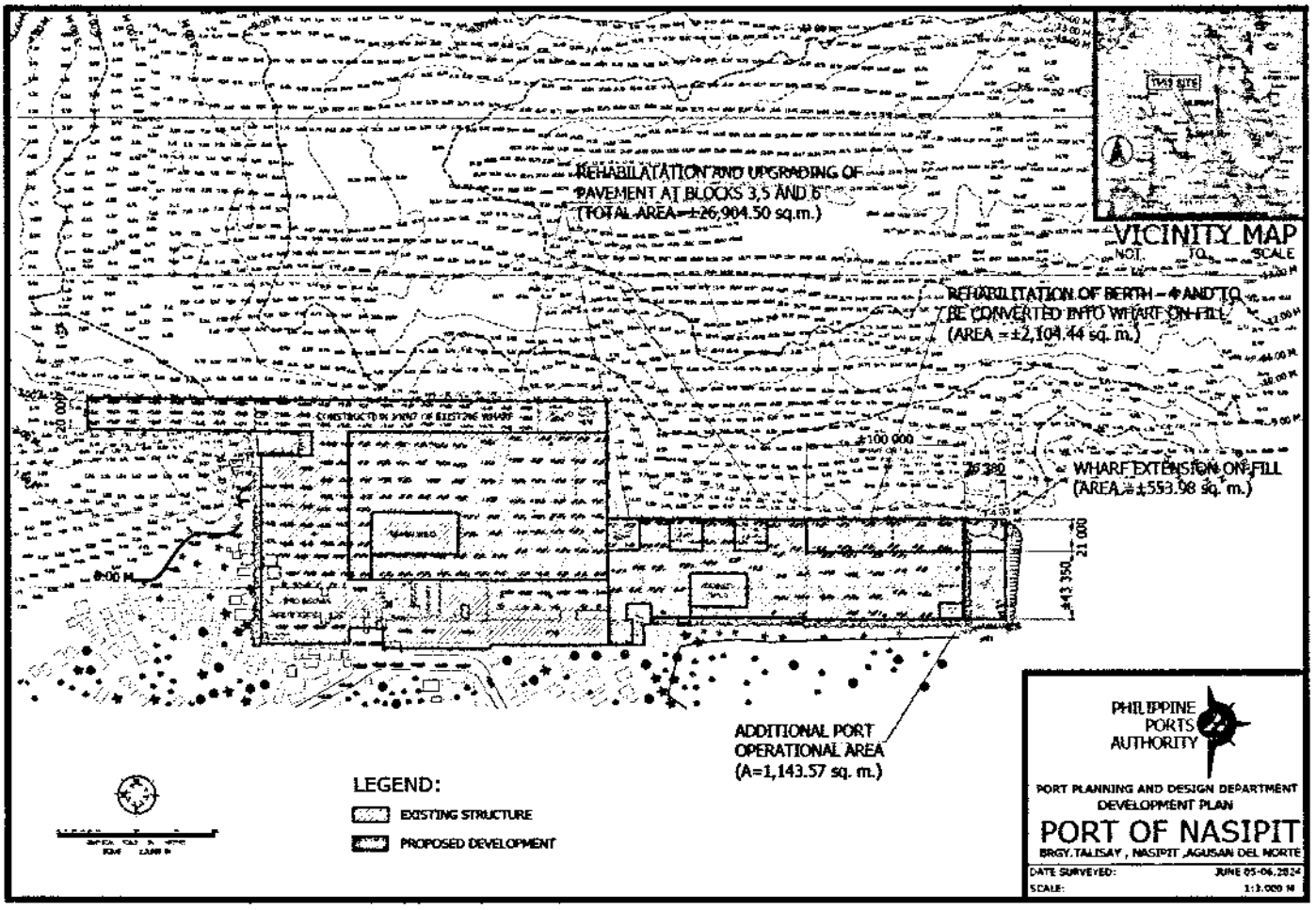
PHILIPPINE PORTS AUTHORITY

NASIPIT PORT EXPANSION AND REHABILITATION PROJECT

PORT OF NASIPIT, AGUSAN DEL NORTE
(HO-INFRA-PPDD-25-0013)



BID DOCUMENTS

NOVEMBER 2025

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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.

SECTION I

INVITATION TO BID

BAGONG PILIPINAS

PHILIPPINE PORTS AUTHORITY

INVITATION TO BID

FOR THE

NASIPIT PORT EXPANSION AND REHABILITATION PROJECT, PORT OF NASIPIT, AGUSAN DEL NORTE

The Philippine Ports Authority, through the Corporate Budget of the Authority for CY 2025, intends to apply the sum of **P530,972,253.18** being the Approved Budget for the Contract (ABC) to payments under the contract for the **NASIPIT PORT EXPANSION AND REHABILITATION PROJECT, PORT OF NASIPIT, AGUSAN DEL NORTE (HO-INFRA-PPDD-25-0013).** 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 **Six Hundred Sixty (660) 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 **27 November 2025** 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 **SEVENTY FIVE THOUSAND PESOS (P75,000.00).** 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 **05 December 2025 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 **18 December 2025 at 8:00 a.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 **18 December 2025 at 9:00 a.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: LARGE B – Port, Harbor and Offshore Engineering**

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. 8 527-47-35
8 527-83-56 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 ***Nasipit Port Expansion and Rehabilitation Project, Port of Nasipit, Agusan del Norte*** with Project Identification Number ***HO-INFRA-PPDD-25-0013.***

The ***Nasipit Port Expansion and Rehabilitation Project, Port of Nasipit, Agusan del Norte*** 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 ***CY2025*** in the amount of **₱ 530,972,253.18**.

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:
<table>
<tr><th>Description/Clarification</th><th>Unit of Measure</th><th>Quantity (at least)</th></tr>
<tr><td>1. Pile Driving works (off-shore)
2. Reinforced Concrete works
3. Rockworks (50-1,000 kg/pc.)
4. Placing of fill materials
5. Construction of Portland cement concrete pavement</td><td>l.m.
cu.m.
cu.m.
cu.m.
sq.m.</td><td>2,147
450
6,278
8,267
14,426</td></tr>
</table></td></tr>
<tr><td>7.1</td><td>Portion of Works allowed to be subcontracted:

Subcontracting is not allowed</td><td colspan="2">Maximum Percentage allowed to be subcontracted:

Subcontracting is not allowed</td></tr>
<tr><td>10.3</td><td colspan="3">For Joint Venture:

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:
<table>
<tr><th>Key Personnel</th><th>General Experience</th><th>Relevant Experience (Minimum)</th></tr>
<tr><td>a. Project Manager
b. Project Engineer
c. Materials Engineer II
d. Construction Safety and Health Officer
e. Foreman</td><td></td><td>Five (5) years
Three (3) years
One (1) year
One (1) year
Five (5) years</td></tr>
</table></td></tr>
</table>

10.5	*The minimum major equipment requirements are the following:* **Please refer to Section 8, *Annex 3 Minimum Major Equipment Requirements***
12	*Value Engineering Clause:* **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: a. The amount of not less than **₱ 10,619,445.06,** if bid security is in cash, cashier's/manager's check, bank draft/guarantee or irrevocable letter of credit; b. The amount of not less than **₱ 26,548,612.66**, 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, stitched, 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: **Not Allowed**
20	*Other appropriate licenses and permits required:* **None**
21	*Other contract documents are as follows:* *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

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

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

4. The Contractor's Obligations

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

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

5. Performance Security

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

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

6. Site Investigation Reports

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

7. Warranty

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

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

8. Liability of the Contractor

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

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

9. Termination for Other Causes

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

10. Dayworks

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

11. Program of Work

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

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

12. Instructions, Inspections and Audits

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

13. Advance Payment

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

14. Progress Payments

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

15. Operating and Maintenance Manuals

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

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

SECTION V

SPECIAL CONDITIONS OF CONTRACT

Special Conditions of Contract

GCC Clause	
2	*Sectional Completion:* **None**
4.1	The Procuring Entity shall give possession of all parts of the Site to the Contractor upon commencement of the project.
6	*Site Investigation Report:* **None**
7.2	*Permanent structures: Fifteen (15) years* 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 _____. 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

ITEM 01 : DEMOLITION AND REMOVAL WORKS

DESCRIPTION

The work includes the furnishing of all labor, materials and equipment required to carry out the demolition and removal of old structures, port accessories and obstructions including demolition of miscellaneous concrete curbs etc., as required for the execution of the Contract.

The Contractor shall submit the proposed methodology or procedure of demolition work with detailed drawings and calculations if necessary, to the Engineer for approval, before the execution of the Works.

The Contractor shall keep all pavements and landing areas to and from the site of the disposal area clean and free of mud, dirt and debris during and after the execution of disposal. Disposal of debris and materials shall be as directed by the Engineer.

GENERAL PROVISIONS

1. The Contractor shall be deemed to have satisfied himself of the site conditions, and to have included in his unit prices provision for all risks that may arise during or in connection with the work.

2. The demolition shall be carried out by approved methods and equipment such as concrete breakers, gas-cutters, hydraulic jacks, compressed air disintegrators, etc., however, no blasting shall be used unless approved in writing by the Engineer and after obtaining the written permission of the concerned authorities.

3. The Contractor shall provide suitable equipment, skilled labor and appropriate temporary works such as scaffoldings to ensure safety in his demolition works as well as in the adjacent area.

4. Contractor shall demolish all the structural members above the level on which the subsequent and permanent works under this Contract will begin. To this end, the temporary construction works such as excavation shall be conducted by the Contractor.

5. Materials coming from the demolition works, except general earth, shall remain the property of the Procuring Entity, the designated part of which shall be stored by the Contractor at places specified by the Engineer/ Accepting authority. Receiving copy of Turn-Over Report shall be provided.

6. In case of demolition of wharf deck and platform, the contractor shall ensure that no debris will be remained/deposited at seabed.

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.

EXECUTION

1. Prior to the commencement of demolition works, the alignments of the new construction works to existing structure shall be checked.

2. The width and alignment of portion of existing structure to be demolished shall be marked by paint.

3. With these lines as guides, concrete shall be broken and reinforcing bars cut, such that panels or portions of the structure can be lifted out for disposal elsewhere outside of the operational work area.

4. Rocks removed from existing slope protection shall be stored for re-use in new construction.

5. Demolish pavements, curbs, fences, utilities, services, navigation aids and the likes as determined in the field for each project and as shown on the drawings or as directed by the Engineer.

6. Materials coming from the demolition works shall be properly disposed by the Contractor.

SAFETY

During the course of survey and clearing, any obstacles which are recognized and seemed to be explosive or hazardous to workers shall be removed from the site by the proper Authority.

At the end of each day's work, the Contractor shall keep the workplace in safe condition and clean so that no part is in danger of falling or creating hazard to personnel or equipment.

ITEM 02 : EXCAVATION WORKS

SCOPE OF WORK

General Provisions

1. The area shall be excavated at the *required depth* as indicated on the Drawing/s.

2. The work includes furnishing of all labor, materials, plants and equipment required to complete/finish the excavation works.

Work Schedules

1. After examinations of all relevant data, coordination needs, work constrains, equipment to be used and other matters, a PERT/CPM diagram showing the detailed schedule/duration and sequences for the execution of excavation work shall be submitted to the Engineer for approval within 15 days before the proposed commencement of the Works.

2. Before the commencement of excavation works, the Contractor together with the Authority's Representatives and Surveyors shall conduct a pre-joint hydrographic and topographic survey which will form basis of actual quantity of excavated materials to be removed/excavated.

3. Prior to excavation works, the Contractor shall establish visible markers to clearly define the limits of the excavation.

EQUIPMENT/LAYOUT OF WORK

Plant

1. The Contractor shall keep on the job sufficient equipment/plant to meet the requirement of the project.

2. The equipment/plant shall be in satisfactorily operating conditions and capable of efficiently performing the excavation works with safety as set forth herein and shall be subject to inspection by the Engineer at all times.

Physical Data/Layout of Work

1. The Authority does not guarantee to keep the project excavation area free from obstructions.

2. The Contractor shall conduct the work in such manner not to disrupt the port operational activities at all times.

3. The Contractor shall layout his work from the government established ranges and gauges which shall be pointed out to him prior to commencement of the excavation work but shall be responsible for all measurements in connection therewith.

4. The Contractor shall furnish, at his own expense, survey equipment, range markers, poles, buoys, etc., and labor as may be required in laying out any part of the excavation work.

5. The Contractor shall be responsible for the installation, maintenance and preservation of all gauges, ranges, platforms, excavation limit markers. Upon completion of the work, the Contractor shall promptly remove all ranges, markers, and other marker placed by him that may be detrimental to port operation.

EXECUTION

EXCAVATION WORKS

Description

1. This item shall consist for the removal of existing seabed/fill in conformity with the dimensions shown in hydrographic and topographic survey plan or as established by the Engineer.

2. The excavated suitable materials shall be used if proven to pass the requirements as backfilling materials.

3. The excavated good materials shall be stockpiled within the project site to be designated by the Engineer. The good materials shall be used for backfilling as directed by the Engineer.

Progress of Work

1. Upon mobilizing sufficient labors, materials, plants and equipment, the Contractor shall works at such hours as may be necessary, subject to existing laws, to ensure the prosecution of work in accordance with the approved schedule (PERT/CPM). If the Contractor falls behind the approved excavation schedule, the Engineer may require the Contractor to increase the number of shifts and/or equipment without extra cost to the Authority.

2. Failure of the Contractor to comply with the requirements shall be reasonable grounds to assume that the Contractor is not performing the excavation work with such diligence as will insure completion within the specified time, in which case, the Engineer may be compelled to take steps to protect the interest of the PPA.

3. When the Contractor elects to work overtime and on Sundays and legal holidays, appropriate authority from those concern must be secured and notice of his intention to do so shall be submitted to the Engineer within the reasonable time in advance thereof.

4. The Contractor shall *submit daily excavation reports in duplicate* within two (2) days after the end of the day covered by the report duly signed by the Contractor or his duly authorized representative and the Engineer. The report shall be made in forms and to be provided by the Authority.

5. The Contractor shall take necessary measures to protect the life and health of his men in accordance with the existing laws and regulations of the Government. The Contractor shall provide safety devices to Engineer and personnel while on board the equipment/plant in performance of their official duties.

6. The Contractor shall put up and maintain such markers and buoys as will prevent any accident in consequence of his excavation work. No liability whatsoever attaches to the Authority, if as a result of the operations or installation, an accident happens in the project area. The Contractor shall hold the Authority free and harmless against any or all claims of persons involve in such accidents.

EXCAVATED MATERIALS

1. Disposal of excavated unsuitable materials from seabed shall be transported and deposited at 10.00 kms. (minimum) away from the area to be excavated.

2. Stockpiling and usage of excavated materials from existing backfill shall be approved by the Engineer in coordination with the Agency.

Displace Materials

1. Should the Contractor, during the progress of the excavation works, lose, dump, throw overboard, sink, misplace any materials, plant, machinery or appliance which may be dangerous to or obstruct navigation and/or port operations activities, the Contractor shall immediately give notice with description and location of such obstruction to the Authority and when required, shall mark the obstruction until such time the same is removed.

2. Should the Contractor refuse, neglect or delay compliance with the above requirements, such obstructions shall be removed by the Authority and the cost of its removal shall be deducted from any money due or to become due to the Contractor or proceeded against his performance bond.

3. Any excavated materials that is deposited other than the designated area will not be paid and the Contractor shall be required to remove such misplaced materials and deposit it to where directed at his expense.

INSPECTION

1. No PPA Project Engineer or Authority's Representative is authorized to change any provisions of the excavation specifications without written authorization of the Authority.

2. Nor shall the presence or absence of a PPA project Engineer or Authority's Representative relieve the Contractor from any of his responsibility under the Contract.

PAY LIMITS

It is to be clearly understood that no payments will be made for excavation beyond the excavation limits. The Contractor shall bear all the cost of over excavation beyond the project depth and in addition, of any remedial measures ordered by the Authority or its representative to be taken in areas over excavation is not permitted.

SOUNDINGS

1. The Contractor, in the presence or joint with the Authority's Representative and during the progress of the excavation works, shall perform continuous checking of the depth thru soundings.

2. For the purpose of work progress payments; the Contractor, jointly with the Authority's Representative and/or Surveyors, shall conduct soundings on areas subjected to excavation activities during the month or the preceding period for which payment is being claimed.

3. The Contractor will be responsible for all costs involved in the above mentioned such as costs for the survey equipment, measurement, markings, materials and other cost related thereto.

ITEM 03 : PILING WORKS (STEEL PIPE SHEET PILE)

SCOPE OF WORK

This section covers the minimum requirements for the fabrication, hauling, spotting, driving and finishing of all interconnected tubular piles to be used as containment and berthing wall/wharf.

The Contractor may however, adopt, in addition to these minimum requirements additional provisions as may be necessary to ensure the successful prosecution of the work related to the said undertaking.

METHOD STATEMENT

Before the commencement of any piling works, the Contractor shall submit (allowing sufficient time for consideration) to the Engineer for approval a Safety Policy and a Method Statement which shall include the following information:

1. Program of Works detailing sequence and timing of individual portions of works.

2. Maximum proposed lead at any stage of driving between a pile and its neighbor and the limitations of same if hard driving is encountered.

3. Contingency plan in the event of encountering obstructions or reaching driving refusal to minimize disruption/delay especially when using pitch and drive methods.

MATERIAL REQUIREMENTS

STEEL PIPE PILES

Steel tubular piles required under this heading may either be fluted or plain, tapered or cylindrical, seamless or welded type or as indicated in the drawing conforming to the requirements of ASTM A 252, equal or better. Minimum shell thickness shall be as indicated in the drawings.

Steel sheet piles shall be of the type indicated on the drawings with continuous interlock. The sections and grade of steel shall be as shown on the drawings or approved equivalent. All steel sheet piles shall conform to ASTM A 328 or approved equivalent.

Tubular Pipe – ASTM 252 Grade 3, fy = 310MPa, fs = 455MPa

CONCRETE AND REINFORCEMENT WORKS

Concrete and reinforcement work for filler of steel pipe piles, concrete jacket and pile cap shall be in accordance with the Section "Reinforced Concrete" where the compressive strength at 28 days shall be 24 mpa (3,500 psi).

TIE - RODS, WAILING and FITTINGS

All components of tie-rod assemblies to be supplied, assembled and installed by the Contractor shall be in accordance with the applicable requirements of the ASTM standards. The tie-rods shall have upset treaded ends and the minimum yield point shall be as shown on the drawings.

Structural steel shapes for wailings shall be supplied, fabricated, assembled and installed by the Contractor as shown on the drawings. The sections and grade of steel shall be as shown on the drawings or approved equivalent.

Bolts for assembly of structural steel wailings and for connections or special sections shall conform to ASTM A 36, A 325, and ASTM A 307 and or as specified on the Drawings.

SAND FILLER

The filler materials shall be fine aggregates with the same requirements as in "Reinforced Concrete Aggregates". The volume shall be in accordance with the approved drawings and sounding conducted in site.

PROTECTIVE COATING

GENERAL

The following abbreviations and definition of terms are used in this Specification:

DFT	Dry Film Thickness
ISO	International Organization for Standardization
NACE	National Association of Corrosion Engineers
SSPC	Steel Structures Painting Council
µm	Micron
WFT	Wet Film Thickness

Definition of Terms

Company Representative	A duly appointed representative of the facility owner
"Shall"	A mandatory requirement of compliance
Spot Blast	Blasting operations carried out to remove localized corrosion, or damage, to otherwise sound coatings
Stripe Coat	Brush applied coating, usually to edges, welds, and other areas susceptible to coating breakdown
Substrate	Base material over which a protective coating is applied
Whip Blast	Light blasting carried out to abrade a surface, with minimal removal of substrate

CODES, STANDARDS AND TEST METHODS

Materials and workmanship shall comply with any requirements of any Acts or Regulations of any Statutory Authority having jurisdiction over the works. Occupational Health & Safety and Environmental legislations relevant to the works must be adhered to.

Unless noted otherwise, all works shall be performed in accordance with the current version of the relevant global standard / test method (including ASTM, ISO, NACE & SSPC), including (but not limited to) those listed below:

ASTM D4285	Indicating Oil or Water in Compressed Air
ISO 8501	Preparation of steel substrates before application of paints and related products –Visual assessment of surface cleanliness
ISO 8502	Preparation of steel substrates before application of paints and related products – Tests for the assessment of surface cleanliness

ISO 8503	Preparation of steel substrates before application of paints and related products – Surface roughness characteristics of blast-cleaned steel substrates
ISO 8504	Preparation of steel substrates before application of paints and related products – *Surface preparation methods*
ISO 9000 Series	Quality Management Systems Series
NACE SP0188	Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates
SSPC-SP1	Steel Structures Painting Council (SSPC) – Solvent cleaning
SSPC-SP6	Commercial Blast Cleaning
SSPC-SP10	Steel Structures Painting Council (SSPC) – Near-white blast cleaning
SSPC Vis 1	Steel Structures Painting Council (SSPC) –Visual standard for abrasive blast cleaned steel

WORKMANSHIP

Application

All surface preparation and coating application activities shall be carried out by suitably trained operators,
preferably with a minimum of two years' practical experience with these tasks.

The Contractor shall ensure that the supervision of application staff and all quality inspections are carried out by a suitably qualified specialist with a minimum of 3 years industry experience.

Quality Assurance

The Contractor shall compile appropriate Inspection & Test Plans for each part of the surface preparation and coating application works. These shall be submitted to the Company Representative for approval prior to the works commencing.

The Company Representative reserves the right to appoint a third party to conduct quality inspections of the coatings applied under this Specification. These inspections are in addition to those required by the Contractor. These inspections do not remove any of the Contractor's obligations under this Specification.

Non Conformances

Any work which does not conform to the requirements of this Specification shall be repaired to the satisfaction of the Company Representative. Such work may include complete removal of the non-conforming coating, surface preparation and application of the new coating system.

Such rectification work will be at the expense of the Contractor.

Work Method

Where possible, surface preparation and coating application shall be performed when all fabrication, including attachment of secondary steelwork and brackets, is complete. Where this is not possible, work method and inspection must ensure all exposed surfaces are treated in accordance with this specification.

Surfaces which are not to be painted shall be protected from damage and overspray. These surfaces include, but are not limited to:

- Stainless steel
- Machined surfaces
- Gauge faces

Access to the Work Surfaces

Access to the work surface must be suitable so as to allow full and proper treatment of all surfaces to be coated under this specification. Scaffolding, if necessary, shall be erected in accordance with local legislative requirements. Care shall be taken to minimize damage to coated surfaces during manipulation of scaffolding / access equipment. Any damage to the applied coating shall be repaired to the full requirement of this specification.

Protection of Environment

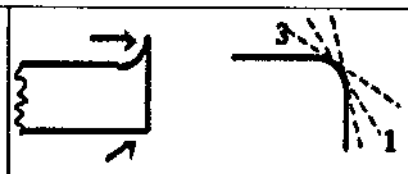
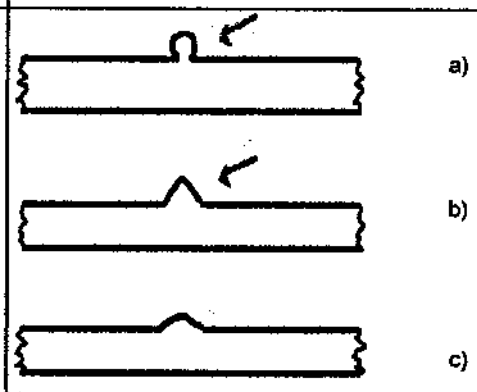
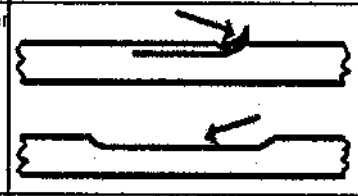
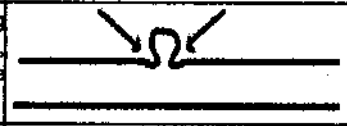
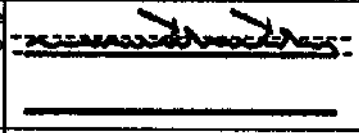
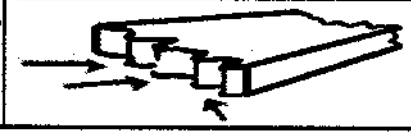
All work carried out under this specification shall be performed in accordance with local legislative and site specific requirements. Care shall be taken to eliminate impact on adjacent work areas from noise, dust, overspray and other activities. Paint, thinners, rags, empty paint cans and other refuge generated shall be disposed of thoughtfully and in accordance with local legislative requirements.

SURFACE PREPARATION

General

Prior to surface preparation activities, the steel surface to be coated shall be thoroughly cleaned to remove all oil, grease, fats, drilling and cutting compounds, and other contaminants in accordance with ISO 8504, or SSPC-SP1. Soluble salts shall be removed by thorough water washing. Where a chloride level of greater than 50 mg/m² (or less if recommended by the protective treatment supplier) as determined by ISO 8502, the substrate shall be wet abrasive blasted, high-pressure water jetted, or otherwise washed, and then reblasted. The substrate shall then be retested for chloride salt contamination, and the cleaning / reblasting process shall be repeated until the chloride level is shown to be less than the required value.

All sharp edges, corners, holes, feathering at saw cuts, or sharp irregularities shall be ground to a minimum radius of 2.0mm, where specified on the project engineering drawing. Burrs, surface shell, slag, weld spatter and other surface defects such as cracks, laminations and slag inclusions shall be repaired before the commencement of blast cleaning activities. Temporary welds shall be ground to a flush finish. Weld porosity and associated defects shall be removed by grinding and repaired/filled with weld. Please see table below for surface imperfections.

SHARP EDGE	Edges should be treated to a rounded radius of minimum 2mm, or subjected to three pass grinding or equivalent.	
WELD SPATTER	1. Remove spatter observed before blasting by grinder, chipping hammeretc. 2. For spatter observed after blasting: a) Remove with chipping hammer/scraper etc. b) Where spatter is sharp, use disc sander or grinder until obtuse c) Obtuse spatter – no treatmentrequired	
PLATE LAMINATION	Any lamination to be removed by grinder ordisc sander	
UNDERCUT	Where undercut is to a depth exceeding 1mm and a width smaller than the depth, repair by welding or grinding may be necessary	
MANUAL WELD	For welding bead with surface irregularity or with excessive sharp edges, remove by discsander or grinder	
GAS CUTSURFACE	For surfaces of excessive irregularity, remove by disc sander or grinder	

Abrasive Blast Cleaning

Blast cleaning operators shall wear approved safety clothes and equipment at all times during the blast cleaning process. Helmets shall meet all required statutory requirements and guidelines.

Work shall NOT be performed in the following circumstances:
•When the relatively humidity of the surrounding air is above 85%.

Unless otherwise stated herein, all surfaces to be coated shall be abrasive blast cleaned to Sa2½ (in accordance with ISO 8501-1); or in accordance with SSPC-SP10.

Unless otherwise stated herein, a surface profile of 50-75 microns (2 - 3 mil) shall be achieved as measured by ISO 8503. The resultant surface shall have a sharp angular profile.

The use of silica sand, flint, or ilmenite abrasives shall NOT be permitted. Steel shot alone shall not be used but a mix of steel shot and grit may be used.

The type and size of abrasive, the equipment and the procedure adopted shall be chosen to ensure the required degree of cleanliness and surface profile is achieved. The blasting medium shall be

free of organic material and shall have a chloride salt content not greater than 50 ppm. The compressed air supply used for blasting shall be completely free of water and oil. The design of the compressed air system shall incorporate the appropriate number of serviceable in-line separators and traps which shall be cleaned and drained on a regular basis.

Care shall be exercised to ensure spent blast media does not impinge onto soft or freshly applied coating when blast cleaning in close proximities (e.g. on-site repair).

Welding spatter, slivers, surface shell, cracks, lamination, deep pitting and other surface defects detrimental to the performance of the protective coating system exposed by the blast cleaning process shall be removed by grinding or other approved method. Where necessary these defects shall be welded closed after grinding, and the repair ground to blend in with the adjacent surface. The repair area shall be re-blasted to re-establish the correct surface condition.

Immediately after completion of the blast cleaning process, the surface shall be dusted, vacuumed or blown down with clean dry compressed air to remove spent abrasive. Special attention shall be given to corners, intersects and horizontal areas where settlement of dust is likely to occur.

Where site abrasive blasting is required over water, preventative measures shall be employed to protect the environment from contamination by spent abrasive and blast debris. All used blast materials shall be disposed off-site in a statutory approved dumping facility.

Power Tool Cleaning (for small areas/ repair only)

Power Tool cleaning operators shall wear approved safety clothes and equipment at all times during the power tool cleaning process.

Work shall NOT be performed in the following circumstances:
- If the surface is wet, or likely to become wet after power tool and before primer application.
- On surface where the formation of condensation is likely i.e. where the surface temperature of steel is less than 3°C above dew point.
- When the relatively humidity of the surrounding air is above 85%.

Unless otherwise stated herein, all carbon steel surfaces shall be power tool cleaned using an orbital sander with cup brush followed with disc sanding pad (flap disc) having grit size ideally ranging from 80- 120, to create profile (roughness). Care should be exercised so as to not over grind the carbon steel. The objective is to leave the metal bare and generate surface profile. A bare metal power-tool cleaned surface, when viewed without magnification, shall be free of all visible oil, grease, dirt, rust, coating, oxides, mill scale, corrosion products, and other foreign material, Slight residues of rust and coating are permitted to remain in the lower portions of pits if the original surface is pitted. Acceptable variations in appearance that do not affect surface cleanliness as defined earlier include variations caused by type of steel, original surface condition, thickness of the steel, weld metal, mill or fabrication marks, heat treating, heat-affected zones, or the texture/features associated with the use of a particular power tool.

Immediately after completion of the power tool cleaning process, the surface shall be dusted, vacuumed or blown down with clean dry compressed air to remove debris from removed coatings, corrosion etc. Special attention shall be given to corners, intersects and horizontal areas where settlement of dust is likely to occur.

Care of Prepared Surfaces

The application of the prime coat to the prepared surface shall commence within four (4) hours of the commencement of the blasting process, and before any deterioration of the prepared surface occurs. The time lapse between blasting and primer application shall be recorded on the Contractor's Inspection report forms.

Blast cleaned surfaces shall be kept free of any contamination and shall not be touched by bare hands or contaminated gloves.

Any prepared surface which becomes contaminated shall be re-blasted to the specified visual condition above.

APPLICATION OF COATINGS

General

Coating application operators shall wear approved safety clothes and equipment at all times during the blast cleaning process. Respirators and associated equipment shall meet all required statutory requirements and guidelines.

Work shall NOT be performed in the following circumstances:
• If the surface is wet, or likely to become wet after blasting and before primer application.
• On surface where the formation of condensation is likely i.e. where the surface temperature of steel is less than 3°C above dew point.
• When the relatively humidity of the surrounding air is above 85%.
• When the ambient temperature, or the surface temperature, exceeds 50°C or is less than 5°C.

Immediately prior to paint application, the surface shall be dusted, vacuumed or blown down with clean dry compressed air to remove spent abrasive. Special attention shall be given to intersects and horizontal areas where settlement of dust is likely to occur.

Each coat shall be free of sags, runs, mud cracking, wrinkling, fat edges, blisters, pinholes, holidays, dry spray, entrapped foreign bodies, heavy brush marks and other similar defects consistent with a finish for industrial applications. Prior to the commencement of work, the Contractor shall produce a "reference area" for approval by the Company Representative. The reference area shall be representative of the type of surfaces being treated. Once approved by the Company Representative the reference area shall be used to determine acceptable finish quality.

All ventilation equipment required during application shall be left operating until cure of the applied coating is achieved.

Adhesion of all coats shall be sound throughout. Coatings with poor adhesion shall be removed and re- instated at the cost of the Contractor.

The Contractor acknowledges that variations in weather conditions affects minimum and maximum recoat times of coating material, and that this is taken into account when planning coating operations.

Materials

All primers and final coat shall be of the approved make, type and colour. All coats in the system applied shall be from coating manufacturer only.

Where two component paint is used, it shall be mixed at the site of application in the manner prescribed by the coating manufacturer. Mixed paint remaining unused after the coating manufacturer's prescribed pot life shall be discarded and removed from the site of application.

All colouring or tinting of paint shall be performed by the coating manufacturer.
Stripe Coating

All external edges shall be stripe coated (either spray or brush) prior to spray application of the full coat. All welds, crevices, holes, corners, and other difficult access areas shall be stripe coated by brush painted prior to spray application of the full coat. All nuts and bolts which have been specified

to be painted, or which the Company Representative has instructed to be painted, shall be brush painted prior to spray application of the full coat. This process shall be repeated where necessary to ensure the correct film thickness is achieved over these areas.

Brush and Roller Application

Application by brush or roller shall be limited to small areas only. Multiple application of each coat in the system will be required to achieve the required dry film thickness. A uniform method of application shall be adopted when painting large areas. The application direction shall be towards already painted areas so as to maintain a wet edge and minimize paint joint buildup.

The paint shall be spread evenly over the entire area with the minimum practical amount of brushing. The method of application and type of brush used shall be suitable to the paint specified and the surface being painted.

The method of "laying off" shall be suitable to the paint specified and shall be executed with the minimum amount of brush marking.

Measurement of Film Thickness

Irrespective of the method of application, the Contractor shall ensure that frequent measurements of wet film thickness are taken throughout the application process. An approved wet film gauge shall be used. The level of thinner additional shall be taken into account when measuring wet film thickness to ensure the correct dry film thickness is achieved.

After each coating has cured, the dry film thickness shall be tested and recorded by the Contractor. Inspection regime and acceptance of results shall be in accordance with ISO 2808.

The minimum dry film thickness considered acceptable is that specified within the given coating system, where the measurement has been determined according to the rules in ISO 2808.

The maximum dry film thickness considered acceptable is dependent on products and systems being applied, and should be determined in consultation with the coating manufacturer.

Multiple Coat Applications

The existing surface shall be treated in accordance with Section General of the Application of Coatings of this Specification. Ensure the previously coated surface is free of water, moisture, dust and dirt immediately prior to application of the successive coat.

Successive coats shall be applied only under the following conditions:
- The surface is clean and dry.
- The coating manufacturer's stated minimum recoat time has elapsed, and the maximum recoat time has not been exceeded. If the maximum recoat time has been exceeded, then pre-treatment of the surface shall be in accordance with the coating manufacturer's recommendation.
- Damaged and non-conforming areas in the previous coating have been made good.

Transport and Handling

Particular care shall be taken to avoid damage to coatings in handling and transport. Coated items shall not be handled until the coating has cured in accordance with the manufacturer's instructions. Coated items shall be handled and transported in a manner that will not chip, abrade or otherwise damage the finished coatings. All slings, lifting devices, dunnage, packing, tie-downs, and the like, shall be of a type that is designed to achieve this end.

No sign writing, stenciling, or marking whatsoever shall be applied to painted surfaces of plant, machinery and equipment unless specifically approved by the Company Representative. Such markings shall be compatible with the specified coating system.

Rectification and Touch-up Painting

Surfaces where the paint coating has been damaged or marked in any way shall be touched up or repainted in accordance with the coating manufacturer's instructions, this Specification, and as otherwise approved by the Company Representative. Repairs performed after installation require special attention to ensure blast media, paint overspray, fumes and other contaminants, do not affect adjacent work areas.

The treatment shall be:
• Pre-clean the damaged area in accordance with Section General of Surface Preparation on this Specification.
• Remove the damaged coating back to a sound adherent surface in accordance with Section Abrasive Blast Cleaning of Surface Preparation on this Specification.
• Spot abrasive blast clean the damaged area
• Feather back the repair area by a minimum 50mm overlap by sanding or sweep blasting.
• Clean surface to remove dust.
• Build up the repair area using the same type of paints and same dry film thickness as were originally specified in the appropriate section of this Specification.

INSPECTION AND TESTING

Initial Inspection

The procedure associated with the surface preparation and application of each coating shall, in the first instance, be carried out in the presence of the Contractor's site supervisor, the Company Representative or any other technical representative.

Once the procedure for each stage of the operation has been witnessed and approved, these procedures shall then apply to all similar operations unless subsequently varied by the Company Representative. Work subsequently identified as being carried out using procedures not previously approved shall be rejected or improved at the sole discretion of the Company Representative.
The Contractor shall give the Company Representative a minimum of five (5) working days' notice of the intention to paint the steel work.

Contractor Inspection

The Contractor shall ensure that all work is inspected and appropriate testing carried out progressively to ensure that it is in accordance with the specified requirements. Inspection and testing records shall be maintained on a daily basis. As a minimum, these reports shall include appropriate information concerning the following:

• Job identification;
• Surface preparation performed and equipment used;
• Surface profile measurement;
• Coating applied and equipment used;
• Material used, batch number, colour, mix ratio and thinner;
• Application details including which coat was applied, wet film thickness and dry film thickness of each coat;
• Weather conditions including air temperature, surface temperature, relative humidity, dew point, wind conditions and general weather conditions. These measurements shall be taken immediately prior to surface preparation and application work, and then every four (4) hours, or whenever a change in the weather conditions is apparent.

Inspection & Test Plans (ITP) shall be compiled and submitted to the Company Representative prior to any work commencing. In addition, the Contractors facility and inspection records shall be made available to the Company Representative for inspection of the works at any time during the performance of the contract.

Inspection by Company Representative

Steelwork will be inspected by the Company Representative at each stage of the coating operation in this case, after surface preparation, prior to application of each coat, and following final topcoat application. Additional inspection will also be conducted after any touch up coats that may be required.

The Company Representative may, at their discretion, vary the frequency of inspection. This may involve the waiver of inspection for a specific step in the operation. Such a waiver shall not be deemed as the precedent to determine the frequency of any future inspection.

Inspection performed by the Company Representative, as well as any waiver of inspection, shall not relieve the Contractor of the obligation to perform their own supervision and inspection of surface preparation and coating application operations as required by this Specification.

Test Methods

The following, but not limited to, test methods shall be used for inspection of the surface preparation and coating application operations:

Compressed Air Quality

Prior to using compressed air, the quality of air downstream of the separator shall be tested in accordance with ASTM D4285. The test shall be performed at the beginning of each shift and at four (4) hourly intervals. The test also shall be made after any interruption of the air compressor operation or as required by the Company Representative. The air shall be used only if the blotter test indicates no visible contamination, oil, or moisture. If contaminants are evident, the equipment deficiencies shall be corrected and the air stream shall be retested. Separators shall be bled continuously. All lines shall be tested individually prior to use. Surfaces which are determined to have been blasted, blown down, or applied using contaminated air shall be re- cleaned to remove oil, grease, and contaminants and new coatings applied using clean air.

Surface Profile

Surface profile shall be tested after every blasting operation. Surface profile shall be measured in accordance with ISO 8503. The tape shall be included in the test reports for future reference.

Salt Contamination Test (Surface)

Surface Salt Contamination Test on surface shall be tested after every blasting operation. Test method in accordance with ISO 8502-6 and 9 results shall be recorded, value shall be 10 micrograms/cm2 or below.

Dust Assessment Test

Dust contamination on substrate prior to application of primer and subsequent coats shall be tested in accordance with ISO8502-3, dust quantity must be less than or equal to Class 2 of ISO 8502-3 Dust Quantity Rating. Test results shall be included in the test reports for future reference.

Wet Film Thickness

Wet film thickness shall be tested during the application operation of all coats in any given coating system. Wet film thickness shall be measured in accordance with ISO 2808.

3. Length of pile, marked same as (1)

4. Meters mark in two faces, throughout the length

DOCUMENTS TO BE SUBMITTED

1. Steel Pipe manufacturing plan (Steel pipe production plan, welding method, welding material, production location, production method, transportation, etc.)

2. Design plan

3. Manufacturing process

4. Shipment method and stacking plan

5. Steel pipe inspection certificate

6. Size inspection record

7. Radiographic Test record

STEEL PIPE PILES

The Contractor shall submit to the Engineer three (3) copies of test reports by the approved steel mill certifying that the steel pipe pile meets the requirements specified in these technical specifications.

REINFORCED CONCRETE

The requirements regarding testing of concrete and reinforcement used in the reinforced concrete piles and sheet piles shall be in accordance with Section "Reinforced Concrete".

SAND FILLER

The requirement regarding testing of fine aggregates shall be used.

STORAGE AND HANDLING

1. Piles may be stored in open air but on wooden sleepers to be placed in a manner so as not to cause excessive bending.

2. Piles shall be stacked on a stable yard and shall not be stacked more than three (3) tiers high.

3. All piles shall be carefully lifted at the location of the lifting points as indicated in the Drawings. Other practical and convenient methods may be used subject to the approval of the Engineer.

DRIVING OF PILES

A diesel or hydraulic pile hammer shall be used for driving the steel pipe piles.

The required weight of ram for the diesel or hydraulic pile hammer ranges from 2.5 to 3.5 tons or at least 25% (1/4) of the weight of longest pile.

Piles driven shall be held firmly in position in axial alignment with the hammer by means of leads of adequate length. Approved cushions shall be provided to the pile butts.

BEARING POWER OF PILES

Each pile shall be driven to attain not less than the required minimum bearing power shown in the pile schedule, as determined by the Hiley's Formula as follows:

$$\text{For Diesel Pile Hammer :} \qquad R = \frac{1}{6} \times \frac{2WH}{S + 2.54}$$

where : R = allowable bearing capacity of pile (tf)

W = weight of ram (tf)

H = fall of ram (cm)

S = set (cm)

In case of the use of hydraulic pile hammer, the computed minimum bearing power shall be submitted to the Port Planning and Design Department (PPDD) and shall be evaluated and approved by the Designing Engineer.

DRIVING RECORDS

The Contractor shall keep complete and accurate piling records. Two (2) signed copies of these records shall be submitted to the Engineer not more than 48 hours from the date of works detailed therein. The pile records shall always be submitted with sufficient time for the Engineer's approval.

The records shall contain the following information:

1. Pile reference number
2. Pile type and Steel Grade
3. Pile Length
4. Commencing surface level and final toe level
5. Depth driven, time, date when piles were driven
6. Where required the number of blows to drive each 250 mm over the last 2.5 meter shall be recorded
7. Comments regarding unusual/unexpected driving conditions

INTERRUPTED DRIVING

When driving is stopped before final penetration is reached and/or refusal is attained, the record of pile penetration shall be taken only after a minimum of 30 cm. (12 in.) total penetration has been obtained on resumption of driving.

ALIGNMENT TOLERANCE

Piles driven shall be within the allowable tolerance in alignment of 10 cm. (4 in.) in any direction.

DAMAGED AND MISDRIVEN PILES

1. Piles shall not be more than 10 cm. (4 in.) out of place at cut-off level. All steel pipe piles shall not be more than 2% out of plumb.

2. Any pile damaged by improper driving or driven out of its proper location, or driven out of elevation fixed on the plans, shall be corrected correspondingly at the Contractor's expense by any of the following methods:

    a. Withdrawal of the pile and replacement by a new pile.

    b. Driving a second pile adjacent to the defective one.

    c. Splicing an additional length.

The method to be adopted in each case shall be at the discretion of the Engineer.

EXTRACTION OF SEABED MATERIALS FROM DRIVEN PILES

Extraction of seabed materials, if necessary, shall be in accordance to the required elevations and sections in conformance to the drawings.

All extracted materials shall be disposed in the location approved by the Engineer in coordination with the authority.

ITEM 04 : ROCKWORKS

SCOPE OF WORK

The work includes the furnishing of all labor, materials and equipment required for the rock works including armour rocks, underlayer and rock fill in accordance with the Specifications and as indicated in the drawings or as directed by the Engineer.

SETTING OUT OF WORKS

1. Topographic/Hydrographic Survey

   Prior to commencement of Works, the Contractor together with the Engineer shall conduct topographic and hydrographic surveys in order to establish the actual field condition or bathymetry of the project site. The said survey shall be used as the basis of quantity measurement.

2. The Contractor shall set out the Works and shall solely be responsible for the accuracy of such undertaking. Visible construction markers shall be used to clearly define horizontal limits prior to placing of any material.

MATERIAL REQUIREMENTS

1. All rocks to be used shall be angular, hard, durable and not likely to disintegrate in seawater. Rock layers to be installed should more or less be "global in shape", "angular in surface" and should avoid "river run rocks". Rocks that are sub-angular may be subject to the approval of the Engineer. Rounded or well rounded pieces will not be accepted.

2. All rocks shall have a minimum unit weight of 2,650 kg per cubic meter (specific gravity 2.65) of solid materials when measured dry.

3. Rocks with specific gravity higher than the above specified is preferable and will readily be accepted. But no adjustment (increase) in the contract price will be made on this account.

4. Rocks of the primary cover layer shall be sound, durable and hard. It shall be free from laminations, weak cleavages, and undesirable weathering, and shall be of such character that it will not disintegrate from the action of the air, seawater, or in handling and placing. All stone shall be angular quarry stone.

5. All rocks shall conform to the following test designations:

Apparent specific gravity	ASTM C 127
Abrasion	ASTM C 535

EXECUTION

QUARRY SITE AND ROCK QUANTITY

1. It is the Contractor's responsibility to make necessary surveys / investigations on quarry sites applicable to the Works, taking into consideration the nature of the rock works required under the Contract such as required quality, total quantity and daily required quantity, transportation method and route etc.,

2. The Contractor shall submit data on characteristics of proposed quarry sites together with the location of sites, test results of their products and samples for the approval of the Engineer.

3. When the Contractor intends to operate a quarry for the Works, the Contractor shall take all the responsibilities in connection with its operation including, but not limited to, obtaining all necessary permits and approvals, payment of safety measures or like (if any), provisions and maintenance of safety measures and temporary access roads, all of private and public roads and temporary jetties to be used to transport quarried materials and the compliance with all regulations etc. required by the authorities having jurisdiction over any part of the operation.

   Should any explosive be used in the quarry operations, the Contractor shall be responsible to meet laws and regulations, wherever applicable, established by the Local Government and Central Government Department concerned.

4. Despite the Engineer's previous approval of the natural rock and borrow pits, the Engineer reserves the right to suspend any operation in connection with the rock, if, in its opinion, such rock is not suitable for the work. In such case, the Contractor shall comply with the Engineer's instructions.

5. The finish bulkhead shall be true to grade and section. The spaces/voids between rocks shall be filled/sealed with 2 kg. to 16 kg. rocks and shall be approved by the Engineer before placing geotextile filter thereon to prevent the filling materials (soil and sand) from escaping to cause scouring and settlement of finished surface.

STORAGE OF MATERIALS

Quarried rock materials shall be stored by weight/class or in a manner approved by the Engineer and in a yard kept clean, free from undesirable materials.

SAMPLING TEST

1. Thirty (30) days prior to commencement of rock works, samples and test results of rock material which conforms to the Specifications called for in the Contract shall be submitted to the Engineer for evaluation and approval.

2. Rock samples from different sources and of different classes shall also be submitted, together with test results and its corresponding certificates, for the Engineer's approval.

3. Rocks accepted at the quarries before shipments or at the site before placement shall not be used as a waiver. The Engineer has the right to reject any inferior rock quality.

4. Samples for each class of approved materials are to be kept in the field for comparison/checking of delivered rock materials. A test shall be required for every 1,500 cu.m.

CROSS-SECTIONS OF COMPLETED ROCKWORK

Cross-sections showing the elevations of the completed rock works and the terrain of the existing seabed prior to construction shall go together with every progress report and request for progress or final payment.

Rock works which was previously paid should be easily identified from sections being requested for payment.

ITEM 05 : GEOTEXTILE FABRIC

SCOPE OF WORK

This work covers all the following requirements regarding the installation of geotextile (filter fabric) in accordance with the lines, grades, and dimensions shown in the drawings.

MATERIAL REQUIREMENTS

The geotextile fabric shall meet the following requirements in full. If required, a sample of 1.0 sq.m. shall be supplied to the Engineer for approval and retention for purposes of comparative testing against materials randomly sampled from the site.

1. PHYSICAL PROPERTIES

   a. The geotextile material shall be a nonwoven needle punched type comprising of needle punched polypropylene fibers or its equivalent.

   b. The geotextile material shall be UV stabilized to ensure retention of minimum 70% original tensile strength after 90 days exposure to sunlight. The manufacturer shall submit test results to the Engineer for approval.

   c. The geotextile must be highly resistant to long term contact with damp cementatious substances or acid or alkali solutions in the pH range 2-13. The manufacturer shall submit test data to ensure resistance of the polymer.

2. MECHANICAL AND HYDRAULIC PROPERTIES

The geotextile supplier is required to certify that the materials delivered to site will be proven to meet or exceed the following properties:

TECHNICAL PROPERTIES	UNIT	MINIMUM	TEST STANDARD
A. Physical Characteristics:			
Minimum Mass (per unit area)	(g/m^2)	540	ASTM D5261
Thickness (F=2 kpa)	mm	4.5	ASTM D5199
B. Mechanical Properties:			
Tensile Strength (md/cd)	kN/m	13/22	ASTM D4595
Tensile elongation (md/cd)	%	90/40	ASTM D4595
CBR Puncture Resistance	N	3000	ASTM D6241
C. Hydraulic Properties:			
Effective Opening Size (O_{90} Wet Sieving)	(mm)	0.08	ASTM D4751
Water Permeability: Permittivity	(s^{-1})	0.5	ASTM D4491

EXECUTION

1. The geotextile shall be delivered to site with an outer wrapper to protect it from exposure to the elements.

2. Prior to laying of geotextile filter, stone filler shall be placed between gaps or voids of armour / core rocks as likewise mentioned in the requirements of Item "Rock Works".

3. The non-woven geotextile filter shall be installed and lay manually at site as per design drawings. The filter shall be laid lengthwise down slopes and appropriately anchored along the top edge.

4. The Engineer reserves the right to sample geotextile delivered to site for individual quality control testing at the contractor's expense. A material not meeting the manufacturer's certified values will be rejected from the site.

5. The geotextile shall be proven to resist dynamic puncture damage when subject to impact stress from stone armour (200-400 kg.) dropped from a minimum height of 2.0 m. and should be laid on at least 1-foot sand and gravel bedding. Geotextile failing to resist puncture shall not be accepted.

6. To facilitate site Quality Assurance, each roll of geotextile delivered to site shall be clearly labeled with brand name, grade, and production batch number.

7. Geotextile overlaps shall be at least 1.0 m unless otherwise stated on the drawings. Alternatively, geotextile overlaps are to be heat-welded or sewn using appropriate polypropylene or other synthetic thread and portable hand sewing equipment.

ITEM 06 : RECLAMATION AND FILL

SCOPE OF WORK

This item shall consist of the construction of back-up area in accordance with the Specifications and in conformity with the lines, grades, and dimensions shown on the Plans or established by the Engineer.

The area to be upgraded shall be as indicated on the Drawings.

The works includes furnishing of all labor, materials and equipment required to complete/finish the upgrading of the area in accordance with the Drawings and the Specifications.

The following major items of works are included:

1. Supply and fill of suitable materials to places required to upgrade elevation of areas as shown in the drawings.

    a. Compaction of fill materials
    b. Supply and placing of filter fabric

2. The work may also include the construction of temporary dike or structure to enclose the reclamation material before the completion of a permanent waterfront containment structure.

MATERIAL REQUIREMENTS

1. Filling Materials

    a. General

    All sources of filling materials shall be approved by the Engineer.

    Appropriate quantities of sample of all materials to be used in the Works shall be submitted for acceptance and approval by the Engineer thirty (30) days before the commencement of work.

    General filling shall consist of approved material from approved sources of suitable grading obtained from excavation, quarries or borrow pits, without excess fines, clay or silt, free from vegetation and organic matter.

    Sample of approved materials shall be kept/stored in the field for ready reference/comparison of the delivered materials.

    The Contractor shall ensure that adequate quantities of required materials that comply with the specifications and quality approved by the engineer are available at all times.

    b. Fill Materials other than Dredged/Excavated Materials

    Fill materials for reclamation purposes other than dredged materials shall be pit sand, quarry run, gravel or mine tailings. The fill material shall be of the same quality or better as approved by the Engineer.

c. Type of Fill Materials

c.1 Sand and Gravel Fill (Offshore/Reclamation)

The materials shall be composed of at least 50% sand and 50% gravel in terms of volume and shall be free from rock boulders, wood, scrap, vegetables, and refuse. The materials shall not have organic content and the maximum particle size shall not exceed 100mm diameter. Source of materials shall be river or mountain quarry or manufactured.

c.2 Excavated Materials from Seabed (Offshore/Reclamation)

The excavated materials shall be used for backfilling as directed by the Engineer.

c.3 Select Materials (General Embankment)

All materials used for fill shall be free of rock boulders, wood, scrap materials, organic matters and refuse.

The material shall not have high organic content and shall meet the following requirements:

i. Not more than 10 percent by weight shall pass the No. 200 sieve (75 microns).

ii. Maximum particles size shall not exceed 75 mm.

iii. The fill materials shall be capable of being compacted in the manner and to the density of not less than 95%.

iv. The material shall have a plasticity index of not more than 6 as determined by AASHTO T 90.

v. The material shall have a soaked CBR value of not less than 25% as determined by AASHTO T 193.

2. Unsuitable Material – Material other than suitable materials such as:

(a) Materials containing detrimental quantities of organic materials, such as grass, roots and sewerage.

(b) Organic soils such as peat and muck.

(c) Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.

(d) Soils with a natural water content exceeding 100%.

(e) Soils with very low natural density, 800 kg/m3 or lower.

(f) Soils that cannot be properly compacted as determined by the Engineer.

will not be accepted by the Engineer.

EXECUTION

Reclamation and Fill

a. General

The Contractor shall be responsible for all ancillary earthworks that are necessary for the reception of the fill material and including, all spout handling, temporary dike or shoring construction where necessary, temporary protection to dikes in the sea and drainage of excess water.

The arrangements of these ancillary earthworks shall be laid out in consultation with the Engineer and to the Engineer's satisfaction and care shall be taken to minimize the loss of fill.

b. Replacement, backfilling and reclamation may be done by any method acceptable to the Engineer. Prior to start of Work, the Contractor shall submit his method and sequence of performing the works to the Engineer for approval. However, the Engineer's approval of the method and sequence of construction shall not release the Contractor from the responsibility for the adequacy of labor and equipment.

c. The Engineer shall approve the type of material to be used as fill prior to its placement. If the material is rejected, such material shall be deposited into areas designated or as directed by the Engineer.

d. Reclamation of fill material shall be placed in horizontal layers not exceeding 200mm (8 inches), loose measurement, and shall be compacted as specified before the next layer is placed. Effective spreading equipment shall be used on each lift to obtain uniform thickness prior to compacting. As the compaction of each layer progresses, continuous leveling and manipulating will be required to assure uniform density. Water shall be added or removed, if necessary, in order to obtain the required density. Removal of water shall be accomplished through aeration by plowing, blading, dicing, or other methods satisfactory to the Engineer.

Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until the necessary compaction is obtained.

Hauling and leveling equipment shall be so routed and distributed over each layer of the fill in such a manner as to make use of compaction effort afforded thereby and to minimize rutting and uneven compaction.

TRIAL SECTION

Before finish grade 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 sub-base, 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.

CROSS-SECTIONS OF COMPLETED RECLAMATION

Cross-sections showing the elevations of the completed reclamation and the terrain of the existing seabed prior to construction shall go together with every progress report and request for progress or final payment.

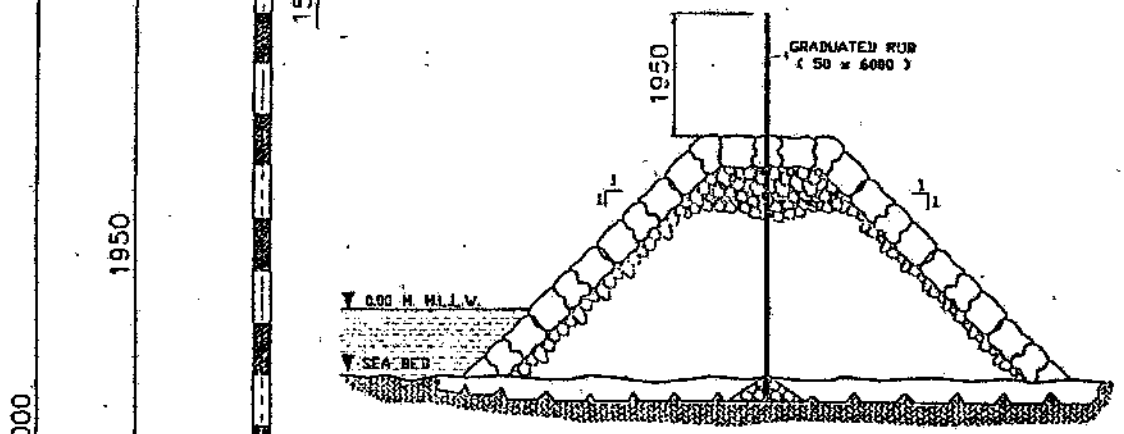
FIELD COMPACTION TEST

Field Density tests to determine the percent of compaction of the compactable material shall be conducted. Compaction of each layer thereafter shall continue until the required field density in accordance with AASHTO T/180 Method D has been achieved. In place density determination shall be made in accordance with AASHTO T191/ ASTM D 1556.

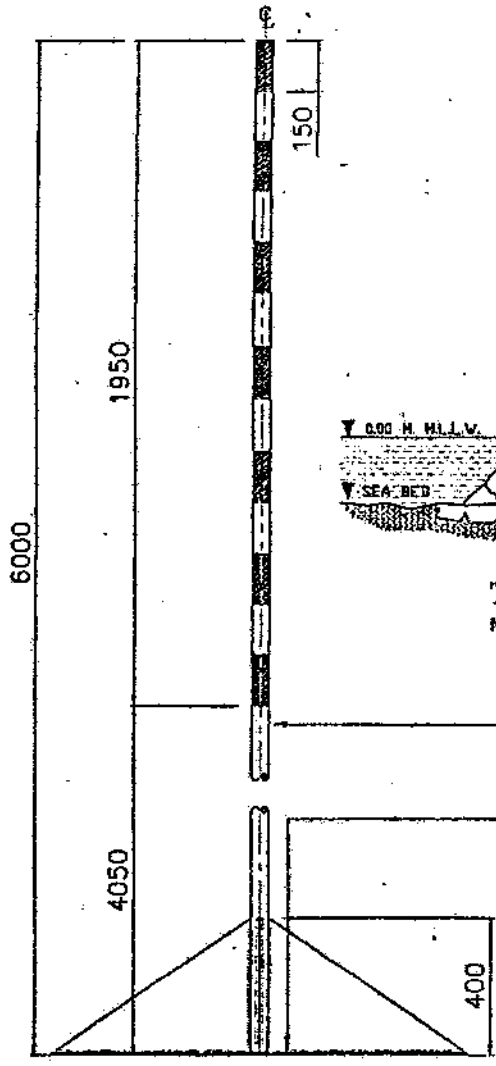
TOLERANCE

Elevation : plus 5 cm.

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TYPICAL DETAIL OF INSTALLATION
NOT TO SCALE

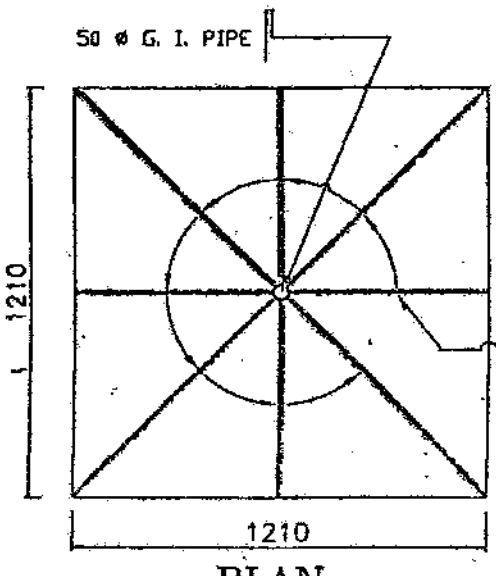


ELEVATION
SCALE 1:20

NOTES :

1) *ALL JOINTS SHALL BE FILLET WELDED ALL AROUND.*

2) *THE GRADUATED SETTLEMENT ROD INCLUDING THE BASE SHALL BE PAINTED WITH TWO (2) COATS OF ANTI-RUST PAINT AND THE 1.95 M. PAINTED WITH ALTERNATIVE BANDS OF RED AND WHITE ENAMEL, 0.15 M. LONG ALL AROUND.*



PLAN
SCALE 1:20

DETAILS OF STANDARD GRADUATED SETTLEMENT ROD

ITEM 07 : REINFORCED CONCRETE

SCOPE OF WORK

All works falling under this Section shall include reinforced concrete for all kinds and parts of any reinforced concrete structure.

GENERAL PROVISIONS

1. Full cooperation shall be given to the other trades to install embedded items. Suitable templates or instructions will be provided for setting, items shall have been inspected, and tests for concrete or other materials or for mechanical operations shall have been completed and approved.

2. The following publications of the issues listed below, but referred to thereafter by basic designation only, form as an integral part of this Specification to the extent indicated by the reference thereto:

   a. American Concrete Institute (ACI) Standards:

ACI 117	Standard Specifications for Tolerances for Concrete Construction and Materials
ACI 121R	Quality Management System for Concrete Construction
ACI 201.2R	Guide to Durable Concrete
ACI 211.1	Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 214R	Recommended Practice for Evaluation of Strength Test Results of Concrete
ACI 301	Specifications for Structural Concrete
ACI 304.2R	Placing Concrete by Pumping Methods
ACI 304R	Guide for Measuring, Mixing, Transporting, and Placing Concrete
ACI 305R	Hot Weather Concreting
ACI 306.1	Standard Specification for Cold Weather Concreting
ACI 308R	Guide to Curing Concrete
ACI 309R	Guide for Consolidation of Concrete
ACI 311.4R	Guide for Concrete Inspection
ACI 318M	Metric Building Code Requirements for Structural Concrete and Commentary
ACI 347	Guide to Formwork for Concrete

ACI SP-15 Field Reference Manual: Standard Specifications for Structural Concrete with Selected ACI and ASTM References

ACI SP-2 ACI Manual of Concrete Inspection

b. American Society for Testing and Materials (ASTM) Publications:

ASTM C 150 Standard Specification for Portland Cement

ASTM C 114 Standard Method for Chemical Analysis of Hydraulic Cement

ASTM C 185 Standard Method for Air Content of Hydraulic Cement

ASTM C 115 Standard Test Method for Fineness of Portland Cement by the Turbidimeter

ASTM C 204 Standard Test Method for Fineness of Hydraulic Cement by Air-Permeability Apparatus

ASTM C 151 Standard Test Method for Autoclave Expansion of Portland Cement

ASTM C 109 Standard Test Method for Compressive Strength of Hydraulic Cement Mortars

ASTM C 266 Standard Test Method for Time of Setting of Hydraulic-Cement Paste Gilmore Needles

ASTM C 191 Standard Test Method of Time Setting of Hydraulic Cement by Vicat Needle

ASTM C 33 Standard Specification for Concrete Aggregates

ASTM C 136 Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates

ASTM C 117 Standard Test Method for Materials Finer than 75 micron (No. 200) Sieve in Mineral Aggregates by Washing

ASTM C 29 Standard Test Method for Bulk Density (Unit Weight") and Voids in Aggregate

ASTM C 128 Standard Test Method for Density, Relative Density (Specific Gravity), and Absorption of Fine Aggregates

ASTM C 87 Standard Test Method for Effect of Organic Impurities in Fine Aggregate on Strength of Mortar

ASTM C 88 Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate

ASTM C 142 Standard Test Method for Clay Lumps and Friable Particles in Aggregates

ASTM C 97 Standard Test Method for Absorption and Bulk Specific Gravity of Dimension Stone

ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 535	Standard Test Method for Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 131	Test Method for Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM D 512	Chloride Ion in Water
ASTM D 516	Sulfate Ion in Water
ASTM A 615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 510	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
ASTM A 6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
ASTM C 78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete
ASTM C 174	Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores
ASTM C 143	Standard Test Method for Slump of Hydraulic-Cement Concrete
ASTM C 494	Standard Specification for Chemical Admixtures for Concrete

ASTM C 1017 Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete

ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete

ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete

ASTM 5329 Standard Test Methods for Sealants and Fillers, Hot Applied, For Joints and Cracks in Asphaltic and Portland Cement Concrete Pavements

ASTM D 5167 Standard Practice for Melting of Hot Applied Joint and Crack Sealant and Filler for Evaluation

ASTM A 706 Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement

ASTM A 966 Standard Test Method for Magnetic Particle Examination of Steel Forgings using Alternating Current

ASTM C 1064 Standard Test Method for Temperature of Freshly Mixed Hydraulic-Cement Concrete

ASTM C 1077 Standard Practice for Laboratories Testing Concrete and Concrete Aggregates for use in Construction and Criteria for Laboratory Evaluation

ASTM C 1107 Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

ASTM C 1116 Standard Specification for Fiber-Reinforced Concrete

ASTM C 1157 Standard Specification for Hydraulic Cement

ASTM C 138 Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete

ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method

ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete

ASTM C 295 Petrographic Examination of Aggregates for Concrete

ASTM C 33 Standard Specification for Concrete Aggregates

ASTM C 42 Standard Test Method for Obtaining and Test Drilled cores and Sawed Beams of Concrete

ASTM C 469 Static Modulus of Elasticity and Poisson's Ratio of Concrete in Compression

ASTM C 595 Standard Specification for Blended Hydraulic Cements

ASTM C1116 Standard Specification for Fiber-Reinforced Concrete and Shotcrete

ASTM C 1751 Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction.(Non-extruding and Resilient Bituminous Types).

ASTM D 1179 Fluoride Ion in Water

ASTM D 1190 Standard Specification for Concrete Joint Sealer, Hot-Applied Elastic Type

ASTM D 1751 Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Non-extruding and Resilient Bituminous Types)

ASTM E 329 Standard Specification for Agencies Engaged in the Testing and/ or Inspection of Materials used in Construction

c. American Welding Society (AWS)

D 12 Welding Reinforcing Steel, Metal Inserts and Connections in Reinforced Concrete Construction.

d. Philippine National Standard (PNS)

PNS 49 Steel Bars for Concrete Reinforcement

e. DPWH Standard Specifications

e. All other standards hereinafter indicated.

f. The edition or the revised version of such codes and standards current at the date twenty eight (28) days prior to date of bid submission shall apply. During Contract execution, any changes in such codes and standards shall be applied after approval by the Owner.

SUBMITTALS

1. Test Reports and Certificates shall be furnished and approval received before delivery of certified or tested materials to the Project Sites.

a. Submit Test Reports for the following:

a.1 Concrete mixture proportions

Submit copies of test reports by independent test labs conforming to ASTM C 1077 showing that the mixture has been successfully tested to produce concrete with the properties specified and that mixture will be suitable for the job conditions. Test reports shall be submitted along with the concrete mixture proportions. Obtain approval before concrete placement. Fully describe the processes and methodology whereby mixture proportions were developed and tested and how proportions will be adjusted during progress of the work to achieve, as closely as possible, the designated levels of relevant properties.

a.2 Aggregates

Submit test results for aggregate quality in accordance with ASTM C 33. Where there is potential for alkali-silica reaction, provide results of tests conducted in accordance with ASTM C 227 or ASTM C 1260. Submit

results of all tests during progress of the work in tabular and graphical form as noted above, describing the cumulative combined aggregate grading and the percent of the combined aggregate retained on each sieve.

a.3 Admixtures

Submit test results in accordance with ASTM C 494 and ASTM C 1017 for concrete admixtures, ASTM C 260 for air-entraining agent, and manufacturer's literature and test reports for corrosion inhibitor and anti-washout admixture. Submitted data shall be based upon tests performed within 6 months of submittal.

a.4 Cement

Submit test results in accordance with ASTM C 150 Portland cement. Submit current mil data.

a.5 Water

Submit test results in accordance with ASTM D 512 and ASTM D 516.

b. Submit Certificates for the following:

b.1 Curing concrete elements

Submit proposed materials and methods for curing concrete elements.

b.2 Form removal schedule

Submit proposed materials and methods for curing concrete elements.

b.3 Concrete placement and compaction

Submit technical literature for equipment and methods proposed for use in placing concrete. Include pumping or conveying equipment including type, size and material for pipe, valve characteristics, and the maximum length and height concrete will be pumped. No adjustments shall be made to the mixture design to facilitate pumping.

Submit technical literature for equipment and methods proposed for vibrating and compacting concrete. Submittal shall include technical literature describing the equipment including vibrator diameter, length, frequency, amplitude, centrifugal force, and manufacturer's description of the radius of influence under load. Where flat work is to be cast, provide similar information relative to the proposed compacting screed or other method to ensure dense placement.

b.4 Mixture designs

Provide a detailed report of materials and methods used, test results, and the field test strength (fcr) for marine concrete required to meet durability requirements.

2. The Contractor shall submit shop drawings and erection drawings for formwork and scaffolding at least 14 days prior to commencing the work.

Each shop drawing and erection drawing shall bear the signature of a Contractor's qualified Engineer. Details of all proposed formwork to be prefabricated and formwork to produce special finishes shall be submitted to the Engineer for approval before any materials are ordered. If the Engineer so requires, samples of proposed formworks shall be constructed and concrete placed at the Contractor's expense so that the proposed methods and finished effect can be demonstrated.

The Contractor shall submit shop drawings showing reinforcing bar placing and bar lists for the Engineer's approval. Such shop drawings shall show also supplemental bars for forming, strengthening frames of bars of sufficient rigidity to withstand forces during placing concrete. If necessary, shaped steel may be added to improve rigidity of the frame of bar.

Such shop drawings shall clearly indicate bar sizes, spacing, location and quantities of reinforcement, mesh, chairs, spacers and other details to be as per ACI Manual of Standard Practice for Detailing Reinforced Concrete Structures.

Details shall be prepared for placement of reinforcement where special conditions occur, including most congested areas and connection between pre-cast concrete and concrete in-situ.

All shop drawings shall be reviewed by the Engineer within seven (7) days after receiving them. At least two (2) days prior to pouring concrete, the Contractor shall submit to the Engineer a pouring permit for his inspection and approval.

MATERIAL REQUIREMENTS

CEMENT

Unless otherwise specified in the Drawings, only one (1) brand of cement shall be used for any individual structure. In determining the approved mix, only Portland cement shall be used as the cementitious material.

1. Portland Cement: ASTM C 150

   Type I (for general use in construction)

ADMIXTURE (IF NECESSARY)

Unless otherwise required by field conditions, admixture may be used subject to the expressed approval of the Engineer. The cost of which shall already be included in the unit cost bid of the Contractor for the concrete.

1. Air Entraining Admixture shall conform to ASTM C 260.
2. Admixture other than air entraining agent shall conform to ASTM C 494.
3. Admixture containing chloride ions, or other ions producing deleterious effect shall not be used.

AGGREGATES

1. Crushed Coarse Aggregate

Conforming to ASTM C 33 and having nominal sizes passing 38.0 mm to 19.0 mm, 19.0 mm to 9.5 mm to No. 4 sieve. The material shall be well graded between the limits indicated and individually stockpiled. It shall be the Contractor's responsibility to blend the materials to meet the gradation requirements for various types of concrete as specified herein.

Nominal sizes for combined gradation shall be as follows:

ASTM Sieves	Nominal Size of Coarse Aggregates			
	% by Weight Passing			
	40mm	25mm	19mm	10mm
50.0mm (2")	100	-	-	-
38.0mm (1 1/2")	95 - 100	100	-	-
31.8mm (1 1/4")	-	90 - 100	100	-
25.0mm (1")	-	-	90 - 100	-
19.0mm (3/4")	35 - 70	25 - 90	-	100
16.0mm (5/8")	-	-	20 - 55	85 - 100
9.5mm (3/8")	10 - 30	0 - 10	0 - 10	0 - 20
No. 4	0 - 5			

2. Fine Aggregate

ASTM C 33 except for gradation which has been revised to meet local conditions unless otherwise required by the Engineer, grading of find aggregate shall be as follows:

ASTM Sieves	% by Weight Passing
9.5mm (3/8")	100
No.4	90 - 100
No. 8	80 - 100
No. 16	50 - 90
No. 30	25 - 60
No. 50	5 - 30
No. 100	0 - 10

a. Grading of fine aggregates shall be reasonably uniform and fineness modulus thereof shall not vary more than 0.2 from that of the representative sample in which mix proportions of concrete are based.

b. Due care shall be taken to prevent segregation.

WATER

The mixing water shall be clear and apparently clean. If it contains quantities or substances that discolor it or make it smell or taste unusual or objectionable, or cause suspicion, it shall not be used unless service records of concrete made with it (or other information) indicated that it is not injurious

to the quality, shall be subject to the acceptance criteria as shown in Table 6.3 and Table 6.4 or as designated by the purchaser.

When wash water is permitted, the producer will provide satisfactory proof or data of non-detrimental effects if potentially reactive aggregates are to be used. Use of wash water will be discontinued if undesirable reactions with admixtures or aggregates occur.

Table 6.3 Acceptance Criteria for Questionable Water Supplies

Test	Limits
Compressive strength, min. % Control at 7 days	90
Time of Setting deviation from control	from 1:00 earlier to 1:30 later
Time of Setting (Gillmore Test) Initial Final Set	 No marked change No marked change
Appearance	Clear
Color	Colorless
Odor	Odorless
Total Solids	500 parts/million max.
PH value	4.5 to 8.5

Table 6.4 Chemical Limitation for Wash Water

	Limits
Chemical Requirements, Minimum Concentration Chloride as $C1^{(-1)}$ expressed as a mass percent of cement when added to the $C1^{(-1)}$ in the other components of the concrete mixtures shall not exceed the following levels:	
1. Prestressed Concrete	0.06 percent
2. Conventionally reinforced concrete in a moist environment and exposed to chloride	0.10 percent
3. Conventionally reinforced concrete in a moist environment but not exposed to chloride	0.15 percent
4. Above ground building construction where the concrete will stay dry	No limit for corrosion
Sulfate as SO_4, ppm[A]	3,000
Alkalies as (Na_2O + 0.658 K_2O), ppm	600
Total Solids, ppm	50,000

Wash water reused as mixing water in concrete may exceed the listed concentrations of sulfate if it can be shown that the concentration calculated in the total mixing water, including mixing water on the aggregate and other sources, does not exceed that stated limits.

Water will be tested in accordance with, and shall meet the suggested requirements of AASHTO T 26.

Water known to be of potable quality may be used without test.

CURING MATERIALS

1. Impervious Sheet Materials

   ASTM C 171 type, optional, except that polyethylene film, if used, shall be white opaque.

2. Burlap of commercial quality, non-staining type, consisting of 2 layers minimum.

3. Membrane Forming Curing Compound

   ASTM C 309; submit evidence that product conforms to specifications.

JOINTING MATERIALS

1. Sealant

   Sealant shall be multi-component, polyurethane base compound, gray in color, self-leveling for horizontal joints, 2 part polythremdyne, terpolymer compound, gray in color; non-sag for vertical joints.

   Sealant shall be compatible with materials in contact and to perform satisfactorily under salt water and traffic conditions, and be capable of making joint watertight and allow movement 25% of the width of joint in any direction.

   Sealant shall be guaranteed against leakage, cracking, crumbling, melting, shrinkage, running, loss of adhesion for a period of five years from the date of acceptance of work.

2. Joint backing shall be expanded extruded polyethylene, low density, oval in shape to fit the joints as indicated on the drawings and to be compatible with sealant.

3. Where required, primer shall be compatible with joint materials and installed in accordance with manufacturer's instructions.

4. Joint filler shall conform to ASTM D1751 (AASHTO M213) non-extruding, resilient bituminous type. Filler shall be furnished for each joint in single piece for depth and width required for joint, unless otherwise authorized by the Engineer. When more than one piece is authorized for a joint, abutting ends shall be fastened and hold securely to shape by stapling or other positive fastening.

EPOXY BONDING COMPOUND

ASTM C 881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Class B if placement temperature is between 4 and 16°C; or Class C if placement temperature is above 16°C.

REINFORCEMENT

Steel reinforcement, other than Steel for Pre-stressing, used in Reinforced Concrete, shall conform to ASTM and PNS as follows:

ASTM Designation A615 - Deformed Billet Steel Bars for Concrete Reinforcement. Minimum yield strength of 276 MPa (40,000 psi).

PNS 49 - Steel Bars for Concrete Reinforcement

TIE WIRE

Tie wire shall be plain, cold drawn annealed steel wire 1.6 mm diameter.

SAMPLES AND TESTING

1. Cement

Sampled either at the mill or at the site of work and tested by an independent commercial or government testing laboratory duly accredited by the Bureau of Research and Standards (BRS) of the DPWH, Department of Science and Technology (DOST) or the Department of Trade and Industry (DTI) at no additional cost to PPA. Certified copies of laboratory test reports shall be furnished for each lot of cement and shall include all test data, results, and certificates that the sampling and testing procedures are in conformance with the Specifications. No cement shall be used until notice has been given by the Engineer that the test results are satisfactory. Cement that has been stored, other than in bins at the mills, for more than 3 months after delivery to the Site shall be re-tested before use. Cement delivered at the Site and later found after test to be unsuitable shall not be incorporated into the permanent works.

2. Aggregates: Tested as prescribed in ASTM C 33

At least 28 days prior to commencing the work, the Contractor shall inform the Engineer of the proposed source of aggregates and provide access for sampling.

Gradation tests will be made on each sample without delay. All other aggregates tests required by these Specifications shall be made on the initial source samples, and shall be repeated whenever there is a change of source. The tests shall include an analysis of each grade of material and an analysis of the combined material representing the aggregate part of the mix.

3. Reinforcement

Certified copies of mill certificates shall accompany deliveries of steel bar reinforcement. If requested by the Engineer additional testing of the materials shall be made at the Contractor's expense.

4. Concrete Tests

For test purposes, provide 1 set of three (3) concrete cylinder samples taken from each day's pouring and to represent not more than 75 cu.m. of concrete class or fraction thereof of concrete placed. Samples shall be secured in conformance with ASTM C 172. Tests specimens shall be made, cured, and packed for shipment in accordance with ASTM C 31. Cylinders will be tested by and at the expense of the Contractor in accordance with ASTM C 39. Test specimens will be evaluated separately by the Engineer, for meeting strength level requirements for each with concrete quality of ACI 318. When samples fail to conform to the requirements for strengths, the Engineer shall have the right to order a change in the proportions of the concrete mix for the remaining portions of the work at no additional cost to the Authority.

5. Test of Hardened Concrete in or Removed from the Structure

When the results of the strength tests of the concrete specimens indicates the concrete as placed does not meet the Specification requirements or where there are other evidences that the quality of concrete is below the specification requirement in the opinion of the Engineer, tests on cores of in-place concrete shall be made in conformance with ASTM C 42.

Core specimens shall be obtained by the Contractor and shall be tested. Any deficiency shall be corrected or if the Contractor elects, he may submit a proposal for approval before the load test is made. If the proposal is approved, the load test shall be made by the Contractor and the test results evaluated by the Engineer in conformance with Chapter 20 of ACI 318. The cost of the load tests shall be borne by the Contractor. If any concrete shows evidence of failure during the load test, or fails the load test as evaluated, the deficiency be corrected in a manner approved by the Engineer at no additional cost to the Authority.

6. Chemical Admixtures/Additives

The admixtures/additives if approved shall conformed to ASTM C 494 and ASTM C 1017. The testing shall be conducted with cement and aggregate proposed for the Project. The admixtures/additives shall be tested and those that have been in storage at the Project Site for longer than six (6) months shall not be used until proven by retest to be satisfactory.

Samples of any admixtures/additives proposed by the Contractor shall be submitted for testing at least 56 days in advance of use, which shall require approval of the Engineer. Testing of admixtures/additives proposed by the Contractor including test mixing and cylinder test shall be at the Contractor's expense.

7. Jointing Materials and Curing Compound Samples

At least 28 days prior to commencing the work, the Contractor shall submit to the Engineer for his approval samples of the following materials proposed for use together with manufacturer's certificate.

a. 10 kg of joint sealant
b. 1m length of joint filler
c. 5 li. of curing compound
d. 1m length of joint backing

The Engineer shall deliver to the Contractor his assessment on the materials within seven (7) days after receiving them.

EXECUTION

DELIVERY, STORAGE AND HANDLING OF MATERIALS

1. Cement

Do not deliver concrete until vapor barrier, forms, reinforcement, embedded items, and chamfer strips are in place and ready for concrete placement. ACI 301 and ASTM A 934 for job site storage of materials. Protect materials from contaminants such as grease, oil, and dirt. Ensure materials can be accurately identified after bundles are broken and tags removed.

Immediately upon receipt at the Site, the cement shall be stored separately in a dry weathertight, properly ventilated structures with adequate provisions for prevention of

absorption of moisture. Storage accommodations for concrete materials shall be subject to approval and shall afford easy access for inspection and identification of each shipment in accordance with test reports.

Cement shall be delivered to the Site in bulk or in sound and properly sealed bags and while being loaded or unloaded and during transit to the concrete mixers whether conveyed in vehicles or in mechanical means, cement shall be protected from whether by effective coverings. Efficient screens shall be supplied and erected during heavy winds.

If the cement is delivered in bulk, the Contractor shall provide, at his own cost, approved silos of adequate size and numbers to store sufficient cement to ensure continuity of work and the cement shall be placed in these silos immediately after it has been delivered to the Site. Approved precautions shall be taken into consideration during unloading to ensure that the resulting dust does not constitute a nuisance.

If the cement is delivered in bags, the Contractor shall provide, at his own cost, perfectly waterproofed and well ventilated sheds having a floor of wood or concrete raised at least 0.5m above the ground. The sheds shall be large enough to store sufficient cement to ensure continuity of the work and each consignment shall be stacked separately therein to permit easy access for inspection, testing and approval. Upon delivery, the cement shall at once be placed in these sheds and shall be used in the order in which it has been delivered.

Cement bags should not be stacked more than 13 bags high. All cement shall be used within two months of the date of manufacture. If delivery conditions render this impossible, the Engineer may permit cement to be used up to three (3) month after manufacturing, subject to such conditions including addition of extra cement as he shall stipulate.

2. Aggregate

All fine and coarse aggregate for concrete shall be stored on close fitting, steel or concrete stages design with drainage slopes or in bins of substantial construction in such a manner as to prevent segregation of sizes and to avoid the inclusion of dirt and other foreign materials in the concrete. All such bins shall be emptied and cleaned at intervals of every six (6) months or as required by the Engineer. Each size of aggregate shall be stored separately unless otherwise approved by the Engineer.

Stockpiles of coarse aggregate shall be built in horizontal layers not exceeding 1.2 m in depth to minimize segregation.

FORMWORK

1. Forms

Designed, constructed, and maintained so as to insure that after removal of forms the finished concrete members will have true surfaces free of offset, waviness or bulges and will conform accurately to the indicated shapes, dimensions, lines, elevations and positions. Form surfaces that will be in contact with concrete shall be thoroughly cleaned before each use.

2. Design

Studs and wales shall be spaced to prevent deflection of form material. Forms and joints shall be sufficiently tight to prevent leakage of grout and cement paste during placing of concrete. Juncture of formwork panels shall occur at vertical control joints, and construction joints. Forms placed on successive units for continuous surfaces shall be fitted in accurate alignment to assure smooth completed surfaces free from irregularities and signs of discontinuity. Temporary opening shall be arranged to wall and where otherwise required

to facilitate cleaning and inspection. Forms shall be readily removable without impact, shock, or damage to the concrete.

3. Form Ties

Factory fabricated, adjustable to permit tightening of the forms, removable or snap-off metal of design that will not allow form deflection and will not spall concrete upon removal. Bolts and rods that are to be completely withdrawn shall be coated with a non-staining bond breaker. Ties shall be of the type which provide watertight concrete.

4. Chamfering

External corners that will be exposed shall be chamfered, beveled, or rounded by mouldings placed in the forms or as indicated in the drawings.

5. Coatings

Forms for exposed surfaces shall be coated with form oil or form-release agent before reinforcement is placed. The coating shall be a commercial formulation of satisfactory and proven performance that will not bond with, stain, or adversely affect concrete surfaces, and shall not impair subsequent treatment of concrete surfaces depending upon bond or adhesion nor impede the wetting of surfaces to be cured with water or curing compounds. The coating shall be used as recommended in the manufacturer's printed or written instructions. Forms for unexposed surfaces may be wet with water in lieu of coating immediately before placing of concrete. Surplus coating on form surfaces and coating on reinforcement steel and construction joints shall be removed before placing concrete.

6. Removal of Forms shall be done in a manner as to prevent injury to the concrete and to insure complete safety of the structure after the following conditions have been met. Where the structure as a whole is supported on shores, forms for beam and girder sides, and similar vertical structural members may be removed before expiration of curing period. Care shall be taken to avoid spalling the concrete surface or damaging concrete edges. Wood forms shall be completely removed.

Minimum stripping and striking time shall be as follows unless otherwise approved by the Engineer.

Vertical sides of beams, walls, and columns, lift not 12 hours exceeding 1.2 m

Vertical sides of beams and walls, lift exceeding 1.2 m 36 hours Softlifts of main slabs and beams (props left under) 5 days

Removal of props from beams and mains slabs and other work 10 days

7. Control Test

If the Contractor proposes to remove forms earlier than the period stated above, he shall be required to submit the results of control tests showing evidence that concrete has attained sufficient strength to permit removal of supporting forms. Cylinders required for control tests shall be provided in addition to those otherwise required by this Specification. Test specimens shall be removed from molds at the end of 24 hours and stored in the structure as near the points as practicable, the same protection from the elements during curing as is given to those portions of the structure which they represent, and shall not be removed from the structure for transmittal to the laboratory prior to expiration of three fourths of the proposed period before removal of forms. Cylinders will be tested by and at the expense of the Contractor. Supporting forms or shoring shall not be removed until control test specimens have attained strength of at least 160 kg/sq cm. The newly unsupported portions of the structure shall not be subjected to heavy construction or material loading.

REINFORCEMENT

1. Reinforcement

Fabricated to shapes and dimensions shown and shall be placed where indicated. Reinforcement shall be free of loose or flaky rust and mill scale, or coating, and any other substance that would reduce or destroy the bond. Reinforcing steel reduced in section shall not be used. After any substantial delay in the work, previously placed reinforcing steel for future bonding shall be inspected and cleaned. Reinforcing steel shall not be bent or straightened in a manner injurious to the steel or concrete. Bars with kinks or bends not shown in the drawings shall not be placed. The use of heat to bend or straighten reinforcing steel shall not be permitted. Bars shall be moved as necessary to avoid interference with other reinforcing steel, conduits, or embedded items. If bars are moved more than one bar diameter, the resulting arrangement of bars including additional bars necessary to meet structural requirements shall be approved before concrete is placed. In slabs, beams and girders, reinforcing steel shall not be spliced at points of maximum stress unless otherwise indicated. Unless otherwise shown in the drawings, laps or splices shall be 40 times the reinforcing bar diameter.

2. The nominal dimensions and unit weights of bars shall be in accordance with the following table:

Nominal Diameter (mm)	Nominal Perimeter (mm)	Nominal Sectional Area (sq. mm)	Unit Weight (kg/m)
10	31.4	78.54	0.616
12	37.7	113.10	0.888
16	50.3	201.10	1.579
20	62.8	314.20	2.466
25	78.5	490.90	3.854
28	88.0	615.70	4.833
32	100.5	804.20	6.313
36	113.1	1,017.60	7.991
40	125.7	1,256.60	9.864
50	157.1	1,963.50	15.413

3. Welding of reinforcing bars shall only be permitted where shown; all welding shown shall be performed in accordance with AWS D 12.1.

4. Exposed reinforcement bars, dowels and plates intended for bonding with future extensions shall be protected from corrosion.

5. Supports shall be provided in conformance with ACI 315 and ACI 318, unless otherwise indicated or specified.

6. Concrete Protection for Reinforcement

   a. The minimum concrete cover of reinforcement shall be as shown below unless otherwise indicated in the drawings.

b. Tolerance for Concrete Cover of Reinforcing Steel other than Tendons.

Minimum Cover

7.5cm or more (marine structures and concrete cast against and permanently exposed to earth)

DESIGN STRENGTH OF CONCRETE

Concrete for structural parts or members such as beams, slabs, curtain wall, pile caps and fender/mooring blocks shall develop a minimum 28-day compressive cylinder strength of 24 MPa (3,500 psi) as indicated in the drawings. While for pre-stressed concrete piles a compressive strength of 35 MPa (5,000psi).

TRIAL BATCH FOR CONCRETE

Thirty (30) calendar days before the start of concreting works, the Contractor shall submit design mixes and the corresponding test result made on sample thereof. Sampling and testing shall be in accordance with the ASTM Standard procedures for sampling and testing for the particular design strength(s) required.

The particulars of the mix such as the slump and the proportionate weights of cement, saturated surface dry aggregates and water used shall be stated.

The design mix for concrete to be used shall be submitted together with at least three (3) standard cylinder samples for approval at least one (1) month prior to the start of each concreting schedule. Such samples shall be prepared in the presence of the Engineer.

Standard laboratory strength tests for the 7, 14 and 28 days periods shall be taken to all concrete samples in addition to routine field tests, at cost to the Contractor. Only design mixes represented by test proving the required strength for 7, 14 and 28 days tests shall be allowed.

The cost of sampling, handling and transporting samples from jobsite to the laboratory and the cost of subsequent tests made until the desired mix is attained shall be for the account of the Contractor.

Slump Test shall be made in conformance with ASTM C143, and unless otherwise specified by the Engineer, slump shall be within the following limits:

Structural Element	**Slump for Vibrated Concrete**	
	Minimum	**Maximum**
Pavement Concrete	25mm	50mm
Pre-cast Concrete	50mm	70mm
Lean Concrete	100mm	200mm
Sacked Concrete	25mm	50mm
All other Concrete	50mm	90mm

Sampling : Provide suitable facilities and labor for obtaining representative samples of concrete for the Contractor's quality control and the Engineer's quality assurance testing. All necessary platforms, tools and equipment for obtaining samples shall be furnished by the Contractor.

MIXING CONCRETE

1. GENERAL

a. 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.

b. All concrete shall be mixed in mechanically operated mixers. Mixing plant and equipment for transporting and placing concrete shall be arranged with an ample auxiliary installation to provide a minimum supply of concrete in case of breakdown of machinery or in case the normal supply of concrete is disrupted. The auxiliary supply of concrete shall be sufficient to complete the casting of a section up to a construction joint that will meet the approval of the Engineer.

c. Equipment having components made of aluminum or magnesium alloys, which would be in contact with plastic concrete during mixing, transporting or pumping of Portland cement concrete, shall not be used.

d. Concrete mixers shall be equipped with adequate water storage and a device for accurately measuring and automatically controlling the amount of water used.

e. Materials shall be measured by weighing. The apparatus provided for weighing the aggregates and cement shall be suitably designed and constructed for this purpose. The accuracy of all weighing devices except that for water shall be such that successive quantities can be measured to within one percent of the desired amounts. The water measuring device shall be accurate to plus or minus 0.5 percent. All measuring devices shall be subject to the approval of the Engineer. Scales and measuring devices shall be tested at the expense of the Contractor as frequently as the Engineer may deem necessary to insure their accuracy.

f. Weighing equipment shall be insulated against vibration or movement of other operating equipment in the plant. When the entire plant is running, the scale reading at cut-off shall not vary from the weight designated by the Engineer by more than one percent for cement, 1-½ percent for any size of aggregate, or one percent for the total aggregate in any batch.

g. Manual mixing of concrete shall not be permitted unless approved by the Engineer.

2. MIXING CONCRETE AT SITE

a. Concrete mixers may be of the revolving drum or the revolving blade type and the mixing drum or blades shall be operated uniformly at the mixing speed recommended by the manufacturer.

The pick-up and throw-over blades of mixers shall be restored or replaced when any part or section is worn 20 mm or more below the original height of the manufacturer's design. Mixers and agitators which have an accumulation of hard concrete or mortar shall not be used.

b. When bulk cement is used and the volume of the batch is 0.5 m^3 or more, the scale and weigh hopper for Portland cement shall be separate and distinct from the aggregate hopper or hoppers.

The discharge mechanism of the bulk cement weigh hopper shall be interlocked against opening before the full amount of cement is in the hopper. The discharging mechanism shall be interlocked against opening when the amount of cement in

the hopper is underweight by more than one percent or overweight by more than 3 percent of the amount specified.

c. When the aggregates contain 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.

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

e. Cement shall be batched and charged into the mixer by such means that it will not result in loss of cement due to the effect of wind, or in accumulation of cement on surfaces of conveyors or hoppers, or in other conditions which reduce or vary the required quantity of cement in the concrete mixture.

f. Where required, synthetic fibrous reinforcement shall be added directly to the concrete mixer after placing the sufficient amount of mixing water, cement and aggregates.

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

h. All concrete shall be mixed for a period of not less that 3 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.

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

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

k. In case of rubble concrete, proper mixture and placing of concrete and stones/rocks shall be in accordance to the approved plan. Methodology of work shall be approved by the Engineer.

3. MIXING CONCRETE IN TRUCKS

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

b. The maximum size of batch in truck mixers shall not exceed the minimum rated capacity of the mixer as stated by the manufacture and stamped in metal on the mixer. Truck mixing shall, unless otherwise directed, be continued for not less than

100 revolutions after all ingredients, including water, are in the drum. The mixing speed shall not be less than 4 rpm, nor more than 6 rpm.

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

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

JOINTS

1. No reinforcement, corner protection angles or other fixed metal items shall be run continuously through joints containing expansion-joint filler, through crack-control joints in slabs on grade and vertical surfaces.

2. Preformed Expansion Joint Filler

   a. Joints with Joint Sealant

      At expansion joints in concrete slabs to be exposed, and at other joints indicated to receive joint sealant, preformed expansion-joint filler strips shall be installed at the proper level below the elevation with a slightly tapered, dressed-and-oiled wood strip temporarily secured to the top thereof to form a groove. When surface dry, the groove shall be cleaned of foreign matter, loose particles, and concrete protrusions, then filled flush approximately with joint sealant so as to be slightly concave after drying.

   b. Finish of concrete at joints

      Edges of exposed concrete slabs along expansion joints shall be neatly finished with a slightly rounded edging tool.

   c. Construction Joints

      Unless otherwise specified herein, all construction joints shall be subject to approval of the Engineer. Concrete shall be placed continuously so that the unit will be monolithic in construction. Fresh concrete may be placed against adjoining units, provided the set concrete is sufficiently hard not to be injured thereby. Joints not indicated shall be made and located in a manner not to impair strength and appearance of the structure. Placement of concrete shall be at such rate that the surface of concrete not carried to joint levels will not have attained initial set before additional concrete is placed thereon. Lifts shall terminate at such levels as are indicated or as to conform to structural requirements as directed. If horizontal construction joints are required, a strip of 25mm square-edged lumber, beveled to facilitate removal shall be tacked to the inside of the forms at the construction joint. Concrete shall be placed to a point 25mm above the underside of the strip. The strip shall be removed one hour after the concrete has been placed. Any irregularities in the joint line shall be leveled off with a wood float, and all laitance removed. Prior to placing additional concrete, horizontal construction joints shall be prepared.

Construction Joint which is not indicated in the Drawings shall be located as to least affect the strength of the structure. Such locations will be pointed out by the Engineer.

PREPARATION FOR PLACING

Hardened concrete, debris and foreign materials shall be removed from the interior of forms and from inner surfaces of mixing and conveying equipment. Reinforcement shall be secured in position, and shall be inspected, and approved before placing concrete. Runways shall be provided for wheeled concrete-handling equipment. Such equipment shall not be wheeled over reinforcement nor shall runways be supported on reinforcement.

Notice of any concreting operations shall be served to the Engineer at least three (3) days ahead of each schedule.

PLACING CONCRETE

1. Handling Concrete

Concrete shall be handled from mixers and transported to place for final deposit in a continuous manner, as rapidly as practicable, and without segregation or loss of ingredients until the approved unit of work is completed. Placing will not be permitted when the sun, heat, wind or limitations of facilities furnished by the Contractor prevent proper finishing and curing of the concrete. Concrete shall be placed in the forms, as close as possible in final position, in uniform approximately horizontal layers not over 40cm deep. Forms splashed with concrete and reinforcement splashed with concrete or form coating shall be cleaned in advance of placing subsequent lifts. Concrete shall not be allowed to drop freely more than 1.5m in unexposed work nor more than 1.0 m in exposed work; where greater drops are required, tremie or other approved means shall be employed.

2. Time Interval between Mixing and Placing

Concrete mixed in stationary mixers and transported by non-agitating equipment shall be placed in the forms within 30 minutes from the time ingredients are charged into the mixing drum. Concrete transported in truck mixers or truck agitators shall be delivered to the site of work, discharged in the forms within 45 minutes from the time ingredients are discharged into the mixing drum. Concrete shall be placed in the forms within 15 minutes after discharged from the mixer at the jobsite.

3. Hot Weather Requirements

The temperature of concrete during the period of mixing while in transport and/or during placing shall not be permitted to rise above 36 °C. Any batch of concrete which had reached a temperature greater than 36 °C at any time in the aforesaid period shall not be placed but shall be rejected, and shall not thereafter be used in any part of the permanent works.

a. Control Procedures

Provide water cooler facilities and procedures to control or reduce the temperature of cement, aggregates and mixing handling equipment to such temperature that, at all times during mixing, transporting, handling and placing, the temperature of the concrete shall not be greater than 36 °C.

b. Cold Joints and Shrinkage

Where cold joints tend to form or where surfaces set and dry too rapidly or plastic shrinkage cracks tend to appear, concrete shall be kept moist by fog sprays, or other approved means, applied shortly after placement, and before finishing.

c. Supplementary Precautions

When the aforementioned precautions are not sufficient to satisfy the requirements herein above, they shall be supplemented by restricting work during evening or night. Procedure shall conform to American Concrete Institute Standard ACI 305.

4. Conveying Concrete by Chute, Conveyor or Pump

Concrete may be conveyed by chute, conveyor, or pump if approved in writing. In requesting approval, the Contractor shall submit his entire plan of operation from the time of discharge of concrete from the mixer to final placement in the forms, and the steps to be taken to prevent the formation of cold joints in case the transporting of concrete by chute, conveyor or pump is disrupted. Conveyors and pumps shall be capable of expeditiously placing concrete at the rate most advantageous to good workmanship. Approval will not be given for chutes or conveyors requiring changes in the concrete materials or design mix for efficient operation.

a. Chutes and Conveyors

Chutes shall be of steel or steel lined wood, rounded in cross section rigid in construction, and protected from overflow. Conveyors shall be designed and operated and chute sections shall be set, to assure a uniform flow of concrete from mixer to final place of deposit without segregation of ingredients, loss of mortar, or change in slump. The discharged portion of each chute or conveyor shall be provided with a device to prevent segregation. The chute and conveyor shall be thoroughly cleaned before and after each run. Waste material and flushing water shall be discharged outside the forms.

b. Pumps shall be operated and maintained so that a continuous stream of concrete is delivered into the forms without air pockets, segregation or changes in slump. When pumping is completed, concrete remaining in the pipeline shall be ejected and wasted without contamination of concrete already placed. After each operation, equipment shall be thoroughly cleaned and the flushing water shall be splashed outside the forms.

5. Wall and Abutments

No load shall be placed upon finished walls, foundations or abutments until authorized by the Engineer. Minimum time before loading shall be 7 days.

6. Concrete Placing on Wharf

When placing concrete on wharf decks, the Contractor shall:

Ensure that rate of placing is sufficient to complete proposed placing, finishing and curing operations within the scheduled time; that experienced finishing machine operators and concrete finishers are provided to finish the deck; that curing equipment and finishing tools and equipment are at the site of work and in satisfactory condition for use.
Immediately prior to placing, the Contractor shall place scaffolding and wedges and make necessary adjustments. Care shall be taken to ensure that settlement and deflection due to added weight of concrete will be minimal. The Contractor shall provide suitable means to readily permit measurement of settlement deflection as it occurs.

Should any event occur which, in opinion of the Engineer, would prevent the concrete conforming to specified requirements, the Contractor shall discontinue placing of concrete until corrective measures are provided satisfactory to the Engineer. If satisfactory measures are not provided prior to initial set of concrete in affected areas, the Contractor shall discontinue placing concrete and install a bulkhead at a location determined by the Engineer. Concrete in place beyond bulkheads shall be removed. The Contractor shall limit the size of casting to that which can be finished before beginning of initial set.

COMPACTION

1. Immediately after placing, each layer of concrete shall be completed by internal concrete vibrators supplemented by hand-spading, rodding, and tamping. Tapping or other external vibration of forms will not be permitted unless specifically approved by the Engineer. Vibrators shall not be used to transport concrete inside the forms. Internal vibrators submerged in concrete shall maintain a speed of not less than 7,000 impulses per minute. The vibrating equipment shall at all times be adequate in number of units and power to properly consolidate all concrete.

2. Spare units shall be on hand as necessary to insure such adequacy. The duration of vibrating equipment shall be limited to the time necessary to produce satisfactory consolidation without causing objectionable segregation. The vibrator shall not be inserted into the lower courses that have begun to set. Vibrator shall be applied vertically at uniformly spaced points not further apart than the visible effectiveness of the machine.

EPOXY BONDING COMPOUND

Before depositing new concrete on or against concrete that has set, the surfaces of the set concrete shall be thoroughly cleaned so as to expose the coarse aggregate and be free of laitance, coatings, foreign matter and loose particles. Forms shall be re-tightened. The cleaned surfaces shall be moistened, but shall be without free water when concrete is placed. ASTM C 881. Provide Type I for bonding hardened concrete to hardened concrete; Type II for bonding freshly mixed concrete to hardened concrete; and Type III as a binder in epoxy mortar or concrete, or for use in bonding skid-resistant materials to hardened concrete. Provide Class B if placement temperature is between 4 to 16 °C; or Class C if placement temperature is above 16°C.

FINISHES OF CONCRETE

Within 12 hours after the forms are removed, surface defects shall be remedied as specified herein. The Temperature of the concrete, ambient air and mortar during remedial work including curing shall be above 10 °C. Fine and loose material shall be removed. Honeycomb, aggregate pockets, voids over 13mm in diameter, and holes left by the rods or bolts shall be cut out to solid concrete, reamed, thoroughly wetted, brush-coated with neat cement grout, and filled with mortar. Mortar shall be a stiff mix of one part Portland cement to not more than 2 parts fine aggregate passing the No. 16 mesh sieve, with a minimum amount of water. The color of the mortar shall match the adjoining concrete color. Mortar shall be thoroughly compacted in place. Holes passing entirely through walls shall be completely filled from the inside face by forcing mortar through the outside face. Holes which do not pass entirely through wall shall be packed full. Patchwork shall be finished flush and in the same plane as adjacent surfaces. Exposed patchwork shall be finished to match adjoining surfaces in texture and color. Patchwork shall be damp-cured for 72 hours. Dusting of finish surfaces with dry material or adding water to concrete surfaces will not be permitted.

CONCRETE FINISHING DETAILS

1. Concrete Paving

After concrete is placed and consolidated, slabs shall be screeded or struck off. No further finish is required.

2. Smooth Finish

Required only where specified; screed concrete and float to required level with no coarse aggregate visible. After surface moisture has disappeared and laitance has been removed, the surface shall be finished by float and steel trowel. Smooth finish shall consist of thoroughly wetting and then brush coating the surfaces with cement to not more than 2 parts fine aggregate passing the no. 30 mesh sieve and mixed with water to the consistency of thick paint.

3. Broom Finish

Required for paving; the concrete shall be screeded and floated to required finish level with no coarse aggregate visible. After the surface moisture has disappeared and laitance has been removed, surface shall be float-finished to an even, smooth finish. The floated surfaces shall be broomed with a fiber bristle brush in a direction transverse to the direction of the main traffic.

ITEM 08 : SUBGRADE PREPARATION

DESCRIPTION

This Item shall consist of the preparation of the subgrade for the support of overlying structural layers. It shall extend to full width of the pavement.

MATERIAL REQUIREMENTS

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

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

   Selected Borrow, for topping – soil of such gradation that all particles will pass a sieve with 75 mm (3 inches) square openings and not more than 15 mass percent will pass the 0.075 mm (No. 200) sieve, as determined by AASHTO T 11. The material shall have a plasticity index of not more than 6 as determined by ASSHTO T 90 and a liquid limit of not more than 30 as determined by AASHTO T 89.

2. Unsuitable Material – Material other than suitable materials such as:

   (a) Materials containing detrimental quantities of organic materials, such as grass, roots and sewerage.

   (b) Organic soils such as peat and muck.

   (c) Soils with liquid limit exceeding 80 and/or plasticity index exceeding 55.

   (d) Soils with a natural water content exceeding 100%.

   (e) Soils with very low natural density, 800 kg/m3 or lower.

   (f) Soils that cannot be properly compacted as determined by the Engineer.

CONSTRUCTION REQUIREMENTS

PRIOR WORKS

Prior to commencing preparation of the subgrade, all culverts, cross drains, ducts and the like (including their fully compacted backfill), ditches, drains and drainage outlets shall be completed. Any work on the preparation of the subgrade shall not be started unless prior work herein described shall have been approved by the Engineer.

SUBGRADE LEVEL TOLERANCE

The finished compacted surface of the subgrade shall conform to the allowable tolerances as specified hereunder:

Permitted variation from design LEVEL OF SURFACE	+ 20 mm - 30 mm
Permitted SURFACE IRREGULARITY MEASURED BY 3-m STRAIGHT EDGE	30 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.5 %
Permitted variation from design LONGITUDINAL GRADE over 25 m length	± 0.1 %

SUBGRADE IN COMMON EXCAVATION

Unless otherwise specified, all materials below subgrade level in earth cuts to a depth 150 mm or other depth shown on the Plans or as directed by the Engineer shall be excavated. The material, if suitable, shall be set aside for future use or, if unsuitable, shall be disposed as directed by the Engineer.

Where material has been removed from below subgrade level, the resulting surface shall be compacted to a depth of 150 mm.

All materials immediately below subgrade level in earth cuts to a depth of 150 mm, or to such greater depth as may be specified, shall be compacted in accordance with the materials requirement.

SUBGRADE ON EMBANKMENT

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

PROTECTION OF COMPLETED WORK

The Contractor shall be required to protect and maintain at his own expense the entire work within the limits of his Contract in good condition satisfactory to the Engineer from the time he first started work until all work shall have been completed. Maintenance shall include repairing and recompacting ruts, ridges, soft spots and deteriorated sections of the subgrade caused by the traffic of the Contractor's vehicle/equipment or that of the public.

ITEM 09 : AGGREGATE SUB BASE COURSE

DESCRIPTION

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

MATERIAL REQUIREMENTS

Aggregate for subbase shall consist of hard, durable particles or fragments of crushed stone, crushed slag, or crushed or natural gravel and filler of natural or crushed sand or other finely divided mineral matter. The composite material shall be free from vegetable matter and lumps or balls of clay, and shall be of such nature that it can be compacted readily to form a firm, stable subbase.

The subbase material shall conform to the following Grading Requirements

Grading Requirements

Sieve Designation		Mass Percent Passing
Standard, mm	Alternate US Standard	
50	2"	100
25	1"	55 – 85
9.5	3/8"	40 – 75
0.075	No. 200	0 - 12

The fraction passing the 0.075 mm (No. 200) sieve shall not be greater than 0.66 (two thirds) of the fraction passing the 0.425 mm (No. 40) sieve.

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and plasticity index not greater than 12 as determined by AASHTO T 89 and T 90, respectively.

The coarse portion, retained on a 2.00 mm (No. 10) sieve, shall have a mass percent of wear not exceeding 50 by the Los Angeles Abrasion Tests as determined by AASHTO T 96.

The material shall have a soaked **CBR value of not less than 25%** as determined by AASHTO T 193. The CBR value shall be obtained at the maximum dry density and determined by AASHTO T 180, Method D.

CONSTRUCTION REQUIREMENTS

PLACING

The aggregate subbase material shall be placed at a uniform mixture on a prepared subgrade in a quantity which will provide the required compacted thickness. When more than one layer is required, each layer shall be shaped and compacted before the succeeding layer is placed.

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow. The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

When hauling is done over previously placed material, hauling equipment shall be dispersed uniformly over the entire surface of the previously constructed layer, to minimize rutting or uneven compaction.

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 subbase construction is started, the Contractor shall spread and compact trial sections as directed by the Engineer. The purpose of the trial sections is to check the suitability of the materials and the efficiency of the equipment and construction method which is proposed to be used by the Contractor. Therefore, the Contractor must use the same material, equipment and procedures that he proposes to use for the main work. One trial section of about 500 m^2 shall be made for every type of material and/or construction equipment/procedure proposed for use.

After final compaction of each trial section, the Contractor shall carry out such field density tests and other tests required as directed by the Engineer.

If a trial section shows that the proposed materials, equipment or procedures in the Engineer's opinion are not suitable for subbase, the material shall be removed at the Contractor's expense, and a new trial section shall be constructed.

If the basic conditions regarding the type of material or procedure change during the execution of the work, new trial sections shall be constructed.

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 THICKNESS OF LAYER	± 20 mm
Permitted variation from design LEVEL OF SURFACE	+ 10 mm -20 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	20 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.3%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	± 0.1%

METHOD OF MEASUREMENT

Aggregate Subbase Course will be measured by the cubic meter (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 course. No allowance will be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of subbase herein measured.

ITEM 10 : 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 THICKNESS OF LAYER	± 10 mm
Permitted variation from design LEVEL OF SURFACE	+ 5 mm -10 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	5 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.2%
Permitted variation from design LONGITUDINAL GRADE over 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.

ITEM 11 : PORTLAND CEMENT CONCRETE PAVEMENT

SCOPE OF WORK

The works include the furnishing of all labor, materials and equipment required for the construction of gravel base course and concrete pavement. The works shall be in accordance with the lines and grades shown on the Drawings and in conformity with the Specifications.

MATERIAL REQUIREMENTS

Cement

Portland cement shall conform to the requirements of the Section "Reinforced Concrete".

Fine Aggregate

The fine aggregate shall be well-graded from coarse to fine and shall conform to the requirements of the Section "Reinforced Concrete".

Coarse Aggregate

Coarse aggregate shall conform to the requirements of the Section "Reinforced Concrete".

Water

Clean, fresh, potable water shall be used for the mixing of all concrete and mortar and shall be from a source approved by the Engineer. Sea water or brackish water shall not be used.

Admixture

Admixture shall only be used with the written permission of the Engineer. If air-entraining agents, water reducing agents, set retarders or strength accelerators are permitted to be used, they shall not be used in greater dosages than those recommended by the manufacturer, or as permitted by the Engineer. The cost shall be considered as already in the Contractor's unit cost bid for concrete.

TIE BARS AND SLIP BARS

Tie bars shall be deformed bars conforming to the requirements specified in AASHTO M 31 or M 42, except that rail steel shall not be used for tie bars that are to be bent and re-straightened during construction, sizes as indicated on the Drawings. The deformed bars shall be Grade 40 and shall be shipped in standard bundles, tagged and marked in accordance with the Code of Standard practice of the Concrete Reinforcement Steel Institute.

Slip bars shall be smooth round steel bars conforming to the requirements specified in AASHTO M 31 or plain M 42.

Joint Filler

Poured filler for joint shall conform to the requirements of AASHTO M173.

EXECUTION

Concrete Class

The concrete for pavement shall satisfy the following requirements:

Minimum 28-day comprehensive strength	:	24 MPa
Minimum Flexural Strength	:	3.8 MPa
Maximum Aggregate size	:	25 mm
Maximum water cement ratio	:	0.52

Proportioning, Consistency and Mixing of Concrete

The proportioning, consistency and mixing of concrete shall conform to the requirements of the Section "Reinforced Concrete".

Preparation

The base shall be watered and thoroughly moistened prior to placing of the concrete.

Formwork Construction

Formwork shall comply with the requirements of the Section "Reinforced Concrete". Forms shall be of steel, of an approved section and shall be straight and of a depth equal to 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 not less than 2/3 the height of the form.

All forms shall be rigidly supported on a bed of thoroughly compacted material during the entire operation of placing and finishing the concrete. They shall be set with their faces vertical so as to produce a surface complying with the required tolerance.

Adjacent lanes may be used in lieu of forms for supporting finishing equipment provided that proper protection is afforded to the concrete of the adjacent lanes to prevent damage, and provided further that the surface of the concrete carrying the finishing equipment does not vary by more than 3mm in each meter length. Adjacent lanes in lieu of forms may not be used until the concrete is at least seven (7) days old. Flanged wheels of the finishing equipment shall not be operated on the concrete surface. The inside edge of supporting wheels of the finishing machine shall not operate closer than 100mm from the edge of the concrete lane.

Alternative to placing forms, slip-forming may be used. Slip-form paving equipment shall be equipped with the traveling side forms of sufficient dimensions, shape and strength to support the concrete laterally for a sufficient length of time during placement to produce pavement of the required cross section. No abrupt changes in longitudinal alignment of the pavement will be permitted. The horizontal deviation shall not exceed 20mm from the proper alignment established by the Engineer.

Joints

All joints, longitudinal, transverse, etc., shall be constructed as shown on the Drawings and shall be clean and free of all foreign material after completion of shoulder work prior to acceptance of the work and in accordance with the following provisions:

Longitudinal and Transverse Contact Joints:

Longitudinal contact joints are joints formed between lanes that are poured separately. Transverse contact joints are joints formed between segments of a lane that are poured separately. Transverse contact joints shall be formed perpendicular to pavement centerline at the end of each day of concrete placing, or where concreting has been stopped for 30 minutes or longer but not nearer than 1.5 meters from sawed contraction joints. All contact joints shall have faces perpendicular to the surface of the pavement. Tie bars of the size, length and spacing shown on the Drawings shall be placed across longitudinal and transverse contact joints.

Placing Concrete

The concrete shall be deposited and spread in order that segregation will not occur and place a uniform layer of concrete whose thickness is approximately 20 mm greater than that required for the finished pavement is placed. Rakes shall not be used for handling concrete.

In order to prevent the introduction into the concrete of earth and other foreign materials, the men whose duties require them to work in the concrete, shall in general, confine their movements to the area already covered with fresh concrete. Whenever it becomes necessary for these men to step out of the concrete, their footwear shall be washed or otherwise thoroughly cleaned before returning to the concrete. Repeated carelessness with regard to this detail will be deemed sufficient cause for removing and replacing such worker.

During the operation of striking off the concrete, a uniform ridge of concrete at least 70 mm in height shall be maintained ahead of the strike-off screed for its entire length. Except when making a construction joint, the finishing machine shall at no time be operated beyond that point where this surplus can be maintained in front of the strike-off screed.

After the first operation of the finishing machine, additional concrete shall be added to all low places and honeycombed spots and the concrete rescreeded. In any rescreeding, a uniform head of concrete shall be maintained ahead of the strike-off for its entire length. Honeycombed spots shall not be eliminated by tamping or grouting.

Workers on the job shall have mobile footbridges at their disposal so that they need not walk on the wet concrete.

In conjunction with the placing and spreading, the concrete shall be thoroughly spaded and vibrated along the forms, bulkhead, and joints.

The internal vibrators shall be of pneumatic, gas-driven, or electric type, and shall operate at a frequency of not less than 3,200 pulsations per minute.

Whenever the placing of the concrete is stopped or suspended for any reason, for a period of 30 minutes or longer, a suitable bulkhead shall be placed so as to produce a vertical transverse joint. If an emergency stop occurs within 2.5 meters of the contraction or an expansion joint the concrete shall be removed back to the joint. When the placing of the concrete is resumed, the bulkhead shall be removed and a new concrete placed and vibrated evenly and solidly against the face of previously deposited concrete. Any concrete in excess of the amount needed to complete a given section or that has been deposited outside the forms shall not be used in the work.

The Contractor shall provide suitable equipment for protecting the fresh concrete in case of rain, such as screens which will cause the rain water to run off beyond the edges of the paving, rain proof tarpaulins or other methods approved by the Engineer. The equipment shall be sufficient to shelter from rain all areas equal to that paved in two hours of work.

Finishing Concrete

The concrete shall be compacted and finished by a mechanical, self-propelled finishing machine of approved type, having two independently operated screeds. If a machine possessing only one screed is approved, the screed will not be less than 450 mm wide and shall be equipped with compensating springs to minimize the effect of the momentum of the screed on the side forms. The number of driving wheels, the weight of the machine and the power of the motor shall be so coordinated as to prevent slippage. The top of the forms and the surface of the finishing machine wheels shall be kept free from concrete or dirt.

The machine shall at all times be in first-class mechanical condition and shall be capable of compacting and finishing the concrete are herein described. Any machine which causes displacement of the side forms from the line or grade to which they have been properly set, or causes undue delay due to mechanical difficulties, shall be removed from the work and replaced by a machine meeting the Specifications.

The finishing machine shall be operated over each section of pavement two or more times and at such intervals as will produce the desired results. Generally, two passes of the finishing machine are considered the maximum desirable.

The concrete shall be vibrated, compacted, and finished by a vibratory finishing machine. The vibratory machine shall meet the requirements for ordinary finishing, and shall be one of the following type:

1. The machine shall have two independently operated screeds; the front screed shall be equipped with vibratory units with a frequency of not less than 3,500 pulsations per minute. There shall be not less than one vibratory unit for each 2.5 meters length or portion thereof, of vibratory screed surface. The front screed shall not be less than 300mm wide and shall be equipped with a "bull nose" front edge built on a radius of not less than 50mm. This type of vibratory finishing machine shall be operated in such manner that each section of pavement will receive at least one vibratory pass, but not more than two passes, unless otherwise directed, or ;

2. The machine shall be equipped with an independently operated vibratory "pan" (or pans) and two (2) independently operated screeds, the "pan" shall be mounted in a manner that will permit it to come in contact with the forms and will permit vibration of the full width of lane simultaneously.

   There shall be not less than one vibratory unit for each 2 m. length or portion thereof, of vibrating pan surface. The vibratory units in any individual pan shall be synchronized and have a frequency of not less than 3,500 pulsations per minute. The front screed shall be capable of operating in a position that will strike off the concrete at a sufficient height above the top of the forms to allow for proper compaction with the vibrating pan. This type of vibratory finishing machine shall be operated in such manner than each section of pavement will receive at least one vibratory pass but not more than two passes, unless otherwise directed.

   After the final pass of the finishing machine and when the concrete has started to dry, the surface of the pavement shall be finished with an approved longitudinal float. The float may be operated either manually or by mechanical means. The float may be either of wood or metal shall be straight and smooth and light in weight so as not to displace or sink into the concrete surface.

   To be effective, the float shall be at least 300mm wide and 3m long. When manually operated, the float shall be moved from edge to edge with a wiping motion and advance one (1) meter or more.

The succeeding trip shall overlap the previous trip. A light smoothing lute at least 3 meters long may be used provided approved by the Engineer.

The surface of the pavement shall be tested by the Contractor, before the final belting, with an approved standard straightedge 3 meter in length. Irregularities so detected shall be corrected immediately. Special attention shall be given to the concrete adjacent to transverse joints to insure that the edges thereof are not above the grade specified or the adjacent concrete below grade. All depressions or projections shall be corrected before any initial set has developed in the concrete.

After the concrete has been brought to the required grade, contour and smoothness, it shall be finished by passing over the concrete a drag of one or two burlap clothes, which give the surface the required roughness. The vehicles used to carry these cloths may be independent of the concrete-laying machine or may be incorporated with it and may be operated either by hand or mechanically.

Hand finishing will be permitted only on variable width sections of the pavement and other places where the use of the finishing machine would be impractical. Hand finishing shall be accomplished by means of the hand-operated strike-off template of either steel or steel-shod wood construction. The striking template shall be operated forward with a combined longitudinal and transverse motion and shall be so manipulated that neither end will be raised off the side forms. A similar tamper shall be used for tamping the concrete.

As soon as the concrete has attained its initial set, the edges of the pavement, the longitudinal joints, the construction dummy and expansion joints not sawn shall be carefully finished with an edging tool having radius of at least 5mm. The tools, the special accessories for cutting impressed joints and methods of workmanship shall be such as will produce a joint whose edges are of the same quality of concrete as the other portion of the pavement. Methods and workmanship which make use of excess mortar or grout in this area shall be eliminated. Unnecessary tool marks shall be eliminated during work, and the edges left smooth and true to line.

Striking Forms

Forms shall remain in place at least 12 hours after the concrete has been placed. When working conditions are such that the early strength gain of the concrete is delayed, the forms shall remain in place for a longer period, as directed by the Engineer. Bars or heavy load shall not be used against the concrete when still in the forms. Any damage to concrete resulting from form removal shall be repaired promptly by the Contractor as directed by the Engineer without any additional payment to the Contractor.

Curing Concrete

Unless otherwise ordered by the Engineer, curing of concrete shall be done by any method specified in the Section "Reinforced Concrete".

Cleaning and Sealing Joints

After completion of the required curing and before opening of the pavement to traffic, all joints shall be thoroughly cleaned of all concrete aggregate fragments or other materials.

After removal of side forms, the ends at transverse expansion joints at the edges of the pavement shall be carefully cleaned of any concrete within the expansion spaces for the entire depth of slab, care being taken not to injure the ends of the joints. Expansion and contraction joints shall then be poured with a hot joint sealer to the depth as indicated on the Drawings. Joint sealer shall be poured using approved hand pouring pots, with liquid at a temperature not less than that recommended by the approved manufacturer.