS-SHOWN | SHEET NO. B-1 |