

**PHILIPPINE BIDDING DOCUMENTS**  
(As Harmonized with Development Partners)

**Procurement of  
INFRASTRUCTURE  
PROJECTS**

Government of the Republic of the Philippines

**Sixth Edition  
July 2020**

# Preface

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

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

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

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

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

- a. All the documents listed in the Table of Contents are normally required for the procurement of Infrastructure Projects. However, they should be adapted as necessary to the circumstances of the particular Project.
- b. Specific details, such as the “*name of the Procuring Entity*” and “*address for bid submission*,” should be furnished in the Instructions to Bidders, Bid Data Sheet, and Special Conditions of Contract. The final documents should contain neither blank spaces nor options.
- c. This Preface and the footnotes or notes in italics included in the Invitation to Bid, BDS, General Conditions of Contract, Special Conditions of Contract, Specifications, Drawings, and Bill of Quantities are not part of the text of the final document, although they contain instructions that the Procuring Entity should strictly follow.
- d. The cover should be modified as required to identify the Bidding Documents as to the names of the Project, Contract, and Procuring Entity, in addition to date of issue.

- e. Modifications for specific Procurement Project details should be provided in the Special Conditions of Contract as amendments to the Conditions of Contract. For easy completion, whenever reference has to be made to specific clauses in the Bid Data Sheet or Special Conditions of Contract, these terms shall be printed in bold typeface on Sections I (Instructions to Bidders) and III (General Conditions of Contract), respectively.
- f. For guidelines on the use of Bidding Forms and the procurement of Foreign-Assisted Projects, these will be covered by a separate issuance of the Government Procurement Policy Board.

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# ***Glossary of Terms, Abbreviations, and Acronyms***

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

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

**BAC** – Bids and Awards Committee.

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

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

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

**BIR** – Bureau of Internal Revenue.

**BSP** – Bangko Sentral ng Pilipinas.

**CDA** – Cooperative Development Authority.

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

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

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

**CPI** – Consumer Price Index.

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

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

**Foreign-funded Procurement or Foreign-Assisted Project** – Refers to procurement whose funding source is from a foreign government, foreign or international financing institution as

specified in the Treaty or International or Executive Agreement. (2016 revised IRR, Section 5[b]).

**GFI** – Government Financial Institution.

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

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

**GOP** – Government of the Philippines.

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

**LGUs** – Local Government Units.

**NFCC** – Net Financial Contracting Capacity.

**NGA** – National Government Agency.

**PCAB** – Philippine Contractors Accreditation Board.

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

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

**PSA** – Philippine Statistics Authority.

**SEC** – Securities and Exchange Commission.

**SLCC** – Single Largest Completed Contract.

**UN** – United Nations.

## ***Section I. Invitation to Bid***

### **Notes on the Invitation to Bid**

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

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

- a. The date of availability of the Bidding Documents, which shall be from the time the IB is first advertised/posted until the deadline for the submission and receipt of bids;
- b. The place where the Bidding Documents may be acquired or the website where it may be downloaded;
- c. The deadline for the submission and receipt of bids; and
- d. Any important bid evaluation criteria.

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





PORT MANAGEMENT OFFICE OF WESTERN LEYTE/ BILIRAN

EBONY ST. DISTRICT 2, PORT AREA, ORMOC CITY, 6541  
TEL. NO. (053) 561 4664, (053) 832 4427, FAX NO. (053) 561 4663

Email Address: [pmowlb\\_opm@yahoo.com.ph](mailto:pmowlb_opm@yahoo.com.ph)

## INVITATION TO BID

FOR

### ***REPAIR OF DAMAGED PORT FACILITIES CAUSED BY TYPHOON ODETTE, PORT OF MAASIN, SO., LEYTE***

The Philippine Ports Authority, Port Management Office – Western Leyte/Biliran, through the Corporate Budget of the Authority for CY 2022, intends to apply the sum of **P 32,723,502.00** being the Approved Budget for the Contract (ABC) to payments under the contract for the project – ***Repair of Damaged Port Facilities Caused by Typhoon Odette, Port of Maasin, So., Leyte (NRP-WLB-01-22)***. Bids received in excess of the ABC shall be automatically rejected at bid opening.

The Philippine Ports Authority, Port Management Office – Western Leyte/Biliran now invites bids for the ***Repair of Damaged Port Facilities Caused by Typhoon Odette, Port of Maasin, So., Leyte (NRP-WLB-01-22)***. Completion of Works required for the project is ***Three Hundred Forty Eight (348) Calendar Days***. Bidders should have completed a contract similar to the Project. The description of an eligible bidder is contained in the Bidding Documents, particularly, in Section II. Instruction to Bidders.

Bidding will be conducted through open competitive bidding procedures using non-discretionary pass/fail criterion as specified in the 2016 Revised Implementing Rules and Regulations (IRR) of Republic Act 9184 (RA 9184), otherwise known as the “Government Procurement Reform Act”.

Interested bidders may obtain further information from *Philippine Ports Authority, Port Management Office – Western Leyte/Biliran* and inspect the Bidding Documents at the address given below from 8:00am – 5:00pm.

A complete set of Bidding Documents may be acquired by interested Bidders on ***October 25, 2022*** from the address below and upon payment of the applicable fee for the Bidding Documents pursuant to the latest Guidelines issued by GPPB, in the amount of **P 25,000.00**. The Procuring Entity shall allow the bidder to present its proof of payment for the fees only in person. *[specify the manner if it will be presented in person, by facsimile, or through electronic means.]*

The *Philippine Ports Authority, Port Management Office – Western Leyte/Biliran* will hold a Pre-Bid Conference on **November 02, 2022, 10:00 A.M.** at *Philippine Ports Authority, Port Management Office – Western Leyte/Biliran Conference Room, Ebony St., District 2, Port Area Ormoc City*, which shall be open to prospective bidders.

Bids must be duly received by the BAC Secretariat through manual submission at the office address as indicated below on or before **November 14, 2022, 10:00 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 the amount stated in the **ITB CLAUSE 16**.

Bid opening shall be on **November 14, 2022, 10:30 A.M.** at *Philippine Ports Authority, Port Management Office – Western Leyte/Biliran, Conference Room, Ebony St., District 2, Port Area Ormoc City*. Bids will be opened in the presence of the bidders' representatives who choose to attend at the address below. Late bids shall not be accepted.

- **Equipment Requirements**

1	unit	Backhoe, 0.5 cu.m cap bucket with Hydraulic Breaker	- owned/leased
1	unit	Backhoe, 0.5cu.m. cap. Bucket	- owned
1	unit	Dumptruck, 10 cu.m cap.	- owned/leased
1	unit	Vibratory Road Roller, 4.5T cap	- owned/leased
1	unit	Boom Truck. 2T to 5T cap.	- owned
2	unit	Bar Cutter	- owned
1	unit	Electric Wood Saw	- owned
1	unit	Concrete Screeder	- owned
2	unit	One Bagger Concrete Mixer	- owned
1	unit	Concrete Vibrator	- owned
2	unit	Welding Machine, 400A	- owned
1	unit	Oxy/Acetylene w/ cutting Outfit incl. tanks	- owned
1	unit	Diamond Coring Machine	- owned/leased
1	unit	Road Grader	- owned/leased
1	unit	Transit Mixer, 5 cu.m cap.	– owned/leased
1	unit	Tug Boat	- owned/leased
2	unit	Jack Hammer with Compressor	- owned
- **Required PCAB Registration : Medium A – Ports, Harbor and Offshore Engineering**

The *Philippine Ports Authority* reserves the right to accept or 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 Section 41 of RA 9184 and its IRR, without thereby incurring any liability to the affected bidder or bidders.

For further information, please refer to:

**FEBIE P. CAPUYAN**

Philippine Ports Authority,  
Port Management Office – Western Leyte/Biliran  
Ebony St., District 2, Port Area Ormoc City  
Tel. No. 053-5614662  
Fax No. 053-5614663  
Email add: pmowlb\_esd@yahoo.com.ph

**IRVIN PAUL H. CONEJO**  
Chairman  
Bids and Awards Committee

*Section II. Instructions to Bidders*

**Notes on the Instructions to Bidders**

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

## 1. Scope of Bid

The Procuring Entity, **Philippine Ports Authority, Port Management Office – Western Leyte/Biliran** invites Bids for the **REPAIR OF DAMAGED PORT FACILITIES CAUSED BY TYPHOON ODETTE, PORT OF MAASIN SO., LEYTE** with Project Identification Number (*NRP-WLB-01-22*).

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

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

## 2. Funding Information

2.1. The GOP through the source of funding as indicated below for *Repair and Maintenance Projects CY 2022* in the amount of *Php 33,214,355.00*.

2.2. The source of funding is:

a. GOCC and GFIs, the Corporate Operating Budget.

## 3. Bidding Requirements

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

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

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

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

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

## 5. Eligible Bidders

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

5.2. The Bidder must have an experience of having completed a Single Largest Completed Contract (SLCC) that is similar to this Project, equivalent to at least fifty percent (50%) of the ABC adjusted, if necessary, by the Bidder to

current prices using the PSA's CPI, except under conditions provided for in Section 23.4.2.4 of the 2016 revised IRR of RA No. 9184.

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

- 5.3. For Foreign-funded Procurement, the Procuring Entity and the foreign government/foreign or international financing institution may agree on another track record requirement, as specified in the Bidding Document prepared for this purpose.
- 5.4. The Bidders shall comply with the eligibility criteria under Section 23.4.2 of the 2016 IRR of RA No. 9184.

## **6. Origin of Associated Goods**

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

## **7. Subcontracts**

- 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:  
[*Select one, delete other/s*]

**Subcontracting is not allowed.**

## **8. Pre-Bid Conference**

The Procuring Entity will hold a pre-bid conference for this Project on the specified date and time and either at its physical address **Pre-Bid Conference on November 02, 2022, 10:00 A.M at Philippine Ports Authority, Port Management Office – Western Leyte/Biliran Conference Room, Ebony St., District 2, Port Area Ormoc City**, 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. In joint ventures, a special PCAB License, and registration for the type and cost of the contract for this Project, shall be required. Any additional type of Contractor license or permit shall be indicated in the **BDS**.
- 10.4. A List of Contractor's key personnel (e.g., Project Manager, Project Engineers, Materials Engineers, and Foremen) assigned to the contract to be bid, with their complete qualification and experience data shall be provided. These key personnel must meet the required minimum years of experience set in the **BDS**.
- 10.5. A List of Contractor's major equipment units, which are owned, leased, and/or under purchase agreements, supported by proof of ownership, certification of availability of equipment from the equipment lessor/vendor for the duration of the project, as the case may be, must meet the minimum requirements for the contract set in the **BDS**.

## **11. Documents Comprising the Bid: Financial Component**

- 11.1. The second bid envelope shall contain the financial documents for the Bid as specified in **Section IX. Checklist of Technical and Financial Documents**.
- 11.2. Any bid exceeding the ABC indicated in paragraph 1 of the **IB** shall not be accepted.
- 11.3. For Foreign-funded procurement, a ceiling may be applied to bid prices provided the conditions are met under Section 31.2 of the 2016 revised IRR of RA No. 9184.

## **12. Alternative Bids**

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

## **13. Bid Prices**

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

## **14. Bid and Payment Currencies**

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

- a. Philippine Pesos.

## **15. Bid Security**

- 15.1. The Bidder shall submit a Bid Securing Declaration or any form of Bid Security in the amount indicated in the **BDS**, which shall be not less than the percentage of the ABC in accordance with the schedule in the **BDS**.
- 15.2. The Bid and bid security shall be valid until **March 14, 2023**. Any bid not accompanied by an acceptable bid security shall be rejected by the Procuring Entity as non-responsive.

## **16. Sealing and Marking of Bids**

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

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

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

## **17. Deadline for Submission of Bids**

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

## **18. Opening and Preliminary Examination of Bids**

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

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

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

## **19. Detailed Evaluation and Comparison of Bids**

- 19.1. The Procuring Entity's BAC shall immediately conduct a detailed evaluation of all Bids rated "*passed*" using non-discretionary pass/fail criteria. The BAC shall consider the conditions in the evaluation of Bids under Section 32.2 of 2016 revised IRR of RA No. 9184.
- 19.2. If the Project allows partial bids, all Bids and combinations of Bids as indicated in the **BDS** shall be received by the same deadline and opened and evaluated simultaneously so as to determine the Bid or combination of Bids offering the lowest calculated cost to the Procuring Entity. Bid Security as required by **ITB** Clause 16 shall be submitted for each contract (lot) separately.
- 19.3. In all cases, the NFCC computation pursuant to Section 23.4.2.6 of the 2016 revised IRR of RA No. 9184 must be sufficient for the total of the ABCs for all the lots participated in by the prospective Bidder.

## **20. Post Qualification**

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

## **21. Signing of the Contract**

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



## ***Section III. Bid Data Sheet***

### **Notes on the Bid Data Sheet (BDS)**

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

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

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

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

# Bid Data Sheet

ITB Clause							
5.2	For this purpose, contracts similar to the Project refer to contracts which have the same major categories of work, which shall be: [Site Works and Port Facilities].						
7.1	Subcontracting is not allowed.						
10.3	No Further Instructions.						
10.4	The key personnel must meet the required minimum years of experience set below: <table><tr><td>Key Personnel</td><td>General Experience</td><td>Relevant Experience</td></tr><tr><td></td><td></td><td></td></tr></table>	Key Personnel	General Experience	Relevant Experience			
Key Personnel	General Experience	Relevant Experience					
10.5	The minimum major equipment requirements are the following: <table><tr><td>Equipment</td><td>Capacity</td><td>Number of Units</td></tr><tr><td></td><td></td><td></td></tr></table>	Equipment	Capacity	Number of Units			
Equipment	Capacity	Number of Units					
12	No Further Instructions.						
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 <b>654,470.04</b> [two percent (2%) of ABC], 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 <b>1,636,175.10</b> [ five percent (5%) of ABC] if bid security is in Surety Bond.						
19.2	Partial bid is not allowed. The infrastructure project is packaged in a single lot and the lot shall not be divided into sub-lots for the purpose of bidding, evaluation, and contract award.  In all cases, the NFCC computation, if applicable, must be sufficient for all the lots or contracts to be awarded to the Bidder.						
20	Licenses and permits relevant to the Project - Certified True Copy of DTI Registration/ SEC Registration; - Certified True Copy of Valid PCAB License; - Certified True Copy of Mayor’s/Business Permit						
21	Additional contract documents:  1.)Manpower Utilization Schedule 2.)Construction Methods 3.)Equipment Utilization Schedule 4.)Construction Safety and Health Program Approved by the Department of Labor and Employment. 5.)PERT/CPM						



## ***Section IV. General Conditions of Contract***

### **Notes on the General Conditions of Contract**

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

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

Any complementary information, which may be needed, shall be introduced only through the Special Conditions of Contract.

## 1. Scope of Contract

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

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

## 2. Sectional Completion of Works

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

## 3. Possession of Site

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

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

## 4. The Contractor's Obligations

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

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

## **5. Performance Security**

- 5.1. Within ten (10) calendar days from receipt of the Notice of Award from the Procuring Entity but in no case later than the signing of the contract by both parties, the successful Bidder shall furnish the performance security in any of the forms prescribed in Section 39 of the 2016 revised IRR.
- 5.2. The Contractor, by entering into the Contract with the Procuring Entity, acknowledges the right of the Procuring Entity to institute action pursuant to RA No. 3688 against any subcontractor be they an individual, firm, partnership, corporation, or association supplying the Contractor with labor, materials and/or equipment for the performance of this Contract.

## **6. Site Investigation Reports**

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

## **7. Warranty**

- 7.1. In case the Contractor fails to undertake the repair works under Section 62.2.2 of the 2016 revised IRR, the Procuring Entity shall forfeit its performance security, subject its property(ies) to attachment or garnishment proceedings, and perpetually disqualify it from participating in any public bidding. All payables of the GOP in his favor shall be offset to recover the costs.
- 7.2. The warranty against Structural Defects/Failures, except that occasioned-on force majeure, shall cover the period from the date of issuance of the Certificate of Final Acceptance by the Procuring Entity. Specific duration of the warranty is found in the **SCC**.

## **8. Liability of the Contractor**

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

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

## **9. Termination for Other Causes**

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

## **10. Dayworks**

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

## **11. Program of Work**

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

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

## **12. Instructions, Inspections and Audits**

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

## **13. Advance Payment**

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

## **14. Progress Payments**

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

## **15. Operating and Maintenance Manuals**

- 15.1. If required, the Contractor will provide “as built” Drawings and/or operating and maintenance manuals as specified in the **SCC**.
- 15.2. If the Contractor does not provide the Drawings and/or manuals by the dates stated above, or they do not receive the Procuring Entity’s Representative’s approval, the Procuring Entity’s Representative may withhold the amount stated in the **SCC** from payments due to the Contractor.



## ***Section V. Special Conditions of Contract***

### **Notes on the Special Conditions of Contract**

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

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

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

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

# Special Conditions of Contract

GCC Clause	
2	The <b>Intended Completion Date</b> is <b>348 Calendar Days after the effectivity of the Notice to Proceed.</b>
4.1	The <b>Procuring Entity</b> shall give possession of all parts of the Site to the Contractor <i>ten (10) days after the signing of the Notice to Proceed.</i>
6	The site investigation reports are: <i>[list here the required site investigation reports.]</i>
7.2	<p><i>[Select one, delete the other.]</i></p> <p><i>[In case of permanent structures, such as buildings of types 4 and 5 as classified under the National Building Code of the Philippines and other structures made of steel, iron, or concrete which comply with relevant structural codes (e.g., DPWH Standard Specifications), such as, but not limited to, steel/concrete bridges, flyovers, aircraft movement areas, ports, dams, tunnels, filtration and treatment plants, sewerage systems, power plants, transmission and communication towers, railway system, and other similar permanent structures:]</i> Fifteen (15) years.</p> <p><i>[In case of semi-permanent structures, such as buildings of types 1, 2, and 3 as classified under the National Building Code of the Philippines, concrete/asphalt roads, concrete river control, drainage, irrigation lined canals, river landing, deep wells, rock causeway, pedestrian overpass, and other similar semi-permanent structures:]</i> Five (5) years.</p> <p><i>[In case of other structures, such as bailey and wooden bridges, shallow wells, spring developments, and other similar structures:]</i> Two (2) years.</p>
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 <i>[10]</i> 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 <i>[equivalent to the amount payable to the contractor]</i> .
13	The amount of the advance payment is <i>[insert amount as percentage of the contract price that shall not exceed 15% of the total contract price and schedule of payment]</i> .
14	Payment of Materials and equipment delivered on the site but not completely put in place shall not be included for payment.
15.1	<p>The date by which operating and maintenance manuals are required is <i>[during final inspection]</i>.</p> <p>The date by which "as built" drawings are required is <i>[during final billing]</i>.</p>
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 <i>[equivalent to the amount payable to the contractor]</i> .

## ***Section VI. Specifications***

### **Notes on Specifications**

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

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

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

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

#### **Sample Clause: Equivalency of Standards and Codes**

Wherever reference is made in the Contract to specific standards and codes to be met by the goods and materials to be furnished, and work performed or tested, the provisions of the latest current edition or revision of the relevant standards and codes in effect shall apply, unless otherwise expressly stated in the Contract. Where such standards and codes

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

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

## **DIVISION 2 SITE WORKS**

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### **2.1 DEMOLITION AND REMOVAL WORKS**

#### **2.1.1 DESCRIPTION**

The work includes the furnishing of all labor, materials and equipment required to carry out the demolition and removal of obstructions, portions of existing piers including extraction/cutting of timber and R.C piles at required depth and demolition of miscellaneous buildings, pavements, fences, utilities, navigation aids and wrecks 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

For off-shore obstructions to pile driving and dredging, survey shall be executed by the Contractor with the Engineer before any demolition and removal of wrecks commence and shall be as directed by the Engineer.

#### **2.1.2 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 work 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. The 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's authorized Representative.

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#### **2.1.3 INTERFERENCE WITH PORT OPERATIONS**

1. During the execution of the work, the Contractor shall not interfere with the shipping, navigation and other traffic in the port.
2. 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.
3. Prior to commencement of the demolition works, the Contractor shall inform/announce to port users the schedule of disconnection of utilities.

#### **2.1.4 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 location of their storage shall be described. 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.

Debris, if it does not contain any pollutant in the opinion of the Contractor may be dumped at the offshore area.

The Contractor may dump debris 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.

#### **2.1.5 EXECUTION**

1. Prior to the commencement of demolition works, the alignments of the new construction works to existing pier 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. Extract concrete piles with care in order not to damage existing or adjacent structures, equipment or materials.

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5. Piles (timber/concrete) for demolition/extraction shall be done with care and/or to the required level indicated in the plan as shown in the drawings.

6. Rocks removed from existing slope protection shall be stored for reuse in new construction.

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

8. Materials coming from the demolish works shall be properly disposed by the Contractor.

#### **2.1.6 SAFETY**

At the end of each day's work, the site shall be left in safe condition, so that no part is in danger of toppling, or falling or creating hazards to personnel or equipment.

#### **2.1.7 MEASUREMENT AND PAYMENT**

Demolition and removal, unless otherwise noted, shall be measured by number or unit quantities or lump sums as appropriate for each class of work for each category. Cost of disposal of debris shall be incidental to the work and shall not be paid for separately.

Demolition and removal of existing pavement shall be measured and paid for under this section unless such pavement falls within or above the new subgrade, in which case, measurement and payment shall be under Division 5, "Roads and Pavements."

The price listed above shall be full compensation for all labor, materials, tools and equipment and all incidental works necessary for the successful completion of work.

## **2.2 SURVEYS, SOUNDINGS, SOIL INVESTIGATIONS, INSTALLATION OF MARKERS, ETC.**

### **2.2.1 GENERAL**

Work under this Contract shall be in accordance with Section 1, "General Requirements" of these Specifications and shall apply to this Section whether herein referred to or not.

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### **2.2.2 SCOPE OF WORK**

This Section covers topographic and hydrographic surveys including setting out of works, as well as soil investigations.

### **2.2.3 PRELIMINARY REMARK**

All data relating to surveys, soundings, soil investigations, included in the Bid Documents and all data contained in the Drawings are honestly given in order to provide the Contractor with the best possible information needed for the proper performance of the works.

Relating to these data, the Contractor will have to make his own investigations to verify and to complete the given data.

These additional investigations by the Contractor are deemed to be included in the Contract Prices and will not involve any additional cost to the Engineer.

### **2.2.4 TOPOGRAPHIC AND HYDROGRAPHIC SURVEYS**

1. References: All surveys shall be carried out with reference to benchmarks or monuments and Chart Datum proposed by the Contractor and approved by the Engineer.
2. Surveying: All survey work specified in this Section shall be carried out by licensed surveyors. The Contractor shall submit in advance for the Engineer's approval, true copies of the license and qualifications of the surveyors to be employed for the works.
3. The Contractor shall carry out the topographic and hydrographic surveys of the job-site, as required for the proper performance and quantity measurement of the works, by means of traversing, sounding and leveling, and shall prepare topographic maps and/or hydrographic charts at the appropriate scales.

### **2.2.5 SOILS INVESTIGATIONS**

1. The Contractor shall locate the sites of soils investigations based on the Engineer's maps and drawings. The Contractor shall also establish the ground levels and the various levels of investigations. He shall be solely responsible for the accuracy of such locations and elevations.
2. The boring schedule to verify the foundations of the proposed new structures is described below.

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3. All borings shall be made using rotary drilling. Samples for identification of soils shall be taken at every 1.5 m and at any point where material changes in character. Each sample shall be kept in an approved sample bottle which shall be sealed and on which a label with the descriptions of the sample shall be fixed. The Contractor shall submit to the Engineer all samples in sealed bottles placed in a case/container for permanent storage thereof.
4. During the boring operations, standard penetration tests shall be carried out at one-meter intervals in accordance with ASTM D 1586.

### **2.2.6 SETTING OUT OF WORKS**

1. The Contractor shall set out the Works and shall be solely responsible for the accuracy of such setting out. The Contractor shall provide, fix and maintain all stakes, marks or the like which are necessary for the accurate setting out of the Works, and shall take all necessary precautions to prevent their removal or disturbance, all as approved by the Engineer. The Contractor shall provide a suitable range in the water to indicate the face lines of the quays, revetment, breakwater and related facilities.

2. Setting Out of Works shall include the verifications of position of all markers and the supply and installation of any and all other markers which the Contractor may require for the proper execution and completion of the Works, and shall also include the repositioning of the PPA's markers if such repositioning is deemed necessary by the Contractor and approved by the Engineer.

#### **2.2.7 FIELD NOTES, ETC.**

Field notes, calculation sheets and all other documents shall be prepared in the English language and in a manner acceptable to the Engineer. The Contractor shall submit such notes and other documents upon completion of the respective works or if so required, the Engineer may have the option to inspect even during the progress of works.

#### **2.2.8 MEASUREMENT AND PAYMENT**

##### **2.2.8.1 TOPOGRAPHIC AND HYDROGRAPHIC SURVEYS**

1. Cost for the topographic and hydrographic surveys including preparation of topographic maps and hydrographic charts that could be required for the proper execution of the works and/or for the calculation of the quantities to be paid shall be deemed to be included in the unit prices of the corresponding works.

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2. Separate payment will not be made for setting out of works as such setting out will be considered as incidental to and part of the various works to be executed.

##### **2.2.8.2 SOIL INVESTIGATIONS**

Borings and soil tests made by the Contractor in addition to the given data shall not be normally paid separately. The cost shall be deemed to be included in the Contract unit prices.

#### **2.3 MAJOR FACILITIES FOR CONSTRUCTION**

##### **2.3.1 GENERAL**

1. Work under this contract shall be subject to the terms and conditions stipulated in the Conditions of Contract.

2. This Section generally defines the major facilities needed for construction as a whole and major terms of work to be done under each facility.

3. This Section relates the general composition of the Technical Specifications in correlation of this Document to the Bill of Quantities.

##### **2.3.2 BRIEF DESCRIPTION/LOCATION OF THE FACILITIES**

[Indicate Port Facilities to be included as part of the Project. Listed below are the major part facilities.]

###### **1. WHARVES/PIERS/TRESTLES**

A wharf, pier or trestle is a reinforced concrete apron on reinforced concrete (RC) or steel pipe piles reaching depths not less than those



shown on the Drawings. These structures are for multi-purpose uses.

## 2. CAUSEWAY

A causeway is a rock mound jetty with a roadway built generally perpendicularly to the shoreline to reach the future port basin area.

## 3. REVETMENT

A revetment is a rock structure enclosing, protecting and retaining a causeway or a reclaimed area.

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## 4. RECLAMATION AREA

A reclaimed area is a yard area obtained by fill on land or on water.

## 5. RO-RO RAMP

A Ro-Ro ramp is a berthing facility with a sloping ramp to be used for loading/unloading transport vehicles to/from vessels.

## 6. STAIR LANDING

A stair landing is a stepped RC facility located on the slope of revetment with its lower level at about 0.00 meter MLLW.

### **2.3.3 MAJOR FACILITIES WORK ITEMS**

[Listed below is major Port Facilities Work Item. Indicate the required Port Facilities for Particular Project]

#### 1. Wharf/Pier & Ro-Ro Ramp Construction

- a. Casting of RC and Steel Pipe Piles
- b. Driving of RC and Steel Pipe Piles
- c. Casting of Pile Caps
- d. Casting of Beams & Fascia Beams
- e. Casting of Apron Slab
- f. Supply & Installation of Fenders
- g. Supply & Installation of Bollards and Bitts

#### 2. Dolphin and Fender Construction

- a. Supply of timber piles
- b. Driving of timber piles

#### 3. Causeway/Revetment

- a. Quarrying and placing of rocks
- b. Rock grading

#### 4. Dredging and Reclamation

- a. Dredging works
- b. Reclamation works

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#### 5. Stair Landing

- a. Casting and installation of concrete block
- b. Asphalt Concrete Pavement/Portland Concrete Pavement Works

#### 6. Roads and Pavement

- a. Base courses
- b. Concrete works

#### 7. Buildings

- a. Excavation and backfilling
- b. Concrete Works
- c. Masonry Works
- d. Steel and Metal Works
- e. Doors and Windows
- f. Finishes

- g. *Utilities*

## **DIVISION 3 PORT FACILITIES**

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### **3.1 LAYOUT AND INSTALLATION OF MARKERS**

#### **3.1.1 GENERAL**

1. Work under this contract shall be in accordance with Division 1, "General Requirements" of these Specifications and shall be applicable to this Section, herein referred to or not.
2. Applicable requirement under Section 2.2 "Surveys/Soundings, Soil Investigations, Installation of Markers, etc." shall apply to this section.

#### **3.1.2 SCOPE OF WORK**

This Section covers layout and setting of reference points.

#### **3.1.3 SETTING OF REFERENCE POINTS**

1. The Contractor shall establish new permanent benchmarks and monuments based on existing ones designated by the Engineer that can serve as reference points to delineate the technical description of the port zone and plan layout.
2. The Contractor shall submit field notes and computations regarding the above item 3.1.3.1 for reference of the Engineer.
3. Setting of reference points shall include the supply and installation of markers which the Contractor may require for the proper execution and completion of the project. The Contractor shall be solely responsible for the accuracy of setting surveyed points.

### **3.2 CONCRETE WORKS**

#### **3.2.1 GENERAL**

Work under this Contract shall be in accordance with Division 1 "General Requirements" of these Specifications and shall be applicable to this Section, whether herein referred to or not.

##### **3.2.1.1 SCOPE OF WORK**

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

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##### **3.2.1.2 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  
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 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 A 185 Standard Specification for Steel  
 Welded Wire Reinforcement, Plain, for  
 Concrete  
 ASTM A 496 Standard Specification for Steel  
 Wire, Deformed, for Concrete Reinforcement  
 ASTM A 497 Standard Specification for Steel Welded Wire  
 Reinforcement, Deformed, for Concrete  
 ASTM A 615 Standard Specification for Deformed and Plain  
 Carbon-Steel Bars for Concrete Reinforcement  
 ASTM A 706 Standard Specification for Low-Alloy Steel  
 Deformed and Plain Bars for Concrete  
 Reinforcement  
 ASTM A 82 Standard Specification for Steel Wire, Plain, for  
 Concrete Reinforcement  
 ASTM A 934  
 Standard Specification for Epoxy-Coated  
 Prefabricated Steel Reinforcing Bars  
 ASTM A 966 Standard Test Method for Magnetic Particle  
 Examination of Steel Forgings Using  
 Alternating Current  
 ASTM C 1017 Standard Specification for Chemical  
 Admixtures for Use in Producing Flowing  
 Concrete  
 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  
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 ASTM C 1107 Standard Specification for Packaged Dry,  
 Hydraulic-Cement Grout (Nonshrink)

ASTM C 1116 Standard Specification for Fiber-Reinforced Concrete  
 ASTM C 1157 Standard Specification for Hydraulic Cement  
 ASTM C 1202 Standard Test Method for Electrical Indication of Concrete's Ability to Resist Chloride Ion Penetration  
 ASTM C 1218 Standard Specification for Water-Soluble Chloride in Mortar and Concrete  
 ASTM C 1240 Standard Specification for Silica Fume Used in Cementitious Mixtures  
 ASTM C 1260 Standard Test Method for Potential Alkali Reactivity of Aggregates (Mortar-Bar Method)  
 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 127 Test Method for Specific Gravity and Absorption of Coarse Aggregate  
 ASTM C 138 Standard Test Method for Density ("Unit Weight"), Yield, and Air Content (Gravimetric) of Concrete  
 ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete  
 ASTM C 150 Standard Specification for Portland Cement  
 ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete  
 ASTM C 172 Standard Practice for Sampling Freshly Mixed Concrete  
 ASTM C 173 Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method  
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 ASTM C 192 Making and Curing Concrete Test Specimens in the Laboratory  
 ASTM C 227 Potential Alkali Reactivity of Cement-Aggregate Combinations (Mortar-Bar Method)  
 ASTM C 231 Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method  
 ASTM C 260 Standard Specification for Air-Entraining Admixtures for Concrete  
 ASTM C 295 Petrographic Examination of Aggregates for Concrete  
 ASTM C 309 Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete  
 ASTM C 31 Standard Practice for Making and Curing Concrete Test Specimens in the Field  
 ASTM C 33 Standard Specification for Concrete Aggregates  
 ASTM C 39 Standard Test Method for Compressive

Strength of Cylindrical Concrete Specimens  
 ASTM C 42 Standard Test Method for Obtaining and  
 Testing Drilled Cores and Sawed Beams of  
 Concrete  
 ASTM C 441  
 Effectiveness of Pozzolans or Ground Blast-  
 Furnace Slag in Preventing Excessive  
 Expansion of Concrete Due to the Alkali-Silica  
 Reaction  
 ASTM C 469 Static Modulus of Elasticity and Poisson's Ratio  
 of Concrete in Compression  
 ASTM C 494 Standard Specification for Chemical Admixtures  
 for Concrete  
 ASTM C 496 Standard Test Method for Splitting Tensile  
 Strength of Cylindrical Concrete Specimens  
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 ASTM C 595 Standard Specification for Blended Hydraulic  
 Cements  
 ASTM C 597 Pulse Velocity Through Concrete  
 ASTM C 618 Standard Specification for Coal Fly Ash and  
 Raw or Calcined Natural Pozzolan for Use in  
 Concrete  
 ASTM C 642 Density, Absorption, and Voids in Hardened  
 Concrete  
 ASTM C 805 Rebound Number of Hardened Concrete  
 ASTM C 881 Standard Specification for Epoxy-Resin-Base  
 Bonding Systems for Concrete  
 ASTM C 920  
 Standard Specification for Elastomeric Joint  
 Sealants  
 ASTM C 94 Standard Specification for Ready-Mixed  
 Concrete  
 ASTM C 989  
 ASTM C1116  
 Standard Specification for Ground Granulated  
 Blast-Furnace Slag for Use in Concrete and  
 Mortars  
 Standard Specification for Fiber-Reinforced  
 Concrete and Shotcrete  
 ASTM C 1751 Preformed Expansion Joint Fillers for Concrete  
 Paving and Structural Construction. (Nonextruding  
 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 1339 Sulfite Ion in Water  
 ASTM D 1751 Standard Specification for Preformed  
 Expansion Joint Filler for Concrete Paving and  
 Structural Construction (Non-extruding and  
 Resilient Bituminous Types)

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ASTM D 1752 Standard Specification for Preformed Sponge Rubber Cork and Recycled PVC Expansion

Nitrite-Nitrate in Water

ASTM D 3867

Nitrite-Nitrate in Water

ASTM D 512 Chloride Ion in Water

ASTM D 516 Sulfate Ion in Water

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. All other standards hereinafter indicated.

e. 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.

### 3.2.1.3 SUBMITTALS

1. Refer to The Technical Specifications Division 1, "General Requirements".

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

a. Submit Test Reports for the following:

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

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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.

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.

3) Admixtures (if required to be used by field conditions subject to

approval by the Design Engineer)

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.

4) Fiber-Reinforced Concrete (if required to be used by field conditions subject to approval by the Design Engineer)

Test to determine flexural toughness index I5 in accordance with ASTM C 1116.

5) Cement

Submit test results in accordance with ASTM C 150 Portland cement and/or ASTM C 595 and ASTM C 1157 for blended cement. Submit current mil data.

6) Water

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

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7) Reinforcement and Protective Coating

Provide coating manufacturer's and coating applicator's test data sheets certifying that applied coating meets the requirements of ASTM A 934.

b. Submit Certificates for the following:

1) Curing concrete elements

Submit proposed materials and methods for curing concrete elements.

2) Form removal schedule

Submit proposed materials and methods for curing concrete elements.

3) Concrete placement and compaction

a) 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.

b) 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.

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.

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

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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 precast 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.

#### 4. Field Samples

##### a. Slab Finish Sample

Install minimum of 3m x 3m slab. Finish as required by Specification.

##### b. Underwater Concrete Sample

Place concrete in four 5 gallon buckets below water. Permanently mark as "7 days," "14 days," "28 days," and "Extra." Include date and station. Provide specimen sets at every 46 lineal meter of seawall with a minimum of one set per day of underwater concrete placement. Retrieve specimens at specified intervals. Extract 100 mm diameter by 250 mm core and test in accordance with ASTM C 39.

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### 3.2.2 MATERIAL REQUIREMENTS

#### 3.2.2.1 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)

##### 2. High-Early Strength Portland Cement may be used for precast



concrete. Cement Type III shall conform to ASTM C 150 with a tricalcium aluminate limited to 8 percent.

#### 3.2.2.2 SYNTHETIC FIBROUS REINFORCEMENT (OPTIONAL)

Unless otherwise indicated on the Drawings or as required by the Design Engineer, synthetic fiber reinforcement shall conform to BS 5139 or ASTM C 1116.

Synthetic fiber reinforcement shall be 100% virgin polypropylene synthetic fiber with micro multi-filament design.

This material shall mainly be used in the following structures:

1. Suspended slabs
2. Plastering on walls of building structures
3. Concrete topping

#### 3.2.2.3 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.

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#### 3.2.2.4 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**

40 mm 25 mm 19 mm 10 mm

50.0 mm (2")

38.0 mm (1 1/2")

31.8 mm (1 1/4")

25.0 mm (1")

19.0 mm (3/4")

16.0 mm (5/8")

9.5 mm (3/8")

No. 4

100

95-100

-

-

35-70

-

10-30

0-5

-

100

90-100

-

25-90

-

0-10

-

-

100

90-100

-

20-55

0-10

-

-

-

-

100

85-100

0-20

## 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 fine aggregate shall be as follows:

### **ASTM Sieves % by Weight Passing**

9.5 mm (3/8")

No. 4

No. 8

No. 16

No. 30

No. 50

No. 100

100

90 - 100

80 - 100

50 - 90

25 - 60

10 - 30

2 - 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.

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b. Due care shall be taken to prevent segregation.

### 3.2.2.5 WATER

The water used in concrete, mortar and grout shall be free from objectionable quantities of silt, organic matter, alkali, salts and other

impurities. Sea water shall not be used at any time.

#### 3.2.2.6 ANCHORAGE ITEMS

Dowels for anchoring mechanical items to concrete shall be in conformity to manufacturer's standard and of types required to engage with the anchors to be provided and installed therein under other sections of these Specifications, and shall be subject to the approval of the Engineer.

#### 3.2.2.7 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.

#### 3.2.2.8 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.

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4. Joint filler shall conform to ASTM D1751 (AASHTO M213) nonextruding, 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.

#### 3.2.2.9 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.

#### 3.2.2.10 NEOPRENE BEARING PAD

Neoprene bearing pad shall be of 60 Durometer Hardness and of size as shown on drawings. It shall conform to AASHTO M 251.

#### 3.2.2.11 REINFORCEMENT

Steel reinforcement, other than Steel for Prestressing, used in Reinforced Concrete, shall conform to ASTM as follows:

- ASTM Designation A615-Deformed Billet Steel Bars for Concrete Reinforcement. Minimum yield strength of 230 MPa (33,400 psi) for diameter of 6 mm to 10 mm and 276 MPa (40,000 psi) for diameter of 12 mm to 36 mm.

- Welded steel wire ASTM Designation A185, Fabric for Reinforcement of Concrete.

All bar reinforcement shall have deformed surfaces except that 6 mm bars may be plain.

#### 3.2.2.12 TIE WIRE

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

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### 3.2.3 SAMPLES AND TESTING

1. Refer to Section 1.6.

2. 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.

3. 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.

4. 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.

5. Concrete Tests: For test purposes, provide three (3) sets of test specimens taken under the instruction of the Engineer from each 50 cu.m. or fraction thereof of each class of concrete placed. At least one (1) set of test specimen shall be provided for each class of concrete placed in each 8-hour shift. Each shall consist of two test specimens, and shall be made from a separate batch. 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

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each with concrete quality of ACI 318. The standard age of test shall be 28 days, but 7 day tests may be used, with the permission of the Engineer, provided that the relation between the 7-day and 28-day strengths of the concrete is established by tests for the materials and proportions used. 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 Engineer.

6. 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 Engineer.

7. Synthetic Fibrous Reinforcement: Tested for conformance to the referenced specifications under which it is furnished. The testing shall be conducted with cement and aggregate proposed for the Project.

8. Admixtures/Additives: The admixtures/additives if approved shall be tested for conformance to the referenced specification under which it is furnished. 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. Five (5) liters of 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.

9. Jointing Materials and Curing Compound Samples: At least 28 days prior to commencing the work, the Contractor shall submit to the

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Engineer for his approval samples of the following materials proposed for use together with manufacturer's certificate.

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

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

### **3. 2. 4 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 weather 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

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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.

### **3. 2. 5 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. Junction 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

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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.

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

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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.

### **3. 2. 6 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)**

6

10

12

16

20

25

28

18.8

31.4

37.7

50.3

62.8

78.5

88.0

28.27

78.54

113.10

201.10

314.20

490.90

615.70

0.222

0.616

0.888

1.579

2.466

3.854

4.833

32

36

40

50

100.5

113.1

125.7

157.1

804.20

1017.60

1256.60

1963.50

6.313

7.991

9.864

15.413

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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 Maximum Variation**

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

less than 7.5 cm (other structures)

9 mm

6 mm

**3. 2. 7 CLASSES OF CONCRETE AND USAGE**

1. Strength Requirement:

a. Concrete of the various classes unless specified in other Sections or indicated on the Drawings or directed by the Engineer shall be proportioned and mixed to achieve the following strengths:

**Class**

**Specified Compressive Strength – 28 days**

**$F_c' = \text{MPa}$   $f_c' = \text{psi}$**

A

B1

B2

C

D

E

35

35

25

21

17

41.4

5,000

5,000

3,500

3,000

2,500

6,000

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b. In addition to the above, the maximum permissible water-cement ratio by weight shall not be greater than 0.55 unless otherwise permitted by the Engineer.

c. However, for projects located in remote areas where the concrete transit mixer (batching plant) is not available such that the 5,000 psi compressive strength is not attainable for Classes A and B1, the minimum compressive strength of 3,500 psi may be used.

2. Usage: Concrete of the various classes to be used shall be as follows:

a. Class A concrete : Special cases for marine structures

b. Class B1 concrete : Marine Structures (piles/RC for sheet piles and coping for sheet piles/retaining walls/wharf/pier deck), precast or in-situ concrete.

c. Class B2 concrete : Concrete pavement for causeways and roads, stair landings and curbs

d. Class C concrete : Building Works, Utility RC works

e. Class D concrete : Concrete blocks, concrete slabs for buildings with no vehicle access.

f. Class E concrete : Interlocking Concrete Block Pavement

### **3.2.8 PROPORTIONING OF CONCRETE MIXES**

1. Trial design batches and testing to meet requirements of the classes of concrete specified shall be the responsibility of the Contractor. The design mix shall be of consistencies specified hereinafter in Paragraph 3.2.8.6. Tests for slump, unit weight, and air content shall be performed in the field under the presence of the Engineer.

2. Synthetic fibrous reinforcement shall conform to the recommended dosage of the manufacturer.

Water reducing agents, set retarders or strength accelerators shall not be used in greater dosages than those recommended by the manufacturers.

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3. Concrete Proportioning: Samples of approved aggregates shall be obtained in accordance with the requirements of ASTM D 75. Samples of materials other than aggregates shall be representative of those proposed for the Project and shall be accompanied by the manufacturer's test reports indicating compliance with applicable specified requirements. Trial mixes having proportions, consistencies and air content suitable for the work shall be made based on ACI Standard 211.1 using at least three different water-cement ratios which will produce a range of strength encompassing those required for the work. Trial mixes shall be designed for maximum permitted slump and air content. The temperature of concrete in each trial batch shall be reported. For each water-cement ratio at least three test cylinders for each test age shall be made and cured in accordance with ASTM C 39. From these test results, a curve shall be plotted showing the relationship between water-cement ratio and strength.

4. Average Strength: For each portion of the structure, proportions shall be selected so that the maximum permitted water-cement ratio is not exceeded and so as to produce an average strength to exceed the specified strength  $f_c'$  by the amount indicated below. Where production facility has a standard deviation record determined in accordance with ACI 214, based on 30 consecutive strength tests of similar mixture proportions as proposed it shall be used in selecting average strength.

The average strength used as the basis for selecting proportions shall exceed the specified strength  $f_c'$  by at least:

a. 2.94 MPa if standard deviation is less than 1.96 MPa

b. 3.92 MPa if standard deviation is 1.96 to 2.94 MPa

c. 4.90 MPa if standard deviation is 2.94 to 3.92 MPa

d. 5.88 MPa if standard deviation is 3.92 to 4.90 MPa

e. If a standard deviation record is not available, proportions shall be selected to produce an average strength of at least 6.86 MPa greater than the specified strength.

5. Corrective additions to remedy deficiencies in aggregate gradation shall be used only on written approval of the Engineer.

6. Slump: Tests shall be made in conformance with ASTM C 143, and unless otherwise specified by the Engineer, slump shall be within the following limits:

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#### **Structural Element**

#### **Slump for Vibrated Concrete**

##### **Minimum Maximum**

Pavement Concrete

Precast Concrete

Lean Concrete

All other Concrete

25 mm

50 mm

100 mm

50 mm

50 mm

70 mm

200 mm

90 mm

7. 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.

### **3.2.9 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

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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<sup>3</sup> 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

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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 placed 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 than 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.

### **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

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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.

### **3.2.10 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

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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 with structural requirements as directed. If horizontal construction joints are required, a strip of 25 mm 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 25 mm 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 as specified in sub-section 3.2.14, "Bonding."

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.

## 3.2.11 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.

### **3. 2. 12 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 40 cm 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 1.5 m in unexposed work nor more than 1.0 m in exposed work; where greater drops are required, tremie or other approved means

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shall be employed. The discharge of the tremie shall be controlled so that the concrete may be effectively compacted into horizontal layers not more than 40 cm thick, and the spacing of the tremies shall be such that segregation does not occur. Concrete to be overlayed shall be screeded to the proper level to avoid excessive shimming or grouting. Conduits and pipes shall not be embedded in concrete unless specifically indicated.

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 reduced 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,

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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 Deck

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.

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– 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.

### **3. 2. 13 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.

### **3. 2. 14 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.

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Apply a thin coat of compound to dry and clean surfaces. Scrub compound into the surface with a stiff-bristle brush. Place concrete while compound is tacky. Do not permit compound to harden prior to concrete placement. Follow manufacturer's instructions regarding safety and health precautions when working with epoxy resins.

### **3. 2. 15 SETTING OF BASE PLATES**

1. Preparation: After being plumbed and properly positioned, base plates shall be provided with full bearing with damp-pack bedding mortar, except where expansive grout is indicated. The space between the top of concrete or masonry bearing surfaces and the bottom of the plate

shall be approximately 1/24 of the width of the plate, but not less than 13 mm for plates less than 30 cm wide. Concrete surfaces shall be rough, clean, free of oil, grease and laitance, and shall be damp. Metal surfaces shall be cleaned and free of oil, grease and rust.

2. Mortar: Damp-pack bedding mortar shall consist of one part Portland cement and 2.5 parts of fine aggregates, suitable to the work required, proportioned by weight and not more than 17 liters of water per bag of cement. The space between the top of the plate shall be packed with the bedding mortar by tamping or ramming with a bar or rod until the voids are completely filled.

3. Expansive Grout: Grout shall derive its expansive properties from the liberation of gas into the mixture during and after mixing. This includes typically, the chemical reaction of metallic aluminum with alkali hydroxides in solution which causes the evolution of hydrogen gas. Expansion of such materials may be expected to continue after the gas liberating mechanism has been exhausted or until the mixture has solidified to such an extent that the tendency for the evolving gas to expand is effectively registered by the stiffness of the grout.

a. When tested as provided for herein, an expansive grout shall meet the following performance requirements:

Expansion, 28 days, % 0.4 (max)

0.03 (min)

b. It will be the Contractor's responsibility to supply the necessary manufacturer's certificates.

### **3.2.16 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

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pockets, voids over 13 mm 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.

### **3.2.17 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, stair landings; 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.

4. Tolerance: Smooth and broom finished surfaces shall be true to plane with no deviation in excess of 3 mm in any direction when tested with a 3 m straightedge.

### **3.2.18 CURING**

1. Concrete shall be protected against moisture loss, rapid temperature changes, mechanical injury from rain or flowing water, for a minimum period of time given below:

Types A, B1 and B2

7 days

Types C and D 5 days

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2. Concrete shall be maintained in a moist condition throughout the specified curing period and until remedial work is started under subsection 3.2.16, "Finishes of Concrete". Curing activities shall be started as soon as free water has disappeared from the surface of the concrete after placing and finishing. Formed under-surfaces shall be moist cured with forms in place for the full curing period or, if forms are removed prior to the end of the curing period, by other approved means. Curing shall be accomplished by any of the following methods or combination thereof, as approved.

3. Moist Curing: Unformed surfaces shall be covered with burlap or mats, wetted before placing and overlapped at least 15 cm. Burlap or mats shall be kept continually wet and in intimate contact with the surface. Where formed surfaces are cured, the forms shall be kept continually wet. If the forms are removed before the end of the curing period, curing shall be continued as on unformed surfaces, using suitable materials.

4. Impervious-sheet Curing: All surfaces shall be thoroughly wetted with a fine spray of water and be completely covered with waterproof paper, polyethylene sheeting or with polyethylene coated burlap having the burlap thoroughly water saturated before placing. Covering shall be laid with light-colored side up. Covering shall be lapped not less than 30 cm and securely weighted down or shall be lapped not less than 10 cm and taped to form a continuous cover with completely close joints. Sheets shall be weighted to prevent displacement or billowing from winds. Coverings shall be folded down over exposed edges of slabs and secured by approved means. Sheets shall be immediately repaired or replaced if tears or holes appear during the curing period.

5. Membrane-forming Compound Curing: Before applying curing compound, tops of joints that are to receive sealant shall be tightly

closed with temporary material to prevent entry of the compound and to prevent moisture loss during the curing period. The compound shall be applied on damp surfaces as soon as the moisture film has disappeared. The curing compound shall be applied by power spraying using a spray nozzle equipped with a wind guard. The compound shall be applied in a two-coat, continuous operation at a coverage of not more than 10 sq m per liter for each coat.

When application is made by hand sprayers the second coat shall be applied in a direction approximately at right angles to the direction of the first coat. The compound shall form a uniform, continuous, adherent film that shall not check, crack, or peel and shall be free from pinholes or other imperfections. Surfaces subjected to rainfall within 3 hours after compound has been applied, or surfaces damaged by subsequent construction operations within the curing period, shall be immediately re-sprayed at the rate specified above. Membrane

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forming curing compound shall not be used on surfaces that are maintained at curing temperatures with free steam. Where membraneforming curing compounds are permitted, permanently exposed surfaces shall be cured by use of non-pigmented membrane-forming curing compound containing a fugitive dye. Where non-pigmented type curing compounds are used, the concrete surface shall be shaded from the direct rays of the sun for the duration of the curing period. Surfaces coated with curing compound shall be kept free of foot and vehicular traffic, and from other causes of abrasion and contamination during the curing period.

### **3. 2. 19 UNDER WATER CONCRETE**

1. Concrete placement under water, when unavoidable, shall be made in accordance with the following requirements and provided always with the Engineer's approval.

- a. Water cement ratio shall be within 50 percent.
- b. Weight of cement per one cubic meter shall be not less than 370 kg.
- c. Use of water reducing admixtures and/or admixtures that reduce concrete contamination by sea water shall be recommended.
- d. Slump shall be within the following limits:

#### **Construction Method Slump**

Using tremie or concrete pump

Using bottom opening type box or  
buck

Between 13 to 18 cm

Between 10 to 13 cm

- e. Coverage of reinforcement shall be 10 cm or more.
- f. Concrete shall be placed under water in accordance with Subsection 3.2.12 "Placing Concrete" unless otherwise mentioned below.

1) Concrete shall be placed under calm weather conditions and current shall be within 3 m/min.

2) Concrete shall be placed using tremies or concrete pumps or any other approved equipment.

- 3) Tremies shall be watertight and of size which can deliver concrete freely without any segregation or change in slump. Tremies shall be filled with concrete fully during placing.
- 4) Pipes of concrete pumps shall be watertight.
- 5) Tremies shall move carefully up to the designated height under continuous concrete placement operations so that concrete can spread uniformly.
- 6) Concrete shall not be agitated after placing in the forms in order to prevent laitance formation at the top of the works.
- 7) Successive concrete placement can be carried out only after all laitance has been removed from existing surfaces.

### **3.2.20 MEASUREMENT AND PAYMENT**

#### **3.2.20.1 MEASUREMENT**

1. Concrete shall be measured by the cubic meters of various kind and classes of respective items of work required as shown in the Drawings or as specified and as installed and accepted in completed work. Volumes of concrete shall be reduced by the amount occupied by pipes, conduits, chases or other places with net cross section areas more than 100 cm<sup>2</sup> other than the following items:

- a. Reinforcing steel and anchor bolts.
- b. Space required for or occupied by expansion/construction joints, joint fillers, water stops, chamfers and like details of relatively small size.

Setting out of the work to be paid for shall not be measured separately, the cost shall be deemed as part of and incidentals to the foundation works.

2. Formwork shall not be measured separately for payment. The cost is deemed as part and incidentals to the concrete works.

3. Reinforcing steel bars shall be measured in kilograms incorporated into work, computed from theoretical unit mass for sizes of bars multiplied by length of bars as shown on approved shop drawings except where specified otherwise.

No measurement shall be made for reinforcing steel in catch drains, catch basins, manholes and precast concrete. The cost will be included in the price for each item of work.

Separate measurement will not be made for:

- a. Increase of bar sizes or decrease of bar spacing, unless approved in advance by the Engineer.
- b. Increase in number of bars resulting from Contractor's constructing method.
- c. Bar splicers added for Contractor's convenience or made necessary as a result of using bar lengths less than 10 meters.
- d. Weight of quantity of tie wires, chairs, spacers or other accessory items necessary for erection of steel work.
- e. Sleeves and work incidental to and necessary for installation of dowels for expansion/construction joints for slabs.

4. Cost of all testing and records to be made shall be deemed included in the unit cost of concrete.

#### **3.2.20.2 PAYMENT**

1. The quantities measured as provided above, shall be paid for at the contract unit price according to the class of concrete for the pay item shown in the Bill of Quantities. The unit price shall be considered to include all formwork including scaffolding, forms for construction and expansion joints, vapor barrier and sealant, form oil coating, synthetic fibrous reinforcement/admixtures where required, necessary accesses for pipes, conduits, sewer drains and the like and work required for placing concrete in the final position including material, batching, mixing, transporting, handling, placing, compacting, curing, protection and finishing of concrete surfaces.

2. The quantity of reinforcing steel bars to be paid for shall be measured (as in 3.2.21.1.3) by the weight of reinforcing steel bars supplied and installed completely and certified by the Engineer for payment. The cost shall constitute full compensation for furnishing materials, labor, equipment, tools, and incidentals necessary to complete reinforcing steel works as indicated in the Bill of Quantities.

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### **3.3 PILING WORKS**

#### **3.3.1 GENERAL**

Work under this Contract shall be in accordance with Division 1, "General Requirements", and shall apply to the Section, whether herein referred to or not.

##### **3.3.1.1 SCOPE OF WORK**

This section covers the technical requirements for the material, workmanship, fabrication, installation and testing of piling works, and shall form part of this Specification to the extent indicated by the reference thereto.

##### **3.3.1.2 GENERAL PROVISIONS**

The following publications listed below, but referred to thereafter by basic designation only, form a part of this Specification to the extent indicated by the reference thereto:

AWS D1.1 Structural Welding Code

ASTM D1143 Load Settlement Relation for Individual  
Vertical Piles under Static Axial Load

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.

##### **3.3.1.3 COATING PROTECTION**

Steel Pipe Pile Coating Protection, when required, shall be as specified in the drawing.

##### **3.3.1.4 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.

### **3.3.2 MATERIAL REQUIREMENTS**

#### **3.3.2.1 PRECAST REINFORCED CONCRETE PILES (RC PILES)**

Precast concrete for reinforced concrete piles and its reinforcement shall conform to the requirement of Section 3.2 "Concrete Works".

##### **1. Fabrication Yard and Equipment**

Reinforced concrete piles shall be products of approved manufacturers regularly engaged in pile production of the same size or larger for a period of three years or more. However, the Contractors may be allowed to manufacture RC piles upon presentation to the Engineer of proof that they have past experienced in manufacturing RC piles from their previous contracts having the same or bigger requirements. Before casting of piles is started, approval shall be obtained of the casting method, the casting yard and storage site and equipment. The Contractor shall provide all equipment necessary for the fabrication of piles. Special care shall be made for curing, handling and transport of piles.

##### **2. Casting and Fabrication**

Piles shall be cast separately. The formwork for the piles shall have an even and solid bed and be constructed so that the piles can be easily removed from the form. The formwork and its placing shall be approved before casting of concrete. The formwork shall not be removed from its bed until the concrete has attained a compressive strength of at least 70% of its required 28 day strength.

The pile shall not be removed from its casting bed until it has reached its full 28 day compressive strength. Piles shall be moist cured for a period of 28 days after casting.

The Contractor shall determine the points where the piles will be supported during handling, transportation and storage. Care shall be taken to prevent piles from any damage during transportation. If the piles are placed in stacks, the supporting points at each layer shall be vertically over one another and the location of the supporting points shall be approved by the Engineer.

##### **3. Formwork**

Forms shall conform to the applicable provisions in Section 3.2, "Concrete Works." Chamfers shall be provided at each corner of piles as indicated on the Drawings.

##### **4. Marking**

After the concrete has hardened, the piles shall be marked in approved format in durable paint indicating:

- a. Serial Number, marked close to both ends
- b. Date of casting, marked as (a)
- c. Date of arrival, marked as (b)
- d. Length of pile, marked as (c)
- e. Position of lifting points as approved by the Engineer
- f. Meter marks in two faces, throughout the length

#### **3.3.2.2 PRESTRESSED REINFORCED CONCRETE PILES (RC PILES)**



Prestressed concrete piles shall be constructed in accordance with the normal practice employed for the particular system specified and as directed by the Engineer subject to the following clauses.

1. Prestressed concrete piles shall be of readymade products of approved fabricator regularly engaged in the production of prestressed concrete piles for a period of three years or more.
2. The design report, specification, handling manual and shop drawings of piles to be applied shall be submitted by the Contractor for the Engineer's approval.
3. If an alternative system of prestressing to that shown in the Drawings is proposed by the Contractor, full details, procedures and explanations shall be submitted in writing to the Engineer for his approval. When approved for the work, the provisions of this Specification and such other provisions as he may require shall be fully satisfied.
4. Concrete strength, wires/strands, bars to be used for prestressed concrete work shall be as specified in the Drawings.

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5. The Contractor shall submit the casting method including prestressing, application of stress and casting schedule and shall obtain the approval of the Engineer before commencement of fabrication of the piles.

6. The Contractor shall arrange for the Engineer to have free access to the place of manufacture of the piles.

7. Casting of prestressed concrete piles shall be in a manner that there shall be no leakage of concrete or grout into the space to be occupied by the steel. The ducts shall be of the correct cross-section, the ends being formed out as shown on the Drawings or as required by the prestressing system in use. Adequate means, subject to the Engineer's approval, shall be employed to ensure that their location is maintained exactly throughout the concreting operations. Passage shall be provided in the locations indicated on the Drawings for the injection and escape of grout and the release of air.

Piles shall be cast on a horizontal platform in approved steel moulds and details of the formwork and methods of concreting shall be as specified. The concreting of each pile shall be completed on one continuous operation and no interruption shall be permitted.

The ends of the piles must be formed truly square to the axis of the pile.

8. Anchorages shall be made from steel of a suitable quality to withstand permanently the forces imposed upon them, and shall in general be in accordance with the normal practice of the proprietors of the prestressing system in use.

9. Application of stress, grouting of prestressing cables, protection of prestressing cable anchorages and other necessary steps to complete the prestressing process shall conform to the standard practice of the prestressing system in use or as directed by the Engineer.

When the stress has been transferred to the pile, the pile shall exhibit no curvature in its length on any face greater than 3 millimeters deviation along a chord of 15 meters (1 in 500).

10. Precast prestressed units shall be lifted only by lifting holes near the

ends of the units, or when not provided can be lifted by slings placed securely at corresponding points. Units shall be kept in the upright position at all times and shock shall be avoided. Any unit considered by the Engineer to have become sub-standard in any way shall be rejected and replaced by an acceptable unit.

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11. Each prestressed member is to be uniquely and permanently marked to show its type, date of casting and reinforcement.

12. Forms shall conform to the applicable provisions in Section 3.2. Chamfer shall be provided at each corner of piles as shown on the Drawings.

13. The Contractor or approved manufacturer shall mark the casted piles in same manner discussed in Sub-section 3.3.2.1.4).

### 3.3.2.3 REINFORCED CONCRETE SHEET PILES

Same requirements for reinforced concrete piles shall be applied to reinforced concrete sheet piles.

### 3.3.2.4 STEEL PIPE OR TUBULAR PILES

#### 1. 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 drawings conforming to the requirements of ASTM A 252 Grade 2, equal or better. Minimum shell thickness shall be as indicated in the drawings. Piles may be supplied knockdown in the sections then fabricated or welded to the required length in the field prior to driving.

#### a. Underwater Petrolatum Tape System with High Density Polyethylene (HDPE) Jacket as Protective Coating of Steel Piles

Unless otherwise specified on the Drawings, the Underwater Petrolatum Tape System with High Density Polyethylene (HDPE) Jacket (Heavy Duty Application) shall be used as protective coating for steel piles.

#### (1) Material Requirements:

##### (a) Petrolatum Paste

- Petrolatum Paste is a soft paste containing water displacing, corrosion inhibiting and flow control additives with broad-spectrum biocides. It does not dry, harden or crack.
- Applicable to badly corroded and fitted steel above and below water surface prior to the application of the marine piling tape. It fills pits and depressions on the steel pile surface and does not contain volatile organic components.

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- Specially designed for underwater applications.

Properties:

Flash point = 180°C (minimum)

Specific Gravity = + 1.08

Temperature Range:

For Application = 0°C to 40°C

For Service = - 30°C to 55°C

#### (b) Petrolatum Marine Piling Tape

- Petrolatum Marine Piling Tape is a synthetic filament fabric coated with a neutral compound based on saturated petroleum hydrocarbons and inert mineral fillers with additional inhibitors and water displacing agents.
- It is primarily used for the protection of jetty piles particularly in the splash and inter-tidal zones.
- It is an anti-corrosion tape that can be applied to metal under water that adheres and remains attached to all cleaned, sound, wet or dry metal surfaces.

(c) High Density Polyethylene (HDPE) Jacket

- HDPE Jacket is a flexible plastic outer cover, new, seamless, non-rigid virgin material. The sheet shall be uniform throughout, free from dirt, oil and other foreign matter and free from cracks. This sheet shall conform to the following mechanical and physical properties:

Tensile Strength @ Break = 187 kg/cm<sup>2</sup>

Elongation @ Break = 610%

Thickness = 2.00 mm

Tear Resistance = 146 kg/cm<sup>2</sup>

(2) Installation Procedure

(a) Surface Preparation

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- Prior to the application of Petrolatum Paste, the Pile Surface should be thoroughly cleaned starting from the interface of the bottom of pile cap down to elev. – 3.00m (Splash Zone).
- All Marine growths, loose and flaking paint, adhering rust scale and deep pitting corrosion products should be removed by chipping hammers and/or hand power tools.
- Weld scars and protrusion of any kind (other than the welded seam on the pile) should be cut away and smoothed to removed sharp edges and sudden changes of profile.

(b) Petrolatum Paste

- Apply the petrolatum Paste by hand, brush, glove, rag or roller.
- Apply a thin uniform film over the entire surface to be wrapped with Petrolatum Marine Piling tape.

(c) Petrolatum Marine Piling Tape

- A minimum of two layers of marine piling tape should be wrapped around the surface of the steel piles along the splash zone.

(d) High Density Polyethylene (HDPE) Jacket

- A minimum of 50 mm overlap width is required along joints.

b. Other Protective Coating for Steel Piles

Unless otherwise specified on the drawings, when the steel pipe piles or tubular piles are extended aboveground surface or water

surface, they shall be protected by two (2) coats of epoxy coal tar. If concrete jacket is required, a minimum thickness of 0.15m shall be used. These protections extend 1.00m below the water elevation on finished ground to the top of the exposed steel.

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#### c. Exterior Surfaces

All exterior surfaces of pile shall be shop coated with red lead primer or as indicated in the drawings.

#### 2. Concrete and Reinforcement Works

Concrete and reinforcement works (where required) for filler of steel pipe piles, concrete jacket and pile cap shall be in accordance with Section 3.2, "Concrete Works" where concrete compressive strength at 28 days shall be [35.0] MPa [5,000 psi].

Provide reinforced concrete filler for steel pipe piles from the top of piles up to 2.00 m below MLLW (Elevation 0.00). Concrete jacket (100 mm thick) shall be provided up to 1.00 meter below MLLW as indicated on the Drawings.

#### 3. Welding Requirements

The welding material used for the production of steel piles by circumferential welding of steel pile or in the attachment of accessories shall have a tensile strength not less than the following standards.

JIS Z 3211 - Covered Electrodes for Mild Steel

JIS Z 3213 - Covered Electrodes for High Tensile Strength Steel

JIS Z 3312 - MAG Welding Solid Wires for Mild

JIS Z 3313 - Flux Cored Wives for Gas Shielded and self-shielded Metal Arc Welding of Mild Steel, High Strength Steel and Low Temperature Service Steel

JIS Z 3352 - Submerged Arc Welding Fluxes for Carbon Steel and Low Alloy Steel

The welder shall have a qualification specified in JIS Z 3801 Standard Qualification Procedure for Welding Technique or equivalent.

#### 4. Splicing

The Contractor shall splice the pile as shown on the drawings or by other methods approved by the Engineer.

#### 5. Tip Protection

The Contractor shall submit shop drawing and methods of pile tip protection to the Engineer for approval.

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#### 6. Marking

The pile shall be marked on durable paint indicating:

1. Serial Number, marked close to both ends
2. Date of Arrival, marked same as (i)
3. Length of pile, marked same as (i)
4. Meter marks in two faces, throughout the length

#### 7. Workmanship

All piles shall be correctly finished free of cracks, surface flaws, laminations and all other defects. The repairs of minor defects by welding or otherwise will be permitted but such repairs shall only be done after obtaining the permission of the Engineer in writing. Detail of the defect and of the proposed method of repair shall be submitted to the Engineer at least 48 hours before it is desired to effect the repair.

#### 8. Documents to be submitted

The following documents shall be submitted to the Engineer prior to the commencement of welding work of tubular steel piles:

1. Steel pipe (pile) 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

#### 3.3.2.5 STEEL SHEET PILES

##### 1. Quantities and Dimensions

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.

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##### 2. Quantities and Dimensions (Tie-Rods, Walings 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 walings shall be supplied, fabricated, assembled and installed by the Contractor as shown on the Drawings. The structural steel shall conform to Section 3.15 "Steel and Metal Works".

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

#### 3.3.2.6 TIMBER PILES

##### 1. Material

The timber piles shall be straight and treated apitong or equivalent and creosoted with minimum butt diameter of and a minimum tip diameter of 200mm and a length as shown on the Drawings. The piles shall be free from ring shakes, unsound spots or knots and short bends. All knots shall be trimmed close to the body and the piles peeled soon after cutting. The piles shall have a uniform taper such that a line drawn from the center of the top to the center of the tip shall be within the body of the pile. No piles shall be driven without the acceptance of the Engineer.

##### 2. Creosoting

Creosoting of piles shall be by the Pressure Process and in accordance with the Philippine Standard Association, Inc. Standard Specification for preservation of Timber Piles by pressure Process, (PHILSA 168:1978).

##### a. Conditioning

1) Air Seasoning - Seasoning to a moisture content of 35% and below

2) Streaming Temperature - 118 C, maximum  
Duration - 20 hours, maximum

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3) Boultonizing Temperature - 110 C, maximum

Duration - 20 hours, maximum

Vacuum - 550 mm Hg, maximum

4) Heating in Preservative - 104 C, maximum

Duration - no time limit

b. Treatment

1) Pressure - 10.5 kg/cm<sup>2</sup>, minimum

14 kg/cm<sup>2</sup>, maximum

Duration - 3 hours, maximum

2) Expansion Bath Temperature -104 C, maximum

Duration - as required

3) Final Steaming Temperature -118 C, maximum

c. Retention

Creosote retention shall be 320 kg/m<sup>3</sup>

d. Sampling Zone

Sampling zone shall be 0 to 75mm from the surface of each timber pile.

e. Determination of Penetration

All boring shall be taken between the butt and tip of each pile.

Penetration of creosote preservative shall be 100% of the sapwood or not less than 25mm from the surface of the pile.

All holes made for determining penetration of preservative shall be filled with tight-fitting treated plugs.

### **3.3.3 GENERAL REQUIREMENTS**

Pile Length: Pile lengths shown on the Drawings are for estimating purpose only and are based upon probable lengths remaining in place in the completed structure.

1. Test piles of length shown on the drawings shall be driven at such points as designated by the Engineer that they may be left in place, cut off, and become a part of the permanent structure. From their performance under driving, the Engineer will determine the lengths of piles required.

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This pile shall be longer than ordinary piles shown in the pile schedule to provide for contingencies due to variations in soil behavior. Pile penetration observed per blow of the hammer shall be recorded. If refusal is observed while the required penetration is not yet obtained, the Contractor shall continue driving the pile with the aid of water jets. Water jets shall be carried out in all respect with rigorous control and not to detriment the surrounding ground or any part of the Works. If necessary, test pile/s shall be spliced and redriven until the bearing power and penetration are acceptable to the Engineer.

2. Lengths of regular piles shall be computed by the Hiley Formula or other formulas accepted by the Engineer.

The above shall not be construed to mean that driving may stop when such penetration as shown on the plans has been secured, but that

driving shall continue in every case until the total penetration obtained is satisfactory to the Engineer, regardless of the fact that sufficient bearing capacity as determined by the formula may be obtained at a lesser depth.

#### **3.3.4 TESTING OF MATERIALS**

##### **1. Reinforced Concrete Piles and Concrete Sheet Piles**

The requirements regarding testing of concrete and reinforcement used in reinforced concrete piles and sheet piles shall be in accordance with Section 3.2, "Concrete Works".

However, the Engineer may conduct the necessary testing at the approved fabricator's casting yard whenever he considers necessary.

Tests shall be carried out at the Contractor's expense.

##### **2. Steel Pipe Piles and Steel Sheet 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 or steel sheet pile meets the requirements specified in these technical specifications.

##### **3. Timber Piles**

The Contractor shall submit to the Engineer three (3) copies of the test reports certifying the timber pile meets the specified requirements in accordance with the Standard Specifications for preservation of Timber Piles by pressure Process.

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#### **3.3.5 STORAGE AND HANDLING**

1. When raising or transporting piles, the Contractor shall provide slings or other equipment to avoid any appreciable bending of the pile or cracking of the concrete. Pile materials damaged in handling or driving shall be removed from the site and replaced by the Contractor at his expense.

Concrete piles shall be so handled at all times as to avoid breaking or chipping of the edges.

Before delivering steel pipe piles to the construction site, they shall be inspected as to external appearances, shapes, and dimensions in accordance with ASTM A 252, Grade 2 or its equivalent.

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

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

#### **3.3.6 PILE DRIVING**

1. Uncapped pile heads shall be protected against damage by the use of appropriate pile driving caps and/or cushions to centralize the driving impact.

2. The pile headers shall be of sufficient rigidity and fixity to hold the pile firmly in position and true alignment during driving operations.

3. The procedure and the data for the hammer to be used in driving shall be submitted to the Engineer prior to starting the driving operation.

The Engineer's approval of the pile driving equipment will not release the Contractor from the responsibility for the adequacy of selected equipment.

A steam or diesel pile hammer shall be used for driving reinforced

concrete and tubular steel piles. For timber piles a gravity or drop hammer may be allowed.

When steam hammers are used, the energy delivered in the pile being driven shall not be less than 5,300 ft.-lbs. The total energy developed by the hammer shall not be less than 6,000 ft.-lbs. per blow. Selfpowered or diesel hammers of corresponding energy may be used in lieu of steam hammer for the particular pile/s being driven. For gravity hammers, the weight of ram shall be at least 50% of the weight of the pile being driven but should not be less than 907 kg. (2,000 lbs) for piles weighing 1,814 kg. (4,000 lbs) or less.

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The fall of hammer shall not exceed 6 m (19.18 ft) and shall be of uniform frequency to avoid injury to the piles.

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.

4. Piling shall commence from the interior outward as the lateral displacement of soil may influence driving and heaving of already driven piles.

5. Every effort shall be made to drive continuously without interruption.

6. The Contractor shall repair all damages to piles during driving. A minimum cut-off allowance, not less than 600 mm shall be provided for all corrections at in-place splices and at all the pile heads for removal after completion of the driving.

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, or
- c. Splicing an additional length

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

7. The piles which have been uplifted after being driven shall be re-driven to the required penetration after completing other activities in the nearby areas. As heaving is anticipated, survey benchmarks should be established and elevations must be taken of the driven piles adjoining the piles being driven to avoid pile displacement affected by the swell rise of sub-soil structures.

8. Splicing of piles if any, shall be subject to the Engineer's approval. The Contractor may propose splicing procedures.

### **3.3.7 OBSTRUCTION**

Where boulders or other obstructions make it impossible to drive certain piles in the location shown and to the required bearing strata, the Engineer may order additional pile or piles driven at other suitable location after consultation with the Structural Engineer.

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### **3.3.8 PILE DRIVING RECORDS**

#### **3.3.8.1 R.C. PILES**

Pile driving records shall be prepared for each pile on Form No. 001



attached at the end of this Section and shall be submitted to the Engineer two (2) signed typewritten copies daily. The records shall show the number of blows per 0.75 m. penetration from the pile tip, attain a depth of 5.0 m., the penetration under the last 10 blows, and the calculated safe load according to the Hiley Formula or other formula acceptable to the Engineer.

### 3.3.8.2 STEEL PIPE PILES

#### Driven Piles

##### 1. Pile Details (for each pile)

- a. The date, start time and finish time of driving the pile.
- b. Date of casting and concrete quality.
- c. The location number, identification number, pile dimensions and specified rake.
- d. The seabed elevation.
- e. The pile toe elevation.
- f. Elevation of soil inside the pile upon completion of each driving operation, and hence the drawdown of the soil plug.
- g. Elevation of the pile head after driving.
- h. Actual length of the pile, cut-offs and extensions.
- i. Deviation of the pile from the true location, orientation and rake.
- j. Pile penetration (before and after driving).

##### 2. Equipment Used

- a. The make, model, type, size and efficiency of hammer and its stroke and characteristics including rated energy and operating speed.
- b. Weight of hammer and ram.
- c. Type, thickness and condition of cap block and pile cushion.
- d. Weight and dimensions of drive cap and follower.
- e. For gravity and single-acting hammers: the height of drop
- f. For double-acting hammers: the frequency of lows.

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##### 3. Driving Details

- a. The number of blows per 250 mm penetration.
- b. The final set of mm/blow for the last ten blows and the actual stroke of the hammer.
- c. The results of the Pile Driving Analyzer and CAPWAP analysis showing total resistance, friction and tip resistance, maximum pile press and effective pile length.
- d. Unusual behavior of hammer or pile during driving.
- e. Details of interruption in driving, including "set up" time.
- f. Details of re driving.

In case a pile in-situ, then the record shall also show the length of extension, time of welding, results of non-destructive tests on the weld, date and time of restarting pile driving and details of protective coating of the weld and adjacent area.

### 3.3.9 PERMISSIBLE TOLERANCE

1. Position error in plan : + 100 mm
2. Cut-off elevation : + 10 mm

### 3.3.10 NOT PERMITTED

Pulling the head of the pile to attain the design position shall not be permitted.

### **3.3.11 MEASUREMENT AND PAYMENT**

#### **3.3.11.1 R.C. SHEET PILING**

1. The quantity of precast R.C. sheet piles wall to be paid for shall be measured by the linear meter or a fraction thereof-cast in accord with the contract and as ordered, specified and accepted by the Engineer.
2. Driving of R.C. sheet piles which consist of regular and corner RC sheet piles including grouting of gap between piles, to be paid for shall be measured by the linear meter or a fraction thereof placed in accord with the Contract and accepted in completed work, excluding pile length cut from driven piles to adjust to the cut-off elevations and as required and shown in the drawing.

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3. In case of sheet piles not driven to full length due to unforeseen obstruction, the Contractor shall be compensated for the whole cost of driving the full length of piles without additional cost for the cutting of pile to meet the desired cut-off elevation.

#### **4. Accessories**

- a. Supply and installation of structure steel walings shall be measured by weight in kilograms of waling materials supplied and installed. The unit price shall include loading, transportation, unloading, storage, cutting connection, fabrication at the site, and installation of waling. The unit price shall also include bolts, nuts, and other fittings as shown on the drawings.

- b. Supply and installation of tie rods shall be measured per sets of each dimension of tie rods. The unit price shall include loading, transportation, unloading, fabrication, storage at the site, and installation of tie rods. The unit price shall also include fittings and joints as shown on the drawings. Temporary support of suspended tie rod shall be incidental to the work and shall not be measured separately.

5. Measurement and payment for concrete work for concrete coping and concrete anchor block shall be in accordance with Section 3.2, Concrete Works.

#### **3.3.11.2 PRESTRESSED CONCRETE PILES AND PRECAST REINFORCED CONCRETE PILINGS WORKS**

1. The quantity of Pre stressed Concrete Piles and Precast R.C. piles, to be paid for shall be measured by the linear meter or a fraction thereof as ordered cast in accordance with the Contract and as specified and accepted by the Engineer.
2. Driving of Pre stressed concrete piles and Precast R.C. piles to be paid for shall be measured by the linear meter or a fraction thereof placed in accord with the contract and accepted in completed work up to desired cut-off elevation as shown on the drawings.
3. Chip-off/cut-off elevation: The quantity to be paid shall be the actual number per unit of driven piles chipped-off and cut-off to the desired elevation as shown on the drawings and approved by the Engineer. Payment shall include the cost of disposal, labor, tools, equipment and other incidental expenses necessary to complete the work.)
4. If splicing is necessary, cost of splicing shall not be paid separately but included under pay-item for driving of piles.

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### 3.3.11.3 STEEL PIPE PILES AND STEEL SHEET PILES

1. The quantity of steel pipe piles and Steel sheet piles, to be paid for shall be measured by the linear meters or a fraction thereof as ordered in accordance with the Contract and as specified and accepted by the Engineer.
2. Driving of steel pipe piles and Steel sheet piles to be paid for shall be measured by the linear meter or a fraction thereof placed in accord with the Contract and accepted in completed work up to desired cut-off elevation as shown on the drawings.
3. There will not be any particular payment for cutting of steel pipe piles and steel sheet piles to adjust to desired cut-off elevation.
4. The cost is included in the driving price as specified above.
5. If splicing is necessary, cost of splicing shall not be paid separately but included under pay-item for driving of piles.
6. All concrete and reinforcement works shall not be paid separately but shall be included under concrete works of structures where concrete filled steel pipe piles shall be installed. No additional payment shall be made for any incidental works that may arise to comply with the requirements specified under Sub-section 3.3.2.4.2 since such expenses incurred shall be included under above-mentioned pay-item for concrete works.

### 3.3.11.4 TIMBER PILES

1. Timber piles shall be measured and paid for in lineal meter of materials shall be measured by the linear meters or a fraction thereof as ordered in accordance with the Contract and as specified and accepted by the Engineer.
2. Driving of steel pipe piles and Steel sheet piles to be paid for shall be measured by the linear meter or a fraction thereof placed in accord with the Contract and accepted in completed work up to desired cut-off elevation as shown on the drawings.
3. There will not be any particular payment for cutting of steel pipe piles and steel sheet piles to adjust to desired cut-off elevation.
4. The cost is included in the driving price as specified above and as shown on the Drawings and supplied and delivered on site.

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### 3.3.11.5 TEST PILES

The supply and driving of test piles shall be measured per pile tested at the site and accepted by the engineer. Payment for test piles will be made at the contract unit price by the number of each test pile actually placed and accepted in the final position. The unit price will be full compensation for furnishing all materials, labor, tools, test, and other incidental expenses necessary to complete the work.

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### PILE RECORD

Sheet No.

Date

Ref. Elev.

Form No.

001

Job No.

Plant

Water  
 Depth  
 HAMMER DATA  
 PILE DATA  
 Pile  
 No.  
 Butt  
 Dia  
 Tip  
 Dia  
 Length  
 Ground  
 Elev.  
 Cutoff  
 Elev.  
 Final Tip  
 Elev.  
 Make  
 Model  
 Energy  
 Blows/Min

#### **DRIVING RECORD**

Tip  
 Elevation  
 (m)  
 Depth of  
 Penetration  
 (m)  
 Total  
 Blows  
 Blows per  
 30 cm  
 Length of  
 Stroke  
 (m)

Remarks

Note: Indicate by number in remarks column, thus 1, 2, etc. any important information e.g. jetting, delays, breakage, out of plumb, obstruction, etc.

Contractor

:

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### **3. 4 CAUSEWAY**

#### **3. 4. 1 GENERAL**

Work under this Contract shall be in accordance with Division 1, "General Requirements" and shall apply to this section, whether herein referred to or not.

##### **3.4.1.1 SCOPE OF WORK**

This Specification covers the construction of the causeways for the Project.

The works to be carried out shall be, but not limited to the following:

1. Supply and laying of core rocks

2. Supply and laying of secondary rock - one (1) or two (2) layers
3. Supply and laying of armour rock - one (1) or two (2) layers
4. Supply and laying of quarry run filler to fill the voids of top core rocks.
5. Placement of concrete curb
6. Construction of concrete pavement
7. Toe Protection

#### 3.4.1.2 SETTING OUT WORKS

##### 1. Topographic/Hydrographic Survey:

Prior to commencement of the work, the Contractor shall conduct a topographic/hydrographic survey in conjunction with the Engineer's instructions. This survey shall form the basis for future quantity measurements.

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

Prior to placement of any material, the Contractor shall establish construction markers to clearly define the horizontal and vertical limits of works.

3. Applicable requirements under Section 2.3 shall apply to this Section.

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#### 3.4.2 MATERIAL REQUIREMENTS

1. Concrete work and reinforcement work (where required) for curbs shall be in accordance with Section 3.2, "Concrete Works", where concrete compressive strength ( $f_c'$ ) = [25] MPa.

2. Concrete works for payment shall be in accordance with Division 5.0, "Roads and Pavements."

3. 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.

4. 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.

5. 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.

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

7. The greatest dimensions individual rock unit should be no greater than three times the least dimensions.

8. All rocks should conform to the following test designations: Apparent specific gravity, ASTM C-127 and abrasion, ASTM C-131.

9. Weight of the individual pieces of rock.

##### a. Armour Rock

Refer to the Drawings for the required sizes of the armour rocks for the 1<sup>st</sup> and 2<sup>nd</sup> layers.

##### b. Core Rock

Refer to the Drawings for the required sizes of the core rock.

Core rock bedding shall be reasonably well graded in weight between the minimum and maximum sizes.

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c. Quarry run filler shall consists of pieces of varied sizes of small rocks from quarry (minimum of 10% of the weight of core rocks) to fill the voids of top rocks prior to the placing of subbase course.

### **3. 4. 3 EXECUTION**

1. Construction method of concrete pavement shall be in accordance with Division 5.0 "Roads and Pavements".

2. The core rock shall be placed at convenient height and width for each delivery of materials.

3. Armour rocks shall cover the sides and berm of the causeway.

4. Armour rock fillers shall not be less than one half (1/2) of the weight of the armour rock.

5. Armour rocks shall be placed with the longitudinal section perpendicular to the slope and longitudinal section of the causeway.

6. No cutting, spalling or coursing of the stones shall be allowed, but it is expected that the work shall be done in a workmanlike and skilled manner, which implies careful selection of stones.

7. The armour rock fillers shall be wedged firmly in between the facing of armour rocks so that the latter shall be in the stable position.

8. Armour rocks shall be placed individually by crane equipped with suitable bucket or by other means acceptable to the Engineer.

9. Secondary rocks of specified sizes and weights could be dumped along the size slopes of the structure after the core rock has been placed up to required elevation as shown on the Drawings. Utilizing a crane, the materials can be placed individually maintaining the alignment along the side slopes.

10. The rock causeway can be constructed by any method acceptable to the Engineer. Prior to the start of work, the Contractor shall submit to the Engineer for approval his method and sequence of construction. The Engineer approval of the method and sequence of construction shall not release the Contractor from the responsibility to achieve the satisfactory implementation of the work.

11. Quarry run fillers shall be wedged firmly in between the facing of top core rocks at minimum depth of 300 mm below the neat line and elevation so that the latter shall be in stable position.

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12. Permissible Tolerance

a. Core Rock

Slope : plus or minus 0.30 m

Elevation : plus or minus 0.30 m

b. Armour Rock

Slope : plus or minus 0.30 m

Elevation : plus or minus 0.20 m

### **3. 4. 4 QUARRY SITE AND ROCK QUANTITY**

Refer to Section 3.5 of these Specifications.

### **3. 4. 5 MEASUREMENT AND PAYMENT**

1. Quantities of core rocks, secondary rocks and armour rocks to be paid for shall each be measured in cubic meters. The volume to be paid for

shall be measured by taking cross-sections of the sea bed on the site of work at 10-meter intervals or closer, if necessary, immediately before placing the rock. The volume of the different classes of rocks shall then be computed based on the neat lines and elevations shown on the Drawings and on the foregoing data, with probable settlement as shown in the Drawings.

Quarry run fillers shall not be measured separately as the payment for quarry run fillers shall be included under pay-item for top rocks.

2. Unless otherwise directed by the Engineer, measurement for settlement shall be done by providing a 28mm diameter x 6.0m round bar calibrated rod attached or welded to the center of a one (1) m x one (1) m steel plate at 6mm thick. Measurement device shall be installed at 20.0m interval prior to laying of 1st stage rock.

3. Measurement and payment for concrete and reinforcement works for the construction of R.C. Curb shall be in accordance with Section 3.2, "Concrete Works."

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### **3.5 REVETMENT**

#### **3.5.1 GENERAL**

Work under this Contract shall be in accordance with Division 1, "General Requirements" and shall apply to this Section, whether herein referred to or not.

##### **3.5.1.1 SCOPE OF WORK**

This Specification covers the construction of all revetments for the Project.

The works to be carried out shall be, but not limited to the following:

1. Supply and laying of erosion protection mat (filter fabric) as shown in the drawings. Refer to Section 3.8 "Reclamation" of these Specifications.

2. Supply and laying of core rocks as shown in the drawings.

3. Supply and laying of secondary rocks as shown in the drawings.

4. Supply and laying of armour rock as shown in the drawings.

5. Casting of reinforced concrete curbs as shown in the drawings.

##### **3.5.1.2 SURVEY AND SETTING OUT**

1. Topographic/Hydrographic Surveys: Prior to commencement of the Work the Contractor shall conduct a topographic/hydrographic survey in conjunction with the Engineer instructions. This survey shall form the basis for future quantity measurements.

2. The Contractor shall set out Works and shall be solely responsible for accuracy of such setting out. Prior to placement of any materials, the Contractor shall establish visible construction markers to clearly define horizontal limits of Works.

#### **3.5.2 MATERIAL REQUIREMENTS**

1. Type of Revetment (as shown in the drawings).

2. Concrete curb shall be fabricated in accordance with Section 3.2 - Concrete Works. Use  $f_c' = [25]$  MPa.

3. The weight of individual pieces may exceed the maximum specified in the drawings by up to 25 percent.

4. Rock works shall be in accordance with Section 3.4, "Causeway."

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#### **3.5.3 EXECUTION**

1. Revetments may be constructed by any method acceptable to the Engineer. Prior to start of work, the Contractor shall submit his method and sequence of construction for approval to the Engineer. The Engineer's approval of the method and sequence of construction shall not release the Contractor from the responsibility to achieve the satisfactory implementation of the Work.

2. Core rocks shall be placed as uniformly as possible by controlled dumping or by other means acceptable to the Engineer.

3. Armour rocks and secondary rocks where required or as indicated in the Drawings shall be placed individually by a crane equipped with a suitable bucket or by other means acceptable to the Engineer.

4. Permissible Tolerance

a. Core Rock:

Alignment : plus or minus 0.30 m

Elevation : plus 0.20 m

b. Armour Rock:

Alignment : plus or minus 0.30 m

Elevation : plus 0.20 m

c. Reinforced Concrete Curb

Alignment : plus or minus 0.05 m

Elevation : plus 0.05 m

#### **3.5.4 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.

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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.

#### **3.5.5 MEASUREMENT AND PAYMENT**



1. Quantities of core rock, rubble, secondary rock, armour rock and rock fragments to be paid for shall each be measured in cubic meters. The volumes to be paid for shall be measured by taking cross-sections of the sea bed on the site of work at 10 meter intervals or closer, if necessary, immediately before placing the rock. The volumes of the different classes of rock shall then be computed based on the neat lines and elevations shown on the drawings and on the foregoing data, with probable settlement as shown in the drawings.

2. Unless otherwise directed by the Engineer, measurement for settlement shall be done by providing a 28mm diameter x 6.0m round bar calibrated rod attached or welded to the center of a one (1) x one (1) m steel plate at 6mm thick. Measuring device shall be installed at 20.0m interval prior to laying of 1<sup>st</sup> stage rock.

3. Concrete works for reinforced concrete curb shall be measured and paid for by the length in linear meters of each type of curb along its front face at the finished grade elevation. Reinforcing steel bars for R.C. curb shall be measured in accordance with Section 3.2, "Concrete Works".

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### **3.6 DREDGING**

#### **3.6.1 GENERAL**

Work under this Contract shall be in accordance with Division 1, "General Requirements" shall apply to this Section whether herein specified or not.

##### **3.6.1.1 SCOPE OF WORK**

Dredging of the sea bed where required (where shown on the drawings).

##### **3.6.1.2 GENERAL REQUIREMENTS**

1. If dredged materials are to be used for reclamation, separate payment will not be made for dredging. These costs shall be considered as incidental to and part of the reclamation works.

2. A marine survey of the dredged area inside the port shall be carried out by the Contractor and monitored by the Engineer after dredging stages are completed. In the event the survey reveals that any finished area was under-dredged, the Contractor shall complete that portion of the dredging.

a. Upon assumed completion of all the dredging operations inside the project area, the Contractor shall sweep the dredged areas within the limits stated in the specification to ensure that no shoals higher than the specified depth exist. The Contractor shall remove all shoals so discovered.

b. The Contractor shall be responsible during the Work for all horizontal layouts and vertical profiling of the dredging work inside the port.

#### **3.6.2 CHARACTERISTICS OF MATERIALS**

Information regarding the characteristics of soils which may be encountered in the performance of this Contract is shown in the Tender Drawings for review.

#### **3.6.3 INTERFERENCE WITH NAVIGATION**

1. The Contractor shall familiarize himself with vessel movement and fishery activities in the area affected by dredging operations. The work shall be in a manner that will not impede navigation including

movement of vessels at adjacent wharves or interfere with fishing operations.

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2. The Contractor shall coordinate dredging works with Harbor Authorities, port users and other Contractors.

#### **3. 6. 4 NATURE OF MATERIALS TO BE DREDGED**

1. Refer to borehole logs as indicated in the drawings for characteristics of material to be dredged at each location. The data is made available for information only and the Engineer does not warrant its accuracy at any location other than the referenced borehole.

2. After examination, determine properties of materials to be dredged, the most suitable method and equipment to be employed including disposal of dredged spoil.

#### **3. 6. 5 ASSISTANCE TO THE ENGINEER**

On request of the Engineer, furnish use of such boats, equipment, labor and materials forming ordinary and usual part of dredging plant as may be reasonably necessary to inspect and supervise work.

#### **3. 6. 6 EXECUTION**

1. Dredging shall consist of all underwater excavation/removal of all materials.

2. The equipment to be used in dredging and filling operations is subject to approval by the Engineer.

3. Dredging shall be carried out only in the locations and in the order as approved by the Engineer, and only within limits shown on the drawings or as shown on drawings prepared by the Contractor and approved by the Engineer.

4. Approved dredged materials is to be deposited in areas allocated for port developments whereas dredged material, unsuitable for fill, shall be deposited in areas approved by the Engineer.

5. The dredging and the disposal of the dredged material including placing and operation of equipment and conveying pipes, and transportation of dredged material to disposal sites shall be done without interference with port operations.

6. Stones which may be encountered in the materials to be dredged, and having a smallest dimension of at least 300 mm may be buried in the seabed. No part of buried stones must extend above a level 500 mm below the dredging levels indicated. Stones smaller than those mentioned above may be left on the seabed of partly embedded provided that the stones are below the dredging levels indicated.

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#### **3. 6. 7 PREPARATION**

1. The Contractor shall mark floating equipment with lights in accordance with International Regulations for Prevention of Collision at Sea and maintain a radio watch on board.

2. The Contractor shall place and maintain buoys, markers and lights required to define work and disposal areas.

3. The Contractor shall layout work from baseline established by the Engineer. He shall be responsible for accuracy of work relative to established baseline and shall provide and maintain equipment as normally required for accurate dredging control.

4. The Contractor shall establish and maintain tide gauges in order that proper depth of dredging can be determined. Locate gauges so as to be clearly visible.
5. The Contractor shall establish and maintain on-land targets for location and definition of designated dredge area limits. Targets to be suitable for control of dredging operations and locating soundings. Remove targets on completion of work.

#### **3.6.8 DREDGING OF SLOPES FOR DYKES**

1. Details on temporary slopes, dredged for the execution of Dykes, to be provided by the Contractor and shall be included in their construction method.
2. The work shall be measured and approved by the Engineer before any sand or stone material is placed unless directed otherwise by the Engineer.

#### **3.6.9 DREDGING OF BASINS AND APPROACH CHANNEL**

1. The lines shown on drawings indicate the boundaries of the dredging. Carry out dredging to a depth equal to or below the specified level, with a maximum permissible over-dredging of 400 mm below the specified level.
2. Cut side slopes between original seabed and dredged levels as shown on the drawings unless otherwise authorized in writing by the Engineer.
3. The Engineer shall verify that the dredging has been carried out as required. In general, the dredged depths shall be checked by Echo-Sounder recording. The survey pattern and method, and the Echo-Sounder type shall be approved by the Engineer. In areas where additional precision is required, the verification shall be carried out by  
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suspending a 6 to 10m long straight edge from a vessel, so that the underside of the straight edge is horizontal and level with the indicated dredging level. A sounding rod shall be connected to each end of the straight edge and shall extend vertically above the water surfaces in order to determine the vertical movements of the straight edge.
4. The vessel shall be moved slowly across the area in a manner which will ensure that the total area is covered by the straight edge. Areas where the straight edge cannot pass freely shall be marked and dredged and the check shall be repeated.
5. In case of excessive over dredging the Contractor shall backfill the Over dredged areas and/or take all necessary measures as directed by the Engineer without cost to the Engineer.

#### **3.6.10 DREDGING IN FRONT OF WATERFRONT STRUCTURE**

1. In addition to the requirements of Sub-section 3.6.9, the following shall apply for dredging carried out in front of waterfront structure.
2. The maximum permissible overdredging is 200 mm.
3. Dredging may proceed unrestricted in accordance with Section 3.6.9 and provided that in the opinion of the Engineer, a stable, temporary slope to the edge of the strip is maintained.
4. The Contractor shall be fully responsible for the safety of the permanent structures in the temporary phases of construction. Temporary and permanent bench marks and reference points shall be established as directed by the Engineer for recording immediate and

future movements of waterfront structures.

5. In case of excessive overdredging, the Contractor shall on his account backfill the overdredged areas and/or take all necessary measures as directed by the Engineer.

### **3. 6. 11 SPOILS FROM DREDGING**

1. All dredged material, which in the opinion of the Engineer is unsuitable for fill, shall be dumped at the spoil area indicated on the drawings or into the open sea of depth of at least 20 m MLLW and at least 500m away from the project site.

2. Deposit dredged material suitable for fill in accordance with Sub-Section 3.8, "Reclamation."

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3. All dredged material, which in the opinion of the Engineer, is suitable for fill but is in excess of the quantities required for the present project shall be deposited as directed by the Engineer.

### **3. 6. 12 ARTICLES OF VALUE**

Disposal of all articles of value discovered on the site of the works shall be in accordance with appropriate provision of Conditions of Contract.

### **3. 6. 13 WRECKS**

Should any wreck or obstruction be found, other than that caused by the Contractor, the Contractor is to comply with such instructions as the Engineer may issue regarding its removal.

### **3. 6. 14 MEASUREMENT AND PAYMENT**

1. Before dredging in any location and in accordance with the approved schedule, the Contractor shall perform a new sounding survey over the area to be dredged and its adjoining areas in accordance with Division 1, "General Requirements."

2. On completion of dredging in any location, perform a sounding survey in accordance with General Requirements to verify compliance with Contract and as a basis for measurement of dredging quantities.

3. Do not disturb or displace rip-rap or armour protection during dredging. Reset or replace any disturb or displaced materials without additional compensation or time extension.

4. Only materials excavated above dredged line and within side slope specified or indicated in the drawings or authorized in writing by the Engineer will be measured for payment.

5. Dredging will be measured in cubic meters, in place measurement determined from approved soundings - taken before and after dredging.

6. Dredged volumes by section of work shall be considered for inspection and acceptance.

7. Supply all equipment and assistance needed for inspection and measurement by the Engineer. Cost of such assistance is incidental to dredging work and shall not be measured for payment.

8. Disposal is incidental to dredging work and will not be measured for payment.

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9. No additional cost shall be charged to the Engineer where excavation of corals, bedrocks or hard materials has been encountered by the Contractor.

### **3. 7 SAND REPLACEMENT**

#### **3. 7. 1 GENERAL**

Works under these Contract shall be in accordance with Division I, "General Requirements" and shall apply to this Section, whether herein referred to or not.

##### **3.7.1.1 APPLICATION**

This section shall apply to the sand replacement work to be carried out under the Contract.

##### **3.7.1.2 GENERAL PROVISION**

1. The area, formation levels and slopes of the volume to be replaced shall be as indicated on the drawings. The Contractor shall replace existing marine soft clay with the specified materials, in other words backfilling of specified material into the empty space left after dredging operation or underwater excavation.

2. The provision of Sub-section 3.5.4, "Quarry Site and Rock Quantity" shall also apply to this Section.

#### **3. 7. 2 MATERIAL REQUIREMENTS**

Sand shall be well graded and with less than 20% of its weight or particles classified finer than sand. The sample and its sieving result shall be submitted to the Engineer for approval prior to commencement of the laying works.

Notwithstanding any or all of the requirements of these Specifications, the Engineer shall reject any sand which he considers to be unsuitable and the Contract shall remove such rejected sand from the Site and replaced it with an approved quality at no cost to the Employer.

#### **3. 7. 3 BACKFILLING WORKS**

1. The work methodology and sequence of replacement works shall be submitted to the Engineer for approval prior to the commencement of work.

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2. The dredging depths and slope for the work shall be undertaken as shown on the drawings, prior to the commencement of backfilling.

3. No dredged slope and bottom shall be exposed longer than seven (7) calendar days before backfilling with the replacement material takes place.

4. Interim slope of fill shall not be greater than the slope indicated on the drawings to ensure stability of bottom layer against slope failure.

#### **3. 7. 4 SURVEY WORKS**

Prior to sand replacement, the Contractor shall perform a sounding survey over the area to be filled to provide a basis for measurement of fills.

Sounding work shall be done in conjunction with and to the approval of the Engineer, in accordance with Section 2.3 of these specifications.

On completion of underwater fill in any one section, the Contractor shall perform a sounding survey over the filled area to verify that the fills have been placed to the section shown on the drawings.

Sand replacement shall be inspected and measured by the Engineer as the work proceeds. The Contractor shall attend such inspection and measurement operations and make records as he requires.

The Contractor shall supply all equipment and assistance needed for inspection and measurement and shall plot results on drawings for

approval, as required by the Engineer.

Work covered before inspection and approval of drawings shall not be eligible for payment until satisfactory re-execution in accordance with this Section.

### **3.7.5 MEASUREMENT AND PAYMENT**

Measurement and payment shall be made in cubic meters of material inplaced to the neat lines and elevations. Material outside the neat lines and elevations will not be measured for payment.

Unit Price shall constitute full payment for all labor, material and equipment and all incidental works necessary to complete the work.

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### **3.8 RECLAMATION AND FILL**

#### **3.8.1 GENERAL**

Work under this Contract shall be in accordance with Division 1, "General Requirements" and shall apply to this Section, whether or not referred to herein.

##### **3.8.1.1 SCOPE OF WORK**

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

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

The following major items of work are included:

1. Supply and fill of suitable materials to places required to form the land reclamation 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 bulkhead.

3. Soil Consolidation (if Necessary)

The work shall include the soil consolidation by the use of prefabricated vertical drain to be carried out under this Contract.

The Contractor shall include in his unit prices allowances to cover all risks for any contingencies, except noted otherwise, that may arise during the execution of the works.

##### **3.8.1.2 GENERAL REQUIREMENTS**

The Contractor shall not commence filling any area until that area has been surveyed by the Contractor and the survey results are accepted by the Engineer.

The Contractor shall set out Works and shall be solely responsible for accuracy of such setting out. Prior to placement of such setting out the Contractor shall establish visible construction markers to clearly define horizontal limits of Works.

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The Contractor shall keep all pavements and areas adjacent to and leading to/from the Site, clean and free from mud, dirt and debris.

The Contractor shall not interfere with shipping and navigation or other traffic during execution of the Works.

#### **3.8.2 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 insure 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 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 and called for in dredged material specification.

c. Dredged Materials

Hydraulic fill shall be well-graded gravel.

d. Types of Filling Materials

1) Selected Fill Materials

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

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(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.

2) Sand and Gravel Fill:

The materials shall be composed of 50% sand and 50% gravel and shall be free from rocks, wood, scrap, vegetables, and refuse. The materials shall not have organic content and the maximum particle size shall not exceed 100mm. Source of materials shall be river or mountain quarry.

2. Soil Consolidation: Prefabricated Vertical Drain

The Prefabricated Vertical Drain (PVD) shall be of newly manufactured materials and shall consist of a high density polyethylene core with a cusped profile (to ensure high strength and drainage) enclosed in a non-woven spunbonded polypropylene or polyester fabric filter jacket. The jacket shall allow free passage of pore water to the core without loss of soil material or piping. The core shall provide continuous vertical drainage.

The PVD shall be band-shaped with an aspect ratio (width divided by thickness) exceeding 50.

Refer to the table below for the required properties of the preferred

product specifications:

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**Properties Unit Test Method FD5**

**Core**

Structure

Material

Compressive Strength

-

-

kPa

-

-

ASTM D 1621

Cusped Profile

HDPE

> 450

**Drain**

Weight

Width

Thickness

Discharge Capacity, qw

@ i = 1, 10 kPa

@ i = 1, 350 kPa

Tensile strength

Elongation at 1 kN

g/m

mm

mm

m<sup>3</sup>/s

m<sup>3</sup>/s

kN/100mm

%

-

-

-

ASTM D 4716

ASTM D 4716

ASTM D 4595

ASTM D 4595

70

100

5

90 x 10<sup>-6</sup>

60 x 10<sup>-6</sup>

2.2

< 10

**Filter**

Structure

Material

Tensile Strength



Permeability  
Permittivity  
Apparent Opening Size

-

-

kN/m

m/s

s-1

microns

-

-

ASTM D 4595

ASTM D 4595

ASTM D 4491

ASTM D 4751

Non woven

Spunbond

Polyester

5.5

$1.0 \times 10^{-4}$

0.5

< 75

### ***Packing Details***

Roll Length

Roll Diameter

20ft container

40ft container

m

m

m

m

-

-

-

-

200

$1.2 \pm 5\%$

40,800

86,800

### **3. 8. 3 EXECUTION**

#### **1. 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.

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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. When suction dredges are used, discharge pipework shall be arranged in conjunction with the Engineer's instructions and shall be such that by means of operating valves, material can be deposited to several places without altering the pipework or interrupting dredging. Where necessary vehicle overpasses shall be constructed by the Contractor.
- e. 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.
- Even though the thickness of layers is limited as provided above, the placing of individual rocks and boulders greater than 600 mm in diameter will be permitted provided that when placed, they do not exceed 1200mm (48 inches) in height and provided they are carefully distributed, with the interstices filled with finer material to form a dense and compact mass.
- Each layer shall be leveled and smoothed with suitable leveling equipment and by distribution of spalls and finer fragments of earth. Lifts of material containing more than 25 mass percent of rock larger than 150mm in greatest dimension shall not be constructed above an elevation 300mm (12 inches) below the finished subgrade. The balance of the reclamation work shall be
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- composed of suitable material smoothed and placed in layers not exceeding 200mm (8 inches) in loose thickness and compacted as specified for embankments.
- Dumping and rolling areas shall be kept separate, and no lift shall be covered by another until the necessary compaction is compacted.
- 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.

f. Field Compaction Test

Field Density tests to determine the percent of compaction of the material shall be conducted at elevation + 1.60 from MLLW. Compaction of each layer thereafter shall continue until a field density of at least 98 percent of the maximum dry density in accordance with AASHTO T/180. Method D has been achieved. In place density determination shall be made in accordance with AASHTO T191.

g. Permissible Tolerance

Elevation: plus 5 cm

2. Soil Consolidation

a. General

Prefabricated Vertical Drains (PVD) are artificially created drainage paths which can be installed by one of several methods and which can have a variety of physical characteristics. A PVD can be defined as any prefabricated material or product having the following characteristics:

- 1) ability to be installed vertically into compressible subsurface soil strata under field conditions,
- 2) ability to permit pore water in the soil to seep into the drain, and
- 3) a means by which the collected pore water can be transmitted up and down the length of the drain.

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For a particular project, the performance of the PVD will be influenced by the soil conditions, type of PVD, equipment and construction technique (i.e. contractor). The installation of PVD shall be carried out by the Specialist contractor.

b. Installation of Pre-fabricated Drain

1) Installation Equipment

a) Prefabricated Vertical Drains (PVD) shall be installed with approved modern equipment of a type which will cause minimum disturbances to the subsoil during the installation operation and maintain the mandrel in a vertical position.

b) PVD shall be installed using a mandrel or sleeve which shall be inserted (i.e. pushed or vibrated) into the soil. The mandrel or sleeve shall protect the drain material from tears cuts and abrasion during installation and shall be retracted after each drain is installed.

c) To minimize disturbance of the subsoil, the mandrel or sleeve shall have a maximum cross-sectional area of approximately 65 cm<sup>2</sup> the mandrel or sleeve shall be sufficiently stiff to prevent wobble or deflection during installation.

d) The mandrel or sleeve shall be provided with an anchor plate or similar arrangement at the bottom to prevent the soil from entering the bottom of the mandrel during the installation of the PVD and to anchor the drain tip at the required depth at the time of mandrel withdrawal. The dimensions of the anchor plate shall conform as closely as

possible to the dimensions of the mandrel so as to minimize soil disturbance. The Engineer shall determine the acceptability of the anchorage system and procedure.

e) The mandrel or sleeve shall have visible external markings at maximum one (1) meter increments to enable measurement of penetration depth of PVD.

## 2) Installation Procedures

a) Prior to the commencement of the PVD installation, the Specialist Contractor shall submit full details on the materials equipment, sequence and method proposed for PVD installation to the Engineer for review and approval.

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b) Approval by the Engineer of installation sequence and methods shall not relieve the Specialists contractor of its responsibility to install drains in accordance with the plans and specifications.

c) Prior to the installation of PVD, the Specialist Contractor shall demonstrate that its equipment, methods and materials produce a satisfactory installation in accordance with these specifications. The Specialist Contractor may be given instruction by the Engineer to carry out trial installation of PVD at designated locations.

d) PVD shall be clearly located, numbered and staked-out by the Specialist Contractor using a baseline and benchmark provided by the Engineer. The Specialist Contractor shall take all reasonable precautions to preserve the stakes and is responsible for any necessary re-staking. The as-built location of the PVD shall not vary by more than 250mm from the plan location designated on the drawings.

e) PVD shall be installed from the working platform to the depth shown on the drawings, or to such as directed by the Engineer. The Engineer may vary the depths, spacing or the number of drains to be installed and may revise the plan limits for this work as necessary.

f) Equipment for installing PVD shall be plumbed prior to installing such drain.

g) PVD shall be installed during a continuous push using static weight or vibration.

h) The installation shall be performed without any damage to the PVD during advancement or retraction of the mandrel. In no case will alternate raising or lowering of the mandrel during advancement be permitted. Raising of the mandrel will only be permitted after completion of a drain installation.

i) The completed PVD shall be cut off neatly 150mm above the working platform or as otherwise specified on the contract drawings.

j) Shown below is the detailed rig specifications

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Base Machine Crawler Crane (min. 50 metric ton)  
Penetration Force 9 ton

Extraction Force 9 ton  
Driving System Mechanical System  
Mandrel 120mm x 60mm x 10mm (thk)  
Total Weight 43.5 ton  
Maximum Depth 35.0 m  
Height of PVD Rig Approximately 30m  
PVD Productivity 4,000 m/day/rig

### 3) Splicing

- a) Splicing of PVD material shall be done by stapling a workmanlike manner and so as to ensure structural and hydraulic continuity of the drain.
- b) A maximum of one (1) splice per drain installed will be permitted without specific permission from the Engineer.
- c) The jacket and core shall be overlapped a minimum of 150mm at any splice.

### 4) Obstruction

- a) Where obstruction is encountered below the working platform which cannot be penetrated by the PVD installation equipment, the Specialist Contractor shall complete the drain from the elevation of the working platform to the obstruction and notify the Engineer. At the direction of the Engineer and under his review, the Specialist Contractor shall attempt to install a new drain within 500mm horizontally from the obstructed drain. A maximum of two attempts shall be made as directed by the Engineer. If the drain still cannot be installed to the design tip elevation, the drain location shall be abandoned and the installation equipment shall be moved to the next location, or other action shall be taken as directed by the Engineer.

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- b) If directed by the Engineer, the Specialist Contractor may use auguring, spudding, pre-boring or other methods to penetrate through the obstruction. The cost incurred by the Specialist Contractor to penetrate through the obstruction shall be compensated based on the contract unit price per linear meter.

### 5) Site Records

The Specialist Contractor shall provide competent personnel to continuously supervise and observe the installation of PVD, and furnish the Daily Record sheets to the Engineer each week. The Daily Record Sheets signed by the Specialist Contractor's representative and the Engineer shall contain the following information.

- a) Date of installation
- b) Type of PVD
- c) Location of PVD (installation point)
- d) Depth of length of PVD installed at each location
- e) Details of obstruction, delays and any unusual ground conditions

#### 6) Specialist Contractor

To insure the quality of services rendered the following conditions must be met by the Specialty Contractor:

- a) The Specialty Contractor must be a Filipino owned company with at least 10 years of existence.
- b) The Specialty Contractor must have already installed a total of at least 7 million linear meters of PVD in past completed projects.
- c) The Specialty Contractor must have proven itself capable of installing at least 3 million meters within the duration of one year.
- d) The Specialty Contractor's Project Supervisor must have at least 5 years experience in PVD installation.
- e) The Specialty Contractor's Project Foreman must have at least 5 years experience in PVD installation.

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### **3.8.4 GEOTEXTILE FABRIC**

#### **3.8.4.1 SCOPE**

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

#### **3.8.4.2 GENERAL**

The geotextile fabric shall meet the following requirements in full. If required, a sample of 1.0 m<sup>2</sup> 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 needlepunched polypropylene fibers or its equivalent. The geotextile shall be manufactured from two (2) component geotextile layers with different diameter size fibers needlepunched together to provide a homogenous sheet.
- b. The design of the component layers shall be such that one layer shall exhibit proven constriction characteristics and one layer ensures construction survivability.
- c. 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 support this.
- d. The geotextile must be highly resistant to long term contact with damp cementitious substances or acid or alkali solutions in the pH range 2-13. The manufacturer shall submit test data to ensure resistance of the polymer.
- e. The minimum required porosity of the geotextile shall be >80%.
- f. The geotextile filter should satisfy the Filter Criteria" of  $O_{98} < D_{15}$ , where  $O_{98}$  is the effective opening size of the geotextile which corresponds to the average diameter of a sand fraction 98% of which remains on the geotextiles filter during sieving.

##### **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:

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**TECHNICAL PROPERTIES UNIT Minimum TEST  
STANDARD**

**A. Physical Characteristics:**

Minimum Mass

(per unit area)

(g/m<sup>2</sup>)

600

ASTM D5261

ISO 9864

Thickness

mm

2kPa

4.5

ASTM D5199

ISO 9863

**B. Mechanical Properties:**

Tensile Strength

kN/m

(md/cd)

30/30

ASTM D4595

ISO 10319

Tensile elongation

%

(md/cd)

90/40

ASTM D4595

ISO 10319

CBR Puncture Resistance

N

4,500

ASTM D6241

ISO 12236

Dynamic Drop Cone (mm) 10 EN 918

**C. Hydraulic Properties:**

Effective Opening Size

(O<sub>90</sub> Wet Sieving)

((<sub>95</sub>) Dry apparent Opening)

(mm)

(mm)

.08

< 0.075

ISO12956

ASTM D4751

Water Permeability:

Permittivity

(s<sup>-1</sup>)

0.85

ASTM D4491

**3.8.4.3 STORAGE AND INSTALLATION**

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

2. Installation of the geotextile shall be in accordance with the manufacturer's instructions.
3. 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.
4. The geotextile shall be proven to resist dynamic puncture damage when subject to impact stress from stone armor (200-400 kg) dropped from a minimum height of 2.0 m and should be laid on at least 1-foot sand and/or gravel bedding. Geotextile failing to resist puncture shall not be accepted.
5. To facilitate site Quality Assurance, each roll of geotextile delivered to site shall be clearly labeled with brand name, grade, and production batch number and this information is required to be clearly printed at regular intervals along the entire length of each roll.
6. Geotextile overlaps shall be at least 1.0 m when installed underwater and 0.35 m for installation in dry conditions unless otherwise stated on the drawings. Alternatively, geotextile overlaps are to be heat-welded or sewn using appropriate polyester, polypropylene or other synthetic<sup>121</sup> thread and portable hand sewing equipment. Joint seams shall meet or exceed 80% of the fabric's tensile strength.

### **3.8.5 MEASUREMENT AND PAYMENT**

1. The quantities of fill to be paid for shall be the volume in cubic meters of earthwork material compacted in place, after clearing, grubbing and stripping, and as accepted by the Engineer. The probable settlement indicated in the drawings may be considered for the calculation of the quantities to be paid (subject to Contractor justifications and the Engineer's approval). Compaction test shall be performed by an authorized approved testing laboratory. Cost of test shall be incidental to reclamation and shall not be measured for payment.
2. Filter fabrics to be paid for shall be measured by the actual surface area in square meters of geotextile filter fabric supplied, set in place and finished in accordance with the Specifications and accepted by the Engineer.

All work performed and measured as provided shall be paid for at the contract unit price per square meter for filter fabric, which price shall include furnishing of labor, equipment, tools, materials, supplies and incidentals necessary to complete work.

### **3.9 MULTI-PURPOSE PIER/WHARF/TRESTLE**

#### **3.9.1 GENERAL**

Work under this contract shall be in accordance with Division 1, "General Requirements" and shall apply to this section, whether herein referred to or not.

##### **3.9.1.1 SCOPE OF WORK**

This Section includes the furnishing of all labor, materials, equipment and all incidentals for the construction of the multi-purpose pier and all its appurtenances. The works to be carried out shall be, but not limited to the following:

1. Driving of [\_\_\_] mm and [\_\_\_] mm diameter steel pipe piles



2. Driving of \_\_\_ m x \_\_\_ m pre-cast concrete piles
3. RC and steel pipe pile caps and beams
4. Concrete apron construction
5. Installation of accessories such as mooring bollards, bitts, cleats, fenders and timber pile dolphins.

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### 3.9.1.2 SURVEY AND SETTING OUT

Contractor shall set out Works and shall be solely responsible for accuracy of such setting out. Prior to placement of any materials, the Contractor shall establish visible construction markers to clearly define horizontal / vertical of works.

### 3.9.2 MATERIALS REQUIREMENTS

#### 1. Submittal

##### a. Certified Laboratory Test Report

Before delivery of materials, certified copies in triplicate of the reports of all tests required herein under materials shall be submitted for approval by the Engineer.

##### b. Materials Samples

Representative samples of all materials to be used when required by the Engineer shall be submitted before the delivery of the materials. Representative samples shall be accompanied by certified laboratory test reports.

#### 2. Materials

##### a. Precast/Reinforced Concrete (RC/PC) Piles

##### b. Steel Pipe Piles

##### c. Concrete ( $f_c' = [35]$ MPa)

##### d. Accessories

1) Mooring Bollards, Bitts and Cleats - refer to material requirements in Section 3.14

2) Rubber Fenders - refer to material requirements in Section 3.14

3) Timber Pile Dolphins – refer to material requirements in Section 3.14

e. Guardrail for trestle: Reinforced concrete guardrail shall have the dimensions as specified on the drawings. Concrete and reinforcement works shall conform with the requirements of Section 3.2, "Concrete Works" with concrete compressive strength of [\_\_\_] MPa [(\_\_\_\_\_] psi)] for the pre-cast horizontal beams and for the cast in place columns. Apply non-shrink grout between joints as indicated on the Drawings in the proportions recommended by the manufacturer. The Contractor shall ensure that the grout fills all voids.

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### 3.9.3 EXECUTION

#### 1. Piling Works

a. All piling works shall follow specification prescribed in Section 3.3.

b. The pile length shall be as decided and directed by the Engineer based on the results of the boring investigations and test pile driving.

c. Test piles which may form part of the structure as directed by the

Engineer shall be driven to the required depth and "refusal."

## **2. Replacement of Bed Materials**

The method of dumping, placing of well-graded crushed stone (1-100 kg/pc) over the excavated portion of the seabed is subject to the Engineer's approval.

## **3. Concrete Works**

All concrete works shall follow specifications prescribed in Section 3.2, "Concrete Works."

## **4. Shop Drawings**

The Contractor will submit shop drawings and erection drawings for formwork, falsework and the reinforcing bar lists for the Engineer's review and approval in accordance with the applicable requirements in Section 3.2, "Concrete Works," and Section 3.3, "Piling Works."

## **5. Mooring Bollards, Bitts, Cleats, Rubber Dock Fenders and Timber Pile Dolphins**

a. All materials shall be installed at the location shown on the drawings in accordance with the approved manufacturer's instructions and shop drawings.

b. The Contractor shall submit the detailed construction method based on the manufacturer's recommendations for the Engineer's approval.

c. The installation and testing procedure for the mooring bollards, bitts, cleats, rubber dock fenders and timber pile dolphins shall follow specifications prescribed in Section 3.14, "Mooring and Fender System."

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## **3.9.4 MEASUREMENT AND PAYMENT**

1. Refer to specific sections of this specification for the method of measurement and payment of piles, concrete works, mooring and fender systems necessary for the construction of piers/wharves/trestles and their appurtenances. The unit price shall be considered to include all materials, fabrication, installation, painting and all other incidental work.

## **3.10 RO-RO RAMP**

### **3.10.1 GENERAL**

Division 1, "General Requirements" and shall apply to this section, whether herein referred to or not.

#### **3.10.1.1 SCOPE OF WORK**

This Section includes furnishing of all labor, material, equipment and all incidentals for the construction of the Ro-Ro ramp and all its appurtenances. The works to be carried out shall be, but not limited to the following:

1. Driving of [ ] m x [ ] m precast concrete piles
2. Concrete Works (Section 3.2)
3. Installation of accessories

#### **3.10.1.2 SURVEY AND SETTING OUT**

Contractor shall set out Works and shall be solely responsible for accuracy of such setting out. Prior to placement of any materials, the Contractor shall establish visible construction markers to clearly define horizontal/vertical limits of Works.

### **3. 10. 2 MATERIAL REQUIREMENTS**

1. Precast/reinforced concrete (PC/RC) Piles
2. Concrete ( $f'c = \square$  MPa)
3. Accessories : Fenders
  - a. Rubber Fenders shall be V-type or equivalent with dimensions as shown on the drawings. Refer to Section 3.14, "Mooring and Fender System" for the material requirement of rubber fenders. Rubber Fenders shall be installed as shown in the drawings.

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### **3. 10. 3 EXECUTION**

1. Piling Works
  - a. All piling works shall follow specifications prescribed in Section 3.3, "Piling Works."
  - b. The pile length shall be as decided and directed by the Engineer based on the results of boring investigations and test pile driving.
  - c. Test piles which may form part of the structure as directed by the Engineer shall be driven to the required depth and "refusal."

#### **2. Replacement of Bed Materials**

The method of dumping and placing of well-graded crushed stone (1-100 kg/pc) over the excavated portion of the seabed is subject to the Engineer's approval.

#### **3. Concrete Works**

All concrete works shall follow specifications prescribed in Section 3.2, "Concrete Works."

#### **4. Rubber Dock Fenders**

- a. All materials shall be installed at the location shown on the drawing in accordance with the approved manufacturer's instructions and shop drawings.
- b. The Contractor shall submit the detailed construction method based on the manufacturer's recommendations for the Engineer's approval.
- c. The installation and testing procedure for the Rubber Dock Fenders shall follow specifications prescribed in Section 3.14, "Mooring and Fender System."

### **3. 10. 4 MEASUREMENT & PAYMENT**

Refer to specific sections of this specification for the measurement and payment of piles, concrete works and rubber fenders necessary for the construction of Ro-Ro ramp and its appurtenances.

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## **3. 11 STAIR LANDINGS**

### **3. 11. 1 GENERAL**

Work under this Contract shall be in accordance with Division 1, "General Requirements" and shall apply to this section, whether herein referred to or not.

#### **3.11.1.1 SCOPE OF WORK**

This Section includes furnishing of all labor, material, equipment and all incidentals for the construction of the stair landings and all appurtenances.

The works to be carried out shall be, but not limited the following:

1. In-situ R.C. stair landings (Concrete Works-Section 3.2).
2. Casting and installation of precast concrete block, dimensions as

shown on the drawings.

3. Preparation of rock bedding for the installation of precast concrete block.

4. Installation of Mooring Rings.

#### 3.11.1.2 SURVEY AND SETTING OUT

Contractor shall set out Works and shall be solely responsible for accuracy of such setting out. Prior to placement of any materials, the Contractor shall establish visible construction markers to clearly define horizontal/vertical limits of works.

#### 3. 11. 2 MATERIAL REQUIREMENTS

1. Applicable requirements under Section 3.2, "Concrete Works" shall apply to this Section.

2. Concrete of the stair landing and precast concrete block shall be Class B2 concrete for marine structure with a compressive strength of  $f_c' = [25] \text{ MPa } [(3,500 \text{ psi})]$ .

3. Mooring rings shall be 16 mm  $\square$  stainless steel plain bar.

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#### 3. 11. 3 EXECUTION

##### 3.11.3.1 FABRICATION

1. Fabricated pre-cast concrete blocks shall be free from bends and twists. Where bends shall exist in any section along length of the block, it shall not exceed 5 mm permissible tolerance.

2. Concrete curing shall be done by covering with wet burlap for a period of not less than 21 days.

3. The Contractor will be permitted to obtain precast concrete units from outside suppliers provided that they comply with the specification and that the Contractor obtains the Engineer's approval to each supplier.

##### 3.11.3.2 CONSTRUCTION REQUIREMENT

1. Rock bedding where the precast concrete block will be installed, shall be placed uniformly as possible and graded acceptably to the Engineer.

2. The top of precast concrete block shall be installed at 0.00 elevation referred to M.L.L.W datum with + 0.05 m tolerance.

3. The lowest step shall be at the top of the precast concrete block.

4. The dimension of the steps shall be 30 cm tread with a 20 cm riser.

5. No precast units shall be removed from the casting beds until the concrete samples representing them reach a strength not less than that specified as the minimum concrete strength at seven days for the class of concrete concerned. Similarly no units shall be set in place until the samples representing them reach a strength not less than that specified as the minimum concrete strength at twenty eight (28) days for the class of concrete concerned. All units shall be clearly marked with a serial number and date of casting.

6. The Contractor shall submit to the Engineer's approval full details of his proposed methods of handling pre-cast concrete works.

7. In-situ and precast concrete for the stair landings shall be cast and/or placed to the following tolerances:

1) Lengths: + 20 mm

2) Cross Section (each direction, width and depth)

Outward + 10 mm