30) Contractor's Right to Claim

If the Contractor incurs cost as a result of any of the events under GCC Clauses 22, 23 and 24 in relation to GCC Clause 20, the Contractor shall be entitled to the amount of such cost. If as a result of any of the said events, it is necessary to change the Works, this shall be dealt with as a Variation.

31) Dayworks

31.1 Subject to GCC Clause 40 on Variation Order, and if applicable as indicated in the SCC, the Contractor shall determine the Dayworks rates to be included or indicated in the Bid. The Dayworks rates in the Contractor's bid shall be used for small additional amounts of work only when the Procuring Entity has given written instructions in advance for additional work to be paid for in that way.

31.2 All work to be paid for as Dayworks shall be recorded by the Contractor on forms approved by the Procuring Entity. Each completed form shall be verified and signed by the Procuring Entity within two (2) days of the work being done.

31.3 The Contractor shall be paid for Dayworks subject to obtaining signed Dayworks forms from both the Procuring Entity and Contractor.

32) Early Warning

32.1 The Contractor shall warn the Procuring Entity at the earliest opportunity of specific likely future events or circumstances that may adversely affect the quality of the work, increase the Contract Price, or delay the execution of the Works.

32.2 The Contractor shall cooperate with the Procuring Entity in making and considering proposals for how the effect of such an event or circumstance can be avoided or reduced by anyone involved in the work and in carrying out any resulting instruction of the Procuring Entity. Should such events or circumstances arise which increase the Contract price or delay the execution of Works, the provisions on variation order shall apply.

33) Program of Work

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

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

33.3 The Contractor shall submit to the Procuring Entity 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 may withhold the amount stated in the SCC from the next payment schedule and continue to withhold this amount until the next payment after the date on which the overdue Program of Work has been submitted.

33.4 The Procuring Entity's approval of the Program of Work shall not alter the Contractor's obligations. A revised Program of Work produced by the Contactor

shall show the effect of any approved Variations, and shall include all Variations. The Contractor may revise the Program of Work, based on the Variation Order, and submit it to the Procuring Entity again.

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

34) Management Conferences

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

34.2 The Procuring Entity shall record the business of Management Conferences and provide copies of the record to those attending the Conference and to the Procuring Entity. The responsibility of the parties for the actions to be taken shall be decided by the Procuring Entity either at the Management Conference or after the Management Conference. The Procuring Entity shall communicate these responsibilities in writing to all who attended the Conference.

35) Bill of Quantities

35.1 The Bill of Quantities shall contain items of work for the construction, installation, testing, commissioning of work, materials, and labor among others, to be done by the Contractor.

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

35.3 If the final quantity of any work item completed differs from the quantity indicated in the Bill of Quantities, and the difference does not exceed twenty-five percent (25%) of the original quantity for that item, the Procuring Entity shall adjust the Contract accordingly.

This shall be allowed only if the total amount of all such changes does not go beyond ten percent (10%) of the total Contract price, subject to applicable laws, rules, and regulations.

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

36) Instructions, Inspections and Audits

36.1 The Procuring Entity shall at all reasonable times during construction of the Works be entitled to examine, inspect, measure and test the materials and workmanship, and to check the progress of the construction.

36.2 If the Procuring Entity instructs the Contractor to carry out a test not specified in the Specification to check whether any work has a defect and the test shows that it does, the Contractor shall pay for the test and any samples. In the

absence of any defect, the test shall be a compensation event with no adverse consequences to the contractor.

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

37) Identifying Defects

The Procuring Entity shall check the Contractor's work and notify the Contractor of any defects that are found. Such checking shall not affect the Contractor's responsibilities. The Procuring Entity may instruct the Contractor to check noted defects and test any work that the Procuring Entity considers as substandard and/or defective.

38) Correction of Defects

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

38.2 Every time notice of a defect is given, the Contractor shall correct the notified defect within ninety (90) calendar days from the time the HoPE has issued an order to undertake repair.

38.3 The Contractor shall correct the defects which they notice themselves before the end of the Defects Liability Period.

38.4 The Procuring Entity shall certify that all defects have been duly corrected.

39) Uncorrected Defects

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

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

40) Variation Orders

40.1 Variation Orders may be issued by the Procuring Entity to cover any increase or decrease in quantities, including the introduction of new work items that are not included in the original contract or reclassification of work items that are either due to change of plans, design or alignment to suit actual field conditions resulting in disparity between the preconstruction plans used for purposes of bidding and the "as staked plans" or construction drawings prepared after a joint survey by the Contractor and the Government after award of the contract.

Provided, That in case of positive or additive Variation Order/s, the cumulative amount thereof shall not exceed ten percent (10%) of the original contract price; Provided, further, That the scope of works shall not be reduced as to

accommodate a positive Variation Order. In all cases, the addition of works under Variation Orders should be within the general scope of the project as bid and awarded.

40.2 Any cumulative positive Variation Order beyond ten percent (10%) of the original contract price shall be the subject of another procurement project to be bid out if the Works are separable from the original contract. In exceptional cases where it is urgently necessary to complete the original scope of work, the HoPE, upon the recommendation of the End-User or Implementing Unit, may authorize positive Variation Order/s resulting to a cumulative value of the positive Variation Orders beyond ten percent (10%) but not more than twenty percent (20%) of the original contract price.

All progress payments shall first be charged against the advance payment until the latter has been fully exhausted, at the option of the Procuring Entity.

40.3 A Variation Order may either be in the form of a Change Order or Extra Work Order:

a) A Change Order may be issued by the HoPE or duly authorized representative to cover any increase or decrease in quantities of original work items in the contract.

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

40.4 For Variation Orders, the Contractor shall be paid for additional work items whose unit prices shall be derived based on the following:

a) For additional or extra works duly covered by Change Orders involving work items which are exactly the same or similar to those in the original contract, the applicable unit prices of work items original contract shall be used.

b) For additional or extra works duly covered by Extra Work Orders involving new work items that are not in the original contract, the unit prices of the new work items shall be based on the direct unit costs used in the original contract (e.g., unit cost of cement, rebars, form lumber, labor rate, equipment rental, etc.). All new components of the new work item shall be fixed prices; Provided, The same is acceptable to both the Government and the Contractor; Provided further, That the direct unit costs of new components shall be based on the Contractor's estimate as validated by the Procuring Entity concerned via documented canvass in accordance with existing rules and regulations. The direct cost of the new work item shall then be combined with the mark-up factor (i.e., taxes and profit) used by the Contractor in its bid to determine the unit price of the new work item.

40.5 Under no circumstances shall a Contractor proceed to commence work under any Change Order or Extra Work Order unless it has been approved by the HoPE or its duly authorized representative. However, under any of the following conditions, the Procuring Entity's representative or Project Engineer may, subject to the availability of funds and within the limits of its delegated authority, allow the immediate start of work under any Change Order or Extra Work Order:

a) In the event of an emergency where the prosecution of the work is urgent to avoid detriment to public service, or damage to life and/or property; and/or

b) When time is of the essence;

Provided,however, That such approval is valid on work done up to the point where the cumulative increase in value of work on the project which has not yet been duly fully approved does not exceed five percent (5%) of the adjusted original contract price.

Provided, further, That immediately after the start of work, the corresponding Change Order or Extra Work Order shall be prepared and submitted for approval in accordance with the abovementioned rules. Payments for Works satisfactorily accomplished on any Change Order or Extra Work Order may be made only after approval of the same by the HoPE or its duly authorized representative.

Provided, finally, That for a Change Order or Extra Work Order involving a cumulative amount exceeding five percent (5%) of the original contract price, no work thereon may be commenced unless said Change Order or Extra Work Order has been approved by the HoPE or its duly authorized representative.

41) Contract Completion

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

42) Suspension of Work

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

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

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

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

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

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

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

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

43) Payment on Termination

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

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

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

43.4 If the Contractor has terminated the Contract under GCC Clauses 23 to 24, the Procuring Entity shall promptly return the Performance Security to the Contractor.

44) Extension of Contract Time

44.1 Should the amount of additional work or other special circumstances warrant the entitlement of the Contractor to an extension of contract time, the Procuring Entity shall determine the amount of such extension; Provided, That the Contractor has notified the Procuring Entity of its claim for extension of contract time prior to the expiration of the contract time, and within thirty (30) calendar days after the additional work has been commenced or the circumstances leading to such claim have arisen, as the case may be, in order to give the Procuring Entity the opportunity to investigate the claim. Failure to provide such notice shall constitute a waiver of such a claim by the Contractor. Upon receipt of full and detailed particulars, the Procuring Entity shall examine the facts and extent of the delay and shall extend the contract time to complete the contract work when, in the Procuring Entity's opinion, the findings of facts justify an extension.

44.2 No extension of contract time shall be granted to the Contractor due to ordinary unfavorable weather conditions and inexcusable negligence of the Contractor to provide the required equipment, supplies, or materials.

44.3 Extension of contract time may be granted only when the affected activities fall within the critical path of the PERT, CPM, Precedence Diagram Method or any other project management tool.

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

44.5 Extension of contract time may be granted in the cases indicated in the **SCC.**

44.6 The written consent of the bank, or surety or insurance company, as the case may be, must be attached to any request of the Contractor for extension of contract time and submitted to the Procuring Entity for consideration and the validity of the Performance Security shall be correspondingly extended.

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

44.8 The Procuring Entity shall decide whether and by how much to extend the Intended Completion Date within twenty (20) days of the Contractor asking the Procuring Entity for a decision thereto after fully submitting all supporting information. If the Contractor has failed to give early warning of a delay or has failed to cooperate in dealing with a delay, the delay by this failure shall not be considered in assessing the new Intended Completion Date.

45) Price Escalation

In the event of an extraordinary increase in prices of specific components of the Infrastructure Project, price escalation may be considered, subject to prior approval of

the GPPB. If the cost of construction components increases by more than ten percent (10%) of the unit price of work items, as determined against the prevailing price indices of the PSA, a price escalation may be authorized at a no-loss, no-gain basis, using the appropriate formula prescribed by the GPPB. For the purpose of this Section, the PSA shall ensure that its price indices are region-specific and updated on a monthly basis

46) Completion

The Contractor shall request the Procuring Entity to issue a Certificate of Completion of the Works, and the Procuring Entity will do so upon determining that the work is completed.

47) Taking Over

The Procuring Entity shall take over the Site and the Works within seven (7) days from the date of issuance of a Certificate of Completion; Provided, That it shall not release the Contractor of its responsibilities within the defects liability period.

48) Operating and Maintenance Manuals

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

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

SECTION V

SPECIAL CONDITIONS OF CONTRACT

Special Conditions of Contract

GCC Clause	
1.1	The **Intended Completion Date** is based on the project duration of **720** calendar days. *NOTE: The contract duration shall be reckoned from the start date and not from contract effectivity date.*
1.2	The **Procuring Entity** is: **PHILIPPINE PORTS AUTHORITY** PPA Corporate Bldg., Bonifacio Drive, South Harbor, Port Area, Manila, Philippines 1018
1.3	The **Site** is located at ***Port of Catbalogan, Catbalogan, Samar*** and is defined in drawings.
1.4	The **Start Date** is _____. *NOTE: The start date shall be the date of receipt of the Notice to Proceed.*
1.5	The **Works** consist of the following: **A. Port Operational Area with 2-Units Roro Ramp on Fill** **B. Pumphouse with Domestic Water Tank and Rainwater Tank** **C. Powerhouse** **D. Construction of Gate Complex 1 and 2**
2.2	*Sectional Completion:* **None**
5.1	The **Philippine Ports Authority** shall give possession of all parts of the Site to the Contractor upon commencement of the project until the date of its termination and/or issuance of Certificate of Final Acceptance by the Philippine Ports Authority.
6.5	The Contractor shall employ the following **Key Personnel:** ***Please refer to BDS ITB clause no .12.1(h)(ll)***
7.1	No further instructions.
8.1	Not applicable.

9.1	No further instructions.
9.4	The first progress payment may be paid by the Procuring Entity to the Contractor; Provided, that at least *20%* of the Works has been physically accomplished as certified by the Procuring Entity.
12.7	No further instructions.
13.1	Site Investigation Report: **None**
15.3	No further instructions.
15.5	*In case of permanent structures, such as buildings of types 4 and 5 as classified under the National Building Code of the Philippines and other structures made of steel, iron, or concrete which comply with relevant structural codes (e.g., DPWH Standard Specifications), such as, but not limited to, steel/concrete bridges, flyovers, aircraft movement areas, ports, dams, tunnels, filtration and treatment plants, sewerage systems, power plants, transmission and communication towers, railway system, and other similar permanent structures:* Fifteen (15) years.
19.2	The Arbitrator is the person appointed jointly by the Procuring Entity and the Contractor: **None**
20	All partners to the joint venture shall be jointly and severally liable to the Procuring Entity.
25(a)	No further instructions.
27.2	a) Failure of the Contractor, due solely to its fault or negligence, to mobilize and start work or performance within the specified period in the Notice to Proceed ("NTP"); b) Failure by the Contractor to fully and faithfully comply with its contractual obligations without valid cause, or failure by the Contractor to comply with any written lawful instruction of the Procuring Entity or its representative(s) pursuant to the implementation of the contract. For the procurement of infrastructure projects or consultancy contracts, lawful instructions include but are not limited *to* the following: i) Employment of competent technical personnel, competent engineers and/or work supervisors; ii) Provision of warning signs and barricades in accordance with approved plans and specifications and contract provisions; iii) Stockpiling in proper places of all materials and removal from the project site of waste and excess materials, including broken pavement and excavated debris in accordance with approved plans and specifications and contract provisions; iv) Deployment of committed equipment, facilities, support

	staff and manpower; and v) Renewal of the effectivity dates of the performance security after its expiration during the course of contract implementation. c) Assignment and subcontracting of the contract or any part thereof or substitution of key personnel named in the proposal without prior written approval by the Procuring Entity. d) Poor performance by the Contractor or unsatisfactory quality and/or progress of work arising from its fault or negligence as reflected in the CPES rating sheet. In the absence of the CPES rating sheet, the existing performance monitoring system of the Procuring Entity shall be applied. Any of the following acts by the Contractor shall be construed as poor performance: i) Negative slippage of fifteen (15%) and above within the critical path of the project due entirely to the fault or negligence of the Contractor; and ii) Quality of materials and workmanship not complying with the approved specifications arising from the Contractor's fault or negligence. e) Willful or deliberate abandonment or non-performance of the project or contract by the Contractor resulting to substantial breach thereof without lawful and/or just cause. In addition to the penalty of suspension, the performance security posted by the Contractor shall also be forfeited.]
31.1	No dayworks are applicable to the contract.
33.1	The Contractor shall submit the Program of Work to the Procuring Entity within ____ days of delivery of the Notice of Award.
33.3	The period between Program of Work updates is ____ days. The amount to be withheld for late submission of an updated Program of Work is _____.
36.3	The Funding Source is the ***PPA Corporate Fund.***
43.1	The percentage to apply to the value of the work not completed is ____.
44.5	Extension of Contract Time may be granted in the following cases: a) rainy/unworkable days considered unfavorable for the prosecution of the Works at the site, based on the actual conditions obtained at the site, in excess of the number of rainy/unworkable days pre-determined by the Procuring Entity in relation to the original contract time during the conduct of detailed engineering and in the preparation of the contract documents as agreed upon by the parties before contract perfection, and/or

	b) major calamities such as exceptionally destructive typhoons, floods and earthquakes, and epidemics, c) delays attributable to the Procuring Entity, such as non-delivery on time of materials, working drawings, or written information to be furnished by the Procuring Entity, non-acquisition of permit to enter private properties or non-execution of deed of sale or donation within the right-of-way resulting in complete paralyzation of construction activities, and d) other meritorious causes as determined by the Procuring Entity and approved by the HoPE such as shortage of construction materials, general labor strikes, and peace and order problems that disrupt construction operations through no fault of the Contractor may be considered as additional grounds for extension of contract time provided they are publicly felt and certified by appropriate government agencies such as DTI, DOLE, DILG, and DND, among others.
48.1	The date by which operating and maintenance manuals are required is _____. The date by which "as built" drawings are required is _____.
48.2	The amount to be withheld for failing to produce "as built" drawings and/or operating and maintenance manuals by the date required is _____.

SECTION VI

TECHNICAL SPECIFICATIONS

SECTION VI – SPECIFICATIONS

TABLE OF CONTENTS

PAGE

ITEM 1: EXCAVATION WORKS

1. Scope of Work 1
2. Execution 2

ITEM 2: PILING WORKS (STEEL SHEET PILES)

1. Scope of Work 4
2. Material Requirements 4
3. Execution 14

ITEM 3: ROCKWORKS

1. Scope of Work 18
2. Material Requirements 18
3. Execution 18

ITEM 4: GEOTEXTILE FABRIC

1. Scope of Work 20
2. Material Requirements 20
3. Execution 21

ITEM 5: RECLAMATION AND FILL

1. Scope of Work 22
2. Material Requirements 22
3. Execution 24

ITEM 6: SUBGRADE PREPARATION

1. Description 27
2. Material Requirements 27
3. Construction Requirements 27

ITEM 7: AGGREGATE SUB-BASE COURSE

1. Description 29
2. Material Requirements 29
3. Construction Requirements 29
4. Method of Measurement 31

ITEM 8: AGGREGATE BASE COURSE

1. Description 32
2. Material Requirements 32
3. Construction Requirements 33
4. Method of Measurements 35

ITEM 9: AGGREGATE SURFACE COURSE

1. Description 36
2. Material Requirements 36
3. Construction Requirements 37
4. Method of Measurements 38

ITEM 10: DRAINAGE WORKS

1. Scope of Work 39
2. Material Requirements 39
3. Execution 40

ITEM 11: PORTLAND CEMENT CONCRETE PAVEMENT

1. Scope of Work 42
2. Material Requirements 42
3. Execution 43

ITEM 12: PILING WORKS (PRE-STRESSED CONCRETE PILES)

1. Scope of Work 48
2. Material Requirements 48
3. Execution 49

ITEM 13: REINFORCED CONCRETE

1. Scope of Work 53
2. General Provisions... 53
3. Material Requirements 59
4. Execution 65

ITEM 14: SECURITY FENCE

1. Description 77
2. Material Requirements 77
3. Construction Requirements 78

ITEM 15: CONSTRUCTION JOINTS

1. Scope of Work 80
2. Material Requirements 80
3. Execution 80

ITEM 16: STEEL AND METAL WORKS

1. Scope of Work 81
2. Material Requirements 81
3. Execution 82

ITEM 17: ZINC (HOT-DIPPED GALVANIZED)

1. Scope of Work 91
2. Material Requirements 91
3. Execution 91

ITEM 18: MOORING AND FENDER SYSTEM

1. Scope of Work 97
2. Material Requirements 97
3. Execution 101

ITEM 19: MASONRY

1. Scope of Work 102
2. Material Requirements 102
3. Execution 103

ITEM 20: ARCHITECTURAL

A. Finishes 106
B. Roofing and Tinsmithry 115
C. ACP 117
D. Railings 121
E. Modulars, Tables, and Chairs 125
F. Concrete Water Proofing 127
G. Painting 129
H. Persons with Disability 137
I. Termite & Bukbok Proofing 138
J. Signages and Logo 141
K. Carpentry and Joinery Works 142

ITEM 21: PLUMBING AND SANITARY WORKS

1. Scope of Work 146
2. Material Requirements 146
3. Execution 150

ITEM 22: WATER PUMPS AND PRESSURE TANKS

1. Scope of Work 156
2. Material Requirements 156
3. Execution 156

ITEM 23: PORT LIGHTING SYSTEM

1. Scope of Work 157
2. General Requirements 157
3. Material Requirements 158
4. Execution 160

ITEM 24: ELECTRICAL WORKS

1. General Description 161
2. Submittals 161
3. Material Requirement 165
4. Execution 168

ITEM 25: GROUNDING SYSTEM AND LIGHTNING PROTECTION

1. General 175
2. Material Requirement 176
3. Execution 177

ITEM 26: FIRE DETECTION AND ALARM SYSTEM

1. General 179
2. Material Requirement 182
3. Execution 187

ITEM 27: WIRE COMMUNICATION AND SIGNAL SYSTEM

1. General 190
2. Description of Works 190
3. Execution 191

ITEM 28: MECHANICAL GENERAL REQUIREMENT

1. General 193

ITEM 29: UNITARY AIR-CONDITIONING SYSTEMS

1. General 199
2. Material Requirements 200
3. Execution 202

ITEM 30: EXHAUST EQUIPMENT

1. General 205
2. Products (General Description) 205
3. Execution 205

ITEM 31: DISTRIBUTION TRANSFORMER

1. Scope of work 206
2. General Requirements 206
3. Products (General Description) 207
4. Execution 208

ITEM 32: PROJECT BILLBOARD

1. Specification 209
2. Standard Project Billboard 210
3. Billboard Frame 211

ITEM 33: SAFETY SIGNAGES AND BARRICADES

1. Description 212
2. Specification 212

ITEM 34: FIELD OFFICE DRAWINGS

1. Architectural A01-14
2. Structural S01-11
3. Electrical E01-18
4. Plumbing P01-09

ITEM 01 : EXCAVATION WORKS

SCOPE OF WORK

General Provisions

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

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

Work Schedules

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

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

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

EQUIPMENT/LAYOUT OF WORK

Plant

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

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

Physical Data/Layout of Work

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

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

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

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

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

EXECUTION

EXCAVATION WORKS

Description

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

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

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

Progress of Work

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

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

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

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

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

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

EXCAVATED MATERIALS

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

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

Displace Materials

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

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

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

INSPECTION

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

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

PAY LIMITS

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

SOUNDINGS

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

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

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

ITEM 02 : PILING WORKS (STEEL SHEET PILE)

SCOPE OF WORK

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

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

METHOD STATEMENT

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

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

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

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

MATERIAL REQUIREMENTS

STEEL SHEET PILES

Steel sheet piles required under this heading shall be in accordance to the required steel grade and sheet pile type (cross section) specified on the plans. Effective height and width of the combined pile cross section shall be the minimum and maximum respectively. The section modulus of sheet pile per meter of wall shall not be less than the required as computed and indicated in the plans.

Steel sheet piles shall be of the type indicated on the drawings with continuous interlock.

Equivalent sheet pile system that equates or exceeded the required capacity may be used subject for approval, verifications and conditions of Engineering Office thru Design Department without additional cost to PPA.

All steel sheet piles shall conform to ASTM A 328 or approved equivalent.

CONCRETE AND DOWEL BARS

Dowel bars shall be as indicated on the plans and the coping wall shall be in accordance with the Section "Reinforced Concrete" where the compressive strength at 28 days shall be 24 mpa (3,500 psi).

TIE - RODS, WAILING and FITTINGS

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

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

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

PROTECTIVE COATING

GENERAL

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

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

Definition of Terms

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

CODES, STANDARDS AND TEST METHODS

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

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

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

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

WORKMANSHIP

Application

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

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

Quality Assurance

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

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

Non Conformances

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

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

Work Method

Where possible, surface preparation and coating application shall be performed when all fabrication, including attachment of secondary steelwork and brackets, is complete. Where this is not possible,

work method and inspection must ensure all exposed surfaces are treated in accordance with this specification.

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

- Stainless steel
- Machined surfaces
- Gauge faces

Access to the Work Surfaces

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

Protection of Environment

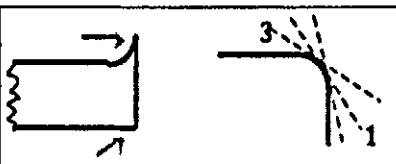
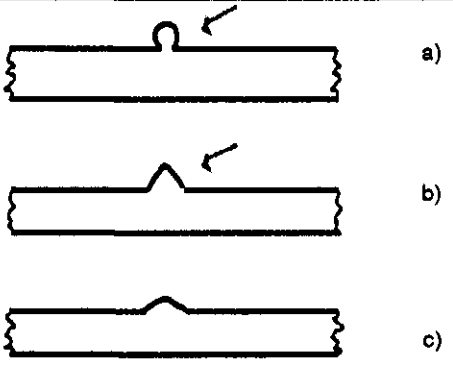
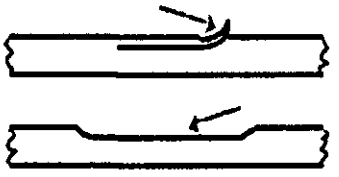
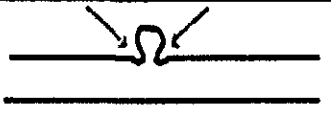
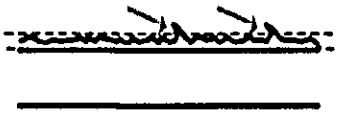
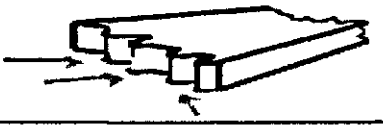
All work carried out under this specification shall be performed in accordance with local legislative and site specific requirements. Care shall be taken to eliminate impact on adjacent work areas from noise, dust, overspray and other activities. Paint, thinners, rags, empty paint cans and other refuge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

SURFACE PREPARATION

General

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

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

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

Abrasive Blast Cleaning

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

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

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

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

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

The type and size of abrasive, the equipment and the procedure adopted shall be chosen to ensure the required degree of cleanliness and surface profile is achieved. The blasting medium shall be free of organic material and shall have a chloride salt content not greater than 50 ppm. The compressed air supply used for blasting shall be completely free of water and oil. The design of the compressed air system shall incorporate the appropriate number of serviceable in-line separators and traps which shall be cleaned and drained on a regular basis.

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

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

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

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

Power Tool Cleaning (for small areas/ repair only)

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

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

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

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

Care of Prepared Surfaces

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

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

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

APPLICATION OF COATINGS

General

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

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

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

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

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

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

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

Materials

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

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

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

All external edges shall be stripe coated (either spray or brush) prior to spray application of the full coat. All welds, crevices, holes, corners, and other difficult access areas shall be stripe coated by brush painted prior to spray application of the full coat. All nuts and bolts which have been specified to be painted, or which the Company Representative has instructed to be painted, shall be brush painted prior to spray application of the full coat. This process shall be repeated where necessary to ensure the correct film thickness is achieved over these areas.

Brush and Roller Application

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

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

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

Measurement of Film Thickness

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

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

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

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

Multiple Coat Applications

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

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

Transport and Handling

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

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

Rectification and Touch-up Painting

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

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

INSPECTION AND TESTING

Initial Inspection

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

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

Contractor Inspection

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

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

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

Inspection by Company Representative

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

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

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

Test Methods

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

Compressed Air Quality

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

Surface Profile

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

Salt Contamination Test (Surface)

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

Dust Assessment Test

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

Wet Film Thickness

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

Dry Film Thickness

Dry film thickness shall be tested following application of each coat within the system, and following application of the final coat. Dry film thickness shall be measured in accordance with ISO 2808. An electronic gauge (Elcometer 345 or similar) shall be used. Calibration of the gauge shall be performed weekly or as required using certified calibration plates. Refer Section 8.6 for acceptance criteria details.

Continuity "Holiday" Testing

Steelwork shall be fully tested for holidays and pinholes. Since thickness is more than 500 microns, High Voltage (Spark) Holiday Test based on NACE SP0188-2006 Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates shall be used.

PROTECTIVE COATING SYSTEMS

	Product Name	Coat Type	Site OR Shop	Application Method	VS %	WFT micron	DFT micron	TSR*1 m2/l	Overcoating Interval at 25C Min - Max	Pot Life at 25C	Thinner
1	Interzone 954 Subsea, Abrasion Resistant and Splash Zone -Modified Epoxy	Full Coat	Shop/ site	Airless Spray, Brush, Roller	85	471	400	1.7	5.5 Hr - 7 D	45 Mir	GTA220
2	Interzone 954 Subsea, Abrasion Resistant and Splash Zone -Modified Epoxy	Full Coat	Shop/ site	Airless Spray, Brush, Roller	85	471	400	1.7	5.5 Hr - 7 D	45 Mir	GTA220
							800				

TSR*1 – Theoretical Spreading Rate.

WELDING REQUIREMENTS

Welding works shall be in accordance to AWSD9.1.

EXECUTION

MARKING

The pile shall be marked on with durable paint indicating:

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

DOCUMENTS TO BE SUBMITTED

1. Steel Pipe manufacturing plan (Steel pipe production plan, welding method, welding material, production location, production method, transportation, etc.)
2. Design plan
3. Manufacturing process
4. Shipment method and stacking plan
5. Steel pipe inspection certificate
6. Size inspection record
7. Radiographic Test record

STEEL SHEET PILES

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

TIE-RODS, ANCHORAGE, WAILING AND FITTINGS

The tie-rod assembly shall be horizontally aligned to the required degrees, unbending and tight all throughout its length thru the anchorage.

Placed adequate filling materials/rocks/false-work behind the anchorage system to counter the forces applied during back-filling works.

The required spacing of tie-rod are maximum while the required lengths are minimum.

Embedment of tie-rod shall not be less than 1.50m.

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

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

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

REINFORCED CONCRETE

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

STORAGE AND HANDLING

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

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

DRIVING OF PILES

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

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

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

BEARING POWER OF PILES

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

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

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

W = weight of ram (tf)

H = fall of ram (cm)

S = set (cm)

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

DRIVING RECORDS

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

The records shall contain the following information:

1. Pile reference number

2. Pile type and Steel Grade

3. Pile Length

4. Commencing surface level and final toe level

5. Depth driven, time, date when piles were driven

6. Where required the number of blows to drive each 250 mm over the last 2.5 meter shall be recorded

7. Comments regarding unusual/unexpected driving conditions

INTERRUPTED DRIVING

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

DAMAGED AND MISDRIVEN PILES

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.

The method to be adopted shall be at the discretion of the Engineer and approved by the Authority.

ITEM 03 : ROCKWORKS

SCOPE OF WORK

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

SETTING OUT OF WORKS

1. Topographic/Hydrographic Survey

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

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

MATERIAL REQUIREMENTS

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

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

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

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

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

Apparent specific gravity	ASTM C 127
Abrasion	ASTM C 535

EXECUTION

QUARRY SITE AND ROCK QUANTITY

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

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

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

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

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

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

STORAGE OF MATERIALS

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

SAMPLING TEST

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

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

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

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

CROSS-SECTIONS OF COMPLETED ROCKWORK

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

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

ITEM 04 : GEOTEXTILE FABRIC

SCOPE OF WORK

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

MATERIAL REQUIREMENTS

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

1. PHYSICAL PROPERTIES

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

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

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

2. MECHANICAL AND HYDRAULIC PROPERTIES

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

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

EXECUTION

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

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

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

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

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

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

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

ITEM 05 : RECLAMATION AND FILL

SCOPE OF WORK

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

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

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

The following major items of works are included:

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

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

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

MATERIAL REQUIREMENTS

1. Filling Materials

    a. General

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

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

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

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

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

    b. Fill Materials other than Dredged/Excavated Materials

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

c. Type of Fill Materials

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

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

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

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

c.3 Select Materials (General Embankment)

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

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

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

ii. Maximum particles size shall not exceed 75 mm.

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

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

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

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

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

(b) Organic soils such as peat and muck.

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

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

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

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

will not be accepted by the Engineer.

EXECUTION

Reclamation and Fill

a. General

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

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

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

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

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

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

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

TRIAL SECTION

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

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

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

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

CROSS-SECTIONS OF COMPLETED RECLAMATION

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

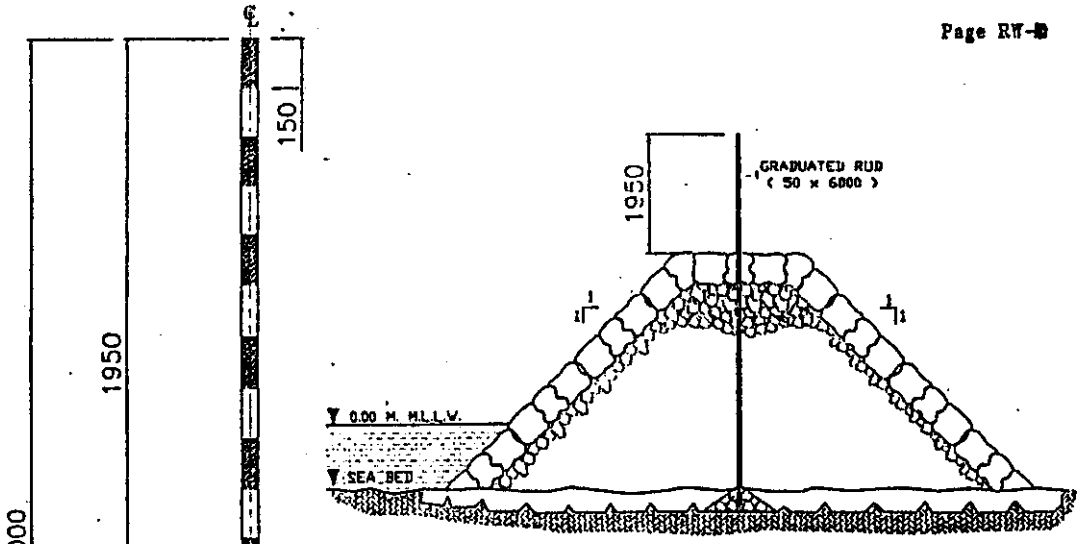
FIELD COMPACTION TEST

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

TOLERANCE

Elevation : plus 5 cm.

Page RW-



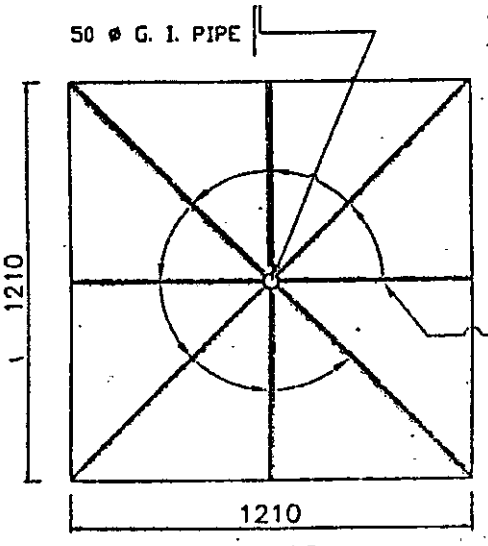
TYPICAL DETAIL OF INSTALLATION
NOT TO SCALE

ELEVATION
SCALE 1:20

NOTES : -

1) ALL JOINTS SHALL BE FILLET WELDED ALL AROUND.

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



PLAN
SCALE 1:20

DETAILS OF STANDARD GRADUATED SETTLEMENT ROD

ITEM 06 : SUBGRADE PREPARATION

DESCRIPTION

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

MATERIAL REQUIREMENTS

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

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

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

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

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

   (b) Organic soils such as peat and muck.

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

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

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

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

CONSTRUCTION REQUIREMENTS

PRIOR WORKS

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

SUBGRADE LEVEL TOLERANCE

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

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

SUBGRADE IN COMMON EXCAVATION

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

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

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

SUBGRADE ON EMBANKMENT

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

PROTECTION OF COMPLETED WORK

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

ITEM 07 : AGGREGATE SUB BASE COURSE

DESCRIPTION

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

MATERIAL REQUIREMENTS

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

The subbase material shall conform to the following Grading Requirements

Grading Requirements

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

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

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

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

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

CONSTRUCTION REQUIREMENTS

PLACING

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

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

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

SPREADING AND COMPACTING

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

Where the required thickness is 150mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate base shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of sub-base material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the base material shall be compacted thoroughly with approved tampers or compactors.

If the layer of base material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a **field density of at least 100 percent** of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191/ASTM D 1556.

TRIAL SECTION

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

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

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

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

SURVEYS AND SETTING OUT WORKS

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

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

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

TOLERANCES

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

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

METHOD OF MEASUREMENT

Aggregate Subbase Course will be measured by the cubic meter (m3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed course. No allowance will be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of subbase herein measured.

ITEM 08 : AGGREGATE BASE COURSE

DESCRIPTION

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

MATERIAL REQUIREMENTS

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

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

The base course material shall conform to the following Grading Requirements

Grading Requirements

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

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

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 25 and plasticity index not greater than 6 as determined by AASHTO T 89 and T 90, respectively.

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

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

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

CONSTRUCTION REQUIREMENTS

PLACING

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

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow.

The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

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

SPREADING AND COMPACTING

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

Where the required thickness is 150mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate base shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of sub-base material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the base material shall be compacted thoroughly with approved tampers or compactors.
If the layer of base material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a **field density of at least 100 percent** of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191/ASTM D 1556.

TRIAL SECTION

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

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

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

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

SURVEYS AND SETTING OUT WORKS

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

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

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

TOLERANCES

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

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

METHOD OF MEASUREMENT

Aggregate Base Course will be measured by the cubic meter (m3). The quantity to be paid for shall be the design volume compacted in-place as shown on the Plans, and accepted in the completed base course. No allowance shall be given for materials placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantity of aggregate base course.

ITEM 09 : AGGREGATE SURFACE COURSE

DESCRIPTION

This item shall consist of a wearing or top course composed of gravel or crushed aggregate and binder material, whichever is called for in the Bill of Quantities, constructed on a prepared base in accordance with this Specification and in conformity with the lines, grades and typical cross-sections shown on the Plans.

MATERIAL REQUIREMENTS

The aggregate shall consist of hard, durable particles or fragments of stone or gravel and sand or other fine mineral particles free from vegetable matter and lumps or balls of clay and of such nature that it can be compacted readily to form a firm, stable layer. It shall conform to the grading requirements shown in table 300.1 when tested by AASHTO T 11 and T 27.

The surface course material shall conform to the following Grading Requirements

Grading Requirements

Sieve Designation		Mass Percent Passing			
Standard Mm	Alternate U. S. Standard	Grading A	Grading B	Grading C	Grading D
25	1"	100	100	100	100
9.5	3/8	50-85	60-100	-	-
4.75	No.4	35-65	50-85	55-100	70-100
2.00	No. 10	25-50	40-70	40-100	55-100
0.425	No.40	15-30	25-45	20-50	30-70
0.075	No. 200	5-20	5-20	6-20	8-25

The coarse aggregate material retained on the 2.00 mm (No.10) sieve shall have a mass percent of wear by the Los Angeles Test (AASHTO T 96) of not more than 45.

When crushed aggregate is called for in the Bill of Quantities, not less than fifty (50) mass percent of the particles retained on the 4.75 mm (No. 4) sieve shall have at least one (1) fractured face.

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

The fraction passing the 0.425 mm (No. 40) sieve shall have a liquid limit not greater than 35 and a plasticity index range of 4 to 9, when tested by AASHTO T 89 and T 90, respectively.

Materials for gravel surface course and crushed aggregate surface course shall have a **soaked CBR Value of not less than 25% and 80%** respectively as determined by AASHTO T 193. The CBR Value shall be obtained at the maximum dry density and determined by AASHTO T 180, Method D.

CONSTRUCTION REQUIREMENTS

PLACING

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

The placing of material shall begin at the point designated by the Engineer. Placing shall be from vehicles especially equipped to distribute the material in a continuous uniform layer or windrow.

The layer or windrow shall be of such size that when spread and compacted the finished layer be in reasonably close conformity to the nominal thickness shown on the Plans.

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

SPREADING AND COMPACTING

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

Where the required thickness is 150mm or less, the material may be spread and compacted in one layer. Where the required thickness is more than 150 mm, the aggregate base shall be spread and compacted in two or more layers of approximately equal thickness, and the maximum compacted thickness of any layer shall not exceed 150 mm. All subsequent layers shall be spread and compacted in a similar manner.

The moisture content of sub-base material shall, if necessary, be adjusted prior to compaction by watering with approved sprinklers mounted on trucks or by drying out, as required in order to obtain the required compaction.

Immediately following final spreading and smoothening, each layer shall be compacted to the full width by means of approved compaction equipment. Rolling shall progress gradually from the sides to the center, parallel to the centerline of the road and shall continue until the whole surface has been rolled. Any irregularities or depressions that develop shall be corrected by loosening the material at these places and adding or removing material until surface is smooth and uniform. Along curbs, headers, and walls, and at all places not accessible to the roller, the base material shall be compacted thoroughly with approved tampers or compactors.
If the layer of base material, or part thereof, does not conform to the required finish, the Contractor shall, at his own expense, make the necessary corrections.

Compaction of each layer shall continue until a **field density of at least 100 percent** of the maximum dry density determined in accordance with AASHTO T 180, Method D has been achieved. In-place density determination shall be made in accordance with AASHTO T 191/ASTM D 1556.

TRIAL SECTION

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

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

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

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

SURVEYS AND SETTING OUT WORKS

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

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

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

TOLERANCES

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

Permitted variation from design THICKNESS OF LAYER	+ 15 mm - 5 mm
Permitted variation from design LEVEL OF SURFACE	+ 15 mm - 5 mm
Permitted SURFACE IRREGULARITY Measured by 3-m straight-edge	5 mm
Permitted variation from design CROSSFALL OR CAMBER	± 0.2%
Permitted variation from design LONGITUDINAL GRADE over 25 m in length	± 0.1%

METHOD OF MEASUREMENT

Aggregate surface course shall be measured by the cubic meter (m3). The quantity to be paid for shall be the number of cubic meters of aggregate including all filler, placed, compacted and accepted in the completed course. No allowance will be given for material placed outside the design limits shown on the cross-sections. Trial sections shall not be measured separately but shall be included in the quantities as measured above.

ITEM 10 : DRAINAGE WORKS

SCOPE OF WORK

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

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

MATERIAL REQUIREMENTS

BACK FILL

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

GRAVEL BEDDING

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

SAND BEDDING

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

CONCRETE

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

CEMENT MORTAR

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

REINFORCED CONCRETE PIPE

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

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

STEEL GRATING

All materials shall be compliant with ASTM A36 or equivalent and Hot Dip Galvanizing shall be in accordance with ASTM A123 with minimum average coating of 610gms/sq.m.

The gratings shall be fusion welded type and non-manually fabricated with loading capacity equivalent to HS20-44. Loads and deflection shall be in accordance with AS3990 and the fabrication shall be covered by the requirements of AWS D1.1.

EXECUTION

EARTHWORKS

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

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

PIPE LAYING

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

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

LATERAL DRAIN

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

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

CATCH BASIN INLETS, MANHOLES AND OUTLETS

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

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

FIELD DENSITY TEST

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

CLEARING AND DISPOSAL

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

ITEM 11 : PORTLAND CEMENT CONCRETE PAVEMENT

SCOPE OF WORK

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

MATERIAL REQUIREMENTS

Cement

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

Fine Aggregate

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

Coarse Aggregate

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

Water

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

Admixture

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

TIE BARS AND SLIP BARS

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

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

Joint Filler

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

EXECUTION

Concrete Class

The concrete for pavement shall satisfy the following requirements:

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

Proportioning, Consistency and Mixing of Concrete

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

Preparation

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

Formwork Construction

Formwork shall comply with the requirements of the Section "Reinforced Concrete". Forms shall be of steel, of an approved section and shall be straight and of a depth equal to thickness of the pavement at the edge. The base of the forms shall be of sufficient width to provide necessary stability in all directions. The flange braces must extend outward on the base not less than 2/3 the height of the form.

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

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

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

Joints

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

Longitudinal and Transverse Contact Joints:

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

Placing Concrete

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

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

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

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

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

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

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

Whenever the placing of the concrete is stopped or suspended for any reason, for a period of 30 minutes or longer, a suitable bulkhead shall be placed so as to produce a vertical transverse joint. If an emergency stop occurs within 2.5 meters of the contraction or an expansion joint the concrete shall be removed back to the joint. When the placing of the concrete is resumed, the bulkhead shall be removed and a new concrete placed and vibrated evenly and solidly against the face of previously deposited concrete. Any concrete

in excess of the amount needed to complete a given section or that has been deposited outside the forms shall not be used in the work.

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

Finishing Concrete

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

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

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

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

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

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

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

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

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

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

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

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

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

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

Striking Forms

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

Curing Concrete

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

Cleaning and Sealing Joints

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

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

Opening to Traffic

The pavement shall be closed to traffic, including the vehicles of the Contractor, for a period of 10 days after the concrete is placed or longer if in the opinion of the Engineer, the weather conditions make it necessary to extend this time. The Contractor shall furnish, place and maintain satisfactory barricades and lights as directed, to exclude all traffic from the pavement.

Any damage to the pavement due to traffic shall be repaired or replaced at the expense of the Contractor. Paving mixers, mechanical concrete spreaders and finishers and other heavy paving equipment shall not be operated on completed concrete lanes in order to construct alternate lanes until after the regular curing period is completed. Even then, planks shall be laid on the finished pavement or other precautions taken to prevent damage to the concrete pavement.

Pavement Smoothness, Thickness and Tolerance

Portland cement concrete pavement shall be constructed to the designed level and transverse slope shown on the Drawing. The allowable tolerance shall be as listed hereunder:

1.	Permitted variation from design thickness of layer	+ - 5mm
2.	Permitted variation from design level of surface	+ - 5mm

The thickness of the pavement will be determined by measurement of cores from the completed pavement in accordance with AASHTO T 148.

The completed pavement shall be accepted on a lot basis. A lot shall be considered as 2,500 sq.m of pavement. The last unit in each slab constitutes a lot in itself when its length is at least ½ of the normal lot length. If the length of the last unit is shorter than ½ of the normal lot length, it shall be included in the previous lot.

Other areas such as intersections, entrances, crossovers, ramp, etc., will be grouped together to form a lot. Small irregular areas may be included with other unit areas to form a lot.

ITEM 12 : PILING WORKS (PRE-STRESSED CONCRETE PILES)

SCOPE OF WORK

This section covers the minimum requirements for the fabrication, hauling, spotting, driving and finishing of all foundation piles to be used in wharves/piers/platforms/pile anchor.

The Contractor may however, adopt, in addition to this minimum requirements additional provisions as may be necessary to insure the successful prosecution of the work related to foundation piling.

METHOD STATEMENT

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

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

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

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

MATERIAL REQUIREMENTS

TYPE OF FOUNDATION PILES

Pre-stressed concrete foundation piles to be used shall be in accordance with the design as shown on the Drawings and called for in the proposal.

PRE-STRESSED CONCRETE PILES

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

1. Pre-stressed concrete piles shall be of readymade products of approved fabricator regularly engaged in the production of pre-stressed concrete piles.

2. If an alternative system of pre-stressing 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.

3. Concrete strength, high tension wires/strands, reinforcing bars to be used for pre-stressed concrete work shall be as specified in the Drawings.

4. The Contractor shall submit the casting method including pre-stressing, application of stress and casting schedule and shall obtain the approval of the Engineer before commencement of fabrication of the piles.

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

6. 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 pile butt must be formed truly square to the axis of the pile. Provision for standard splicing shall be provided unless otherwise ordered by the Engineer.

7. 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 pre-stressing system in use.

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

9. 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. Pre-cast pre-stressed units shall be lifted only by lifting holes/hook as indicated in the Drawings, 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.

11. Each pre-stressed member is to be uniquely and permanently marked to show its type, date of casting, length of pile and any control markings as ordered by the Engineer

12. Forms shall conform to the geometry of the pile with the provision of chamfer as shown on the Drawings.

13. Not less than five (5) cylindrical specimens shall be made for each casting batch of which at least two (2) shall be reserved for 28-day test, one (1) for 7-day, one (1) for 14-day, and one (1) test prior to lifting of pre-stressed concrete piles from the casting bed. Lifting of piles shall only be done if the result of the compressive strength has reached at least 60% of the specified compressive strength.

14. Wires/strands specifications shall be in accordance with ASTM A 416.

EXECUTION

HANDLING OF PILES

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

DRIVING OF PILES

A hydraulic or diesel pile hammer shall be used for driving the pre-stressed concrete piles.

The required weight of ram for the hydraulic or diesel pile hammer, ranges from 3.5 to 4.5 tons.

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.

PILE SPLICING

General Provision

1. The alignment of piles shall be plumb and the length of upper and lower segment shall be in accordance in the approved plans.

2. The splice shall be embedded at least 4m from the design depth elevation.

Surface Preparation

Concrete piles to be bonded must be thoroughly cleaned, free of dirt, paint, grease, oil, curing compound and other contaminants. The concrete surface must be dry. Clean the dowels with steel brush to removed rust and other impurities. Blow compressed air to the dowel holes.

Pile Splicing Epoxy

Piling splicing epoxy is a two components, low viscosity, rapid cure, chemical resistant epoxy with high physical strength.

Preparation and Application of Epoxy Mortar

Mixing and ratio of pile splicing epoxy and dry silica sand, application and curing of epoxy mortar shall refer to product manual.

Compressive Strength

The compressive strength of epoxy mortar (Pile Splicing Epoxy + Dry Silica Sand) shall be at least 1.2 times the design compressive strength of pile or 6,000psi.

Mechanical Properties of Epoxy

Cured state at 27° C (80° F) for 24 hours

Mechanical Properties	**Specification (Test Methods)**
Ultimate Tensile Strength	ASTM D 638
Ultimate Flexural Strength	ASTM D 790
Hardness	ASTM D 2240
Compressive Strength at 1 hour cure	ASTM D 695
Compressive Strength with Silica Sand	**ASTM D 695**

PILE CHIPPING

Each pile shall be chipped-off to required elevation as indicated in the drawing. The contractor shall ensure that no damaged/cracked on the main pile will occurred after each chipping. Reinforcement from driven piles (dowels and strand) shall not be cut and will be incorporated to the construction of deck. Splicing of dowels are allowed in case of pile cutting due to early refusal.

BEARING POWER OF PILES

Each pile shall be driven to achieve not less than the required minimum bearing power indicated in the pile schedule. The allowable bearing capacity shall be determined using Hiley's Formula, as follows:

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

For Hydraulic Pile Hammer : $R = \frac{1}{3} \times \frac{2WH}{S + 2.54}$

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

W = weight of ram (tf)

H = fall of ram (cm)

S = set (cm)

Other Hammer Types

The utilization of other pile hammers may be allowed, subject to approval under the conditions stipulated in the plans, provided that: a) The capacity achieved is within the minimum requirement; b) The driving operation will not inflict damage to the pile; and c) The computed bearing capacity from the empirical formula is treated as an estimate only and shall not be equated directly with the required bearing power.

INTERRUPTED DRIVING

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

ALIGNMENT TOLERANCE

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

DAMAGED AND MISDRIVEN PILES

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

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

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

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

   c. Splicing an additional length.

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

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.

RECORDS

The Contractor shall keep records of each pile driven and shall furnish the Engineer two (2) signed typewritten/computerized copies. The records shall show the number of blows per 0.50 m. of initial penetration taken from the free fall elevation of the pile down to penetration depth of 5.0 m., the penetration under the last 10 blows, and the calculated safe load according to the Hiley's Formula as stated in bearing power of piles.

TESTING OF MATERIALS

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

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.

High Tensile Strand shall be tested according to the latest ASTM Standard and PPA Circular

STORAGE AND HANDLING OF PILES

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.

ITEM 13 : REINFORCED CONCRETE

SCOPE OF WORK

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

GENERAL PROVISIONS

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

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

   a. American Concrete Institute (ACI) Standards:

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

ACI 347 Guide to Formwork for Concrete

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

ACI SP-2 ACI Manual of Concrete Inspection

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

ASTM C 150 Standard Specification for Portland Cement

ASTM C 114 Standard Method for Chemical Analysis of Hydraulic Cement

ASTM C 185 Standard Method for Air Content of Hydraulic Cement

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

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

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

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

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

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

ASTM C 33 Standard Specification for Concrete Aggregates

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

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

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

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

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

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

ASTM C 142	Standard Test Method for Clay Lumps and Friable Particles in Aggregates
ASTM C 97	Standard Test Method for Absorption and Bulk Specific Gravity of Dimension Stone
ASTM C 127	Test Method for Specific Gravity and Absorption of Coarse Aggregate
ASTM C 535	Standard Test Method for Resistance to Degradation of Large-Size Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 88	Standard Test Method for Soundness of Aggregates by Use of Sodium Sulfate or Magnesium Sulfate
ASTM C 131	Test Method for Resistance to Degradation of Small-size Coarse Aggregate by Abrasion and Impact in the Los Angeles Machine
ASTM C 94	Standard Specification for Ready-Mixed Concrete
ASTM D 512	Chloride Ion in Water
ASTM D 516	Sulfate Ion in Water
ASTM A 615	Standard Specification for Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM A 370	Standard Test Methods and Definitions for Mechanical Testing of Steel Products
ASTM A 510	Standard Specification for General Requirements for Wire Rods and Coarse Round Wire, Carbon Steel
ASTM A 6	Standard Specification for General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM C 31	Standard Practice for Making and Curing Concrete Test Specimens in the Field
ASTM C 39	Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
ASTM C 172	Standard Practice for Sampling Freshly Mixed Concrete
ASTM C 192	Standard Practice for Making and Curing Concrete Test Specimens in the Laboratory
ASTM C 293	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Center-Point Loading)
ASTM C 78	Standard Test Method for Flexural Strength of Concrete (Using Simple Beam with Third-Point Loading)
ASTM C 42	Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete

ASTM C 174 Standard Test Method for Measuring Thickness of Concrete Elements Using Drilled Concrete Cores

ASTM C 143 Standard Test Method for Slump of Hydraulic-Cement Concrete

ASTM C 494 Standard Specification for Chemical Admixtures for Concrete

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

ASTM C 171 Standard Specification for Sheet Materials for Curing Concrete

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

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

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

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

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

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

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

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

ASTM C 1116 Standard Specification for Fiber-Reinforced Concrete

ASTM C 1157 Standard Specification for Hydraulic Cement

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

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

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

ASTM C 295 Petrographic Examination of Aggregates for Concrete

ASTM C 33 Standard Specification for Concrete Aggregates

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